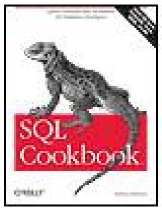

SQL Cookbook

By Anthony Molinaro

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Publisher: **O'Reilly**

Pub Date: **December 2005**

Print ISBN-10: **0-596-00976-3**

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Pages: **628**

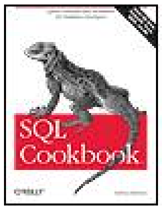
Overview

You know the rudiments of the SQL query language, yet you feel you aren't taking full advantage of SQL's expressive power. You'd like to learn how to do more work with SQL inside the database before pushing data across the network to your applications. You'd like to take your SQL skills to the next level.

Let's face it, SQL is a deceptively simple language to learn, and many database developers never go far beyond the simple statement: SELECT FROM WHERE . But there is *so* much more you can do with the language. In the *SQL Cookbook*, experienced SQL developer Anthony Molinaro shares his favorite SQL techniques and features. You'll learn about:

- Window functions, arguably the most significant enhancement to SQL in the past decade. If you're not using these, you're missing out
- Powerful, database-specific features such as SQL Server's PIVOT and UNPIVOT operators, Oracle's MODEL clause, and PostgreSQL's very useful GENERATE_SERIES function
- Pivoting rows into columns, reverse-pivoting columns into rows, using pivoting to facilitate inter-row calculations, and double-pivoting a result set
- *Bucketization*, and why you should never use that term in Brooklyn.
- How to create histograms, summarize data into buckets, perform aggregations over a moving range of values, generate running-totals and subtotals, and other advanced, data warehousing techniques
- The technique of *walking a string*, which allows you to use SQL to parse through the characters, words, or delimited elements of a string

Written in O'Reilly's popular Problem/Solution/Discussion style, the *SQL Cookbook* is sure to please. Anthony's credo is: "When it comes down to it, we all go to work, we all have bills to pay, and we all want to go home at a reasonable time and enjoy what's still available of our days." The *SQL Cookbook* moves quickly from problem to solution, saving you time each step of the way.



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[M]

Dedication

To my mom:

You're the best! Thank you for everything.

Preface

SQL is *the* language in the database world. If you're developing for or reporting from relational databases, your ability to put data into a database and then get it back out again ultimately comes down to your knowledge of SQL. Yet many practitioners use SQL in a perfunctory manner, and are unaware of the power at their disposal. This book aims to change all that, by opening your eyes to what SQL can really do for you.

The book you're holding in your hands is a cookbook. It's a collection of common SQL problems and their solutions that I hope you'll find helpful in your day-to-day work. Recipes are categorized into chapters of related topics. When faced with a new SQL problem that you haven't solved before, find the chapter that best seems to apply, skim through the recipe titles, and hopefully you will find a solution, or at least inspiration for a solution.

More than 150 recipes are available in this 600-plus page book, and I've only scratched the surface of what can be done using SQL. The number of different SQL solutions available for solving our daily programming problems is eclipsed only by the number of problems we need to solve. You won't find all possible problems covered in this book. Indeed, such coverage would be impossible. You will, however, find many common problems and their solutions. And in those solutions lie techniques that you'll learn how to expand upon and apply to other, new problems that I never thought to cover.

My publisher and I are constantly on the lookout for new, cookbook-worthy SQL recipes. If you come across a good or clever SQL solution to a problem, consider sharing it; consider sending it in for inclusion in the next edition of this book. See "Comments and Questions" for our contact information.

Why I Wrote This Book

Queries, queries, queries. My goal from the beginning of this project has not been so much to write a "SQL Cookbook" as to write a "Query Cookbook." I've aimed to create a book comprised of queries ranging from the relatively easy to the relatively difficult in hopes the reader will grasp the techniques behind those queries and use them to solve his own particular business problems. I hope to pass on many of the SQL programming techniques I've used in my career so that you, the reader, will take them, learn from them, and eventually improve upon them; through this cycle we all benefit. Being able to retrieve data from a database seems so simple, yet in the world of Information Technology (IT) it's crucial that the operation of data retrieval be done as efficiently as possible. Techniques for efficient data retrieval should be shared so that we can all be efficient and help each other improve.

Consider for a moment the outstanding contribution to mathematics by Georg Cantor, who was the first to realize the vast benefit of studying sets of elements (studying the set itself rather than its constituents). At first, Cantor's work wasn't accepted by many of his peers. In time, though, it was not only accepted, but set theory is now considered the foundation of mathematics! More importantly, however, it was not through Cantor's work alone that set theory became what it is today; rather, by sharing his ideas, others such as Ernst Zermelo, Gottlob Frege, Abraham Fraenkel, Thoralf Skolem, Kurt Gödel, and John von Neumann developed and improved the theory. Such sharing not only provided everyone with a better understanding of the theory, it made for a better set theory than was first conceived.

Objectives of This Book

Ultimately, the goal of this book is to give you, the reader, a glimpse of what can be done using SQL outside of what is considered the typical SQL problem domain. SQL has come a very long way in the last ten years. Problems typically solved using a procedural language such as C or JAVA can now be solved directly in SQL, but many developers are simply unaware of this fact. This book is to help make you aware.

Now, before you take what I just said the wrong way, let me state that I am a firm believer in, "If it ain't broke, don't fix it." For example, let's say you have a particular business problem to solve, and you currently use SQL to simply retrieve your data while applying your complex business logic using a language other than SQL. If your code works and performance is acceptable, then great. I am in no way suggesting that you scrap your code for a SQL-only solution; I only ask that you open your mind and realize that the SQL you programmed with in 1995 is not the same SQL being used in 2005. Today's SQL can do so much more.

Audience for This Book

This text is unique in that the target audience is wide, but the quality of the material presented is not compromised. Consider that both complex and simple solutions are provided, and that solutions for five different vendors are available when a common solution does not exist. The target audience is indeed wide:

The SQL novice

Perhaps you have just purchased a text on learning SQL, or you are fresh into your first semester of a required database course and you want to supplement your new knowledge with some challenging real world examples. Maybe you've seen a query that magically transforms rows to columns, or that parses a serialized string into a result set. The recipes in this book explain techniques for performing these seemingly impossible queries.

The non-SQL programmer

Perhaps your background is in another language and you've been thrown into the fire at your current job and are expected to support complex SQL written by someone else. The recipes shown in this book, particularly in the later chapters, break down complex queries and provide a gentle walk-through to help you understand complex code that you may have inherited.

The SQL journeyman

For the intermediate SQL developer, this book is the gold at the end of the rainbow (OK, maybe that's too strong; please forgive an author's enthusiasm for his topic). In particular, if you've been coding SQL for quite some time and have not found your way onto window functions, you're in for a treat. For example, the days of needing temporary tables to store intermediate results are over; window functions can get you to an answer in a single query! Allow me to again state that I have no intention of trying to force-feed my ideas to an already experienced practitioner. Instead, consider this book as a way to update your skill set if you haven't caught on to some of the newer additions to the SQL language.

The SQL expert

Undoubtedly you've seen these recipes before, and you probably have your own variations. Why, then, is this book useful to you? Perhaps you've been a SQL expert on one platform your whole career, say, SQL Server, and now wish to learn Oracle. Perhaps you've only ever used MySQL, and you wonder what the same solutions in PostgreSQL would look like. This text covers different relational database management systems (RDBMSs) and displays their solutions side by side. Here's your chance to expand your knowledge base.

How to Use This Book

Be sure to read this preface thoroughly. It contains necessary background and other information that you might otherwise miss if you dive into individual recipes. The section on "Platform and Version" tells you what RDBMSs this book covers. Pay special attention to "Tables Used in This Book," so that you become familiar with the example tables used in most of the recipes. You'll also find important coding and font conventions in "Conventions Used in This Book." All these sections come later in this preface.

Remember that this is a cookbook, a collection of code examples to use as guidelines for solving similar (or identical) problems that you may have. Do not try to *learn* SQL from this book, at least not from scratch. This book should act as a supplement to, not a replacement for, a complete text on learning SQL. Additionally, following the tips below will help you use this book more productively:

- This book takes advantage of vendor-specific functions. *SQL Pocket Guide* by Jonathan Gennick has all of them and is convenient to have close to you in case you don't know what some of the functions in my recipes do.

- If you've never used window functions, or have had problems with queries using GROUP BY, read Appendix A first. It will define and prove what a group is in SQL. More importantly, it gives a basic idea of how window functions work. Window functions are one of the most important SQL developments of the past decade.

- Use common sense! Realize that it is impossible to write a book that provides a solution to every possible business problem in existence. Instead, use the recipes from this book as templates or guidelines to teach yourself the techniques required to solve your own specific problems. If you find yourself saying, "Great, this recipe works for this particular data set, but mine is different and thus the recipe doesn't work quite correctly," that's expected. In that case, try to find commonality between the data in the book and your data. Break down the book's query to its simplest form and add complexity as you go. All queries start with SELECT…FROM…, so in their simplest form, all queries are the same. If you add complexity as you go, "building" a query one step, one function, one join at a time, you will not only understand how those constructs change the result set, but you will see how the recipe is different from what you actually need. And from there you can modify the recipe to work for your particular data set.

- Test, test, and test. Undoubtedly any table of yours is bigger than the 14 row EMP table used in this book, so please test the solutions against your data, at the very least to ensure that they perform well. I can't possibly know what your tables look like, what columns are indexed, and what relationships are present in your schema. So please, do not blindly implement these techniques in your production code until you fully understand them and how they will perform against your particular data.

- Don't be afraid to experiment. Be creative! Feel free to use techniques different from what I've used. I make it a point to use many of the functions supplied by the different vendors in this book, and often there are several other functions that may work as well as the one I've chosen to use in a particular recipe. Feel free to plug your own variations into the recipes of this book.

- Newer does not always mean better. If you're not using some of the more recent features of the SQL language (for example, window functions), that does not necessarily mean your code is not as efficient as it can be. There are many cases in which traditional SQL solutions are as good or better than any new solution. Please keep this in mind, particularly in the Appendix B, *Rozenshtein Revisited*. After reading this book, you should not come away with the idea that you need to update or change all your existing code. Instead, only realize there are many new and extremely efficient features of SQL available now that were not available 10 years ago, and they are worth the time taken to learn them.

- Don't be intimidated. When you get to the solution section of a recipe and a query looks impossible to understand, don't fear. I've gone to great lengths to not only break down each query starting from its simplest form, but to show the intermediate results of each portion of a query as we work our way to the complete solution. You may not be able to see the big picture immediately, but once you follow the discussion and see not only how a query is built, but the results of each step, you'll find that even convoluted-looking queries are not hard to grasp.

- Program defensively when necessary. In an effort to make the queries in this book as terse as humanly possible without obscuring their meaning, I've removed many "defensive measures" from the recipes. For example, consider a query computing a running total for a number of employee salaries. It could be the case that you have declared the column of type VARCHAR and are (sadly) storing a mix of numeric and string data in one field. You'll find the running total recipe in this book does not check for such a case (and it will fail as the function SUM doesn't know what to do with character data), so if you have this type of "data" ("problem" is a more accurate description), you will need to code around it or (hopefully) fix your data, because the recipes provided do not account for such design practices as the mixing of character and numeric data in the same column. The idea is to focus on the technique; once you understand the technique, sidestepping such problems is trivial.

- Repetition is the key. The best way to master the recipes in this book is to sit down and code them. When it comes to code, reading is fine, but actually coding is even better. You must read to understand why things are done a certain way, but only by coding will you be able to create these queries yourself.

Be advised that many of the examples in this book are contrived. The problems are not contrived. They are real. However, I've built all examples around a small set of tables containing employee data. I've done that to help you get familiar with the example data, so that, having become familiar with the data, you can focus on the technique that each recipe illustrates. You might look at a specific problem and think: "I would never need to do that with employee data." But try to look past the example data in those cases and focus on the technique that I'm illustrating. The techniques are useful. My colleagues and I use them daily. We think you will too.

What's Missing from This Book

Due to constraints on time and book size, it isn't possible for a single book to provide solutions for all the possible SQL problems you may encounter. That said, here are some additional items that did not make the list:

Data Definition

Aspects of SQL such as creating indexes, adding constraints, and loading data are not covered in this book. Such tasks typically involve syntax that is highly vendor-specific, so you're best off referring to vendor manuals. In addition, such tasks do not represent the type of "hard" problem for which one would purchase a book to solve. Chapter 4, however, does provide recipes for common problems involving the insertion, updating, and deleting of data.

XML

It is my strong opinion that XML recipes do not belong in a book on SQL. Storing XML documents in relational databases is becoming increasingly popular, and each RDBMS has their own extensions and tools for retrieving and manipulating such data. XML manipulation often involves code that is procedural and thus outside the scope of this book. Recent developments such as XQUERY represent completely separate topics from SQL and belong in their own book (or books).

Object-Oriented Extensions to SQL

Until a language more suitable for dealing with objects comes along, I am strongly against using object-oriented features and designs in relational databases. At the present time, the object-oriented features available from some vendors are more suitable for use in procedural programming than in the sort of setoriented problem-solving for which SQL is designed.

Debates on Points of Theory

You won't find arguments in this book about whether SQL is relational, or about whether NULL values should exist. These sort of theoretical discussions have their place, but not in a book centered on delivering SQL solutions to real-life problems. To solve real-life problems, you simply have to work with the tools available to you at the time. You have to deal with what you have, not what you wish you had.

> If you wish to learn more about theory, any of Chris Date's "Relational Database Writings" books would be a good start. You might also pick up a copy of his most recent book, *Database in Depth* (O'Reilly).

Vendor Politics

This text provides solutions for five different RDBMSs. It is only natural to want to know which vendor's solution is "best" or "fastest." There is plenty of information that each vendor would gladly provide to show that their product is "best"; I have no intention of doing so here.

ANSI Politics

Many texts shy away from the proprietary functions supplied by different vendors. This text embraces proprietary functions. I have no intention of writing convoluted, poorly performing SQL code simply for the sake of portability. I have never worked in an environment where the use of vendor-specific extensions was prohibited. You are paying for these features; why not use them?

Vendor extensions exist for a reason, and many times offer better performance and readability than you could otherwise achieve using standard SQL. If you prefer ANSI-only solutions, fine. As I mentioned before, I am not here to tell you to turn all your code upside down. If what you have is strictly ANSI and it works for you, great. When it comes down to it, we all go to work, we all have bills to pay, and we all want to go home at a reasonable time and enjoy what's still left of our days. So, I'm not suggesting that ANSI-only is wrong. Do what works and is best for you. But, I want to make clear that if you're looking for ANSI-only solutions, you should look elsewhere.

Legacy Politics

The recipes in this text make use of the newest features available at the time of writing. If you are using old versions of the RDBMSs that I cover, many of my solutions will simply not work for you. Technology does not stand still, and neither should you. If you need older solutions, you'll find that many of the SQL texts available from years past have plenty of examples using older versions of the RDBMSs covered in this book.

Structure of This Book

This book is divided into 14 chapters and 2 appendices:

- Chapter 1, *Retrieving Records*, introduces very simple queries. Examples include how to use a WHERE clause to restrict rows from your result set, providing aliases for columns in your result set, using an inline view to reference aliased columns, using simple conditional logic, limiting the number of rows returned by a query, returning random records, and finding NULL values. Most of the examples are very simple, but some of them appear in more complex recipes, so it's a good idea to read this chapter if you're relatively new to SQL or aren't familiar with any of the examples listed for this chapter.

- Chapter 2, *Sorting Query Results*, introduces recipes for sorting query results. The ORDER BY clause is introduced and is used to sort query results. Examples increase in complexity ranging from simple, single-column ordering, to ordering by substrings, to ordering based on conditional expressions.

- Chapter 3, *Working with Multiple Tables*, introduces recipes for combining data from multiple tables. If you are new to SQL or are a bit rusty on joins, I strongly recommend you read this chapter before reading Chapter 5 and later. Joining tables is what SQL is all about; you must understand joins to be successful. Examples in this chapter include performing both inner and outer joins, identifying Cartesian productions, basic set operations (set difference, union, intersection), and the effects of joins on aggregate functions.

- Chapter 4, *Inserting, Updating, Deleting*, introduces recipes for inserting, updating, and deleting data, respectively. Most of the examples are very straightforward (perhaps even pedestrian). Nevertheless, operations such as inserting rows into one table from another table, the use of correlated subqueries in updates, an understanding of the effects of NULLs, and knowledge of new features such as multi-table inserts and the MERGE command are extremely useful for your toolbox.

- Chapter 5, *Metadata Queries*, introduces recipes for getting at your database metadata. It's often very useful to find the indexes, constraints, and tables in your schema. The simple recipes here allow you to gain information about your schema. Additionally, "dynamic" SQL examples are shown here as well, i.e., SQL generated by SQL.

- Chapter 6, *Working with Strings*, introduces recipes for manipulating strings. SQL is not known for its string parsing capabilities, but with a little creativity (usually involving Cartesian products) along with the vast array of vendor-specific functions, you can accomplish quite a bit. This chapter is where the book begins to get interesting. Some of the more interesting examples include counting the occurrences of a character in a string, creating delimited lists from table rows, converting delimited lists and strings into rows, and separating numeric and character data from a string of alphanumeric characters.

- Chapter 7, *Working with Numbers*, introduces recipes for common number crunching. The recipes found here are extremely common and you'll learn how easily window functions solve problems involving moving calculations and aggregations. Examples include creating running totals; finding mean, median, and mode; calculating percentiles; and accounting for NULL while performing aggregations.

- Chapter 8, *Date Arithmetic*, is the first of two chapters dealing with dates. Being able to perform simple date arithmetic is crucial to everyday tasks. Examples include determining the number of business days between two dates, calculating the difference between two dates in different units of time (day, month, year, etc.), and counting occurrences of days in a month.

- Chapter 9, *Date Manipulation*, is the second of the two chapters dealing with dates. In this chapter you will find recipes for some of the most common date operations you will encounter in a typical work day. Examples include returning all days in a year, finding leap years, finding first and last days of a month, creating a calendar, and filling in missing dates for a range of dates.

- Chapter 10, *Working with Ranges*, introduces recipes for identifying values in ranges, and for creating ranges of values. Examples include automatically generating a sequence of rows, filling in missing numeric values for a range of values, locating the beginning and end of a range of values, and locating consecutive values.

- Chapter 11, *Advanced Searching*, introduces recipes that are crucial for everyday development and yet sometimes slip through the cracks. These recipes are not any more difficult than others, yet I see many developers making very inefficient attempts at solving the problems these recipes solve. Examples from this chapter include finding knight values, paginating through a result set, skipping rows from a table, finding reciprocals, selecting the top *n* records, and ranking results.

- Chapter 12, *Reporting and Warehousing*, introduces queries typically used in warehousing or generating complex reports. This chapter was meant to be the majority of the book as it existed in my original vision. Examples include converting rows into columns and vice versa (cross-tab reports), creating buckets or groups of data, creating histograms, calculating simple and complete subtotals, performing aggregations over a moving window of rows, and grouping rows based on given units of time.

- Chapter 13, *Hierarchical Queries*, introduces hierarchical recipes. Regardless of how your data is modeled, at some point you will be asked to format data such that it represents a tree or parent-child relationship. This chapter provides recipes accomplishing these tasks. Creating tree-structured result sets can be cumbersome with traditional SQL, so vendor-supplied functions are particularly useful in this chapter. Examples include expressing a parent-child relationship, traversing a hierarchy from root to leaf, and rolling up a hierarchy.

- Chapter 14, *Odds 'n' Ends*, is a collection of miscellaneous recipes that didn't seem to fit into any other problem domain, but that nevertheless are interesting and useful. This chapter is different from the rest in that it focuses on vendor-spe-cific solutions only. This is the only chapter of the book where each recipe highlights only one vendor. The reasons are twofold: first, this chapter was meant to serve as more of a fun, geeky chapter. Second, some recipes exist only to highlight a vendor-specific function that has no equivalent in the other RDBMSs (examples include SQL Server's PIVOT/UNPIVOT operators and Oracle's MODEL clause). In some cases, though, you'll be able to easily tweak a solution provided in this chapter to work for a platform not covered in the recipe.

- Appendix A, *Window Function Refresher*, is a window function refresher along with a solid discussion of groups in SQL. Window functions are new to most, so it is appropriate that this appendix serves as a brief tutorial. Additionally, in my experience I have noticed that the use of GROUP BY in queries is a source of confusion for many developers. This chapter defines exactly what a SQL group is, and then proceeds to use various queries as proofs to validate that definition. The chapter then goes into the effects of NULLs on groups, aggregates, and partitions. Lastly, you'll find discussion on the more obscure and yet extremely powerful syntax of the window function's OVER clause (i.e., the "framing" or "windowing" clause).

- Appendix B, *Rozenshtein Revisited*, is a tribute to David Rozenshtein, to whom I owe my success in SQL development. Rozenshtein's book, The *Essence of SQL* (Coriolis Group Books) was the first book I purchased on SQL that was not required by a class. It was from that book that I learned how to "think in SQL." To this day I attribute much of my understanding of how SQL works to David's book. It truly is different from any other SQL book I've read, and I'm grateful that it was the first one I picked up on my own volition. Appendix B focuses on some of the queries presented in The *Essence of SQL*, and provides alternative solutions using window functions (which weren't available when The *Essence of SQL* was written) for those queries.

Platform and Version

SQL is a moving target. Vendors are constantly pumping new features and functionality into their products. Thus you should know up front which versions of the various platforms were used in the preparation of this text:

- DB2 v.8
- Oracle Database 10*g* (with the exception of a handful of recipes, the solutions will work for Oracle8*i* Database and Oracle9*i* Database as well)
- PostgreSQL 8
- SQL Server 2005
- MySQL 5

<b>

```
select * from emp;</b>

EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO

----- ------ --------- ---- ----------- ---- ---- -------

7369 SMITH CLERK 7902 17-DEC-1980 800 20

7499 ALLEN SALESMAN 7698 20-FEB-1981 1600 300 30

7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30

7566 JONES MANAGER 7839 02-APR-1981 2975 20

7654 MARTIN SALESMAN 7698 28-SEP-1981 1250 1400 30

7698 BLAKE MANAGER 7839 01-MAY-1981 2850 30

7782 CLARK MANAGER 7839 09-JUN-1981 2450 10

7788 SCOTT ANALYST 7566 09-DEC-1982 3000 20
```

7839 KING PRESIDENT 17-NOV-1981 5000 10

```
7844 TURNER SALESMAN 7698 08-SEP-1981 1500 0 30
7876 ADAMS CLERK 7788 12-JAN-1983 1100 20
7900 JAMES CLERK 7698 03-DEC-1981 950 30
7902 FORD ANALYST 7566 03-DEC-1981 3000 20
7934 MILLER CLERK 7782 23-JAN-1982 1300 10


<b>
select * from dept;</b>
DEPTNO DNAME LOC
------ -------------- ---------
10 ACCOUNTING NEW YORK
20 RESEARCH DALLAS
30 SALES CHICAGO
```

40 OPERATIONS BOSTON

```
select id from t1;


   ID

   ----------

   1


   select id from t10;

   ID

   ----------

   1

   2

   3

   4

   5

   6

   7

   8

   9
```

As an aside, some vendors allow partial SELECT statements. For example, you can have SELECT without a FROM clause. I don't particularly like this, thus I select against a support table, T1, with a single row, rather than using partial queries.

Any other tables are specific to particular recipes and chapters, and will be introduced in the text when appropriate.

Conventions Used in This Book

I use a number of typographical and coding conventions in this book. Take time to become familiar with them. Doing so will enhance your understanding of the text. Coding conventions in particular are important, because I can't discuss them anew for each recipe in the book. Instead, I list the important conventions here.

Typographical Conventions

The following typographical conventions are used in this book:

UPPERCASE

Used to indicate SQL keywords within text

lowercase

Used for all queries in code examples. Other languages such as C and JAVA use lowercase for most keywords and I find it infinitely more readable than uppercase. Thus all queries will be lowercase.

`Constant width bold`

Indicates user input in examples showing an interaction.

Indicates a tip, suggestion, or general note.

Indicates a warning or caution.

Coding Conventions

My preference for case in SQL statements is to always use lowercase, for both keywords and user-specified identifiers. For example:

```
select empno, ename
          from emp;
```

Your preference may be otherwise. For example, many prefer to uppercase SQL keywords. Use whatever coding style you prefer, or whatever your project requires.

Despite my use of lowercase in code examples, I consistently uppercase SQL keywords and identifiers in the text. I do this to make those items stand out as something other than regular prose. For example:

> The preceding query represents a SELECT against the EMP table.

While this book covers databases from five different vendors, I've decided to use one format for all the output:

```
EMPNO ENAME
         ----- ------
          7369 SMITH
          7499 ALLEN
        …
```

Many solutions make use of *inline views*, or subqueries in the FROM clause. The ANSI SQL standard requires that such views be given table aliases. (Oracle is the only vendor that lets you get away without specifying such aliases.) Thus, my solutions use aliases such as x and y to identify the result sets from inline views:

```
select job, sal
          from (select job, max(sal) sal
                  from emp
                group by job) x;
```

Notice the letter X following the final, closing parenthesis. That letter X becomes the name of the "table" returned by the subquery in the FROM clause. While column aliases are a valuable tool for writing self-documenting code, aliases on inline views (for most recipes in this book) are simply formalities. They are typically given trivial names such as X, Y, Z, TMP1, and TMP2. In cases where I feel a better alias will provide more understanding, I do so.

You will notice that the SQL in the SOLUTION section of the recipes is typically numbered, for example:

```
1 select ename
        2     from emp
        3  where deptno = 10
```

The number is not part of the syntax; I have included it so I can reference parts of the query by number in the discussion section.

Using Code Examples

Comments and Questions

We have tested and verified the information in this book to the best of our ability, but you may find that features have changed or that we have made mistakes. If so, please notify us by writing to:

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Anthony Molinaro

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Chapter 1. Retrieving Records

This chapter focuses on very basic SELECT statements. It is important to have a solid understanding of the basics as many of the topics covered here are not only present in more difficult recipes but also are found in everyday SQL.

Recipe 1.1. Retrieving All Rows and Columns from a Table

Problem

You have a table and want to see all of the data in it.

Solution

Use the special "*" character and issue a SELECT against the table: 1 select * 2 from emp

Discussion

The character "*" has special meaning in SQL. Using it will return every column for the table specified. Since there is no WHERE clause specified, every row will be returned as well. The alternative would be to list each column individually: select empno,ename,job,sal,mgr,hiredate,comm,deptno from emp

In ad hoc queries that you execute interactively, it's easier to use SELECT *. However, when writing program code it's better to specify each column individually. The performance will be the same, but by being explicit you will always know what columns you are returning from the query. Likewise, such queries are easier to understand by people other than yourself (who may or may not know all the columns in the tables in the query).

Recipe 1.2. Retrieving a Subset of Rows from a Table

Problem

You have a table and want to see only rows that satisfy a specific condition.

Solution

Use the WHERE clause to specify which rows to keep. For example, to view all employees assigned to department number 10:

```
select *
  from emp
 where deptno = 10
```

Discussion

The WHERE clause allows you to retrieve only rows you are interested in. If the expression in the WHERE clause is true for any row, then that row is returned.

Most vendors support common operators such as: =, <, >, <=, >=, !, <>. Additionally, you may want rows that satisfy multiple conditions; this can be done by specifying AND, OR, and parenthesis, as shown in the next recipe.

Recipe 1.3. Finding Rows That Satisfy Multiple Conditions

Problem

You want to return rows that satisfy multiple conditions.

Solution

Use the WHERE clause along with the OR and AND clauses. For example, if you would like to find all the employees in department 10, along with any employees who earn a commission, along with any employees in department 20 who earn at most $2000: 1 select * 2 from emp 3 where deptno = 10 4 or comm is not null 5 or sal <= 2000 and deptno=20

Discussion

You can use a combination of AND, OR, and parenthesis to return rows that satisfy multiple conditions. In the solution example, the WHERE clause finds rows such that:

- the DEPTNO is 10, or
- the COMM is NULL, or
- the salary is $2000 or less for any employee in DEPTNO 20.

The presence of parentheses causes conditions within them to be evaluated together.

For example, consider how the result set changes if the query was written with the parentheses as shown below: select * from emp where (deptno = 10 or comm is not null or sal <= 2000) and deptno=20 EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO ----- ------ ----- ----- ----------- ----- ---------- ------ 7369 SMITH CLERK 7902 17-DEC-1980 800 20 7876 ADAMS CLERK 7788 12-JAN-1983 1100 20

```
1 select ename,deptno,sal
```

2 from emp

Discussion

By specifying the columns in the SELECT clause, you ensure that no extraneous data is returned. This can be especially important when retrieving data across a network, as it avoids the waste of time inherent in retrieving data that you do not need.

```
1 select sal,comm

   2 from emp

<b>

   1 select sal as salary, comm as commission 2 from emp</b>

   SALARY COMMISSION

   ------- ----------

   800

   1600 300
```

1250 500

2975

1250 1300

2850

2450

3000

5000

```
1500 0

1100

   950

   3000

   1300
```

Discussion

Using the AS keyword to give new names to columns returned by your query is known as aliasing those columns. The new names that you give are known as aliases. Creating good aliases can go a long way toward making a query and its results understandable to others.

Recipe 1.6. Referencing an Aliased Column in the WHERE Clause

Problem

You have used aliases to provide more meaningful column names for your result set and would like to exclude some of the rows using the WHERE clause. However, your attempt to reference alias names in the WHERE clause fails:

```
select sal as salary, comm as commission
          from emp
         where salary < 5000
```

Solution

By wrapping your query as an inline view you can reference the aliased columns:

```
select *
  from (
select sal as salary, comm as commission
  from emp
       ) x
 where salary < 5000
```

Discussion

In this simple example, you can avoid the inline view and reference COMM or SAL directly in the WHERE clause to achieve the same result. This solution introduces you to what you would need to do when attempting to reference any of the following in a WHERE clause:

- Aggregate functions
- Scalar subqueries
- Windowing functions
- Aliases

Placing your query, the one giving aliases, in an inline view gives you the ability to reference the aliased columns in your outer query. Why do you need to do this? The WHERE clause is evaluated before the SELECT, thus, SALARY and COMMISSION do not yet exist when the "Problem" query's WHERE clause is evaluated. Those aliases are not applied until after the WHERE clause processing is complete. However, the FROM clause is evaluated before the WHERE. By placing the original query in a FROM clause, the results from that query are generated before the outermost WHERE clause, and your outermost WHERE clause "sees" the alias names. This technique is particularly useful when the columns in a table are not named particularly well.

The inline view in this solution is aliased X. Not all databases require an inline view to be explicitly aliased, but some do. All of them accept it.

```
CLARK WORKS AS A MANAGER

   KING WORKS AS A PRESIDENT

   MILLER WORKS AS A CLERK

<b>

   select ename, job from emp

   where deptno = 10</b>

   ENAME JOB

   ---------- ---------

   CLARK MANAGER

   KING PRESIDENT

   MILLER CLERK

1 select ename||' WORKS AS A '||job as msg
```

2 from emp

3 where deptno=10

1 select concat(ename, ' WORKS AS A ',job) as msg

2 from

3 where deptno=10

1 select ename + ' WORKS AS A ' + job as msg

2 from emp

3 where deptno=10

Discussion

Use the CONCAT function to concatenate values from multiple columns. The || is a shortcut for the CONCAT function in DB2, Oracle, and PostgreSQL, while + is the shortcut for SQL Server.

```
ENAME SAL STATUS

    ---------- ---------- ---------

    SMITH 800 UNDERPAID

    ALLEN 1600 UNDERPAID

    WARD 1250 UNDERPAID

    JONES 2975 OK

    MARTIN 1250 UNDERPAID

    BLAKE 2850 OK

    CLARK 2450 OK

    SCOTT 3000 OK

    KING 5000 OVERPAID

    TURNER 1500 UNDERPAID

    ADAMS 1100 UNDERPAID

    JAMES 950 UNDERPAID

    <a name="idx-CHP-1-0023"></a> FORD 3000 OK

    MILLER 1300 UNDERPAID

1 select ename,sal,

    2 case when sal <= 2000 then 'UNDERPAID'

    3 when sal >= 4000 then 'OVERPAID'

    4 else 'OK'
```

5 end as status

6 from emp

Discussion

The CASE expression allows you to perform condition logic on values returned by a query. You can provide an alias for a CASE expression to return a more readable result set. In the solution, you'll see the alias STATUS given to the result of the CASE expression. The ELSE clause is optional. Omit the ELSE, and the CASE expression will return NULL for any row that does not satisfy the test condition.

Recipe 1.9. Limiting the Number of Rows Returned

Problem

You want to limit the number of rows returned in your query. You are not concerned with order; any *n* rows will do.

Solution

Use the built-in function provided by your database to control the number of rows returned.

DB2

In DB2 use the FETCH FIRST clause:

```
select *
  from emp fetch first 5 rows only
```

MySQL and PostgreSQL

Do the same thing in MySQL and PostgreSQL using LIMIT:

```
select *
  from emp limit 5
```

Oracle

In Oracle, place a restriction on the number of rows returned by restricting ROWNUM in the WHERE clause:

```
select *
  from emp
 where rownum <= 5
```

SQL Server

Use the TOP keyword to restrict the number of rows returned:

```
select top 5 *
  from emp
```

Discussion

Many vendors provide clauses such as FETCH FIRST and LIMIT that let you specify the number of rows to be returned from a query. Oracle is different, in that you must make use of a function called ROWNUM that returns a number for each row returned (an increasing value starting from 1).

Here is what happens when you use ROWNUM <= 5 to return the first five rows:

1. Oracle executes your query.
2. Oracle fetches the first row and calls it row number 1.
3. Have we gotten past row number 5 yet? If no, then Oracle returns the row, because it meets the criteria of being numbered less than or equal to 5. If yes, then Oracle does not return the row.
4. Oracle fetches the next row and advances the row number (to 2, and then to 3, and then to 4, and so forth).
5. Go to step 3.

As this process shows, values from Oracle's ROWNUM are assigned *after* each row is fetched. This is a very important and key point. Many Oracle developers attempt to return only, say, the fifth row returned by a query by specifying ROWNUM = 5.

Using an equality condition in conjunction with ROWNUM is a bad idea. Here is what happens when you try to return, say, the fifth row using ROWNUM = 5:

1. Oracle executes your query.
2. Oracle fetches the first row and calls it row number 1.
3. Have we gotten to row number 5 yet? If no, then Oracle discards the row, because it doesn't meet the criteria. If yes, then Oracle returns the row. But the answer will never be yes!
4. Oracle fetches the next row and calls it row number 1. This is because the first row to be returned from the query must be numbered as 1.
5. Go to step 3.

Study this process closely, and you can see why the use of ROWNUM = 5 to return the fifth row fails. You can't have a fifth row if you don't first return rows one through four!

You may notice that ROWNUM = 1 does, in fact, work to return the first row, which may seem to contradict the explanation thus far. The reason ROWNUM = 1 works to return the first row is that, to determine whether or not there are any rows in the table, Oracle has to attempt to fetch at least once. Read the preceding process carefully, substituting 1 for 5, and you'll understand why it's OK to specify ROWNUM = 1 as a condition (for returning one row).

Recipe 1.10. Returning *n* Random Records from a Table

Problem

You want to return a specific number of random records from a table. You want to modify the following statement such that successive executions will produce a different set of five rows:

```
select ename, job
          from emp
```

Solution

Take any built-in function supported by your DBMS for returning random values. Use that function in an ORDER BY clause to sort rows randomly. Then, use the previous recipe's technique to limit the number of randomly sorted rows to return.

DB2

Use the built-in function RAND in conjunction with ORDER BY and FETCH:

```
select ename,job
  from emp
 order by rand() fetch first 5 rows only
```

MySQL

Use the built-in RAND function in conjunction with LIMIT and ORDER BY:

```
select ename,job
  from emp
 order by rand() limit 5
```

PostgreSQL

Use the built-in RANDOM function in conjunction with LIMIT and ORDER BY:

```
select ename,job
  from emp
 order by random() limit 5
```

Oracle

Use the built-in function VALUE, found in the built-in package DBMS_RANDOM, in conjunction with ORDER BY and the built-in function ROWNUM:

```
select *
  from (
 select ename, job
   from emp
  order by dbms_random.value()
       )
  where rownum <= 5
```

SQL Server

Use the built-in function NEWID in conjunction with TOP and ORDER BY to return a random result set:

```
select top 5 ename,job
  from emp
 order by newid()
```

Discussion

The ORDER BY clause can accept a function's return value and use it to change the order of the result set. The solution queries all restrict the number of rows to return *after* the function in the ORDER BY clause is executed. Non-Oracle users may find it helpful to look at the Oracle solution as it shows (conceptually) what is happening under the covers of the other solutions.

It is important that you don't confuse using a function in the ORDER BY clause with using a numeric constant. When specifying a numeric constant in the ORDER BY clause, you are requesting that the sort be done according the column in that ordinal position in the SELECT list. When you specify a function in the ORDER BY clause, the sort is performed on the result from the function as it is evaluated for each row.

```
1 select *
  2 from emp
```

3 where comm is null

Discussion

NULL is never equal/not equal to anything, not even itself, therefore you cannot use = or != for testing whether a column is NULL. To determine whether or not a row has NULL values you must use IS NULL. You can also use IS NOT NULL to find rows without a null in a given column.

Recipe 1.12. Transforming Nulls into Real Values

Problem

You have rows that contain nulls and would like to return non-null values in place of those nulls.

Solution

Use the function COALESCE to substitute real values for nulls:

```
select coalesce(comm,0)
         from emp
```

Discussion

The COALESCE function takes one or more values as arguments. The function returns the first non-null value in the list. In the solution, the value of COMM is returned whenever COMM is not null. Otherwise, a zero is returned.

When working with nulls, it's best to take advantage of the built-in functionality provided by your DBMS; in many cases you'll find several functions work equally as well for this task. COALESCE happens to work for all DBMSs. Additionally, CASE can be used for all DBMSs as well:

```
select case
             when comm is null then 0
             else comm
             end
          from emp
```

While you can use CASE to translate nulls into values, you can see that it's much easier and more succinct to use COALESCE.

```
<b>
    select ename, job from emp
    where deptno in (10,20)</b>
    ENAME JOB
    ---------- ---------
    SMITH CLERK
    JONES MANAGER
    CLARK MANAGER
    SCOTT ANALYST
    KING PRESIDENT
    ADAMS CLERK
    FORD ANALYST
    MILLER CLERK
ENAME JOB
    ---------- ---------
    SMITH CLERK
    JONES MANAGER
    CLARK MANAGER
    KING PRESIDENT
    MILLER CLERK
```

```
1 select ename, job
```

```
2 from emp
   3 where deptno in (10,20) 4 and (ename like '%I%' or job like '%ER')
```

Discussion

When used in a LIKE pattern-match operation, the percent ("%") operator matches any sequence of characters. Most SQL implementations also provide the underscore ("_") operator to match a single character. By enclosing the search pattern "I" with "%" operators, any string that contains an "I" (at any position) will be returned. If you do not enclose the search pattern with "%", then where you place the operator will affect the results of the query. For example, to find job titles that end in "ER", prefix the "%" operator to "ER"; if the requirement is to search for all job titles beginning with "ER", then append the "%" operator to "ER".

Chapter 2. Sorting Query Results

This chapter focuses on customizing how your query results look. By understanding how you can control and modify your result sets, you can provide more readable and meaningful data.

```
ENAME JOB SAL
    ---------- --------- ----------
    MILLER CLERK 1300
    CLARK MANAGER 2450
    KING PRESIDENT 5000
1 select ename,job,sal
```

2 from emp

3 where deptno = 10

4 order by sal asc

<b>

```
select ename,job,sal from emp where deptno = 10

order by sal desc</b>

ENAME JOB SAL

---------- --------- ----------

KING PRESIDENT 5000

CLARK MANAGER 2450

MILLER CLERK 1300
```

<b>

```
select ename,job,sal from emp where deptno = 10

order by 3 desc</b>

ENAME JOB SAL

---------- --------- ----------

KING PRESIDENT 5000

CLARK MANAGER 2450

MILLER CLERK 1300
```

The number 3 in this example's ORDER BY clause corresponds to the third column in the SELECT list, which is SAL.

```
EMPNO DEPTNO SAL ENAME JOB

 ---------- ---------- ---------- ---------- ---------

 7839 10 5000 KING PRESIDENT

 7782 10 2450 CLARK MANAGER

 7934 10 1300 MILLER CLERK

 7788 20 3000 SCOTT ANALYST

 7902 20 3000 FORD ANALYST

 7566 20 2975 JONES MANAGER

 7876 20 1100 ADAMS CLERK

 7369 20 800 SMITH CLERK

 7698 30 2850 BLAKE MANAGER

 7499 30 1600 ALLEN SALESMAN

 7844 30 1500 TURNER SALESMAN

 7521 30 1250 WARD SALESMAN

 7654 30 1250 MARTIN SALESMAN
```

7900 30 950 JAMES CLERK

```
1 select empno,deptno,sal,ename,job
```

```
2 from emp
  3 order by deptno, sal desc
```

Discussion

The order of precedence in ORDER BY is from left to right. If you are ordering using the numeric position of a column in the SELECT list, then that number must not be greater than the number of items in the SELECT list. You are generally permitted to order by a column not in the SELECT list, but to do so you must explicitly name the column. However, if you are using GROUP BY or DISTINCT in your query, you cannot order by columns that are not in the SELECT list.

```
ENAME JOB
---------- ---------
```

KING PRESIDENT

SMITH CLERK

ADAMS CLERK

JAMES CLERK

MILLER CLERK

JONES MANAGER

CLARK MANAGER

BLAKE MANAGER

ALLEN SALESMAN

MARTIN SALESMAN

WARD SALESMAN

TURNER SALESMAN

```
SCOTT ANALYST

FORD ANALYST
```

```
select ename,job
  from emp order by substr(job,length(job)-2)

select ename,job
  from emp order by substring(job,len(job)-2,2)
```

Discussion

Using your DBMS's substring function, you can easily sort by any part of a string. To sort by the last two characters of a string, find the end of the string (which is the length of the string) and subtract 2. The start position will be the second to last character in the string. You then take all characters after that start position. Because SQL Server requires a third parameter in SUBSTRING to specify the number of characters to take. In this example, any number greater than or equal to 2 will work.

```
<b>
    create view V
    as
    select ename||' '||deptno as data from emp
    select * from V</b>
    DATA
    -------------
    SMITH 20
    ALLEN 30
    WARD 30
    JONES 20
    MARTIN 30
    BLAKE 30
    CLARK 10
    SCOTT 20
    KING 10
    TURNER 30
    ADAMS 20
    JAMES 30
    FORD 20
    MILLER 10
DATA
    ----------
    CLARK 10
    KING 10
    MILLER 10
    SMITH 20
    ADAMS 20
    FORD 20
    SCOTT 20
    JONES 20
    ALLEN 30
    BLAKE 30
    MARTIN 30
    JAMES 30
    TURNER 30
    WARD 30
DATA
    ---------
    ADAMS 20
    ALLEN 30

    BLAKE 30

    CLARK 10

    FORD 20

    JAMES 30

    JONES 20

    KING 10

    MARTIN 30

    MILLER 10

    SCOTT 20

    SMITH 20

    TURNER 30

    WARD 30

/* ORDER BY DEPTNO */


    1 select data
```

2 from V

3 order by replace(data, 4 replace(

5 translate(data,'0123456789','##########'),'#',"),")

/* ORDER BY ENAME */

1 select data

2 from emp

```
3 order by replace(
4 translate(data,'0123456789','##########'),'#','')
```

```
/* ORDER BY DEPTNO */
```

```
1 select *
2 from (
3 select ename||' '||cast(deptno as char(2)) as data
```

4 from emp

5) v

6 order by replace(data, 7 replace(

8 translate(data,'##########','0123456789'),'#',"),")

/* ORDER BY ENAME */

1 select *

2 from (

3 select ename||' '||cast(deptno as char(2)) as data

4 from emp

```
5 ) v

6 order by replace(

7 translate(data,'##########','0123456789'),'#','')
```

<b>

```
select data, replace(data, replace(

translate(data,'0123456789','##########'),'#',''),'') nums, replace(

translate(data,'0123456789','##########'),'#','') chars from V</b>

DATA NUMS CHARS

------------ ------ ----------

SMITH 20 20 SMITH

ALLEN 30 30 ALLEN

WARD 30 30 WARD

JONES 20 20 JONES

MARTIN 30 30 MARTIN

BLAKE 30 30 BLAKE

CLARK 10 10 CLARK

SCOTT 20 20 SCOTT

KING 10 10 KING
```

TURNER 30 30 TURNER

ADAMS 20 20 ADAMS

JAMES 30 30 JAMES

FORD 20 20 FORD

MILLER 10 10 MILLER

```
ENAME SAL COMM

    ---------- ---------- ----------

    TURNER 1500 0

    ALLEN 1600 300

    WARD 1250 500

    MARTIN 1250 1400

    SMITH 800

    JONES 2975

    JAMES 950

    MILLER 1300

    FORD 3000

    ADAMS 1100

    BLAKE 2850

    CLARK 2450

    SCOTT 3000

    KING 5000

ENAME SAL COMM

    ---------- ---------- ----------

    SMITH 800

    JONES 2975
```

```
   CLARK 2450

   BLAKE 2850

   SCOTT 3000

   KING 5000

   JAMES 950

   MILLER 1300

   FORD 3000

   ADAMS 1100

   MARTIN 1250 1400

   WARD 1250 500

   ALLEN 1600 300

   TURNER 1500 0

1 select ename,sal,comm

   2 from emp
```

3 order by 3

1 select ename,sal,comm 2 from emp

3 order by 3 desc

/* NON-NULL COMM SORTED ASCENDING, ALL NULLS LAST */

<b>

1 select ename,sal,comm 2 from (

3 select ename,sal,comm, 4 case when comm is null then 0 else 1 end as is_null

5 from emp

```
6 ) x

7 order by is_null desc,comm</b>

ENAME SAL COMM

------ ----- ----------

TURNER 1500 0

ALLEN 1600 300

WARD 1250 500

MARTIN 1250 1400

SMITH 800

JONES 2975

JAMES 950

MILLER 1300

FORD 3000

ADAMS 1100

BLAKE 2850

CLARK 2450

SCOTT 3000

KING 5000
```

/* NON-NULL COMM SORTED DESCENDING, ALL <a name="idx-CHP-2-0065"></a>NULLS LAST */

<b>

1 select ename,sal,comm 2 from (

3 select ename,sal,comm, 4 case when comm is null then 0 else 1 end as is_null

5 from emp

```
6 ) x
7 order by is_null desc,comm desc</b>
ENAME SAL COMM
------ ----- ----------
MARTIN 1250 1400
WARD 1250 500
ALLEN 1600 300
TURNER 1500 0
SMITH 800
JONES 2975
JAMES 950
MILLER 1300
FORD 3000
ADAMS 1100
BLAKE 2850
CLARK 2450
SCOTT 3000
KING 5000
```

/* NON-NULL COMM SORTED ASCENDING, ALL NULLS FIRST */

<b>

1 select ename,sal,comm 2 from (

3 select ename,sal,comm, 4 case when comm is null then 0 else 1 end as is_null

5 from emp

```
6 ) x
7 order by is_null,comm</b>
ENAME SAL COMM
------ ----- ----------
SMITH 800
JONES 2975
CLARK 2450
BLAKE 2850
SCOTT 3000
KING 5000
JAMES 950
MILLER 1300
FORD 3000
ADAMS 1100
TURNER 1500 0
ALLEN 1600 300
WARD 1250 500
MARTIN 1250 1400
```

/* NON-NULL COMM SORTED DESCENDING, ALL <a name="idx-CHP-2-0066"></a>NULLS FIRST */

<b>

1 select ename,sal,comm 2 from (

3 select ename,sal,comm, 4 case when comm is null then 0 else 1 end as is_null

5 from emp

```
6 ) x
7 order by is_null,comm desc</b>
ENAME SAL COMM
------ ----- ----------
SMITH 800
JONES 2975
CLARK 2450
BLAKE 2850
SCOTT 3000
KING 5000
JAMES 950
MILLER 1300
FORD 3000
ADAMS 1100
MARTIN 1250 1400
WARD 1250 500
ALLEN 1600 300
TURNER 1500 0
```

```
/* NON-NULL COMM SORTED ASCENDING, ALL NULLS LAST */

   <b>

   1 select ename,sal,comm
```

```
2 from emp

3 order by comm nulls last</b>

ENAME SAL COMM

------ ----- ---------

TURNER 1500 0

ALLEN 1600 300

WARD 1250 500

MARTIN 1250 1400

SMITH 800

JONES 2975

JAMES 950

MILLER 1300

FORD 3000

ADAMS 1100

BLAKE 2850

CLARK 2450

SCOTT 3000

KING 5000
```

/* NON-NULL COMM SORTED ASCENDING, ALL <a name="idx-CHP-2-0068"></a>NULLS FIRST */

<b>

1 select ename,sal,comm

2 from emp

```
3 order by comm nulls first</b>

ENAME SAL COMM

------ ----- ----------

SMITH 800

JONES 2975

CLARK 2450

BLAKE 2850

SCOTT 3000

KING 5000

JAMES 950

MILLER 1300

FORD 3000

ADAMS 1100

TURNER 1500 0

ALLEN 1600 300

WARD 1250 500

MARTIN 1250 1400
```

/* NON-NULL COMM SORTED DESCENDING, ALL <a name="idx-CHP-2-0069"></a>NULLS FIRST */

<b>

1 select ename,sal,comm

2 from emp

```
3 order by comm desc nulls first</b>

ENAME SAL COMM

------ ----- ----------

SMITH 800

JONES 2975

CLARK 2450

BLAKE 2850

SCOTT 3000

KING 5000

JAMES 950

MILLER 1300

FORD 3000

ADAMS 1100

MARTIN 1250 1400

WARD 1250 500

ALLEN 1600 300

TURNER 1500 0
```

<b>

```
   select ename,sal,comm, case when comm is null then 0 else 1 end as
is_null from emp</b>

   ENAME SAL COMM IS_NULL

   ------ ----- ---------- ----------

   SMITH 800 0

   ALLEN 1600 300 1

   WARD 1250 500 1

   <a name="idx-CHP-2-0072"></a> JONES 2975 0

   MARTIN 1250 1400 1

   BLAKE 2850 0

   CLARK 2450 0

   SCOTT 3000 0

   KING 5000 0

   TURNER 1500 0 1

   ADAMS 1100 0

   JAMES 950 0

   FORD 3000 0

   MILLER 1300 0
```

By using the values returned by IS_NULL, you can easily sort NULLS first or last without interfering with the sorting of COMM.

```
ENAME SAL JOB COMM

    ---------- ---------- --------- ----------

    TURNER 1500 SALESMAN 0

    ALLEN 1600 SALESMAN 300

    WARD 1250 SALESMAN 500

    SMITH 800 CLERK

    JAMES 950 CLERK

    ADAMS 1100 CLERK

    MARTIN 1250 SALESMAN 1300

    MILLER 1300 CLERK

    CLARK 2450 MANAGER

    BLAKE 2850 MANAGER

    JONES 2975 MANAGER

    SCOTT 3000 ANALYST

    FORD 3000 ANALYST

    KING 5000 PRESIDENT

1 select ename,sal,job,comm
```

2 from emp

3 order by case when job = 'SALESMAN' then comm else sal end

<b>

select ename,sal,job,comm, case when job = 'SALESMAN' then comm else sal end as ordered from emp

order by 5</b>

```
ENAME SAL JOB COMM ORDERED

---------- ---------- --------- ---------- ----------

TURNER 1500 SALESMAN 0 0

ALLEN 1600 SALESMAN 300 300

WARD1 250 SALESMAN 500 500

SMITH 800 CLERK 800

JAMES 950 CLERK 950

ADAMS 1100 CLERK 1100

MARTIN 1250 SALESMAN 1300 1300

MILLER 1300 CLERK 1300

CLARK2 450 MANAGER 2450

BLAKE2 850 MANAGER 2850

JONES2 975 MANAGER 2975

SCOTT 3000 ANALYST 3000
```

```
FORD 3000 ANALYST 3000

KING 5000 PRESIDENT 5000
```

Chapter 3. Working with Multiple Tables

This chapter introduces the use of joins and set operations to combine data from multiple tables. Joins are the foundation of SQL. Set operations are also very important. If you want to master the complex queries found in the later chapters of this book, you must start here, with joins and set operations.

```
ENAME_AND_DNAME DEPTNO
    --------------- ----------
    CLARK 10
    KING 10
    MILLER 10
    ----------
    ACCOUNTING 10
    RESEARCH 20
    SALES 30
    OPERATIONS 40
1 select ename as ename_and_dname, deptno
```

2 from emp

3 where deptno = 10

4 union all

5 select '----------', null

6 from t1

7 <a name="idx-CHP-3-0081"></a>union all 8 select dname, deptno

9 from dept

select deptno | select deptno, dname from dept | from dept union all | union select ename | select deptno from emp | from emp

<b>

```
select deptno from emp union

select deptno from dept</b>

DEPTNO

---------

10

20

30

40
```

<b>

```
select distinct deptno from (

select deptno from emp union all select deptno from dept )</b>

DEPTNO

---------

10

20

30
```

You wouldn't use DISTINCT in a query unless you had to, and the same rule applies for UNION; don't use it instead of UNION ALL unless you have to.

```
ENAME LOC
    ---------- ----------
    CLARK NEW YORK
    KING NEW YORK
    MILLER NEW YORK
1 select e.ename, d.loc
```

2 from emp e, dept d

3 where e.deptno = d.deptno 4 and e.deptno = 10

<b>

select e.ename, d.loc, e.deptno as emp_deptno, d.deptno as dept_deptno from emp e, dept d where e.deptno = 10</b>

ENAME LOC EMP_DEPTNO DEPT_DEPTNO

---------- ------------- ---------- -----------

CLARK NEW YORK 10 10

KING NEW YORK 10 10

MILLER NEW YORK 10 10

CLARK DALLAS 10 20

<a name="idx-CHP-3-0092"></a> KING DALLAS 10 20

MILLER DALLAS 10 20

CLARK CHICAGO 10 30

KING CHICAGO 10 30

MILLER CHICAGO 10 30

CLARK BOSTON 10 40

KING BOSTON 10 40

MILLER BOSTON 10 40

<b>

```
   select e.ename, d.loc, e.deptno as emp_deptno, d.deptno as dept_deptno
from emp e, dept d where e.deptno = d.deptno and e.deptno = 10</b>

   ENAME LOC EMP_DEPTNO DEPT_DEPTNO

   ---------- ------------- ---------- -----------

   CLARK NEW YORK 10 10

   KING NEW YORK 10 10

   MILLER NEW YORK 10 10
```

```
select e.ename, d.loc

   from emp e inner join dept d on (e.deptno = d.deptno) where e.deptno =
10
```

Use the JOIN clause if you prefer to have the join logic in the FROM clause rather than the WHERE clause. Both styles are ANSI compliant and work on all the latest versions of the RDBMSs in this book.

Recipe 3.3. Finding Rows in Common Between Two Tables

Problem

You want to find common rows between two tables but there are multiple columns on which you can join. For example, consider the following view V:

```
create view V
as
select ename,job,sal
  from emp
 where job = 'CLERK'

select * from V

ENAME      JOB              SAL
---------- --------- ----------
SMITH      CLERK            800
ADAMS      CLERK           1100
JAMES      CLERK            950
MILLER     CLERK           1300
```

Only clerks are returned from view V. However, the view does not show all possible EMP columns. You want to return the EMPNO, ENAME, JOB, SAL, and DEPTNO of all employees in EMP that match the rows from view V. You want the result set to be the following:

```
EMPNO  ENAME      JOB              SAL     DEPTNO
        --------  ----------  --------- ---------- ---------
           7369   SMITH       CLERK            800         20
           7876   ADAMS       CLERK           1100         20
           7900   JAMES       CLERK            950         30
           7934   MILLER      CLERK           1300         10
```

Solution

Join the tables on all the columns necessary to return the correct result. Alternatively, use the set operation INTERSECT to avoid performing a join and instead return the intersection (common rows) of the two tables.

MySQL and SQL Server

Join table EMP to view V using multiple join conditions:

```
select e.empno,e.ename,e.job,e.sal,e.deptno
  from emp e, V
 where e.ename = v.ename
```

```
   and e.job   = v.job
   and e.sal   = v.sal
```

Alternatively, you can perform the same join via the JOIN clause:

```
select e.empno,e.ename,e.job,e.sal,e.deptno
  from emp e join V
    on (    e.ename   = v.ename
        and e.job     = v.job
        and e.sal     = v.sal )
```

DB2, Oracle, and PostgreSQL

The MySQL and SQL Server solution also works for DB2, Oracle, and PostgreSQL. It's the solution you should use if you need to return values from view V.

If you do not actually need to return columns from view V, you may use the set operation INTERSECT along with an IN predicate:

```
select empno,ename,job,sal,deptno
  from emp
 where (ename,job,sal) in (
  select ename,job,sal from emp
  intersect
  select ename,job,sal from V
 )
```

Discussion

When performing joins, you must consider the proper columns to join on in order to return correct results. This is especially important when rows can have common values for some columns while having different values for others.

The set operation INTERSECT will return rows common to both row sources. When using INTERSECT, you are required to compare the same number of items, having the same data type, from two tables. When working with set operations keep in mind that, by default, duplicate rows will not be returned.

Recipe 3.4. Retrieving Values from One Table That Do Not Exist in Another

Problem

You wish to find those values in one table, call it the source table, that do not also exist in some target table. For example, you want to find which departments (if any) in table DEPT do not exist in table EMP. In the example data, DEPTNO 40 from table DEPT does not exist in table EMP, so the result set should be the following:

```
DEPTNO
          ----------
                  40
```

Solution

Having functions that perform set difference is particularly useful for this problem. DB2, PostgreSQL, and Oracle support set difference operations. If your DBMS does not support a set difference function, use a subquery as shown for MySQL and SQL Server.

DB2 and PostgreSQL

Use the set operation EXCEPT:

```
select deptno from dept
except
select deptno from emp
```

Oracle

Use the set operation MINUS:

```
select deptno from dept
minus
select deptno from emp
```

MySQL and SQL Server

Use a subquery to return all DEPTNOs from table EMP into an outer query that searches table DEPT for rows that are not amongst the rows returned from the subquery:

```
select deptno
         from dept
       where deptno not in (select deptno from emp)
```

Discussion

DB2 and PostgreSQL

The built-in functions provided by DB2 and PostgreSQL make this operation quite easy. The EXCEPT operator takes the first result set and removes from it all rows found in the second result set. The operation is very much like a subtraction.

There are restrictions on the use of set operators, including EXCEPT. Data types and number of values to compare must match in both SELECT lists. Additionally, EXCEPT will not return duplicates and, unlike a subquery using NOT IN, NULLs do not present a problem (see the discussion for MySQL and SQL Server). The EXCEPT operator will return rows from the upper query (the query before the EXCEPT) that do not exist in the lower query (the query after the EXCEPT).

Oracle

The Oracle solution is identical to that for DB2 and PostgreSQL, except that Oracle calls its set difference operator MINUS rather than EXCEPT. Otherwise, the preceding explanation applies to Oracle as well.

MySQL and SQL Server

The subquery will return all DEPTNOs from table EMP. The outer query returns all DEPTNOs from table DEPT that are "not in" or "not included in" the result set returned from the subquery.

Duplicate elimination is something you'll want to consider when using the MySQL and SQL Server solutions. The EXCEPT- and MINUS-based solutions used for the other platforms eliminate duplicate rows from the result set, ensuring that each DEPTNO is reported only one time. Of course, that can only be the case anyway, as DEPTNO is a key field in my example data. Were DEPTNO not a key field, you could use DISTINCT as follows to ensure that each DEPTNO value missing from EMP is reported only once:

```
select distinct deptno
          from dept
         where deptno not in (select deptno from emp)
```

Be mindful of NULLs when using NOT IN. Consider the following table, NEW_ DEPT:

```
create table new_dept(deptno integer)
        insert into new_dept values (10)
        insert into new_dept values (50)
        insert into new_dept values (null)
```

If you try to find the DEPTNOs in table DEPT that do not exist in table NEW_DEPT and use a subquery with NOT IN, you'll find that the query returns no rows:

```
select *
          from dept
         where deptno not in (select deptno from new_dept)
```

DEPTNOs 20, 30, and 40 are not in table NEW_DEPT, yet were not returned by the query. The reason is the NULL value present in table NEW_DEPT. Three rows are returned by the subquery, with DEPTNOs of 10, 50, and NULL. IN and NOT IN are essentially OR operations, and will yield different results because of how NULL values are treated by logical OR evaluations. Consider the following example using IN and its equivalent using OR:

```
select deptno
  from dept
 where deptno in ( 10,50,null )

 DEPTNO
-------
     10


select deptno
  from dept
 where (deptno=10 or deptno=50 or deptno=null)

 DEPTNO
-------
     10
```

Now consider the same example using NOT IN and NOT OR:

```
select deptno
  from dept
 where deptno not in ( 10,50,null )

( no rows )

select deptno
  from dept
 where not (deptno=10 or deptno=50 or deptno=null)

(no rows)
```

As you can see, the condition DEPTNO NOT IN (10, 50, NULL) equates to:

```
not (deptno=10 or deptno=50 or deptno=null)
```

In the case where DEPTNO is 50, here's how this expression plays out:

```
not (deptno=10 or deptno=50 or deptno=null)
        (false or false or null)
        (false or null)
        null
```

In SQL, "TRUE or NULL" is TRUE, but "FALSE or NULL" is NULL! And once you have a NULL result, you'll continue to have NULL result (unless you specifically test for NULL using a technique like that shown in Recipe 1.11). You must keep this in mind when using IN predicates and when performing logical OR evaluations, and NULL values are involved.

To avoid the problem with NOT IN and NULLs, use a correlated subquery in conjunction with NOT EXISTS. The term "correlated subquery" is used because rows from the outer query are referenced in the subquery. The following example is an alternative solution that will not be affected by NULL rows (going back to the original query from the "Problem" section):

```
select d.deptno
  from dept d
 where not exists ( select null
                      from emp e
                    where d.deptno = e.deptno )

    DEPTNO
----------
        40
```

Conceptually, the outer query in this solution considers each row in the DEPT table. For each DEPT row, the following happens:

1. The subquery is executed to see whether the department number exists in the EMP table. Note the condition D.DEPTNO = E.DEPTNO, which brings together the department numbers from the two tables.

2. If the subquery returns results, then EXISTS (…) evaluates to true and NOT EXISTS (…) thus evaluates to FALSE, and the row being considered by the outer query is discarded.

3. If the subquery returns no results, then NOT EXISTS (…) evaluates to TRUE, and the row being considered by the outer query is returned (because it is for a department not represented in the EMP table).

The items in the SELECT list of the subquery are unimportant when using a correlated subquery with EXISTS/NOT EXISTS, which is why I chose to select NULL, to force you to focus on the join in the subquery rather than the items in the SELECT list.

Recipe 3.5. Retrieving Rows from One Table That Do Not Correspond to Rows in Another

Problem

You want to find rows that are in one table that do not have a match in another table, for two tables that have common keys. For example, you want to find which departments have no employees. The result set should be the following:

```
DEPTNO  DNAME           LOC
          ----------  --------------  -------------
                  40  OPERATIONS      BOSTON
```

Finding the department each employee works in requires an equi-join on DEPTNO from EMP to DEPT. The DEPTNO column represents the common value between tables. Unfortunately, an equi-join will not show you which department has no employees. That's because by equi-joining EMP and DEPT you are returning all rows that satisfy the join condition. Instead you want only those rows from DEPT that do not satisfy the join condition.

This is a subtly different problem than in the preceding recipe, though at first glance they may seem the same. The difference is that the preceding recipe yields only a list of department numbers not represented in table EMP. Using this recipe, however, you can easily return other columns from the DEPT table; you can return more than just department numbers.

Solution

Return all rows from one table along with rows from another that may or may not have a match on the common column. Then, keep only those rows with no match.

DB2, MySQL, PostgreSQL, SQL Server

Use an outer join and filter for NULLs (keyword OUTER is optional):

```
select d.*
  from dept d left outer join emp e
    on (d.deptno = e.deptno)
 where e.deptno is null
```

Oracle

For users on Oracle9*i* Database and later, the preceding solution will work. Alternatively, you can use the proprietary Oracle outer-join syntax:

```
select d.*
  from dept d, emp e
 where d.deptno = e.deptno (+)
   and e.deptno is null
```

This proprietary syntax (note the use of the "+" in parens) is the only outer-join syntax available in Oracle8*i* Database and earlier.

Discussion

This solution works by outer joining and then keeping only rows that have no match. This sort of operation is sometimes called an *anti-join*. To get a better idea of how an anti-join works, first examine the result set without filtering for NULLs:

```
select e.ename, e.deptno as emp_deptno, d.*
  from dept d left join emp e
    on (d.deptno = e.deptno)

ENAME       EMP_DEPTNO     DEPTNO DNAME          LOC
----------  ----------  ---------- -------------- -------------
SMITH               20         20 RESEARCH       DALLAS
ALLEN               30         30 SALES          CHICAGO
WARD                30         30 SALES          CHICAGO
JONES               20         20 RESEARCH       DALLAS
MARTIN              30         30 SALES          CHICAGO
BLAKE               30         30 SALES          CHICAGO
CLARK               10         10 ACCOUNTING     NEW YORK
SCOTT               20         20 RESEARCH       DALLAS
KING                10         10 ACCOUNTING     NEW YORK
TURNER              30         30 SALES          CHICAGO
ADAMS               20         20 RESEARCH       DALLAS
JAMES               30         30 SALES          CHICAGO
FORD                20         20 RESEARCH       DALLAS
MILLER              10         10 ACCOUNTING     NEW YORK
                               40 OPERATIONS     BOSTON
```

Notice, the last row has a NULL value for EMP.ENAME and EMP_DEPTNO. That's because no employees work in department 40. The solution uses the WHERE clause to keep only rows where EMP_DEPTNO is NULL (thus keeping only rows from DEPT that have no match in EMP).

<b>

```
select * from emp_bonus</b>

EMPNO RECEIVED TYPE

---------- ----------- ----------

7369 14-MAR-2005 1

7900 14-MAR-2005 2
```

7788 14-MAR-2005 3

<b>

```
select e.ename, d.loc from emp e, dept d where e.deptno=d.deptno</b>

ENAME LOC

---------- -------------

SMITH DALLAS

ALLEN CHICAGO

WARD CHICAGO

JONES DALLAS

MARTIN CHICAGO

BLAKE CHICAGO

CLARK NEW YORK

SCOTT DALLAS

KING NEW YORK

TURNER CHICAGO

ADAMS DALLAS

JAMES CHICAGO

FORD DALLAS

MILLER NEW YORK
```

<b>

```
   select e.ename, d.loc,eb.received from emp e, dept d, emp_bonus eb
where e.deptno=d.deptno and e.empno=eb.empno</b>

   ENAME LOC RECEIVED

   ---------- ------------- -----------

   SCOTT DALLAS 14-MAR-2005

   SMITH DALLAS 14-MAR-2005

   JAMES CHICAGO 14-MAR-2005

ENAME LOC RECEIVED

   ---------- ------------- -----------

   ALLEN CHICAGO

   WARD CHICAGO

   MARTIN CHICAGO

   JAMES CHICAGO 14-MAR-2005

   TURNER CHICAGO

   BLAKE CHICAGO

   SMITH DALLAS 14-MAR-2005

   FORD DALLAS

   ADAMS DALLAS

   JONES DALLAS

   SCOTT DALLAS 14-MAR-2005
   CLARK NEW YORK

   KING NEW YORK

   MILLER NEW YORK

1 select e.ename, d.loc, eb.received

   2 from emp e join dept d 3 on (e.deptno=d.deptno)
```

4 left join emp_bonus eb

5 on (e.empno=eb.empno)

6 order by 2

1 select e.ename, d.loc, eb.received

2 from emp e, dept d, emp_bonus eb 3 where e.deptno=d.deptno 4 and e.empno=eb.empno (+)

5 order by 2

1 select e.ename, d.loc,

2 (select eb.received from emp_bonus eb 3 where eb.empno=e.empno) as received 4 from emp e, dept d 5 where e.deptno=d.deptno

6 order by 2

The scalar subquery solution will work across all platforms.

Discussion

An outer join will return all rows from one table and matching rows from another. See the previous recipe for another example of such a join. The reason an outer join works to solve this problem is that it does not result in any rows being eliminated that would otherwise be returned. The query will return all the rows it would return without the outer join. And it also returns the received date, if one exists.

Use of a scalar subquery is also a convenient technique for this sort of problem, as it does not require you to modify already correct joins in your main query. Using a scalar subquery is an easy way to tack on extra data to a query without compromising the current result set. When working with scalar subqueries, you must ensure they return a scalar (single) value. If a subquery in the SELECT list returns more than one row, you will receive an error.

See Also

See "Converting a Scalar Subquery to a Composite Subquery in Oracle" in Chapter 14 for a workaround to the problem of not being able to return multiple rows from a SELECT-list subquery.

<b>

```
create view V
as
select * from emp where deptno != 10
union all
select * from emp where ename = 'WARD'

select * from V</b>
EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO
----- ---------- --------- ----- ----------- ----- ----- ------
7369 SMITH CLERK 7902 17-DEC-1980 800 20
7499 ALLEN SALESMAN 7698 20-FEB-1981 1600 300 30
7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30
7566 JONES MANAGER 7839 02-APR-1981 2975 20
7654 MARTIN SALESMAN 7698 28-SEP-1981 1250 1300 30
7698 BLAKE MANAGER 7839 01-MAY-1981 2850 30
7788 SCOTT ANALYST 7566 09-DEC-1982 3000 20
7844 TURNER SALESMAN 7698 08-SEP-1981 1500 0 30
7876 ADAMS CLERK 7788 12-JAN-1983 1100 20
7900 JAMES CLERK 7698 03-DEC-1981 950 30
```

```
    7902 FORD ANALYST 7566 03-DEC-1981 3000 20

    7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30

EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO CNT

    ----- ---------- --------- ----- ----------- ----- ----- ------ ---

    7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 1

    7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 2

    7782 CLARK MANAGER 7839 09-JUN-1981 2450 10 1

    7839 KING PRESIDENT 17-NOV-1981 5000 10 1

    7934 MILLER CLERK 7782 23-JAN-1982 1300 10 1

1 (

    2 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 3 count(*) as
cnt
```

4 from V

5 group by empno,ename,job,mgr,hiredate,sal,comm,deptno

6 except

7 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 8 count(*) as cnt

9 from emp

10 group by empno,ename,job,mgr,hiredate,sal,comm,deptno 11)

12 union all

13 (

14 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 15 count(*) as cnt

16 from emp

17 group by empno,ename,job,mgr,hiredate,sal,comm,deptno

18 except

19 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 20 count(*) as cnt

21 from v

22 group by empno,ename,job,mgr,hiredate,sal,comm,deptno 23)

1 (

2 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 3 count(*) as cnt

```
4 from V
5 group by empno,ename,job,mgr,hiredate,sal,comm,deptno
```

6 minus

7 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 8 count(*) as cnt

9 from emp

10 group by empno,ename,job,mgr,hiredate,sal,comm,deptno 11)

12 union all

13 (

14 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 15 count(*) as cnt

16 from emp

17 group by empno,ename,job,mgr,hiredate,sal,comm,deptno

18 minus

19 select empno,ename,job,mgr,hiredate,sal,comm,deptno, 20 count(*) as cnt

21 from v

22 group by empno,ename,job,mgr,hiredate,sal,comm,deptno 23)

1 select *

2 from (

3 select e.empno,e.ename,e.job,e.mgr,e.hiredate, 4 e.sal,e.comm,e.deptno, count(*) as cnt

5 from emp e

6 group by empno,ename,job,mgr,hiredate, 7 sal,comm,deptno 8) e

9 where not exists (

10 select null

11 from (

12 select v.empno,v.ename,v.job,v.mgr,v.hiredate, 13 v.sal,v.comm,v.deptno, count(*) as cnt

14 from v

15 group by empno,ename,job,mgr,hiredate, 16 sal,comm,deptno 17) v

18 where v.empno = e.empno 19 and v.ename = e.ename 20 and v.job = e.job 21 and v.mgr = e.mgr 22 and v.hiredate = e.hiredate 23 and v.sal = e.sal 24 and v.deptno = e.deptno 25 and v.cnt = e.cnt 26 and coalesce(v.comm,0) = coalesce(e.comm,0) 27)

```
union all
select *
from (
select v.empno,v.ename,v.job,v.mgr,v.hiredate,
v.sal,v.comm,v.deptno, count(*) as cnt
```

```
33 from v
34 group by empno,ename,job,mgr,hiredate, 35 sal,comm,deptno 36 ) v
37 where not exists (
38 select null
39 from (
40 select e.empno,e.ename,e.job,e.mgr,e.hiredate,
41 e.sal,e.comm,e.deptno, count(*) as cnt
```

42 from emp e

43 group by empno,ename,job,mgr,hiredate, 44 sal,comm,deptno 45) e

46 where v.empno = e.empno 47 and v.ename = e.ename 48 and v.job = e.job 49 and v.mgr = e.mgr 50 and v.hiredate = e.hiredate 51 and v.sal = e.sal 52 and v.deptno = e.deptno 53 and v.cnt = e.cnt 54 and coalesce(v.comm,0) = coalesce(e.comm,0) 55)

<b>

select count(*)

from emp

union

select count(*)

from dept</b>

COUNT(*)

4

14

<b>

(

select empno,ename,job,mgr,hiredate,sal,comm,deptno, count(*) as cnt

from V

group by empno,ename,job,mgr,hiredate,sal,comm,deptno except

```
select empno,ename,job,mgr,hiredate,sal,comm,deptno, count(*) as cnt

from emp

group by empno,ename,job,mgr,hiredate,sal,comm,deptno )</b>


EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO CNT

----- ---------- --------- ----- ----------- ----- ----- ------ ---

7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 2

<b>

(

select empno,ename,job,mgr,hiredate,sal,comm,deptno, count(*) as cnt

from emp

group by empno,ename,job,mgr,hiredate,sal,comm,deptno minus

select empno,ename,job,mgr,hiredate,sal,comm,deptno, count(*) as cnt

from v

group by empno,ename,job,mgr,hiredate,sal,comm,deptno )</b>


EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO CNT

----- ---------- --------- ----- ----------- ----- ----- ------ ---

7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 1

7782 CLARK MANAGER 7839 09-JUN-1981 2450 10 1
```

```
7839 KING PRESIDENT 17-NOV-1981 5000 10 1

7934 MILLER CLERK 7782 23-JAN-1982 1300 10 1
```

<b>

```
select *

from (

select e.empno,e.ename,e.job,e.mgr,e.hiredate, e.sal,e.comm,e.deptno,
count(*) as cnt from emp e

group by empno,ename,job,mgr,hiredate, sal,comm,deptno

) e

where not exists (

select null

from (

select v.empno,v.ename,v.job,v.mgr,v.hiredate, v.sal,v.comm,v.deptno,
count(*) as cnt from v

group by empno,ename,job,mgr,hiredate, sal,comm,deptno

) v

where v.empno = e.empno and v.ename = e.ename and v.job = e.job and
v.mgr = e.mgr and v.hiredate = e.hiredate and v.sal = e.sal and v.deptno =
e.deptno and v.cnt = e.cnt and coalesce(v.comm,0) = coalesce(e.comm,0) )
```

</b>

```
EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO CNT
```

```
----- ---------- --------- ----- ----------- ----- ----- ------ ---

7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 1

7782 CLARK MANAGER 7839 09-JUN-1981 2450 10 1

7839 KING PRESIDENT 17-NOV-1981 5000 10 1

7934 MILLER CLERK 7782 23-JAN-1982 1300 10 1
```

<b>

```
select *

from (

select v.empno,v.ename,v.job,v.mgr,v.hiredate, v.sal,v.comm,v.deptno,
count(*) as cnt from v

group by empno,ename,job,mgr,hiredate, sal,comm,deptno

) v

where not exists (

select null

from (

select e.empno,e.ename,e.job,e.mgr,e.hiredate, e.sal,e.comm,e.deptno,
count(*) as cnt from emp e

group by empno,ename,job,mgr,hiredate, sal,comm,deptno

) e

where v.empno = e.empno and v.ename = e.ename and v.job = e.job and
v.mgr = e.mgr and v.hiredate = e.hiredate and v.sal = e.sal and v.deptno =
e.deptno and v.cnt = e.cnt and coalesce(v.comm,0) = coalesce(e.comm,0) )
</b>
```

```
EMPNO ENAME JOB MGR HIREDATE SAL COMM DEPTNO CNT

----- ---------- --------- ----- ----------- ----- ----- ------ ---

7521 WARD SALESMAN 7698 22-FEB-1981 1250 500 30 2
```

The results are then combined by UNION ALL to produce the final result set.

Ales Spectic and Jonathan Gennick give an alternate solution in their book Transact-SQL Cookbook (O'Reilly). See the section "Comparing Two Sets for Equality" in Chapter 2.

<b>

```
    select e.ename, d.loc from emp e, dept d where e.deptno = 10</b>

    ENAME LOC

    ---------- -------------

    CLARK NEW YORK

    CLARK DALLAS

    CLARK CHICAGO

    CLARK BOSTON

    KING NEW YORK

    KING DALLAS

    KING CHICAGO

    KING BOSTON

    MILLER NEW YORK

    MILLER DALLAS

    MILLER CHICAGO

    MILLER BOSTON

ENAME LOC

    ---------- ---------

    CLARK NEW YORK

    KING NEW YORK
```

```
   MILLER NEW YORK

1 select e.ename, d.loc

   2 from emp e, dept d 3 where e.deptno = 10

   4 and d.deptno = e.deptno

<b>

   select * from dept</b>

   DEPTNO DNAME LOC

   ---------- -------------- -------------

   10 ACCOUNTING NEW YORK

   20 RESEARCH DALLAS

   30 SALES CHICAGO
```

40 OPERATIONS BOSTON

You can see that department 10 is in New York, and thus you can know that returning employees with any location other than New York is incorrect. The number of rows returned by the incorrect query is the product of the cardinalities of the two tables in the FROM clause. In the original query, the filter on EMP for department 10 will result in three rows. Because there is no filter for DEPT, all four rows from DEPT are returned. Three multiplied by four is twelve, so the incorrect query returns twelve rows. Generally, to avoid a Cartesian product you would apply the n1 rule where n represents the number of tables in the FROM clause and n1 represents the minimum number of joins necessary to avoid a Cartesian product. Depending on what the keys and join columns in your tables are, you may very well need more than n1 joins, but n1 is a good place to start when writing queries.

When used properly, Cartesian products can be very useful. The recipe, , uses a Cartesian product and is used by many other queries. Common uses of Cartesian products include transposing or pivoting (and unpivoting) a result set, generating a sequence of values, and mimicking a loop.

<b>

```
select * from emp_bonus</b>

EMPNO RECEIVED TYPE

----- ----------- ----------

7934 17-MAR-2005 1

7934 15-FEB-2005 2

7839 15-FEB-2005 3
```

7782 15-FEB-2005 1

<b>

```
   select e.empno, e.ename,

   e.sal,

   e.deptno,

   e.sal*case when eb.type = 1 then .1

   when eb.type = 2 then .2

   else .3

   end as bonus

   from emp e, emp_bonus eb where e.empno = eb.empno and e.deptno =
10</b>

   EMPNO ENAME SAL DEPTNO BONUS

   ------- ---------- ---------- ---------- ---------

   7934 MILLER 1300 10 130

   7934 MILLER 1300 10 260

   7839 KING 5000 10 1500
```

7782 CLARK 2450 10 245

```
<b>

   select deptno, sum(sal) as total_sal, sum(bonus) as total_bonus from (

   select e.empno, e.ename,

   e.sal,

   e.deptno,

   e.sal*case when eb.type = 1 then .1

   when eb.type = 2 then .2

   else .3

   end as bonus

   from emp e, emp_bonus eb where e.empno = eb.empno and e.deptno =
10

   ) x

   group by deptno</b>

   DEPTNO TOTAL_SAL TOTAL_BONUS

   ------ ----------- -----------
```

10 10050 2135

```
<b>

   select sum(sal) from emp where deptno=10</b>

   SUM(SAL)

   ----------

   8750

<b>

   select e.ename, e.sal

   from emp e, emp_bonus eb where e.empno = eb.empno and e.deptno =
10</b>

   ENAME SAL

   ---------- ----------

   CLARK 2450

   KING 5000

   MILLER 1300

   MILLER 1300

DEPTNO TOTAL_SAL TOTAL_BONUS

   ------ --------- -----------
```

10 8750 2135

```
select deptno,
   sum(distinct sal) as total_sal,
   sum(bonus) as total_bonus
   from (
   select e.empno,
   e.ename,
   e.sal,
   e.deptno,
   e.sal*case when eb.type = 1 then .1
   when eb.type = 2 then .2
   else .3
```

12 end as bonus

13 from emp e, emp_bonus eb 14 where e.empno = eb.empno 15 and e.deptno = 10

16) x

17 group by deptno

1 select distinct deptno,total_sal,total_bonus 2 from (

3 select e.empno, 4 e.ename,

5 sum(distinct e.sal) over 6 (partition by e.deptno) as total_sal, 7 e.deptno,

8 sum(e.sal*case when eb.type = 1 then .1

9 when eb.type = 2 then .2

10 else .3 end) over 11 (partition by deptno) as total_bonus 12 from emp e, emp_bonus eb 13 where e.empno = eb.empno 14 and e.deptno = 10

15) x

<b>

select d.deptno, d.total_sal,

sum(e.sal*case when eb.type = 1 then .1

when eb.type = 2 then .2

else .3 end) as total_bonus from emp e,

emp_bonus eb, (

select deptno, sum(sal) as total_sal from emp

where deptno = 10

group by deptno) d

where e.deptno = d.deptno and e.empno = eb.empno group by d.deptno,d.total_sal</b>

```
DEPTNO TOTAL_SAL TOTAL_BONUS
--------- ---------- ------------
```

10 8750 2135

<b>

```
select e.empno, e.ename,

sum(distinct e.sal) over (partition by e.deptno) as total_sal, e.deptno,

sum(e.sal*case when eb.type = 1 then .1

when eb.type = 2 then .2

else .3 end) over (partition by deptno) as total_bonus from emp e,
emp_bonus eb where e.empno = eb.empno and e.deptno = 10</b>

EMPNO ENAME TOTAL_SAL DEPTNO TOTAL_BONUS

----- ---------- ---------- ------ -----------

7934 MILLER 8750 10 2135

7934 MILLER 8750 10 2135

7782 CLARK 8750 10 2135
```

7839 KING 8750 10 2135

The windowing function, SUM OVER, is called twice, first to compute the sum of the distinct salaries for the defined partition or group. In this case, the partition is DEPTNO 10 and the sum of the distinct salaries for DEPTNO 10 is 8750. The next call to SUM OVER computes the sum of the bonuses for the same defined partition. The final result set is produced by taking the distinct values for TOTAL_SAL, DEPTNO, and TOTAL_BONUS.

<b>

```
select * from emp_bonus</b>

EMPNO RECEIVED TYPE

---------- ----------- ----------

7934 17-MAR-2005 1
```

7934 15-FEB-2005 2

```
<b>
select deptno,
sum(sal) as total_sal, sum(bonus) as total_bonus from (
select e.empno, e.ename,
e.sal,
e.deptno,
e.sal*case when eb.type = 1 then .1
when eb.type = 2 then .2
else .3 end as bonus from emp e, emp_bonus eb where e.empno = eb.empno and e.deptno = 10
)
group by deptno</b>
DEPTNO TOTAL_SAL TOTAL_BONUS
------ ---------- -----------
```

10 2600 390

<b>

```
select e.empno, e.ename,

e.sal,

e.deptno,

e.sal*case when eb.type = 1 then .1

when eb.type = 2 then .2

else .3 end as bonus from emp e, emp_bonus eb where e.empno =
eb.empno and e.deptno = 10</b>

EMPNO ENAME SAL DEPTNO BONUS

--------- --------- ------- ---------- ----------

7934 MILLER 1300 10 130
```

7934 MILLER 1300 10 260

DEPTNO TOTAL_SAL TOTAL_BONUS

```
------ --------- -----------
```

```
10 8750 390
```

```
select deptno,
   sum(distinct sal) as total_sal, sum(bonus) as total_bonus from (
   select e.empno, e.ename,
   e.sal,
   e.deptno,
   e.sal*case when eb.type is null then 0
   when eb.type = 1 then .1
   when eb.type = 2 then .2
   else .3 end as bonus from emp e left outer join emp_bonus eb on (e.empno = eb.empno) where e.deptno = 10
   )
```

17 group by deptno

1 select distinct deptno,total_sal,total_bonus 2 from (

3 select e.empno, 4 e.ename,

5 sum(distinct e.sal) over 6 (partition by e.deptno) as total_sal, 7 e.deptno,

8 sum(e.sal*case when eb.type is null then 0

9 when eb.type = 1 then .1

10 when eb.type = 2 then .2

11 else .3

12 end) over

13 (partition by deptno) as total_bonus 14 from emp e left outer join emp_bonus eb 15 on (e.empno = eb.empno) 16 where e.deptno = 10

17) x

1 select deptno,

2 sum(distinct sal) as total_sal, 3 sum(bonus) as total_bonus 4 from (

5 select e.empno, 6 e.ename,

7 e.sal,

8 e.deptno,

9 e.sal*case when eb.type is null then 0

10 when eb.type = 1 then .1

11 when eb.type = 2 then .2

12 else .3 end as bonus 13 from emp e, emp_bonus eb 14 where e.empno = eb.empno (+) 15 and e.deptno = 10

16)

17 group by deptno

<b>

```
   select d.deptno, d.total_sal,

   sum(e.sal*case when eb.type = 1 then .1

   when eb.type = 2 then .2

   else .3 end) as total_bonus from emp e,

   emp_bonus eb,

   (

   select deptno, sum(sal) as total_sal from emp

   where deptno = 10

   group by deptno ) d

   where e.deptno = d.deptno and e.empno = eb.empno group by
d.deptno,d.total_sal</b>

   DEPTNO TOTAL_SAL TOTAL_BONUS

   --------- ---------- -----------
```

10 8750 390

<b>

select d.deptno,d.dname,e.ename from dept d left outer join emp e on (d.deptno=e.deptno)</b>

```
DEPTNO DNAME ENAME

--------- -------------- ----------

20 RESEARCH SMITH

30 SALES ALLEN

30 SALES WARD

20 RESEARCH JONES

30 SALES MARTIN

30 SALES BLAKE

10 ACCOUNTING CLARK

20 RESEARCH SCOTT

10 ACCOUNTING KING

30 SALES TURNER

20 RESEARCH ADAMS

30 SALES JAMES

20 RESEARCH FORD

10 ACCOUNTING MILLER
```

40 OPERATIONS

```
insert into emp (empno,ename,job,mgr,hiredate,sal,comm,deptno) select
1111,'YODA','JEDI',null,hiredate,sal,comm,null from emp

   where ename = 'KING'



   <b>

   select d.deptno,d.dname,e.ename from dept d right outer join emp e on
(d.deptno=e.deptno)</b>

   DEPTNO DNAME ENAME

   ---------- ------------ ----------

   10 ACCOUNTING MILLER

   10 ACCOUNTING KING

   10 ACCOUNTING CLARK

   20 RESEARCH FORD

   20 RESEARCH ADAMS

   20 RESEARCH SCOTT

   20 RESEARCH JONES

   20 RESEARCH SMITH

   30 SALES JAMES

   30 SALES TURNER
```

30 SALES BLAKE

30 SALES MARTIN

30 SALES WARD

30 SALES ALLEN

YODA

```
DEPTNO DNAME ENAME
    ---------- ------------ --------
    10 ACCOUNTING CLARK
    10 ACCOUNTING KING
    10 ACCOUNTING MILLER
    20 RESEARCH ADAMS
    20 RESEARCH FORD
    20 RESEARCH JONES
    20 RESEARCH SCOTT
    20 RESEARCH SMITH
    30 SALES ALLEN
    30 SALES BLAKE
    30 SALES JAMES
    30 SALES MARTIN
    30 SALES TURNER
    30 SALES WARD
```

40 OPERATIONS

YODA

1 select d.deptno,d.dname,e.ename

  2 from dept d full outer join emp e 3 on (d.deptno=e.deptno)

1 select d.deptno,d.dname,e.ename

  2 from dept d right outer join emp e 3 on (d.deptno=e.deptno)

4 union

5 select d.deptno,d.dname,e.ename 6 from dept d left outer join emp e 7 on (d.deptno=e.deptno)

1 select d.deptno,d.dname,e.ename

2 from dept d, emp e 3 where d.deptno = e.deptno(+)

4 union

5 select d.deptno,d.dname,e.ename 6 from dept d, emp e 7 where d.deptno(+) = e.deptno

<b>

select d.deptno,d.dname,e.ename from dept d left outer join emp e on (d.deptno = e.deptno)</b>

```
DEPTNO DNAME ENAME

------ -------------- ----------

20 RESEARCH SMITH

30 SALES ALLEN

30 SALES WARD

20 RESEARCH JONES

30 SALES MARTIN

30 SALES BLAKE

10 ACCOUNTING CLARK

20 RESEARCH SCOTT

10 ACCOUNTING KING

30 SALES TURNER

20 RESEARCH ADAMS

30 SALES JAMES
```

20 RESEARCH FORD

10 ACCOUNTING MILLER

40 OPERATIONS

<b>

select d.deptno,d.dname,e.ename from dept d right outer join emp e on (d.deptno = e.deptno)</b>

```
DEPTNO DNAME ENAME

------ -------------- ----------

10 ACCOUNTING MILLER

10 ACCOUNTING KING

10 ACCOUNTING CLARK

20 RESEARCH FORD

20 RESEARCH ADAMS

20 RESEARCH SCOTT

20 RESEARCH JONES

20 RESEARCH SMITH

30 SALES JAMES

30 SALES TURNER

30 SALES BLAKE

30 SALES MARTIN

30 SALES WARD
```

30 SALES ALLEN

YODA

The results from these two queries are unioned to provide the final result set.

```
1 select ename,comm
```

```
2 from emp
  3 where coalesce(comm,0) < ( select comm
```

4 from emp

5 where ename = 'WARD')

<b>

select ename,comm,coalesce(comm,0) from emp where coalesce(comm,0) < (select comm from emp where ename = 'WARD')
</b>

ENAME COMM COALESCE(COMM,0) ---------- ---------- ---------------

SMITH 0

ALLEN 300 300

JONES 0

BLAKE 0

CLARK 0

SCOTT 0

KING 0

TURNER 0 0

ADAMS 0

JAMES 0

FORD 0

MILLER 0

Chapter 4. Inserting, Updating, Deleting

The past few chapters have focused on basic query techniques, all centered around the task of getting data out of a database. This chapter turns the tables, and focuses on the following three topic areas:

- Inserting new records into your database
- Updating existing records
- Deleting records that you no longer want

For ease in finding them when you need them, recipes in this chapter have been grouped by topic: all the insertion recipes come first, followed by the update recipes, and finally recipes for deleting data.

Inserting is usually a straightforward task. It begins with the simple problem of inserting a single row. Many times, however, it is more efficient to use a set-based approach to create new rows. To that end, you'll also find techniques for inserting many rows at a time.

Likewise, updating and deleting start out as simple tasks. You can update one record, and you can delete one record. But you can also update whole sets of records at once, and in very powerful ways. And there are many handy ways to delete records. For example, you can delete rows in one table depending on whether or not they exist in another table.

SQL even has a way, a relatively new addition to the standard, by which you can insert, update, and delete all at once. That may not sound like too useful a thing now, but the MERGE statement represents a very powerful way to bring a database table into sync with an external source of data (such as a flat file feed from a remote system). Check out Section in this chapter for details.

Recipe 4.1. Inserting a New Record

Problem

You want to insert a new record into a table. For example, you want to insert a new record into the DEPT table. The value for DEPTNO should be 50, DNAME should be "PROGRAMMING", and LOC should be "BALTIMORE".

Solution

Use the INSERT statement with the VALUES clause to insert one row at a time:

```
insert into dept (deptno,dname,loc)
        values (50,'PROGRAMMING','BALTIMORE')
```

For DB2 and MySQL you have the option of inserting one row at a time or multiple rows at a time by including multiple VALUES lists:

```
/* multi row insert */
        insert into dept (deptno,dname,loc)
        values (1,'A','B'),
               (2,'B','C')
```

Discussion

The INSERT statement allows you to create new rows in database tables. The syntax for inserting a single row is consistent across all database brands.

As a shortcut, you can omit the column list in an INSERT statement:

```
insert into dept
        values (50,'PROGRAMMING','BALTIMORE')
```

However, if you do not list your target columns, you must insert into *all* of the columns in the table, and be mindful of the order of the values in the VALUES list; you must supply values in the same order in which the database displays columns in response to a SELECT * query.

Recipe 4.2. Inserting Default Values

Problem

A table can be defined to take default values for specific columns. You want to insert a row of default values without having to specify those values. Consider the following table: create table D (id integer default 0)

You want to insert zero without explicitly specifying zero in the values list of an INSERT statement. You want to explicitly insert the default, whatever that default is.

Solution

All brands support use of the DEFAULT keyword as a way of explicitly specifying the default value for a column. Some brands provide additional ways to solve the problem.

The following example illustrates the use of the DEFAULT keyword:

```
insert into D values (default)
```

You may also explicitly specify the column name, which you'll need to do anytime you are not inserting into all columns of a table: insert into D (id) values (default)

Oracle8*i* Database and prior versions do not support the DEFAULT keyword. Prior to Oracle9*i* Database, there was no way to explicitly insert a default column value.

MySQL allows you to specify an empty values list if all columns have a default value defined:

```
insert into D values ()
```

In this case, all columns will be set to their default values.

PostgreSQL and SQL Server support a DEFAULT VALUES clause:

```
insert into D default values
```

The DEFAULT VALUES clause causes all columns to take on their default values.

Discussion

The DEFAULT keyword in the values list will insert the value that was specified as the default for a particular column during table creation. The keyword is available for all DBMSs.

MySQL, PostgreSQL, and SQL Server users have another option available if all columns in the table are defined with a default value (as table D is in this case). You may use an empty VALUES list (MySQL) or specify the DEFAULT VALUES clause (PostgreSQL and SQL Server) to create a new row with all default values; otherwise, you need to specify DEFAULT for each column in the table.

For tables with a mix of default and non-default columns, inserting default values for a column is as easy as excluding the column from the insert list; you do not need to use the DEFAULT keyword. Say that table D had an additional column that was not defined with a default value: create table D (id integer default 0, foo varchar(10))

You can insert a default for ID by listing only FOO in the insert list:

```
insert into D (name) values ('Bar')
```

This statement will result in a row in which ID is 0 and FOO is "Bar". ID takes on its default value because no other value is specified.

Recipe 4.3. Overriding a Default Value with NULL

Problem

You are inserting into a column having a default value, and you wish to override that default value by setting the column to NULL. Consider the following table:

```
create table D (id integer default 0, foo VARCHAR(10))
```

You wish to insert a row with a NULL value for ID.

Solution

You can explicitly specify NULL in your values list:

```
insert into d (id, foo) values (null, 'Brighten')
```

Discussion

Not everyone realizes that you can explicitly specify NULL in the values list of an INSERT statement. Typically, when you do not wish to specify a value for a column, you leave that column out of your column and values lists:

```
insert into d (foo) values ('Brighten')
```

Here, no value for ID is specified. Many would expect the column to taken on the null value, but, alas, a default value was specified at table creation time, so the result of the preceding INSERT is that ID takes on the value 0 (the default). By specifying NULL as the value for a column, you can set the column to NULL despite any default value.

1 insert into dept_east (deptno,dname,loc) 2 select deptno,dname,loc

```
3 from dept
  4 where loc in ( 'NEW YORK','BOSTON' )
```

Discussion

Simply follow the INSERT statement with a query that returns the desired rows. If you want to copy all rows from the source table, exclude the WHERE clause from the query. Like a regular insert, you do not have to explicitly specify which columns you are inserting into. But if you do not specify your target columns, you must insert into all of the table's columns, and you must be mindful of the order of the values in the SELECT list as described earlier in "Inserting a New Record."

Recipe 4.5. Copying a Table Definition

Problem

You want to create a new table having the same set of columns as an existing table. For example, you want to create a copy of the DEPT table and call it DEPT_2. You do not want to copy the rows, only the column structure of the table.

Solution

DB2

Use the LIKE clause with the CREATE TABLE command:

```
create table dept_2 like dept
```

Oracle, MySQL, and PostgreSQL

Use the CREATE TABLE command with a subquery that returns no rows:

```
create table dept_2
as
select *
  from dept
 where 1 = 0
```

SQL Server

Use the INTO clause with a subquery that returns no rows:

```
select *
  into dept_2
  from dept
 where 1 = 0
```

Discussion

DB2

DB2's CREATE TABLE…LIKE command allows you to easily use one table as the pattern for creating another. Simply specify your pattern table's name following the LIKE keyword.

Oracle, MySQL, and PostgreSQL

When using Create Table As Select (CTAS), all rows from your query will be used to populate the new table you are creating unless you specify a false condition in the WHERE clause. In the solution provided, the expression "1 = 0" in the WHERE clause of the query causes no rows to be returned. Thus the result of the CTAS statement is an empty table based on the columns in the SELECT clause of the query.

SQL Server

When using INTO to copy a table, all rows from your query will be used to populate the new table you are creating unless you specify a false condition in the WHERE clause of your query. In the solution provided, the expression "1 = 0" in the predicate of the query causes no rows to be returned. The result is an empty table based on the columns in the SELECT clause of the query.

1 insert all

2 when loc in ('NEW YORK','BOSTON') then 3 <a name="idx-CHP-4-0183"></a>into dept_east (deptno,dname,loc) values (deptno,dname,loc) 4 when loc = 'CHICAGO' then 5 into dept_mid (deptno,dname,loc) values (deptno,dname,loc)

6 else

7 into dept_west (deptno,dname,loc) values (deptno,dname,loc) 8 select deptno,dname,loc

9 from dept

create table dept_east

(deptno integer,

dname varchar(10),

loc varchar(10) check (loc in ('NEW YORK','BOSTON')))

create table dept_mid

(deptno integer,

dname varchar(10),

loc varchar(10) check (loc = 'CHICAGO'))

create table dept_west

(deptno integer,

dname varchar(10),

loc varchar(10) check (loc = 'DALLAS'))

1 insert into (

2 select * from dept_west union all 3 select * from dept_east union all 4 select * from dept_mid 5) select * from dept

MySQL, PostgreSQL, and SQL Server

As of the time of this writing, these vendors do not support multi-table inserts.

Discussion

Oracle

Oracle's multi-table insert uses WHEN-THEN-ELSE clauses to evaluate the rows from the nested SELECT and insert them accordingly. In this recipe's example, INSERT ALL and INSERT FIRST would produce the same result, but there is a difference between the two. INSERT FIRST will break out of the WHEN-THEN-ELSE evaluation as soon as it encounters a condition evaluating to true; INSERT ALL will evaluate all conditions even if prior tests evaluate to true. Thus, you can use INSERT ALL to insert the same row into more than one table.

DB2

My DB2 solution is a bit of a hack. It requires that the tables to be inserted into have constraints defined to ensure that each row evaluated from the subquery will go into the correct table. The technique is to insert into a view that is defined as the UNION ALL of the tables. If the check constraints are not unique amongst the tables in the INSERT (i.e., multiple tables have the same check constraint), the INSERT statement will not know where to put the rows and it will fail.

MySQL, PostgreSQL, and SQL Server

As of the time of this writing, only Oracle and DB2 currently provide mechanisms to insert rows returned by a query into one or more of several tables within the same statement.

Recipe 4.7. Blocking Inserts to Certain Columns

Problem

You wish to prevent users, or an errant software application, from inserting values into certain table columns. For example, you wish to allow a program to insert into EMP, but only into the EMPNO, ENAME, and JOB columns.

Solution

Create a view on the table exposing only those columns you wish to expose. Then force all inserts to go through that view.

For example, to create a view exposing the three columns in EMP:

```
create view new_emps as
        select empno, ename, job
          from emp
```

Grant access to this view to those users and programs allowed to populate only the three fields in the view. Do not grant those users insert access to the EMP table. Users may then create new EMP records by inserting into the NEW_EMPS view, but they will not be able to provide values for columns other than the three that are specified in the view definition.

Discussion

When you insert into a simple view such as in the solution, your database server will translate that insert into the underlying table. For example, the following insert:

```
insert into new_emps
           (empno ename, job)
           values (1, 'Jonathan', 'Editor')
```

will be translated behind the scenes into:

```
insert into emp
           (empno ename, job)
           values (1, 'Jonathan', 'Editor')
```

It is also possible, but perhaps less useful, to insert into an inline view (currently only supported by Oracle):

```
insert into
          (select empno, ename, job
             from emp)
        values (1, 'Jonathan', 'Editor')
```

View insertion is a complex topic. The rules become very complicated very quickly for all but the simplest of views. If you plan to make use of the ability to insert into views, it is imperative that you consult and fully understand your vendor documentation on the matter.

<b>

```
select deptno,ename,sal from emp

where deptno = 20

order by 1,3</b>

DEPTNO ENAME SAL

------ ---------- ----------

20 SMITH 800

20 ADAMS 1100

20 JONES 2975

20 SCOTT 3000
```

20 FORD 3000

1 update emp

```
   2 set sal = sal*1.10

   3 where deptno = 20

<b>

   select deptno, ename,

   sal as orig_sal, sal*.10 as amt_to_add, sal*1.10 as new_sal from emp

   where deptno=20

   order by 1,5</b>

   DEPTNO ENAME ORIG_SAL AMT_TO_ADD NEW_SAL

   ------ ------ -------- ---------- -------

   20 SMITH 800 80 880

   20 ADAMS 1100 110 1210

   20 JONES 2975 298 3273

   20 SCOTT 3000 300 3300
```

20 FORD 3000 300 3300

The salary increase is broken down into two columns: one to show the increase over the old salary, and the other to show the new salary.

<b>

```
    select empno, ename from emp_bonus</b>

    EMPNO ENAME

    ---------- ---------

    7369 SMITH

    7900 JAMES
```

7934 MILLER

1 update emp

2 set sal=sal*1.20

3 where empno in (select empno from emp_bonus)

update emp

set sal = sal*1.20

where exists (select null from emp_bonus where emp.empno=emp_bonus.empno)

You may be surprised to see NULL in the SELECT list of the EXISTS subquery. Fear not, that NULL does not have an adverse effect on the update. In my opinion it increases readability as it reinforces the fact that, unlike the solution using a subquery with an IN operator, what will drive the update (i.e., which rows will be updated) will be controlled by the WHERE clause of the subquery, not the values returned as a result of the subquery's SELECT list.

```
<b>
    select *
    from new_sal</b>
    DEPTNO SAL
    ------ ----------
```

10 4000

<b>

```
select deptno,ename,sal,comm from emp

order by 1</b>

DEPTNO ENAME SAL COMM

------ ---------- ---------- ----------

10 CLARK 2450

10 KING 5000

10 MILLER 1300

20 SMITH 800

20 ADAMS 1100

20 FORD 3000

20 SCOTT 3000

20 JONES 2975

30 ALLEN 1600 300

30 BLAKE 2850

30 MARTIN 1250 1400

30 JAMES 950

30 TURNER 1500 0
```

```
30 WARD 1250 500
```

```
1 update emp e set (e.sal,e.comm) = (select ns.sal, ns.sal/2
```

2 from new_sal ns

3 where ns.deptno=e.deptno) 4 where exists (select null

5 from new_sal ns

6 where ns.deptno = e.deptno)

1 update (

2 select e.sal as emp_sal, e.comm as emp_comm, 3 ns.sal as ns_sal, ns.sal/2 as ns_comm 4 from emp e, new_sal ns 5 where e.deptno = ns.deptno 6) set emp_sal = ns_sal, emp_comm = ns_comm

1 update emp

2 set sal = ns.sal, 3 comm = ns.sal/2

```
4 from new_sal ns
  5 where ns.deptno = emp.deptno
```

1 update e

2 set e.sal = ns.sal, 3 e.comm = ns.sal/2

4 from emp e,

5 new_sal ns

```
 6 where ns.deptno = e.deptno
```

<b>

```
 select e.empno, e.deptno e_dept, ns.sal, ns.deptno ns_deptno from emp e, new_sal ns where e.deptno = ns.deptno</b>
```

```
 EMPNO E_DEPT SAL NS_DEPTNO

 ----- ---------- ---------- ----------

 7782 10 4000 10

 7839 10 4000 10
```

7934 10 4000 10

To enable Oracle to update this join, one of the tables must be key-preserved, meaning that if its values are not unique in the result set, it should at least be unique in the table it comes from. In this case NEW_SAL has a primary key on DEPTNO, which makes it unique in the table. Because it is unique in its table, it may appear multiple times in the result set and will still be considered key-preserved, thus allowing the update to complete successfully.

PostgreSQL and SQL Server

The syntax is a bit different between these two platforms, but the technique is the same. Being able to join directly in the UPDATE statement is extremely convenient. Since you specify which table to update (the table listed after the UPDATE keyword) there's no confusion as to which table's rows are modified. Additionally, because you are using joins in the update (since there is an explicit WHERE clause), you can avoid some of the pitfalls when coding correlated subquery updates; in particular, if you missed a join here, it would be very obvious you'd have a problem.

<b>

```
select deptno,empno,ename,comm from emp

order by 1</b>

DEPTNO EMPNO ENAME COMM

------ ---------- ------ ----------

10 7782 CLARK

10 7839 KING

10 7934 MILLER

20 7369 SMITH

20 7876 ADAMS

20 7902 FORD

20 7788 SCOTT

20 7566 JONES

30 7499 ALLEN 300

30 7698 BLAKE

30 7654 MARTIN 1400

30 7900 JAMES

30 7844 TURNER 0
```

30 7521 WARD 500

<b>

select deptno,empno,ename,comm from emp_commission order by 1</b>

```
DEPTNO EMPNO ENAME COMM
---------- ---------- ---------- ----------
10 7782 CLARK
10 7839 KING
```

10 7934 MILLER

1 merge into emp_commission ec

2 using (select * from emp) emp 3 on (ec.empno=emp.empno)

4 when matched then

5 update set ec.comm = 1000

6 delete where (sal < 2000)

7 when not matched then

8 insert (ec.empno,ec.ename,ec.deptno,ec.comm) 9 values (emp.empno,emp.ename,emp.deptno,emp.comm)

Discussion

The join on line 3 of the solution determines what rows already exist and will be updated. The join is between EMP_COMMISSION (aliased as EC) and the subquery (aliased as emp). When the join succeeds, the two rows are considered "matched" and the UPDATE specified in the WHEN MATCHED clause is executed. Otherwise, no match is found and the INSERT in WHEN NOT MATCHED is executed. Thus, rows from table EMP that do not have corresponding rows based on EMPNO in table EMP_COMMISSION will be inserted into EMP_COMMISSION. Of all the employees in table EMP only those in DEPTNO 10 should have their COMM updated in EMP_COMMISSION, while the rest of the employees are inserted. Additionally, since MILLER is in DEPTNO 10 he is a candidate to have his COMM updated, but because his SAL is less than 2000 it is deleted from EMP_COMMISSION.

```
delete from emp
```

Discussion

When using the DELETE command without a WHERE clause, you will delete all rows from the table specified.

```
delete from emp where deptno = 10
```

Discussion

By using a WHERE clause with the DELETE command, you can delete a subset of rows in a table rather than all the rows.

Recipe 4.14. Deleting a Single Record

Problem

You wish to delete a single record from a table.

Solution

This is a special case of "Deleting Specific Records." The key is to ensure that your selection criterion is narrow enough to specify only the one record that you wish to delete. Often you will want to delete based on the primary key. For example, to delete employee CLARK (EMPNO 7782):

```
delete from emp where empno = 7782
```

Discussion

Deleting is always about identifying the rows to be deleted, and the impact of a DELETE always comes down to its WHERE clause. Omit the WHERE clause and the scope of a DELETE is the entire table. By writing conditions in the WHERE clause, you can narrow the scope to a group of records, or to a single record. When deleting a single record, you should typically be identifying that record based on its primary key or on one of its unique keys.

> If your deletion criterion is based on a primary or unique key, then you can be sure of deleting only one record. (This is because your RDBMS will not allow two rows to contain the same primary or unique key values.) Otherwise, you may want to check first, to be sure you aren't about to inadvertently delete more records than you intend.

Recipe 4.15. Deleting Referential Integrity Violations

Problem

You wish to delete records from a table when those records refer to nonexistent records in some other table. Example: some employees are assigned to departments that do not exist. You wish to delete those employees.

Solution

Use the NOT EXISTS predicate with a subquery to test the validity of department numbers:

```
delete from emp
         where not exists (
           select * from dept
            where dept.deptno = emp.deptno
        )
```

Alternatively, you can write the query using a NOT IN predicate:

```
delete from emp
        where deptno not in (select deptno from dept)
```

Discussion

Deleting is really all about selecting: the real work lies in writing WHERE clause conditions to correctly describe those records that you wish to delete.

The NOT EXISTS solution uses a correlated subquery to test for the existence of a record in DEPT having a DEPTNO matching that in a given EMP record. If such a record exists, then the EMP record is retained. Otherwise, it is deleted. Each EMP record is checked in this manner.

The IN solution uses a subquery to retrieve a list of valid department numbers. DEPTNOs from each EMP record are then checked against that list. When an EMP record is found with a DEPTNO not in the list, the EMP record is deleted.

<b>

create table dupes (id integer, name varchar(10))</b> insert into dupes values (1, 'NAPOLEON') insert into dupes values (2, 'DYNAMITE') insert into dupes values (3, 'DYNAMITE') insert into dupes values (4, 'SHE SELLS') insert into dupes values (5, 'SEA SHELLS') insert into dupes values (6, 'SEA SHELLS') insert into dupes values (7, 'SEA SHELLS')

<b>

select * from dupes order by 1</b>

```
ID NAME

---------- ----------

1 NAPOLEON

2 DYNAMITE

3 DYNAMITE

4 SHE SELLS

5 SEA SHELLS

6 SEA SHELLS
```

7 SEA SHELLS

1 delete from dupes

2 where id not in (select min(id)

3 from dupes

4 group by name)

<b>

select min(id) from dupes group by name</b>

```
MIN(ID)

-----------

2

1

5

4
```

<b>

select name, min(id) from dupes group by name</b>

```
NAME MIN(ID) ---------- ----------

DYNAMITE 2

NAPOLEON 1

SEA SHELLS 5

SHE SELLS 4
```

The rows returned by the subquery represent those to be retained. The NOT IN predicate in the DELETE statement causes all other rows to be deleted.

<b>

```
create table dept_accidents ( deptno integer, accident_name varchar(20) )

insert into dept_accidents values (10,'BROKEN FOOT') insert into
dept_accidents values (10,'FLESH WOUND') insert into dept_accidents
values (20,'FIRE') insert into dept_accidents values (20,'FIRE') insert into
dept_accidents values (20,'FLOOD') insert into dept_accidents values
(30,'BRUISED GLUTE')

select * from dept_accidents</b>

DEPTNO ACCIDENT_NAME

---------- --------------------

10 BROKEN FOOT

10 FLESH WOUND

20 FIRE

20 FIRE

20 FLOOD
```

30 BRUISED GLUTE

1 delete from emp

2 where deptno in (select deptno 3 from dept_accidents

```
4 group by deptno

   5 having count(*) >= 3 )

<b>

   select deptno

   from dept_accidents group by deptno having count(*) >= 3</b>

   DEPTNO

   ----------

   20
```

The DELETE will then delete any employees in the departments returned by the subquery (in this case, only in department 20).

Chapter 5. Metadata Queries

This chapter presents recipes that allow you to find information about a given schema. For example, you may wish to know what tables you've created or which foreign keys are not indexed. All of the RDBMSs in this book provide tables and views for obtaining such data. The recipes in this chapter will get you started on gleaning information from those tables and views. There is, however, far more information available than the recipes in this chapter can show. Consult your RDBMSs documentation for the complete list of catalog or data dictionary tables/views.

For purposes of demonstration, all the recipes in this chapter assume the schema name SMEAGOL.

Recipe 5.1. Listing Tables in a Schema

Problem

You want to see a list all the tables you've created in a given schema.

Solution

The solutions that follow all assume you are working with the SMEAGOL schema. The basic approach to a solution is the same for all RDBMSs: you query a system table (or view) containing a row for each table in the database.

DB2

Query SYSCAT.TABLES:

```
select tabname
          from syscat.tables
         where tabschema = 'SMEAGOL'
```

Oracle

Query SYS.ALL_TABLES:

```
select table_name
          from all_tables
         where owner = 'SMEAGOL'
```

PostgreSQL, MySQL, and SQL Server

Query INFORMATION_SCHEMA.TABLES:

```
select table_name
          from information_schema.tables
         where table_schema = 'SMEAGOL'
```

Discussion

In a delightfully circular manner, databases expose information about themselves through the very mechanisms that you create for your own applications: tables and views. Oracle, for example, maintains an extensive catalog of system views, such as ALL_TABLES, that you can query for information about tables, indexes, grants, and any other database object.

Oracle's catalog views are just that, views. They are based on an underlying set of tables that contain the information in a very user-unfriendly form. The views put a very usable face on Oracle's catalog data.

Oracle's system views and DB2's system tables are each vendor-specific. PostgreSQL, MySQL, and SQL Server, on the other hand, support something called the *information* schema, which is a set of views defined by the ISO SQL standard. That's why the same query can work for all three of those databases.

Recipe 5.2. Listing a Table's Columns

Problem

You want to list the columns in a table, along with their data types, and their position in the table they are in.

Solution

The following solutions assume that you wish to list columns, their data types, and their numeric position in the table named EMP in the schema SMEAGOL.

DB2

Query SYSCAT.COLUMNS:

```
select colname, typename, colno
  from syscat.columns
 where tabname   = 'EMP'
   and tabschema = 'SMEAGOL'
```

Oracle

Query ALL_TAB_COLUMNS:

```
select column_name, data_type, column_id
  from all_tab_columns
 where owner      = 'SMEAGOL'
   and table_name = 'EMP'
```

PostgreSQL, MySQL, and SQL Server

Query INFORMATION_SCHEMA.COLUMNS:

```
select column_name, data_type, ordinal_position
  from information_schema.columns
 where table_schema = 'SMEAGOL'
   and table_name   = 'EMP'
```

Discussion

Each vendor provides ways for you to get detailed information about your column data. In the examples above only the column name, data type, and position are returned. Additional useful items of information include length, nullability, and default values.

```
1 select a.tabname, b.indname, b.colname, b.colseq 2 from syscat.indexes a,
3 syscat.indexcoluse b 3 where a.tabname = 'EMP'

   4 and a.tabschema = 'SMEAGOL'

   5 and a.indschema = b.indschema 6 and a.indname = b.indname

select table_name, index_name, column_name, column_position from
sys.all_ind_columns where table_name = 'EMP'

   and table_owner = 'SMEAGOL'

1 select a.tablename,a.indexname,b.column_name 2 from
pg_catalog.pg_indexes a, 3 information_schema.columns b 4 where
a.schemaname = 'SMEAGOL'

   5 and a.tablename = b.table_name
```

```
show index from emp
```

```
select a.name table_name,
   b.name index_name, d.name column_name, c.index_column_id
   from sys.tables a, sys.indexes b,
   sys.index_columns c, sys.columns d
   where a.object_id = b.object_id and b.object_id = c.object_id and
b.index_id = c.index_id and c.object_id = d.object_id and
c.column_id = d.column_id and a.name = 'EMP'
```

Discussion

When it comes to queries, it's important to know what columns are/aren't indexed. Indexes can provide good performance for queries against columns that are frequently used in filters and that are fairly selective. Indexes are also useful when joining between tables. By knowing what columns are indexed, you are already one step ahead of performance problems if they should occur. Additionally, you might want to find information about the indexes themselves: how many levels deep they are, how many distinct keys, how many leaf blocks, and so forth. Such information is also available from the views/tables queried in this recipe's solutions.

```
1 select a.tabname, a.constname, b.colname, a.type 2 from syscat.tabconst
a, 3 syscat.columns b

   4 where a.tabname = 'EMP'

   5 and a.tabschema = 'SMEAGOL'

   6 and a.tabname = b.tabname 7 and a.tabschema = b.tabschema

1 select a.table_name,

   2 a.constraint_name,

   3 b.column_name,

   4 a.constraint_type

   5 from all_constraints a,
```

6 all_cons_columns b

7 where a.table_name = 'EMP'

8 and a.owner = 'SMEAGOL'

9 and a.table_name = b.table_name 10 and a.owner = b.owner 11 and a.constraint_name = b.constraint_name

1 select a.table_name,

2 a.constraint_name,

3 b.column_name,

4 a.constraint_type

5 from information_schema.table_constraints a, 6 information_schema.key_column_usage b 7 where a.table_name = 'EMP'

8 and a.table_schema = 'SMEAGOL'

9 and a.table_name = b.table_name 10 and a.table_schema = b.table_schema 11 and a.constraint_name = b.constraint_name

Discussion

Constraints are such a critical part of relational databases that it should go without saying why you need to know what constraints are on your tables. Listing the constraints on tables is useful for a variety of reasons: you may want to find tables missing a primary key, you may want to find which columns should be foreign keys but are not (i.e., child tables have data different from the parent tables and you want to know how that happened), or you may want to know about check constraints (Are columns nullable? Do they have to satisfy a specific condition? etc.).

```
select fkeys.tabname,
fkeys.constname,
fkeys.colname,
ind_cols.indname
from (
select a.tabschema, a.tabname, a.constname, b.colname
from syscat.tabconst a,
syscat.keycoluse b
where a.tabname = 'EMP'
and a.tabschema = 'SMEAGOL'
and a.type = 'F'
and a.tabname = b.tabname
and a.tabschema = b.tabschema
) fkeys
```

15 left join

16 (

17 select a.tabschema,

18 a.tabname,

19 a.indname,

20 b.colname

21 from syscat.indexes a, 22 syscat.indexcoluse b 23 where a.indschema = b.indschema 24 and a.indname = b.indname 25) ind_cols

26 on (<a name="idx-CHP-5-0225"></a>fkeys.tabschema = ind_cols.tabschema 27 and fkeys.tabname = ind_cols.tabname 28 and fkeys.colname = ind_cols.colname) 29 where ind_cols.indname is null

1 select a.table_name,

2 a.constraint_name,

3 a.column_name,

4 c.index_name

5 from all_cons_columns a, 6 all_constraints b,

7 all_ind_columns c

8 where a.table_name = 'EMP'

9 and a.owner = 'SMEAGOL'

10 and b.constraint_type = 'R'

11 and a.owner = b.owner 12 and a.table_name = b.table_name 13 and a.constraint_name = b.constraint_name 14 and a.owner = c.table_owner (+) 15 and a.table_name = c.table_name (+) 16 and a.column_name = c.column_name (+) 17 and c.index_name is null

1 select fkeys.table_name,

2 fkeys.constraint_name, 3 fkeys.column_name,

4 ind_cols.indexname

5 from (

6 select a.constraint_schema, 7 a.table_name,

8 a.constraint_name,

9 a.column_name

10 from information_schema.key_column_usage a, 11 information_schema.referential_constraints b 12 where a.constraint_name = b.constraint_name 13 and a.constraint_schema = b.constraint_schema 14 and a.constraint_schema = 'SMEAGOL'

15 and a.table_name = 'EMP'

16) fkeys

17 left join

18 (

19 select a.schemaname, a.tablename, a.indexname, b.column_name 20 from pg_catalog.pg_indexes a, 21 information_schema.columns b 22 where a.tablename = b.table_name 23 and a.schemaname = b.table_schema 24) ind_cols

25 on (fkeys.constraint_schema = ind_cols.schemaname 26 and fkeys.table_name = ind_cols.tablename 27 and fkeys.column_name = ind_cols.column_name) 28 where ind_cols.indexname is null

1 select fkeys.table_name,

2 fkeys.constraint_name, 3 fkeys.column_name,

4 ind_cols.index_name

5 from (

6 select a.object_id,

7 d.column_id,

8 a.name table_name,

9 b.name constraint_name, 10 d.name column_name

11 from sys.tables a

12 join

13 sys.foreign_keys b

14 on (a.name = 'EMP'

15 and a.object_id = b.parent_object_id 16)

17 join

18 sys.<a name="idx-CHP-5-0228"></a>foreign_key_columns c 19 on (b.object_id = c.constraint_object_id)

20 join

21 sys.columns d

22 on (c.constraint_column_id = d.column_id 23 and a.object_id = d.object_id 24)

25) fkeys

```
left join
(
select a.name index_name,
b.object_id,
b.column_id
from sys.indexes a,
sys.index_columns b
where a.index_id = b.index_id
) ind_cols
on ( fkeys.object_id = ind_cols.object_id
and fkeys.column_id = ind_cols.column_id )
where ind_cols.index_name is null
```

Discussion

Each vendor uses its own locking mechanism when modifying rows. In cases where there is a parent-child relationship enforced via foreign key, having indexes on the child column(s) can reducing locking (see your specific RDBMS documentation for details). In other cases, it is common that a child table is joined to a parent table on the foreign key column, so an index may help improve performance in that scenario as well.

```
/* generate SQL to count all the rows in all your tables */


   <b>

   select 'select count(*) from '||table_name||';' cnts from user_tables;</b>
```

CNTS

```
---------------------------------------

select count(*) from ANT;

select count(*) from BONUS;

select count(*) from DEMO1;

select count(*) from DEMO2;

select count(*) from DEPT;

select count(*) from DUMMY;

select count(*) from EMP;

select count(*) from EMP_SALES; select count(*) from EMP_SCORE;
select count(*) from PROFESSOR; select count(*) from T;

select count(*) from T1;

select count(*) from T2;

select count(*) from T3;

select count(*) from TEACH;

select count(*) from TEST;

select count(*) from TRX_LOG;

select count(*) from X;


/* disable foreign keys from all tables */
```

<b>

```
select 'alter table '||table_name||

' disable constraint '||constraint_name||';' cons from user_constraints

where constraint_type = 'R';</b>
```

CONS

----

alter table ANT disable constraint ANT_FK; alter table BONUS disable constraint BONUS_FK; alter table DEMO1 disable constraint DEMO1_FK; alter table DEMO2 disable constraint DEMO2_FK; alter table DEPT disable constraint DEPT_FK; alter table DUMMY disable constraint DUMMY_FK; alter table EMP disable constraint EMP_FK; alter table EMP_SALES disable constraint EMP_SALES_FK; alter table EMP_SCORE disable constraint EMP_SCORE_FK; alter table PROFESSOR disable constraint PROFESSOR_FK; /* generate an insert script from some columns in table EMP */

<b>

select 'insert into emp(empno,ename,hiredate) '||chr(10)||

'values('||empno||','||''''||ename ||''',to_date('||''''||hiredate||'''));' inserts from emp

where deptno = 10;</b>

```
INSERTS

    ----------------------------------------------------

    insert into emp(empno,ename,hiredate) values(
7782,'CLARK',to_date('09-JUN-1981 00:00:00') );

    insert into emp(empno,ename,hiredate) values( 7839,'KING',to_date('17-
NOV-1981 00:00:00') );

    insert into emp(empno,ename,hiredate) values(
7934,'MILLER',to_date('23-JAN-1982 00:00:00') );
```

Discussion

Using SQL to generate SQL is particularly useful for creating portable scripts such as you might use when testing on multiple environments. Additionally, as can be seen by the examples above, using SQL to generate SQL is useful for performing batch maintenance, and for easily finding out information about multiple objects in one go. Generating SQL with SQL is an extremely simple operation, and the more you experiment with it the easier it will become. The examples provided should give you a nice base on how to build your own "dynamic" SQL scripts because, quite frankly, there's not much to it. Work on it and you'll get it.

Recipe 5.7. Describing the Data Dictionary Views in an Oracle Database

Problem

You are using Oracle. You can't remember what data dictionary views are available to you, nor can you remember their column definitions. Worse yet, you do not have convenient access to vendor documentation.

Solution

This is an Oracle-specific recipe. Oracle not only maintains a robust set of data dictionary views, but there are even data dictionary views to document the data dictionary views. It's all so wonderfully circular.

Query the view named DICTIONARY to list data dictionary views and their purposes:

```
select table_name, comments
          from dictionary
          order by table_name;

        TABLE_NAME                     COMMENTS
        ------------------------------ --------------------------------------------
        ALL_ALL_TABLES                 Description of all object and relational
                                       tables accessible to the user

        ALL_APPLY                      Details about each apply process that
                                       dequeues from the queue visible to the
                                       current user
        …
```

Query DICT_COLUMNS to describe the columns in given a data dictionary view:

```
select column_name, comments
             from dict_columns
         where table_name = 'ALL_TAB_COLUMNS';

        COLUMN_NAME                     COMMENTS
        ------------------------------- --------------------------------------------
        OWNER
        TABLE_NAME                      Table, view or cluster name
        COLUMN_NAME                     Column name
        DATA_TYPE                       Datatype of the column
        DATA_TYPE_MOD                   Datatype modifier of the column
        DATA_TYPE_OWNER                 Owner of the datatype of the column
        DATA_LENGTH                     Length of the column in bytes
        DATA_PRECISION                  Length: decimal digits (NUMBER) or binary
                                        digits (FLOAT)
```

Discussion

Back in the day when Oracle's documentation set wasn't so freely available on the Web, it was incredibly convenient that Oracle made the DICTIONARY and DICT_ COLUMNS views available. Knowing just those two views, you could bootstrap to learning about all the other views, and from thence to learning about your entire database.

Even today, it's convenient to know about DICTIONARY and DICT_COLUMNS. Often, if you aren't quite certain which view describes a given object type, you can issue a wildcard query to find out. For example, to get a handle on what views might describe tables in your schema:

```
select table_name, comments
          from dictionary
         where table_name LIKE '%TABLE%'
         order by table_name;
```

This query returns all data dictionary view names that include the term "TABLE". This approach takes advantage of Oracle's fairly consistent data dictionary view naming conventions. Views describing tables are all likely to contain "TABLE" in their name. (Sometimes, as in the case of ALL_TAB_COLUMNS, TABLE is abbreviated TAB.)

Chapter 6. Working with Strings

This chapter focuses on string manipulation in SQL. Keep in mind that SQL is not designed to perform complex string manipulation and you can (and will) find working with strings in SQL to be very cumbersome and frustrating at times. Despite SQL's limitations, there are some very useful built-in functions provided by the different DBMSs, and I've tried to use them in creative ways. This chapter in particular is very representative of the message I tried to convey in the introduction; SQL is the good, the bad, and the ugly. I hope that you take away from this chapter a better appreciation for what can and can't be done in SQL when working with strings. In many cases you'll be surprised by how easy parsing and transforming of strings can be, while at other times you'll be aghast by the kind of SQL that is necessary to accomplish a particular task.

The first recipe in this chapter is critically important, as it is leveraged by several of the subsequent solutions. In many cases, you'd like to have the ability to traverse a string by moving through it a character at a time. Unfortunately, SQL does not make this easy. Because there is no loop functionality in SQL (Oracle's MODEL clause excluded), you need to mimic a loop to traverse a string. I call this operation "walking a string" or "walking through a string" and the very first recipe explains the technique. This is a fundamental operation in string parsing when using SQL, and is referenced and used by almost all recipes in this chapter. I strongly suggest becoming comfortable with how the technique works.

Recipe 6.1. Walking a String

Problem

You want to traverse a string to return each character as a row, but SQL lacks a loop operation. For example, you want to display the ENAME "KING" from table EMP as four rows, where each row contains just characters from "KING".

Solution

Use a Cartesian product to generate the number of rows needed to return each character of a string on its own line. Then use your DBMS's built-in string parsing function to extract the characters you are interested in (SQL Server users will use SUBSTRING instead of SUBSTR):

```
select substr(e.ename,iter.pos,1) as C
  from (select ename from emp where ename = 'KING') e,
       (select id as pos from t10) iter
 where iter.pos <= length(e.ename)

C
-
K
I
N
G
```

Discussion

The key to iterating through a string's characters is to join against a table that has enough rows to produce the required number of iterations. This example uses table T10, which contains 10 rows (it has one column, ID, holding the values 1 through 10). The maximum number of rows that can be returned from this query is 10.

The following example shows the Cartesian product between E and ITER (i.e., between the specific name and the 10 rows from T10) without parsing ENAME:

```
select ename, iter.pos
  from (select ename from emp where ename = 'KING') e,
       (select id as pos from t10) iter

ENAME             POS
---------- ----------
KING                1
KING                2
KING                3
KING                4
KING                5
KING                6
KING                7
KING                 8
KING                 9
KING                10
```

The cardinality of inline view E is 1, and the cardinality of inline view ITER is 10. The Cartesian product is then 10 rows. Generating such a product is the first step in mimicking a loop in SQL.

It is common practice to refer to table T10 as a "pivot" table.

The solution uses a WHERE clause to break out of the loop after four rows have been returned. To restrict the result set to the same number of rows as there are characters in the name, that WHERE clause specifies ITER.POS <= LENGTH(E. ENAME) as the condition:

```
select ename, iter.pos
  from (select ename from emp where ename = 'KING') e,
       (select id as pos from t10) iter
 where iter.pos <= length(e.ename)

ENAME             POS
---------- ----------
KING                1
KING                2
KING                3
KING                4
```

Now that you have one row for each character in E.ENAME, you can use ITER.POS as a parameter to SUBSTR, allowing you to navigate through the characters in the string. ITER.POS increments with each row, and thus each row can be made to return a successive character from E.ENAME. This is how the solution example works.

Depending on what you are trying to accomplish you may or may not need to generate a row for every single character in a string. The following query is an example of walking E.ENAME and exposing different portions (more than a single character) of the string:

```
select substr(e.ename,iter.pos) a,
               substr(e.ename,length(e.ename)-iter.pos+1) b
          from (select ename from emp where ename = 'KING') e,
               (select id pos from t10) iter
         where iter.pos <= length(e.ename)

        A          B
        ---------- ------
        KING       G
        ING        NG
        NG         ING
        G          KING
```

The most common scenarios for the recipes in this chapter involve walking the whole string to generate a row for each character in the string, or walking the string such that the number of rows generated reflects the number of particular characters or delimiters that are present in the string.

```
QMARKS

    --------------

    g'day mate beavers' teeth '
```

1 select 'g''day mate' qmarks from t1 union all 2 select 'beavers'' teeth' from t1 union all

3 select '''' from t1

<b>

    select 'apples core', 'apple''s core', case when '' is null then 0 else 1 end from t1</b>

```
'APPLESCORE 'APPLE''SCOR
CASEWHEN''ISNULLTHEN0ELSE1END

----------- ------------ ----------------------------

apples core apple's core 0
```

<b>

    select '''' as quote from t1</b>

```
Q

-

'
```

When working with quotes, be sure to remember that a string literal comprising two quotes alone, with no intervening characters, is NULL.

```
10,CLARK,MANAGER

1 select (length('10,CLARK,MANAGER')-

   2 length(replace('10,CLARK,MANAGER',',',"')))/length(',') 3 as cnt
```

4 from t1

<b>

select

(length('HELLO HELLO')-

length(replace('HELLO HELLO','LL','')))/length('LL') as correct_cnt, (length('HELLO HELLO')-

length(replace('HELLO HELLO','LL',''))) as incorrect_cnt from t1</b>

CORRECT_CNT INCORRECT_CNT

----------- -------------

2 4

```
ENAME SAL

    ---------- ----------

    SMITH 800

    ALLEN 1600

    WARD 1250

    JONES 2975

    MARTIN 1250

    BLAKE 2850

    CLARK 2450

    SCOTT 3000

    KING 5000

    TURNER 1500

    ADAMS 1100

    JAMES 950

    FORD 3000

    MILLER 1300

ENAME STRIPPED1 SAL STRIPPED2

    ---------- ---------- ---------- ---------

    SMITH SMTH 800 8

    ALLEN LLN 1600 16
```

```
   WARD WRD 1250 125

   JONES JNS 2975 2975

   MARTIN MRTN 1250 125

   BLAKE BLK 2850 285

   CLARK CLRK 2450 245

   SCOTT SCTT 3000 3

   KING KNG 5000 5

   TURNER TRNR 1500 15

   ADAMS DMS 1100 11

   JAMES JMS 950 95

   FORD FRD 3000 3

   MILLER MLLR 1300 13

1 select ename,

   2 replace(translate(ename,'aaaaa','AEIOU'),'a','') stripped1, 3 sal,

   4 replace(cast(sal as char(4)),'0','') stripped2
```

5 from emp

1 select ename,

2 replace(

3 replace(

4 replace(

5 replace(

6 replace(ename,'A',''),'E',''),'I',''),'O',''),'U','') 7 as stripped1, 8 sal,

9 replace(sal,0,'') stripped2

10 from emp

1 select ename,

2 replace(translate(ename,'AEIOU','aaaaa'),'a') 3 as stripped1, 4 sal,

5 replace(sal,0,'') as stripped2

6 from emp

Discussion

The built-in function REPLACE removes all occurrences of zeros. To remove the vowels, use TRANSLATE to convert all vowels into one specific character (I used "a"; you can use any character), then use REPLACE to remove all occurrences of that character.

```
DATA
    ---------------
    SMITH800
    ALLEN1600
    WARD1250
    JONES2975
    MARTIN1250
    BLAKE2850
    CLARK2450
    SCOTT3000
    KING5000
    TURNER1500
    ADAMS1100
    JAMES950
    FORD3000
    MILLER1300
ENAME SAL
    ---------- ----------
    SMITH 800
    ALLEN 1600
```

```
WARD 1250

JONES 2975

MARTIN 1250

BLAKE 2850

CLARK 2450

SCOTT 3000

KING 5000

TURNER 1500

ADAMS 1100

JAMES 950

FORD 3000

MILLER 1300
```

```
select replace(
    translate(data,'0000000000','0123456789'),'0',") ename, cast(
    replace(
    translate(lower(data),repeat('z',26),
'abcdefghijklmnopqrstuvwxyz'),'z',") as integer) sal from (
    select ename||cast(sal as char(4)) data
```

9 from emp

10) x

1 select replace(

2 translate(data,'0123456789','0000000000'),'0') ename, 3 to_number(

5 replace(

6 translate(lower(data), 7 'abcdefghijklmnopqrstuvwxyz', 8 rpad('z',26,'z')),'z')) sal 9 from (

10 select ename||sal data

11 from emp

12)

1 select replace(

2 translate(data,'0123456789','0000000000'),'0',") as ename, 3 cast(

4 replace(

5 translate(lower(data), 6 'abcdefghijklmnopqrstuvwxyz', 7 rpad('z',26,'z')),'z',") as integer) as sal 8 from (

9 select ename||sal as data

10 from emp

11) x

<b>

select data,

translate(lower(data), 'abcdefghijklmnopqrstuvwxyz', rpad('z',26,'z')) sal from (select ename||sal data from emp)</b>

```
DATA SAL

------------------- -------------------

SMITH800 zzzzz800

ALLEN1600 zzzzz1600

WARD1250 zzzz1250

JONES2975 zzzzz2975

MARTIN1250 zzzzzz1250

BLAKE2850 zzzzz2850

CLARK2450 zzzzz2450

SCOTT3000 zzzzz3000

KING5000 zzzz5000

TURNER1500 zzzzzz1500

ADAMS1100 zzzzz1100

JAMES950 zzzzz950
```

```
   FORD3000 zzzz3000

   MILLER1300 zzzzzz1300
```

<b>

```
   select data,

   to_number(

   replace(

   translate(lower(data), 'abcdefghijklmnopqrstuvwxyz', rpad('z',26,'z')),'z'))
sal from (select ename||sal data from emp)</b>

   DATA SAL

   -------------------- ----------

   SMITH800 800

   ALLEN1600 1600

   WARD1250 1250

   JONES2975 2975

   MARTIN1250 1250

   BLAKE2850 2850

   CLARK2450 2450

   SCOTT3000 3000

   KING5000 5000

   TURNER1500 1500

   ADAMS1100 1100
```

```
JAMES950 950

FORD3000 3000

MILLER1300 1300
```

<b>

select data,

translate(data,'0123456789','0000000000') ename from (select ename||sal data from emp)</b>

```
DATA ENAME

-------------------- ----------

SMITH800 SMITH000

ALLEN1600 ALLEN0000

WARD1250 WARD0000

JONES2975 JONES0000

MARTIN1250 MARTIN0000

BLAKE2850 BLAKE0000

CLARK2450 CLARK0000

SCOTT3000 SCOTT0000

KING5000 KING0000

TURNER1500 TURNER0000

ADAMS1100 ADAMS0000

JAMES950 JAMES000
```

```
FORD3000 FORD0000

MILLER1300 MILLER0000
```

<b>

select data,

replace(translate(data,'0123456789','0000000000'),'0') ename from (select ename||sal data from emp)</b>

```
DATA ENAME

-------------------- -------

SMITH800 SMITH

ALLEN1600 ALLEN

WARD1250 WARD

JONES2975 JONES

MARTIN1250 MARTIN

BLAKE2850 BLAKE

CLARK2450 CLARK

SCOTT3000 SCOTT

KING5000 KING

TURNER1500 TURNER

ADAMS1100 ADAMS

JAMES950 JAMES

FORD3000 FORD
```

MILLER1300 MILLER

Put the two techniques together and you have your solution.

```
create view V as
   select ename as data from emp
   where deptno=10
   union all
   select ename||', $'|| cast(sal as char(4)) ||'.00' as data from emp
   where deptno=20
   union all
   select ename|| cast(deptno as char(4)) as data from emp
   where deptno=30
DATA
   --------------------
   CLARK
   KING
   MILLER
   SMITH, $800.00
   JONES, $2975.00
   SCOTT, $3000.00
   ADAMS, $1100.00
   FORD, $3000.00
   ALLEN30
   WARD30

   MARTIN30

   BLAKE30

   TURNER30

   JAMES30

DATA

   -------------

   CLARK

   KING

   MILLER

   ALLEN30

   WARD30

   MARTIN30

   BLAKE30

   TURNER30

   JAMES30

1 select data
```

2 from V

3 where translate(lower(data), 4 repeat('a',36), 5 '0123456789abcdefghijklmnopqrstuvwxyz') =

6 repeat('a',length(data))

```
create view V as
   select ename as data from emp
   where deptno=10
   union all
   select concat(ename,', $',sal,'.00') as data from emp
   where deptno=20
   union all
   select concat(ename,deptno) as data from emp
   where deptno=30
```

1 select data

2 from V

3 where data regexp '[^0-9a-zA-Z]' = 0

1 select data

2 from V

3 where translate(lower(data), 4 '0123456789abcdefghijklmnopqrstuvwxyz', 5 rpad('a',36,'a')) = rpad('a',length(data),'a')

```
select data
from (
select v.data, iter.pos,
substring(v.data,iter.pos,1) c,
ascii(substring(v.data,iter.pos,1)) val
from v,
( select id as pos from t100 ) iter
where iter.pos <= len(v.data)
) x
```

10 group by data

11 having min(val) between 48 and 122

where translate(lower(data),

'0123456789abcdefghijklmnopqrstuvwxyz', rpad('a',36,'a'))

<b>

select data, translate(lower(data), '0123456789abcdefghijklmnopqrstuvwxyz', rpad('a',36,'a')) from V</b>

DATA TRANSLATE(LOWER(DATA) ------------------- -------------------- -

CLARK aaaaa

…

SMITH, $800.00 aaaaa, $aaa.aa …

ALLEN30 aaaaaaa …

<b>

select data, translate(lower(data), '0123456789abcdefghijklmnopqrstuvwxyz', rpad('a',36,'a')) translated, rpad('a',length(data),'a') fixed from V</b>

DATA TRANSLATED FIXED

------------------- -------------------- ----------------

CLARK aaaaa aaaaa …

SMITH, $800.00 aaaaa, $aaa.aa aaaaaaaaaaaaaa …

```
    ALLEN30 aaaaaaa aaaaaaa …
where data regexp '[^0-9a-zA-Z]' = 0
+-----------------+------+------+------+
    | data | pos | c | val |
    +-----------------+------+------+------+
    | ADAMS, $1100.00 | 1 | A | 65 |
    | ADAMS, $1100.00 | 2 | D | 68 |
    | ADAMS, $1100.00 | 3 | A | 65 |
    | ADAMS, $1100.00 | 4 | M | 77 |
    | ADAMS, $1100.00 | 5 | S | 83 |
    | ADAMS, $1100.00 | 6 | , | 44 |
    | ADAMS, $1100.00 | 7 | | 32 |
    | ADAMS, $1100.00 | 8 | $ | 36 |
    | ADAMS, $1100.00 | 9 | 1 | 49 |
    | ADAMS, $1100.00 | 10 | 1 | 49 |
    | ADAMS, $1100.00 | 11 | 0 | 48 |
    | ADAMS, $1100.00 | 12 | 0 | 48 |
    | ADAMS, $1100.00 | 13 | . | 46 |
    | ADAMS, $1100.00 | 14 | 0 | 48 |
    | ADAMS, $1100.00 | 15 | 0 | 48 |
```

Inline view Z not only returns each character in the column DATA row by row, it also provides the ASCII value for each character. For this particular implementation of SQL Server, the range 48122 represents alphanumeric characters. With that knowledge, you can group each row in DATA and filter out any such that the minimum ASCII value is not in the 48122 range.

Stewie Griffin

S.G.

```
1 select replace(

    2 replace(

    3 translate(replace('Stewie Griffin', '.', ''), 4 repeat('#',26), 5
'abcdefghijklmnopqrstuvwxyz'), 6 '#','' ), ' ','.' ) 7 ||'.'
```

8 from t1

1 select case

2 when cnt = 2 then 3 trim(trailing '.' from 4 concat_ws('.', 5 substr(substring_index(name,' ',1),1,1), 6 substr(name, 7 length(substring_index(name,' ',1))+2,1), 8 substr(substring_index(name,' ',-1),1,1), 9 '.'))

10 else

11 trim(trailing '.' from 12 concat_ws('.', 13 substr(substring_index(name,' ',1),1,1), 14 substr(substring_index(name,' ',-1),1,1) 15))

16 end as initials

17 from (

18 select name,length(name)-length(replace(name,' ','')) as cnt 19 from (

20 select replace('Stewie Griffin','.','') as name from t1

21)y

22)x

1 select replace(

2 replace(

3 translate(replace('Stewie Griffin', '.', ''), 4 'abcdefghijklmnopqrstuvwxyz', 5 rpad('#',26,'#')), '#',''),' ','.') ||'.'

6 from t1

<b>

```
   select translate(replace('Stewie Griffin', '.', ''), repeat('#',26),
'abcdefghijklmnopqrstuvwxyz') from t1</b>

   TRANSLATE('STE

   --------------

   S##### G######
```

<b>

```
   select replace(

   translate(replace('Stewie Griffin', '.', ''), repeat('#',26),
'abcdefghijklmnopqrstuvwxyz'),'#','') from t1</b>

   REP

   ---

   S G
```

```
<b>select replace(

   replace(

   translate(replace('Stewie Griffin', '.', ''), repeat('#',26),
'abcdefghijklmnopqrstuvwxyz'),'#',''),' ','.') || '.'

   from t1</b>

   REPLA

   -----
```

S.G

<b>

select translate(replace('Stewie Griffin','.',''), 'abcdefghijklmnopqrstuvwxyz', rpad('#',26,'#')) from t1</b>

TRANSLATE('STE

S##### G######

<b>

select replace(

translate(replace('Stewie Griffin','.',''), 'abcdefghijklmnopqrstuvwxyz', rpad('#',26,'#')),'#','') from t1</b>

REP

S G

<b>

select replace(

replace(

translate(replace('Stewie Griffin','.',''), 'abcdefghijklmnopqrstuvwxyz', rpad('#',26,'#')),'#',''),' ','.') || '.'

from t1</b>

REPLA

```
   -----

   S.G

<b>

   select substr(substring_index(name, ' ',1),1,1) as a,
substr(substring_index(name,' ',-1),1,1) as b from (select 'Stewie Griffin' as
name from t1) x</b>

   A B

   - -

   S G

substr(name,length(substring_index(name, ' ',1))+2,1)

<b>

   select concat_ws('.', substr(substring_index(name, ' ',1),1,1),
substr(substring_index(name,' ',-1),1,1), '.' ) a

   from (select 'Stewie Griffin' as name from t1) x</b>

   A

   -----

   S.G..
```

The last step is to trim the extraneous period from the initials.

```
ENAME
    ----------
    SMITH
    ALLEN
    WARD
    JONES
    MARTIN
    BLAKE
    CLARK
    SCOTT
    KING
    TURNER
    ADAMS
    JAMES
    FORD
    MILLER
ENAME
    ---------
    ALLEN
    TURNER
```

```
   MILLER

   JONES

   JAMES

   MARTIN

   BLAKE

   ADAMS

   KING

   WARD

   FORD

   CLARK

   SMITH

   SCOTT

1 select ename
```

2 from emp

3 order by substr(ename,length(ename)-1,)

1 select ename

2 from emp

3 order by substring(ename,len(ename)-1,2)

Discussion

By using a SUBSTR expression in your ORDER BY clause, you can pick any part of a string to use in ordering a result set. You're not limited to SUBSTR either. You can order rows by the result of almost any expression.

```
create view V as
   select e.ename ||' '||
   cast(e.empno as char(4))||' '||
   d.dname as data
   from emp e, dept d
   where e.deptno=d.deptno
DATA
   ----------------------------
   CLARK 7782 ACCOUNTING
   KING 7839 ACCOUNTING
   MILLER 7934 ACCOUNTING
   SMITH 7369 RESEARCH
   JONES 7566 RESEARCH
   SCOTT 7788 RESEARCH
   ADAMS 7876 RESEARCH
   FORD 7902 RESEARCH
   ALLEN 7499 SALES
   WARD 7521 SALES
   MARTIN 7654 SALES
   BLAKE 7698 SALES
```

```
    TURNER 7844 SALES

    JAMES 7900 SALES

DATA

    --------------------------

    SMITH 7369 RESEARCH

    ALLEN 7499 SALES

    WARD 7521 SALES

    JONES 7566 RESEARCH

    MARTIN 7654 SALES

    BLAKE 7698 SALES

    CLARK 7782 ACCOUNTING

    SCOTT 7788 RESEARCH

    KING 7839 ACCOUNTING

    TURNER 7844 SALES

    ADAMS 7876 RESEARCH

    JAMES 7900 SALES

    FORD 7902 RESEARCH

    MILLER 7934 ACCOUNTING

1 select data

    2 from V
```

3 order by

4 cast(

5 replace(

6 translate(data,repeat('#',length(data)), 7 replace(

8 translate(data,'##########','0123456789'), 9 '#','')),'#','') as integer)

1 select data

2 from V

3 order by

```
   4 to_number(
   5 replace(
   6 translate(data,
   7 replace(
   8 translate(data,'0123456789','##########'), 9 '#'),rpad('#',20,'#')),'#'))
1 select data
   2 from V
```

3 order by

4 cast(

5 replace(

6 translate(data,

7 replace(

8 translate(data,'0123456789','##########'), 9 '#',''),rpad('#',20,'#')),'#','') as integer)

<b>

select data,

translate(data,'0123456789','##########') as tmp from V</b>

```
DATA TMP

------------------------------ ------------------------

CLARK 7782 ACCOUNTING CLARK #### ACCOUNTING

KING 7839 ACCOUNTING KING #### ACCOUNTING

MILLER 7934 ACCOUNTING MILLER #### ACCOUNTING

SMITH 7369 RESEARCH SMITH #### RESEARCH

JONES 7566 RESEARCH JONES #### RESEARCH

SCOTT 7788 RESEARCH SCOTT #### RESEARCH

ADAMS 7876 RESEARCH ADAMS #### RESEARCH
```

```
FORD 7902 RESEARCH FORD #### RESEARCH

ALLEN 7499 SALES ALLEN #### SALES

WARD 7521 SALES WARD #### SALES

MARTIN 7654 SALES MARTIN #### SALES

BLAKE 7698 SALES BLAKE #### SALES

TURNER 7844 SALES TURNER #### SALES

JAMES 7900 SALES JAMES #### SALES
```

<b>

```
select data,

replace(

translate(data,'0123456789','##########'),'#') as tmp from V</b>


DATA TMP

---------------------------- -------------------

CLARK 7782 ACCOUNTING CLARK ACCOUNTING

KING 7839 ACCOUNTING KING ACCOUNTING

MILLER 7934 ACCOUNTING MILLER ACCOUNTING

SMITH 7369 RESEARCH SMITH RESEARCH

JONES 7566 RESEARCH JONES RESEARCH

SCOTT 7788 RESEARCH SCOTT RESEARCH
```

```
ADAMS 7876 RESEARCH ADAMS RESEARCH

FORD 7902 RESEARCH FORD RESEARCH

ALLEN 7499 SALES ALLEN SALES

WARD 7521 SALES WARD SALES

MARTIN 7654 SALES MARTIN SALES

BLAKE 7698 SALES BLAKE SALES

TURNER 7844 SALES TURNER SALES

JAMES 7900 SALES JAMES SALES
```

<b>

```
select data, translate(data, replace(

translate(data,'0123456789','##########'), '#'),

rpad('#',length(data),'#')) as tmp from V</b>


DATA TMP

---------------------------- --------------------------

CLARK 7782 ACCOUNTING #######7782###########

KING 7839 ACCOUNTING #######7839###########

MILLER 7934 ACCOUNTING #######7934###########

SMITH 7369 RESEARCH #######7369#########

JONES 7566 RESEARCH #######7566#########
```

```
SCOTT 7788 RESEARCH #######7788#########

ADAMS 7876 RESEARCH #######7876#########

FORD 7902 RESEARCH #######7902#########

ALLEN 7499 SALES #######7499######

WARD 7521 SALES #######7521######

MARTIN 7654 SALES #######7654######

BLAKE 7698 SALES #######7698######

TURNER 7844 SALES #######7844######

JAMES 7900 SALES #######7900######
```

<b>

```
select data, replace(

translate(data,

replace(

translate(data,'0123456789','##########'), '#'),

rpad('#',length(data),'#')),'#') as tmp from V</b>


DATA TMP

---------------------------- -----------

CLARK 7782 ACCOUNTING 7782

KING 7839 ACCOUNTING 7839
```

```
MILLER 7934 ACCOUNTING 7934

SMITH 7369 RESEARCH 7369

JONES 7566 RESEARCH 7566

SCOTT 7788 RESEARCH 7788

ADAMS 7876 RESEARCH 7876

FORD 7902 RESEARCH 7902

ALLEN 7499 SALES 7499

WARD 7521 SALES 7521

MARTIN 7654 SALES 7654

BLAKE 7698 SALES 7698

TURNER 7844 SALES 7844

JAMES 7900 SALES 7900
```

<b>

```
select data, to_number(

replace(

translate(data,

replace(

translate(data,'0123456789','##########'), '#'),

rpad('#',length(data),'#')),'#')) as tmp from V</b>
```

```
DATA TMP

----------------------------- ----------

CLARK 7782 ACCOUNTING 7782

KING 7839 ACCOUNTING 7839

MILLER 7934 ACCOUNTING 7934

SMITH 7369 RESEARCH 7369

JONES 7566 RESEARCH 7566

SCOTT 7788 RESEARCH 7788

ADAMS 7876 RESEARCH 7876

FORD 7902 RESEARCH 7902

ALLEN 7499 SALES 7499

WARD 7521 SALES 7521

MARTIN 7654 SALES 7654

BLAKE 7698 SALES 7698

TURNER 7844 SALES 7844

JAMES 7900 SALES 7900
```

<b>

```
select data

from V

order by
```

```
    to_number(

    replace(

    translate( data,

    replace(

    translate( data,'0123456789','##########'),
'#'),rpad('#',length(data),'#')),'#'))</b>

    DATA

    --------------------------

    SMITH 7369 RESEARCH

    ALLEN 7499 SALES

    WARD 7521 SALES

    JONES 7566 RESEARCH

    MARTIN 7654 SALES

    BLAKE 7698 SALES

    CLARK 7782 ACCOUNTING

    SCOTT 7788 RESEARCH

    KING 7839 ACCOUNTING

    TURNER 7844 SALES

    ADAMS 7876 RESEARCH

    JAMES 7900 SALES

    FORD 7902 RESEARCH
```

As a final note, the data in the view is comprised of three fields, only one being numeric. Keep in mind that if there had been multiple numeric fields, they would have all been concatenated into one number before the rows were sorted.

Recipe 6.10. Creating a Delimited List from Table Rows

Problem

You want to return table rows as values in a delimited list, perhaps delimited by commas, rather than in vertical columns as they normally appear. You want to convert a result set from this:

```
DEPTNO EMPS
        ------ ----------
            10 CLARK
            10 KING
            10 MILLER
            20 SMITH
            20 ADAMS
            20 FORD
            20 SCOTT
            20 JONES
            30 ALLEN
            30 BLAKE
            30 MARTIN
            30 JAMES
            30 TURNER
            30 WARD
```

to this:

```
DEPTNO EMPS
        ------- ------------------------------------
             10 CLARK,KING,MILLER
             20 SMITH,JONES,SCOTT,ADAMS,FORD
             30 ALLEN,WARD,MARTIN,BLAKE,TURNER,JAMES
```

Solution

Each DBMS requires a different approach to this problem. The key is to take advantage of the built-in functions provided by your DBMS. Understanding what is available to you will allow you to exploit your DBMS's functionality and come up with creative solutions for a problem that is typically not solved in SQL.

DB2

Use recursive WITH to build the delimited list:

```
with x (deptno, cnt, list, empno, len)
    as (
select deptno, count(*) over (partition by deptno),
       cast(ename as varchar(100)), empno, 1
  from emp
 union all
 select x.deptno, x.cnt, x.list ||','|| e.ename, e.empno, x.len+1
  from emp e, x
 where e.deptno = x.deptno
   and e.empno > x. empno
       )
select deptno,list
  from x
 where len = cnt
```

MySQL

Use the built-in function GROUP_CONCAT to build the delimited list:

```
select deptno,
       group_concat(ename order by empno separator, ',') as emps
  from emp
 group by deptno
```

Oracle

Use the built-in function SYS_CONNECT_BY_PATH to build the delimited list:

```
select deptno,
       ltrim(sys_connect_by_path(ename,','),',') emps
  from (
select deptno,
       ename,
       row_number() over
                (partition by deptno order by empno) rn,
       count(*) over
                (partition by deptno) cnt
  from emp
       )
 where level = cnt
 start with rn = 1
connect by prior deptno = deptno and prior rn = rn-1
```

PostgreSQL

PostgreSQL does not offer a standard built-in function for creating a delimited list, so it is necessary to know how many values will be in the list in advance. Once you know the size of the largest list, you can determine the number of values to append to create your list by using standard transposition and concatenation:

```
select deptno,
       rtrim(
           max(case when pos=1 then emps else '' end)||
           max(case when pos=2 then emps else '' end)||
           max(case when pos=3 then emps else '' end)||
           max(case when pos=4 then emps else '' end)||
           max(case when pos=5 then emps else '' end)||
           max(case when pos=6 then emps else '' end),','
       ) as emps
  from (
select a.deptno,
       a.ename||',' as emps,
       d.cnt,
       (select count(*) from emp b
          where a.deptno=b.deptno and b.empno <= a.empno) as pos
  from emp a,
       (select deptno, count(ename) as cnt
          from emp
          group by deptno) d
 where d.deptno=a.deptno
       ) x
 group by deptno
 order by 1
```

SQL Server

Use recursive WITH to build the delimited list:

```
with x (deptno, cnt, list, empno, len)
    as (
select deptno, count(*) over (partition by deptno),
       cast(ename as varchar(100)),
       empno,
       1
  from emp
 union all
select x.deptno, x.cnt,
       cast(x.list + ',' + e.ename as varchar(100)),
       e.empno, x.len+1
  from emp e, x
where e.deptno = x.deptno
  and e.empno > x. empno
           )
select deptno,list
  from x
 where len = cnt
 order by 1
```

Discussion

Being able to create delimited lists in SQL is useful because it is a common requirement. Yet each DBMS offers a unique method for building such a list in SQL. There's very little commonality between the vendor-specific solutions; the techniques vary from using recursion, to hierarchal functions, to classic transposition, to aggregation.

DB2 and SQL Server

The solution for these two databases differ slightly in syntax (the concatenation operators are "||" for DB2 and "+" for SQL Server), but the technique is the same. The first query in the WITH clause (upper portion of the UNION ALL) returns the following information about each employee: the department, the number of employees in that department, the name, the ID, and a constant 1 (which at this point doesn't do anything). Recursion takes place in the second query (lower half of the UNION ALL) to build the list. To understand how the list is built, examine the following excerpts from the solution: first, the third SELECT-list item from the second query in the union:

```
x.list ||','|| e.ename
```

and then the WHERE clause from that same query:

```
where e.deptno = x.deptno
          and e.empno > x.empno
```

The solution works by first ensuring the employees are in the same department. Then, for every employee returned by the upper portion of the UNION ALL, append the name of the employees who have a greater EMPNO. By doing this, you ensure that no employee will have his own name appended. The expression

```
x.len+1
```

increments LEN (which starts at 1) every time an employee has been evaluated. When the incremented value equals the number of employees in the department:

```
where len = cnt
```

you know you have evaluated all the employees and have completed building the list. That is crucial to the query as it not only signals when the list is complete, but also stops the recursion from running longer than necessary.

MySQL

The function GROUP_CONCAT does all the work. It concatenates the values found in the column passed to it, in this case ENAME. It's an aggregate function, thus the need for GROUP BY in the query.

Oracle

The first step to understanding the Oracle query is to break it down. Running the inline view by itself (lines 410), you generate a result set that includes the following for each employee: her department, her name, a rank within her respective department that is derived by an ascending sort on EMPNO, and a count of all employees in her department. For example:

```
select deptno,
       ename,
       row_number() over
                 (partition by deptno order by empno) rn,
       count(*) over (partition by deptno) cnt
  from emp

DEPTNO ENAME      RN CNT
------ ---------- -- ---
    10 CLARK       1   3
```

```
            10 KING        2   3
            10 MILLER      3   3
            20 SMITH       1   5
            20 JONES       2   5
            20 SCOTT       3   5
            20 ADAMS       4   5
            20 FORD        5   5
            30 ALLEN       1   6
            30 WARD        2   6
            30 MARTIN      3   6
            30 BLAKE       4   6
            30 TURNER      5   6
            30 JAMES       6   6
```

The purpose of the rank (aliased RN in the query) is to allow you to walk the tree. Since the function ROW_NUMBER generates an enumeration starting from one with no duplicates or gaps, just subtract one (from the current value) to reference a prior (or parent) row. For example, the number prior to 3 is 3 minus 1, which equals 2. In this context, 2 is the parent of 3; you can observe this on line 12. Additionally, the lines

```
start with rn = 1
        connect by prior deptno = deptno
```

identify the root for each DEPTNO as having RN equal to 1 and create a new list whenever a new department is encountered (whenever a new occurrence of 1 is found for RN).

At this point, it's important to stop and look at the ORDER BY portion of the ROW_NUMBER function. Keep in mind the names are ranked by EMPNO and the list will be created in that order. The number of employees per department is calculated (aliased CNT) and is used to ensure that the query returns only the list that has all the employee names for a department. This is done because SYS_CONNECT_ BY_PATH builds the list iteratively, and you do not want to end up with partial lists.

For heirarchical queries, the pseudocolumn LEVEL starts with 1 (for queries not using CONNECT BY, LEVEL is 0, unless you are on 10g and later when LEVEL is only available when using CONNECT BY) and increments by one after each employee in a department has been evaluated (for each level of depth in the hierarchy). Because of this, you know that once LEVEL reaches CNT, you have reached the last EMPNO and will have a complete list.

> The SYS_CONNECT_BY_PATH function prefixes the list with your chosen delimiter (in this case, a comma). You may or may not want that behavior. In this recipe's solution, the call to the function LTRIM removes the leading comma from the list.

PostgreSQL

PostgreSQL's solution requires you to know in advance the maximum number of employees in any one department. Running the inline view by itself (lines 1118) generates a result set that includes (for each employee) his department, his name with a comma appended, the number of employees in his department, and the number of employees who have an EMPNO that is less than his:

```
deptno  |  emps    | cnt | pos
        --------+----------+-----+-----
            20  |  SMITH,  |   5 |   1
            30  |  ALLEN,  |   6 |   1
```

```
30  |  WARD,    |   6 |   2
20  |  JONES,   |   5 |   2
30  |  MARTIN,  |   6 |   3
30  |  BLAKE,   |   6 |   4
10  |  CLARK,   |   3 |   1
20  |  SCOTT,   |   5 |   3
10  |  KING,    |   3 |   2
30  |  TURNER,  |   6 |   5
20  |  ADAMS,   |   5 |   4
30  |  JAMES,   |   6 |   6
20  |  FORD,    |   5 |   5
10  |  MILLER,  |   3 |   3
```

The scalar subquery, POS (lines 14-15), is used to rank each employee by EMPNO. For example, the line

```
max(case when pos = 1 then ename else '' end)||
```

evaluates whether or not POS equals 1. The CASE expression returns the employee name when POS is 1, and otherwise returns NULL.

You must query your table first to find the largest number of values that could be in any one list. Based on the EMP table, the largest number of employees in any one department is six, so the largest number of items in a list is six.

The next step is to begin creating the list. Do this by performing some conditional logic (in the form of CASE expressions) on the rows returned from the inline view.

You must write as many CASE expressions as there are possible values to be concatenated together.

If POS equals one, the current name is added to the list. The second CASE expression evaluates whether or not POS equals two; if it does, then the second name is appended to the first. If there is no second name, then an additional comma is appended to the first name (this process is repeated for each distinct value of POS until the last one is reached).

The use of the MAX function is necessary because you want to build only one list per department (you can also use MIN; it makes no difference in this case, since POS returns only one value for each case evaluation). Whenever an aggregate function is used, any items in the SELECT list not acted upon by the aggregate must be specified in the GROUP BY clause. This guarantees you will have only one row per item in the SELECT list not acted upon by the aggregate function.

Notice that you also need the function RTRIM to remove trailing commas; the number of commas will always be equal to the maximum number of values that could potentially be in a list (in this case, six).

```
7654,7698,7782,7788

select ename,sal,deptno

    from emp

    where empno in ( '7654,7698,7782,7788' )

1 select empno,ename,sal,deptno
```

2 from emp

3 where empno in (

4 select cast(substr(c,2,locate(',',c,2)-2) as integer) empno 5 from (

6 select substr(csv.emps,cast(iter.pos as integer)) as c 7 from (select ','||'7654,7698,7782,7788'||',' emps 8 from t1) csv, 9 (select id as pos 10 from t100) iter 11 where iter.pos <= length(csv.emps) 12) x

13 where length(c) > 1

14 and substr(c,1,1) = ','

15) y

1 select empno, ename, sal, deptno

2 from emp

3 where empno in

4 (

5 select substring_index(

6 substring_index(list.vals,',',iter.pos),',',-1) empno 6 from (select id pos from t10) as iter, 7 (select '7654,7698,7782,7788' as vals 8 from t1) list 9 where iter.pos <=

10 (length(list.vals)-length(replace(list.vals,',','')))+1

11) x

1 select empno,ename,sal,deptno

2 from emp

3 where empno in (

4 select to_number(

5 rtrim(

6 substr(emps,

7 instr(emps,',',1,iter.pos)+1, 8 instr(emps,',',1,iter.pos+1) 9 instr(emps,',',1,iter.pos)),',')) emps 10 from (select ','||'7654,7698,7782,7788'||',' emps from t1) csv, 11 (select rownum pos from emp) iter 12 where iter.pos <= ((length(csv.emps)-

13 length(replace(csv.emps,',')))/length(','))-1

14)

1 select ename,sal,deptno

2 from emp

3 where empno in (

4 select cast(empno as integer) as empno 5 from (

6 select split_part(list.vals,',',iter.pos) as empno 7 from (select id as pos from t10) iter, 8 (select ','||'7654,7698,7782,7788'||',' as vals 9 from t1) list 10 where iter.pos <=

11 length(list.vals)-length(replace(list.vals,',','')) 12) z

13 where length(empno) > 0

14) x

1 select empno,ename,sal,deptno

2 from emp

3 where empno in (select substring(c,2,charindex(',',c,2)-2) as empno 4 from (

5 select substring(csv.emps,iter.pos,len(csv.emps)) as c 6 from (select ','+'7654,7698,7782,7788'+',' as emps 7 from t1) csv, 8 (select id as pos 9 from t100) iter 10 where iter.pos <= len(csv.emps) 11) x

12 where len(c) > 1

13 and substring(c,1,1) = ','

14) y

,7654,7698,7782,7788,

7654,7698,7782,7788, 654,7698,7782,7788, 54,7698,7782,7788, 4,7698,7782,7788, ,7698,7782,7788, 7698,7782,7788,

698,7782,7788,

98,7782,7788,

8,7782,7788,

,7782,7788,

7782,7788,

782,7788,

82,7788,

2,7788,

,7788,

```
   7788,

   788,

   88,

   8,

   ,
EMPNO

   ------

   7654

   7698

   7782

   7788
+---------------------+

   | empno |

   +---------------------+

   | 7654 |

   | 7654,7698 |

   | 7654,7698,7782 |

   | 7654,7698,7782,7788 |

   +---------------------+

+-------+
   | empno |
   +-------+
   | 7654 |
   | 7698 |
   | 7782 |
   | 7788 |
   +-------+
```

<b>

```
select emps,pos
from (select ','||'7654,7698,7782,7788'||',' emps from t1) csv,
(select rownum pos from emp) iter where iter.pos <=
((length(csv.emps)-length(replace(csv.emps,',')))/length(','))-1</b>
EMPS POS
-------------------- ----------
,7654,7698,7782,7788, 1
,7654,7698,7782,7788, 2
,7654,7698,7782,7788, 3
,7654,7698,7782,7788, 4
```

<b>

```
select substr(emps, instr(emps,',',1,iter.pos)+1, instr(emps,',',1,iter.pos+1)
instr(emps,',',1,iter.pos)) emps from (select ','||'7654,7698,7782,7788'||','
emps from t1) csv,

(select rownum pos from emp) iter where iter.pos <=

((length(csv.emps)-length(replace(csv.emps,',')))/length(','))-1</b> EMPS

-----------

7654,

7698,

7782,

7788,

<b>

select list.vals, split_part(list.vals,',',iter.pos) as empno, iter.pos

from (select id as pos from t10) iter, (select ','||'7654,7698,7782,7788'||','
as vals from t1) list

where iter.pos <=

length(list.vals)-length(replace(list.vals,',',''))</b>

vals | empno | pos ---------------------+-------+-----

,7654,7698,7782,7788, | | 1

,7654,7698,7782,7788, | 7654 | 2

,7654,7698,7782,7788, | 7698 | 3

,7654,7698,7782,7788, | 7782 | 4

,7654,7698,7782,7788, | 7788 | 5
```

The final step is to cast the values (EMPNO) to a number and plug it into a subquery.

```
ENAME
    ----------
    ADAMS
    ALLEN
    BLAKE
    CLARK
    FORD
    JAMES
    JONES
    KING
    MARTIN
    MILLER
    SCOTT
    SMITH
    TURNER
    WARD
OLD_NAME NEW_NAME
    ---------- --------
    ADAMS AADMS
    ALLEN AELLN
```

```
BLAKE ABEKL

CLARK ACKLR

FORD DFOR

JAMES AEJMS

JONES EJNOS

KING GIKN

MARTIN AIMNRT

MILLER EILLMR

SCOTT COSTT

SMITH HIMST

TURNER ENRRTU

WARD ADRW
```

```
select ename,

   max(case when pos=1 then c else '' end)||

   max(case when pos=2 then c else '' end)||

   max(case when pos=3 then c else '' end)||

   max(case when pos=4 then c else '' end)||

   max(case when pos=5 then c else '' end)||

   max(case when pos=6 then c else '' end) from (

   select e.ename, cast(substr(e.ename,iter.pos,1) as varchar(100)) c, cast(row_number( )over(partition by e.ename order by
```

substr(e.ename,iter.pos,1)) 13 as integer) pos 14 from emp e, 15 (select cast(row_number( )over( ) as integer) pos 16 from emp) iter 17 where iter.pos <= length(e.ename) 18) x

19 group by ename

1 select ename, group_concat(c order by c separator '') 2 from (

3 select ename, substr(a.ename,iter.pos,1) c 4 from emp a, 5 (select id pos from t10) iter 6 where iter.pos <= length(a.ename) 7) x

8 group by ename

1 select old_name, new_name

2 from (

3 select old_name, replace(sys_connect_by_path(c,' '),' ') new_name 4 from (

5 select e.ename old_name, 6 row_number() over(partition by e.ename 7 order by substr(e.ename,iter.pos,1)) rn, 8 substr(e.ename,iter.pos,1) c 9 from emp e, 10 (select rownum pos from emp) iter 11 where iter.pos <= length(e.ename)

12 order by 1

```
   13 ) x

   14 start with rn = 1

   15 connect by prior rn = rn-1 and prior old_name = old_name 16 )

   17 where length(old_name) = length(new_name)

create or replace view V as

   select x.*

   from (

   select a.ename, substr(a.ename,iter.pos,1) as c from emp a,

   (select id as pos from t10) iter where iter.pos <= length(a.ename) order by
1,2

   ) x

1 select ename,

   2 max(case when pos=1 then 3 case when cnt=1 then c 4 else
rpad(c,cast(cnt as integer),c)
```

5 end

6 else ''

7 end)||

8 max(case when pos=2 then 9 case when cnt=1 then c 10 else rpad(c,cast(cnt as integer),c)

```
end
else ''
end)||
max(case when pos=3 then
case when cnt=1 then c
else rpad(c,cast(cnt as integer),c)
```

17 end

18 else ''

19 end)||

20 max(case when pos=4 then 21 case when cnt=1 then c 22 else rpad(c,cast(cnt as integer),c)

23 end

24 else ''

25 end)||

26 max(case when pos=5 then 27 case when cnt=1 then c 28 else rpad(c,cast(cnt as integer),c)

29 end

30 else ''

31 end)||

32 max(case when pos=6 then 33 case when cnt=1 then c 34 else rpad(c,cast(cnt as integer),c)

35 end

36 else ''

37 end)

38 from (

39 select a.ename, a.c, 40 (select count(*)

41 from v b

42 where a.ename=b.ename and a.c=b.c) as cnt, 43 (select count(*)+1

44 from v b

45 where a.ename=b.ename and b.c<a.c) as pos

46 from v a

47) x

48 group by ename

1 select ename,

2 max(case when pos=1 then c else '' end)+

3 max(case when pos=2 then c else '' end)+

4 max(case when pos=3 then c else '' end)+

5 max(case when pos=4 then c else '' end)+

6 max(case when pos=5 then c else '' end)+

7 max(case when pos=6 then c else '' end) 8 from (

9 select e.ename, 10 substring(e.ename,iter.pos,1) as c, 11 row_number() over (

12 partition by e.ename 13 order by substring(e.ename,iter.pos,1)) as pos 14 from emp e, 15 (select row_number()over(order by ename) as pos 16 from emp) iter 17 where iter.pos <= len(e.ename) 18) x

19 group by ename

```
ENAME C POS
    ----- - ---
    ADAMS A 1
    ADAMS A 2
    ADAMS D 3
    ADAMS M 4
    ADAMS S 5
    …
ENAME C
    ----- -
    ADAMS A
    ADAMS A
    ADAMS D
    ADAMS M
    ADAMS S
    …
OLD_NAME RN C
    ---------- --------- -
```

```
   ADAMS 1 A

   ADAMS 2 A

   ADAMS 3 D

   ADAMS 4 M

   ADAMS 5 S

   …

OLD_NAME NEW_NAME

   ---------- ---------

   ADAMS A

   ADAMS AA

   ADAMS AAD

   ADAMS AADM

   ADAMS AADMS

   …

ENAME C

   ----- -

   ADAMS A

   ADAMS A

   ADAMS D

   ADAMS M
   ADAMS S

   …

ename | c | cnt | pos

   ------+---+-----+-----

   ADAMS | A | 2 | 1

   ADAMS | A | 2 | 1

   ADAMS | D | 1 | 3

   ADAMS | M | 1 | 4

   ADAMS | S | 1 | 5
```

The extra columns CNT and POS, returned by the inline view X, are crucial to the solution. POS is used to rank each character and CNT is used to determine the number of times the character exists in each name. The final step is to evaluate the position of each character and rebuild the name. You'll notice that each case statement is actually two case statements. This is to determine whether or not a character occursmore than once in a name; if it does, then rather than return that character, what is returned is that character appended to itself CNT times. The aggregate function, MAX, is used to ensure there is only one row per name.

```
create view V as
   select replace(mixed,' ','') as mixed from (
   select substr(ename,1,2)||
   cast(deptno as char(4))||
   substr(ename,3,2) as mixed from emp
   where deptno = 10
   union all
   select cast(empno as char(4)) as mixed from emp
   where deptno = 20
   union all
   select ename as mixed from emp
   where deptno = 30
   ) x
   select * from v

   MIXED
   --------------
   CL10AR
   KI10NG
   MI10LL
```

```
    7369
    7566
    7788
    7876
    7902
    ALLEN
    WARD
    MARTIN
    BLAKE
    TURNER
    JAMES
MIXED
    --------
    10
    10
    10
    7369
    7566
    7788
    7876
```

```
   7902
1 select mixed old,
   2 cast(
   3 case
```

4 when

5 replace(

6 translate(mixed,'9999999999','0123456789'),'9','') = ''

7 then

8 mixed

9 else replace(

10 translate(mixed, 11 repeat('#',length(mixed)), 12 replace(

13 translate(mixed,'9999999999','0123456789'),'9','')), 14 '#','')

15 end as integer) mixed

16 from V

17 where posstr(translate(mixed,'9999999999','0123456789'),'9') > 0

create view V as

select concat(

substr(ename,1,2), replace(cast(deptno as char(4)),' ',''), substr(ename,3,2)
) as mixed

from emp

where deptno = 10

union all

select replace(cast(empno as char(4)), ' ', '') from emp where deptno = 20

union all

select ename from emp where deptno = 30

1 select cast(group_concat(c order by pos separator '') as unsigned)

2 as MIXED1

3 from (

4 select v.mixed, iter.pos, substr(v.mixed,iter.pos,1) as c 5 from V,

6 (select id pos from t10) iter 7 where iter.pos <= length(v.mixed) 8 and ascii(substr(v.mixed,iter.pos,1)) between 48 and 57

9) y

10 group by mixed

11 order by 1

1 select to_number (

2 case

3 when

4 replace(translate(mixed,'0123456789','9999999999'),'9') 5 is not null

6 then

7 replace(

8 translate(mixed, 9 replace(

10 translate(mixed,'0123456789','9999999999'),'9'), 11 rpad('#',length(mixed),'#')),'#') 12 else

13 mixed

14 end

15) mixed

```
16 from V
   17 where instr(translate(mixed,'0123456789','9999999999'),'9') > 0
1 select cast(
   2 case
```

3 when

4 replace(translate(mixed,'0123456789','9999999999'),'9','') 5 is not null

6 then

7 replace(

8 translate(mixed, 9 replace(

10 translate(mixed,'0123456789','9999999999'),'9',''), 11 rpad('#',length(mixed),'#')),'#','') 12 else

13 mixed

14 end as integer) as mixed

15 from V

```
   16 where strpos(translate(mixed,'0123456789','9999999999'),'9') > 0

<b>

   select mixed as orig, translate(mixed,'0123456789','9999999999') as
mixed1, replace(translate(mixed,'0123456789','9999999999'),'9','') as
mixed2, translate(mixed,

   replace(

   translate(mixed,'0123456789','9999999999'),'9',''),
rpad('#',length(mixed),'#')) as mixed3, replace(

   translate(mixed,

   replace(

   translate(mixed,'0123456789','9999999999'),'9',''),
rpad('#',length(mixed),'#')),'#','') as mixed4

   from V

   where strpos(translate(mixed,'0123456789','9999999999'),'9') > 0</b>

   ORIG | MIXED1 | MIXED2 | MIXED3 | MIXED4 | MIXED5

   --------+--------+--------+--------+--------+--------

   CL10AR | CL99AR | CLAR | ##10## | 10 | 10

   KI10NG | KI99NG | KING | ##10## | 10 | 10

   MI10LL | MI99LL | MILL | ##10## | 10 | 10

   7369 | 9999 | | 7369 | 7369 | 7369
```

```
7566 | 9999 | | 7566 | 7566 | 7566

7788 | 9999 | | 7788 | 7788 | 7788

7876 | 9999 | | 7876 | 7876 | 7876

7902 | 9999 | | 7902 | 7902 | 7902
```

<b>

```
select v.mixed, iter.pos, substr(v.mixed,iter.pos,1) as c from V,

( select id pos from t10 ) iter where iter.pos <= length(v.mixed) order by
1,2</b>
```

```
+--------+------+------+

| mixed | pos | c |

+--------+------+------+

| 7369 | 1 | 7 |

| 7369 | 2 | 3 |

| 7369 | 3 | 6 |

| 7369 | 4 | 9 |

…

| ALLEN | 1 | A |

| ALLEN | 2 | L |

| ALLEN | 3 | L |

| ALLEN | 4 | E |

| ALLEN | 5 | N |
…

| CL10AR | 1 | C |

| CL10AR | 2 | L |

| CL10AR | 3 | 1 |

| CL10AR | 4 | 0 |

| CL10AR | 5 | A |

| CL10AR | 6 | R |

+--------+------+------+
```

<b>

```
    select v.mixed, iter.pos, substr(v.mixed,iter.pos,1) as c from V,

    ( select id pos from t10 ) iter where iter.pos <= length(v.mixed) and
ascii(substr(v.mixed,iter.pos,1)) between 48 and 57

    order by 1,2</b>

    +--------+------+------+

    | mixed | pos | c |

    +--------+------+------+

    | 7369 | 1 | 7 |

    | 7369 | 2 | 3 |

    | 7369 | 3 | 6 |

    | 7369 | 4 | 9 |

    …
```

```
| CL10AR | 3 | 1 |

| CL10AR | 4 | 0 |

…

+--------+------+------+
```

<b>

```
select cast(group_concat(c order by pos separator '') as unsigned) as
MIXED1

from (

select v.mixed, iter.pos, substr(v.mixed,iter.pos,1) as c from V,

( select id pos from t10 ) iter where iter.pos <= length(v.mixed) and
ascii(substr(x.mixed,iter.pos,1)) between 48 and 57

) y

group by mixed

order by 1</b>

+--------+

| MIXED1 |

+--------+

| 10 |

| 10 |

| 10 |

| 7369 |
| 7566 |
| 7788 |
| 7876 |
| 7902 |
+--------+
```

As a final note, keep in mind that any digits in each string will be concatenated to form one numeric value. For example, an input value of, say, '99Gennick87' will result in the value 9987 being returned. This is something to keep in mind, particularly when working with serialized data.

```
create view V as

   select 'mo,larry,curly' as name from t1

   union all

   select 'tina,gina,jaunita,regina,leena' as name from t1

<b>

   select * from v</b>

   NAME

   -------------------

   mo,larry,curly

   tina,gina,jaunita,regina,leena

SUB

   -----

   larry

   gina

1 select substr(c,2,locate(',',c,2)-2)

   2 from (

   3 select pos, name, substr(name, pos) c, 4 row_number() over( partition
by name 5 order by length(substr(name,pos)) desc) rn 6 from (

   7 select ',' ||csv.name|| ',' as name, 8 cast(iter.pos as integer) as pos 9 from
V csv,
10 (select row_number( ) over( ) pos from t100 ) iter 11 where iter.pos <= length(csv.name)+2

12 ) x

13 where length(substr(name,pos)) > 1

14 and substr(substr(name,pos),1,1) = ','

15 ) y

16 where rn = 2
```

```
select name
from (
select iter.pos,
substring_index(
substring_index(src.name,',',iter.pos),',',-1) name
from V src,
(select id pos from t10) iter,
where iter.pos <=
length(src.name)-length(replace(src.name,',',"))
) x
where pos = 2
```

1 select sub

2 from (

3 select iter.pos,

4 src.name,

5 substr(src.name,

6 instr(src.name,',',1,iter.pos)+1, 7 instr(src.name,',',1,iter.pos+1) -

8 instr(src.name,',',1,iter.pos)-1) sub 9 from (select ','||name||',' as name from V) src, 10 (select rownum pos from emp) iter 11 where iter.pos < length(src.name)-length(replace(src.name,',')) 12)

13 where pos = 2

```
select name
  from (
select iter.pos, split_part(src.name,',',iter.pos) as name
  from (select id as pos from t10) iter,
       (select cast(name as text) as name from v) src
 where iter.pos <=
       length(src.name)-length(replace(src.name,',',"))+1
       ) x
 where pos = 2
```

```
select substring(c,2,charindex(',',c,2)-2)
  from (
select pos, name, substring(name, pos, len(name)) as c,
       row_number() over(
```

5 partition by name

6 order by len(substring(name,pos,len(name))) desc) rn 7 from (

8 select ',' + csv.name + ',' as name, 9 iter.pos

10 from V csv,

11 (select id as pos from t100) iter 12 where iter.pos <= len(csv.name)+2

13) x

14 where len(substring(name,pos,len(name))) > 1

15 and substring(substring(name,pos,len(name)),1,1) = ','

16) y

17 where rn = 2

<b>

select ','||csv.name|| ',' as name, iter.pos

from v csv,

(select row_number() over( ) pos from t100) iter where iter.pos <= length(csv.name)+2</b>

EMPS POS

------------------------------ ----

,tina,gina,jaunita,regina,leena, 1

,tina,gina,jaunita,regina,leena, 2

,tina,gina,jaunita,regina,leena, 3

```
   …

<b>

   select pos, name, substr(name, pos) c, row_number() over(partition by
name order by length(substr(name, pos)) desc) rn from (

   select ','||csv.name||',' as name, cast(iter.pos as integer) as pos from v csv,

   (select row_number() over() pos from t100 ) iter where iter.pos <=
length(csv.name)+2

   ) x

   where length(substr(name,pos)) > 1</b>

   POS EMPS C RN

   --- -------------- --------------- --

   1 ,mo,larry,curly, ,mo,larry,curly, 1

   2 ,mo,larry,curly, mo,larry,curly, 2

   3 ,mo,larry,curly, o,larry,curly, 3

   4 ,mo,larry,curly, ,larry,curly, 4

   …

<b>

   select pos, name, substr(name,pos) c, row_number() over(partition by
name order by length(substr(name, pos)) desc) rn from (

   select ','||csv.name||',' as name, cast(iter.pos as integer) as pos from v csv,

   (select row_number() over( ) pos from t100 ) iter where iter.pos <=
length(csv.name)+2
```

```
    ) x
    where length(substr(name,pos)) > 1
    and substr(substr(name,pos),1,1) = ','</b>
    POS EMPS C RN
    --- -------------- ---------------- --
    1 ,mo,larry,curly, ,mo,larry,curly, 1
    4 ,mo,larry,curly, ,larry,curly, 2
    10 ,mo,larry,curly, ,curly, 3
    1 ,tina,gina,jaunita,regina,leena, ,tina,gina,jaunita,regina,leena, 1
    6 ,tina,gina,jaunita,regina,leena, ,gina,jaunita,regina,leena, 2
    11 ,tina,gina,jaunita,regina,leena, ,jaunita,regina,leena, 3
    19 ,tina,gina,jaunita,regina,leena, ,regina,leena, 4
    26 ,tina,gina,jaunita,regina,leena, ,leena, 5
```

substr(substr(name,pos),1,1) = ','

<b>

```
    select iter.pos, src.name from (select id pos from t10) iter, V src
    where iter.pos <=
    length(src.name)-length(replace(src.name,',',''))</b>
    +------+-------------------------------+
    | pos | name |
    +------+-------------------------------+

    | 1 | mo,larry,curly |

    | 2 | mo,larry,curly |

    | 1 | tina,gina,jaunita,regina,leena |

    | 2 | tina,gina,jaunita,regina,leena |

    | 3 | tina,gina,jaunita,regina,leena |

    | 4 | tina,gina,jaunita,regina,leena |

    +------+-------------------------------+
```

<b>

```
    select iter.pos,src.name name1, substring_index(src.name,',',iter.pos)
name2, substring_index(

    substring_index(src.name,',',iter.pos),',',-1) name3

    from (select id pos from t10) iter, V src

    where iter.pos <=

    length(src.name)-length(replace(src.name,',',''))</b>
```

```
+------+-------------------------------+-------------------------+---------+

| pos | name1 | name2 | name3 |

+------+-------------------------------+-------------------------+---------+

| 1 | mo,larry,curly | mo | mo |

| 2 | mo,larry,curly | mo,larry | larry |

| 1 | tina,gina,jaunita,regina,leena | tina | tina |
| 2 | tina,gina,jaunita,regina,leena | tina,gina | gina |

| 3 | tina,gina,jaunita,regina,leena | tina,gina,jaunita | jaunita |

| 4 | tina,gina,jaunita,regina,leena | tina,gina,jaunita,regina | regina |

+------+-------------------------------+------------------------+---------+
```

<b>

```
   select iter.pos, src.name, substr( src.name,

   instr( src.name,',',1,iter.pos )+1, instr( src.name,',',1,iter.pos+1 ) instr(
src.name,',',1,iter.pos )-1) sub from (select ','||name||',' as name from v) src,
(select rownum pos from emp) iter where iter.pos < length(src.name)-
length(replace(src.name,','))</b>

   POS NAME SUB

   --- ------------------------------- -------------

   1 ,mo,larry,curly, mo 1 , tina,gina,jaunita,regina,leena, tina 2
,mo,larry,curly, larry 2 , tina,gina,jaunita,regina,leena, gina 3
,mo,larry,curly, curly 3 , tina,gina,jaunita,regina,leena, jaunita 4 ,
tina,gina,jaunita,regina,leena, regina 5 , tina,gina,jaunita,regina,leena, leena
```

<b>

```
   select iter.pos, src.name as name1, split_part(src.name,',',iter.pos) as
name2

   from (select id as pos from t10) iter, (select cast(name as text) as name
from v) src where iter.pos <=

   length(src.name)-length(replace(src.name,',',"))+1</b>

   pos | name1 | name2

   -----+-------------------------------+---------
```

1 | mo,larry,curly | mo 2 | mo,larry,curly | larry 3 | mo,larry,curly | curly 1 | tina,gina,jaunita,regina,leena | tina 2 | tina,gina,jaunita,regina,leena | gina 3 | tina,gina,jaunita,regina,leena | jaunita 4 | tina,gina,jaunita,regina,leena | regina 5 | tina,gina,jaunita,regina,leena | leena

I've shown NAME twice so you can see how SPLIT_PART parses each string using POS. Once each string is parsed, the final step is the keep the rows where POS equals the nth substring you are interested in, in this case, 2.

111.22.3.4

```
A B C D

----- ----- ----- ---

   111 22 3 4
```

```
1 with x (pos,ip) as (

   2 values (1,'.92.111.0.222') 3 union all

   4 select pos+1,ip from x where pos+1 <= 20

   5 )

   6 select max(case when rn=1 then e end) a, 7 max(case when rn=2 then e
end) b, 8 max(case when rn=3 then e end) c, 9 max(case when rn=4 then e
end) d 10 from (

   11 select pos,c,d,

   12 case when posstr(d,'.') > 0 then substr(d,1,posstr(d,'.')-1) 13 else d

   14 end as e,

   15 row_number() over( order by pos desc) rn 16 from (

   17 select pos, ip,right(ip,pos) as c, substr(right(ip,pos),2) as d 18 from x

   19 where pos <= length(ip) 20 and substr(right(ip,pos),1,1) = '.'

   21 ) x

   22 ) y
```

```
1 select substring_index(substring_index(y.ip,'.',1),'.',-1) a, 2
substring_index(substring_index(y.ip,'.',2),'.',-1) b, 3
substring_index(substring_index(y.ip,'.',3),'.',-1) c, 4
substring_index(substring_index(y.ip,'.',4),'.',-1) d 5 from (select '92.111.0.2'
as ip from t1) y

1 select ip,

   2 substr(ip, 1, instr(ip,'.')-1 ) a, 3 substr(ip, instr(ip,'.')+1, 4 instr(ip,'.',1,2)-
instr(ip,'.')-1 ) b, 5 substr(ip, instr(ip,'.',1,2)+1, 6 instr(ip,'.',1,3)-
instr(ip,'.',1,2)-1 ) c, 7 substr(ip, instr(ip,'.',1,3)+1 ) d 8 from (select
'92.111.0.2' as ip from t1)

1 select split_part(y.ip,'.',1) as a,

   2 split_part(y.ip,'.',2) as b, 3 split_part(y.ip,'.',3) as c, 4 split_part(y.ip,'.',4)
as d 5 from (select cast('92.111.0.2' as text) as ip from t1) as y

1 with x (pos,ip) as (

   2 select 1 as pos,'.92.111.0.222' as ip from t1

   3 union all

   4 select pos+1,ip from x where pos+1 <= 20

   5 )

   6 select max(case when rn=1 then e end) a, 7 max(case when rn=2 then e
end) b, 8 max(case when rn=3 then e end) c, 9 max(case when rn=4 then e
end) d 10 from (

   11 select pos,c,d,

   12 case when charindex('.',d) > 0

   13 then substring(d,1,charindex('.',d)-1) 14 else d

   15 end as e,

   16 row_number() over(order by pos desc) rn 17 from (
   18 select pos, ip,right(ip,pos) as c, 19 substring(right(ip,pos),2,len(ip)) as d 20 from x

   21 where pos <= len(ip) 22 and substring(right(ip,pos),1,1) = '.'

   23 ) x

   24 ) y
```

Discussion

By using the built-in functions for your database, you can easily walk through parts of a string. The key is being able to locate each of the periods in the address. Then you can parse the numbers between each.

Chapter 7. Working with Numbers

This chapter focuses on common operations involving numbers, including numeric computations. While SQL is not typically considered the first choice for complex computations, it is very efficient for day-to-day numeric chores.

> Some recipes in this chapter make use of aggregate functions and the GROUP BY clause. If you are not familiar with grouping, please read at least the first major section, called "Grouping," in Appendix A.

Recipe 7.1. Computing an Average

Problem

You want to compute the average value in a column, either for all rows in a table or for some subset of rows. For example, you might want to find the average salary for all employees as well as the average salary for each department.

Solution

When computing the average of all employee salaries, simply apply the AVG function to the column containing those salaries. By excluding a WHERE clause, the average is computed against all non-NULL values:

```
select avg(sal) as avg_sal
  from emp

   AVG_SAL
----------
2073.21429
```

To compute the average salary for each department, use the GROUP BY clause to create a group corresponding to each department:

```
select deptno, avg(sal) as avg_sal
  from emp
 group by deptno

    DEPTNO     AVG_SAL
----------  ----------
        10  2916.66667
        20        2175
        30  1566.66667
```

Discussion

When finding an average where the whole table is the group or window, simply apply the AVG function to the column you are interested in without using the GROUP BY clause. It is important to realize that the function AVG ignores NULLs. The effect of NULL values being ignored can be seen here:

```
create table t2(sal integer)
        insert into t2 values (10)
        insert into t2 values (20)
        insert into t2 values (null)


        select avg(sal)    select distinct 30/2
```

```
  from t2            from t2

  AVG(SAL)               30/2
----------         ----------
        15                 15


select avg(coalesce(sal,0))    select distinct 30/3
  from t2                        from t2

AVG(COALESCE(SAL,0))                 30/3
--------------------           ----------
                  10                   10
```

The COALESCE function will return the first non-NULL value found in the list of values that you pass. When NULL SAL values are converted to zero, the average changes. When invoking aggregate functions, always give thought to how you want NULLs handled.

The second part of the solution uses GROUP BY (line 3) to divide employee records into groups based on department affiliation. GROUP BY automatically causes aggregate functions such as AVG to execute and return a result for each group. In this example, AVG would execute once for each department-based group of employee records.

It is not necessary, by the way, to include GROUP BY columns in your select list. For example:

```
select avg(sal)
  from emp
 group by deptno

  AVG(SAL)
----------
2916.66667
      2175
1566.66667
```

You are still grouping by DEPTNO even though it is not in the SELECT clause. Including the column you are grouping by in the SELECT clause often improves readability, but is not mandatory. It is mandatory, however, to avoid placing columns in your SELECT list that are not also in your GROUP BY clause.

See Also

Appendix A for a refresher on GROUP BY functionality.

<b>

```
1 select min(sal) as min_sal, max(sal) as max_sal 2 from emp</b>

MIN_SAL MAX_SAL

---------- ----------
```

800 5000

<b>1 select deptno, min(sal) as min_sal, max(sal) as max_sal

```
2 from emp

3 group by deptno</b>

DEPTNO MIN_SAL MAX_SAL

---------- ---------- ----------

10 1300 5000

20 800 3000
```

30 950 2850

<b>

```
select deptno, comm from emp

where deptno in (10,30) order by 1</b>

DEPTNO COMM

---------- ----------

10

10

10

30 300
```

30 500

30

30 0

30 1300

30

<b>

select min(comm), max(comm) from emp</b>

MIN(COMM) MAX(COMM) ---------- ----------

0 1300

```
<b>

select deptno, min(comm), max(comm) from emp

group by deptno</b>

DEPTNO MIN(COMM) MAX(COMM) ---------- ---------- ----------

10

20
```

30 0 1300

```
select min(comm), max(comm)

   from emp

   group by deptno

   MIN(COMM) MAX(COMM) ---------- ----------
```

0 1300

Here you are still grouping by DEPTNO even though it is not in the SELECT clause. Including the column you are grouping by in the SELECT clause often improves readability, but is not mandatory. It is mandatory, however, that any column in the SELECT list of a GROUP BY query also be listed in the GROUP BY clause.

See Also

Appendix A for a refresher on GROUP BY functionality.

<b>

```
1 select sum(sal) 2 from emp</b>

SUM(SAL) ----------

29025
```

<b>

```
1 select deptno, sum(sal) as total_for_dept
```

2 from emp

```
3 group by deptno</b>

DEPTNO TOTAL_FOR_DEPT

---------- --------------

10 8750

20 10875
```

30 9400

<b>

```
select deptno, comm from emp where deptno in (10,30) order by 1</b>

DEPTNO COMM

---------- ----------

10

10

10

30 300
```

30 500

30

30 0

30 1300

30

<b> select sum(comm) from emp

SUM(COMM) ----------

2100

select deptno, sum(comm) from emp where deptno in (10,30) group by deptno</b>

DEPTNO SUM(COMM) ---------- ----------

10

30 2100

See Also

Appendix A for a refresher on GROUP BY functionality.

<b>

```
1 select count(*) 2 from emp</b>

COUNT(*)

----------

14
```

<b>

```
1 select deptno, count(*)
```

2 from emp

3 group by deptno</b>

DEPTNO COUNT(*) ---------- ----------

10 3

20 5

30 6

<b>

```
select deptno, comm from emp</b>

DEPTNO COMM

---------- ----------

20

30 300
```

30 500

20

30 1300

30

10

20

10

30 0

20

30

20

10

<b>

select count(*), count(deptno), count(comm), count('hello') from emp</b>

COUNT(*) COUNT(DEPTNO) COUNT(COMM) COUNT('HELLO') ---------- ------------- ----------- --------------

14 14 4 14

<b>

select deptno, count(*), count(comm), count('hello') from emp

group by deptno</b>

DEPTNO COUNT(*) COUNT(COMM) COUNT('HELLO') ---------- ---------- ----------- --------------

10 3 0 3

20 5 0 5

30 6 4 6

```
<b>

   select count(*) from emp

   group by deptno</b>

   COUNT(*)

   ----------

   3

   5

   6
```

Notice that you are still grouping by DEPTNO even though it is not in the SELECT clause. Including the column you are grouping by in the SELECT clause often improves readability, but is not mandatory. If you do include it (in the SELECT list), it is mandatory that is it listed in the GROUP BY clause.

See Also

Appendix A for a refresher on GROUP BY functionality.

<b> select count(comm) from emp</b>

```
COUNT(COMM) -----------
```

4

Discussion

When you "count star," as in COUNT(*), what you are really counting is rows (regardless of actual value, which is why rows containing NULL and non-NULL values are counted). But when you COUNT a column, you are counting the number of non-NULL values in that column. The previous recipe's discussion touches on this distinction. In this solution, COUNT(COMM) returns the number of non-NULL values in the COMM column. Since only commissioned employees have commissions, the result of COUNT(COMM) is the number of such employees.

<b>

1 select ename, sal, 2 sum(sal) over (order by sal,empno) as running_total

3 from emp

```
4 order by 2</b>

ENAME SAL RUNNING_TOTAL

---------- ---------- -------------

SMITH 800 800

JAMES 950 1750

ADAMS 1100 2850

WARD 1250 4100

MARTIN 1250 5350

MILLER 1300 6650

TURNER 1500 8150

ALLEN 1600 9750

CLARK 2450 12200

BLAKE 2850 15050

JONES 2975 18025

SCOTT 3000 21025

FORD 3000 24025

KING 5000 29025
```

<b>

1 select e.ename, e.sal, 2 (select sum(d.sal) from emp d 3 where d.empno <= e.empno) as running_total

4 from emp e

```
5 order by 3</b>

ENAME SAL RUNNING_TOTAL

---------- ---------- -------------

SMITH 800 800

ALLEN 1600 2400

WARD 1250 3650

JONES 2975 6625

MARTIN 1250 7875

BLAKE 2850 10725

CLARK 2450 13175

SCOTT 3000 16175

KING 5000 21175

TURNER 1500 22675

ADAMS 1100 23775

JAMES 950 24725

FORD 3000 27725

MILLER 1300 29025
```

<b>

```
select empno, sal,

sum(sal)over(order by sal,empno) as <a name="idx-CHP-7-0317">
</a>running_total1, sum(sal)over(order by sal) as running_total2

from emp

order by 2</b>

ENAME SAL RUNNING_TOTAL1 RUNNING_TOTAL2

---------- ---------- -------------- --------------

SMITH 800 800 800

JAMES 950 1750 1750

ADAMS 1100 2850 2850

WARD 1250 4100 5350

MARTIN 1250 5350 5350

MILLER 1300 6650 6650

TURNER 1500 8150 8150

ALLEN 1600 9750 9750

CLARK 2450 12200 12200

BLAKE 2850 15050 15050

JONES 2975 18025 18025

SCOTT 3000 21025 24025

FORD 3000 24025 24025

KING 5000 29025 29025
```

<b>

```
   select e.ename as ename1, e.empno as empno1, e.sal as sal1, d.ename as
ename2, d.empno as empno2, d.sal as sal2

   from emp e, emp d

   where d.empno <= e.empno and e.empno = 7566</b>

   ENAME EMPNO1 SAL1 ENAME EMPNO2 SAL2

   ---------- ---------- ---------- ---------- ---------- ----------

   JONES 7566 2975 SMITH 7369 800

   JONES 7566 2975 ALLEN 7499 1600

   JONES 7566 2975 WARD 7521 1250

   JONES 7566 2975 JONES 7566 2975
```

Every value in EMPNO2 is compared against every value in EMPNO1. For every row where the value in EMPNO2 is less than or equal to the value in EMPNO1, the value in SAL2 is included in the sum. In this snippet, the EMPNO values for employees Smith, Allen, Ward, and Jones are compared against the EMPNO of Jones. Since all four employees' EMPNOs meet the condition of being less than or equal to Jones' EMPNO, those salaries are summed. Any employee whose EMPNO is greater than Jones' is not included in the SUM (in this snippet). The way the full query works is by summing all the salaries where the corresponding EMPNO is less than or equal to 7934 (Miller's EMPNO), which is the highest in the table.

Recipe 7.7. Generating a Running Product

Problem

You want to compute a running product on a numeric column. The operation is similar to "Calculating a Running Total," but using multiplication instead of addition.

Solution

By way of example, the solutions all compute running products of employee salaries. While a running product of salaries may not be all that useful, the technique can easily be applied to other, more useful domains.

DB2 and Oracle

Use the windowing function SUM OVER and take advantage of the fact that you can simulate multiplication by adding logarithms:

```
select empno,ename,sal,
       exp(sum(ln(sal))over(order by sal,empno)) as running_prod
  from emp
 where deptno = 10

EMPNO ENAME          SAL            RUNNING_PROD
----- ----------    ----    --------------------
 7934 MILLER        1300                    1300
 7782 CLARK         2450                 3185000
 7839 KING          5000             15925000000
```

It is not valid in SQL to compute logarithms of values less than or equal to zero. If you have such values in your tables you need to avoid passing those invalid values to SQL's LN function. Precautions against invalid values and NULLs are not provided in this solution for the sake of readability, but you should consider whether to place such precautions in production code that you write. If you absolutely must work with negative and zero values, then this solution may not work for you.

An alternative, Oracle-only solution is to use the MODEL clause that became available in Oracle Database 10*g*. In the following example, each SAL is returned as a negative number to show that negative values will not cause a problem for the running product:

```
select empno, ename, sal, tmp as running_prod
  from (
select empno,ename,-sal as sal
  from emp
 where deptno=10
       )
model
  dimension by(row_number()over(order by sal desc) rn )
  measures(sal, 0 tmp, empno, ename)
  rules (
    tmp[any] = case when sal[cv()-1] is null then sal[cv()]
```

```
                   else tmp[cv()-1]*sal[cv()]
              end
    )

EMPNO ENAME       SAL         RUNNING_PROD
----- ---------- ---- --------------------
 7934 MILLER     -1300               -1300
 7782 CLARK      -2450             3185000
 7839 KING       -5000        -15925000000
```

MySQL, PostgreSQL, and SQL Server

You still use the approach of summing logarithms, but these platforms do not support windowing functions, so use a scalar subquery instead:

```
select e.empno,e.ename,e.sal,
       (select exp(sum(ln(d.sal)))
          from emp d
         where d.empno <= e.empno
           and e.deptno=d.deptno) as running_prod
from emp e
where e.deptno=10

EMPNO  ENAME         SAL             RUNNING_PROD
-----  ----------   ----    --------------------
 7782  CLARK        2450                    2450
 7839  KING         5000                12250000
 7934  MILLER       1300             15925000000
```

SQL Server users use LOG instead of LN.

Discussion

Except for the MODEL clause solution, which is only usable with Oracle Database 10*g* or later, all the solutions take advantage of the fact that you can sum two numbers by:

1. Computing their respective natural logarithms
2. Summing those logarithms
3. Raising the result to the power of the mathematical constant *e* (using the EXP function)

The one caveat when using this approach is that it doesn't work for summing zero or negative values, because any value less than or equal to zero is out of range for an SQL logarithm.

DB2 and Oracle

For an explanation of how the window function SUM OVER works, see the previous recipe "Generating a Running Total."

In Oracle Database 10*g* and later, you can generate running products via the MODEL clause. Using the MODEL clause along with the window function ROW_NUMBER allows you to easily access prior rows. Each item in the MEASURES list can be accessed like an array. The arrays can then be searched by using the items in the DIMENSIONS list (which are the values returned by ROW_NUMBER, alias RN):

```
select empno, ename, sal, tmp as running_prod,rn
  from (
select empno,ename,-sal as sal
  from emp
 where deptno=10
      )
 model
   dimension by(row_number()over(order by sal desc) rn )
   measures(sal, 0 tmp, empno, ename)
  rules ()

EMPNO   ENAME              SAL  RUNNING_PROD            RN
-----   ----------  ----------  ------------    ----------
 7934   MILLER           -1300             0             1
 7782   CLARK            -2450             0             2
 7839   KING             -5000             0             3
```

Observe that SAL[1] has a value of1300. Because the numbers are increasing by one with no gaps, you can reference prior rows by subtracting one. The RULES clause:

```
rules (
           tmp[any] = case when sal[cv()-1] is null then sal[cv()]
                           else tmp[cv()-1]*sal[cv()]
                      end
        )
```

uses the built-in operator, ANY, to work through each row without hard-coding. ANY in this case will be the values 1, 2, and 3. TMP[*n*] is initialized to zero. A value is assigned to TMP[*n*] by evaluating the current value (the function CV returns the current value) of the corresponding SAL row. TMP[1] is initially zero and SAL[1] is1300. There is no value for SAL[0] so TMP[1] is set to SAL[1]. After TMP[1] is set, the next row is TMP[2]. First SAL[1] is evaluated (SAL[CV( )1] is SAL[1] because the current value of ANY is now 2). SAL[1] is not null, it is1300, so TMP[2] is set to the product of TMP[1] and SAL[2]. This is continued for all the rows.

MySQL, PostgreSQL, and SQL Server

See "Generating a Running Total" earlier in this chapter for an explanation of the subquery approach used for the MySQL, PostgreSQL, and SQL Server solutions.

Be aware that the output of the subquery-based solution is slightly different from that of the Oracle and DB2 solutions due to the EMPNO comparison (the running product is computed in a different order). Like a running total, the summation is driven by the predicate of the scalar subquery; the ordering of rows is by EMPNO for this solution whereas the Oracle/DB2 solution order is by SAL.

```
ENAME SAL RUNNING_DIFF

    ---------- ---------- ------------

    MILLER 1300 1300

    CLARK 2450 -1150

    KING 5000 -6150
```

```
1 select ename,sal,

    2 sum(case when rn = 1 then sal else -sal end) 3 over(order by sal,empno)
as running_diff 4 from (

    5 select empno,ename,sal, 6 row_number()over(order by sal,empno) as rn
```

7 from emp

8 where deptno = 10

9) x

1 select a.empno, a.ename, a.sal,

2 (select case when a.empno = min(b.empno) then sum(b.sal) 3 else sum(-b.sal) 4 end

5 from emp b

6 where b.empno <= a.empno 7 and b.deptno = a.deptno) as rnk

8 from emp a

9 where a.deptno = 10

Discussion

The solutions are identical to those of "Generating a Running Total." The only difference is that all values for SAL are returned as negative values with the exception of the first (you want the starting point to be the first SAL in DEPTNO 10).

```
<b>
    select sal from emp where deptno = 20
    order by sal</b>
    SAL
    ----------
    800
    1100
    2975
    3000
    3000
```

1 select sal

2 from (

3 select sal, 4 dense_rank()over(order by cnt desc) as rnk 5 from (

6 select sal, count(*) as cnt

8 from emp

9 where deptno = 20

10 group by sal

11) x

12) y

13 where rnk = 1

1 select max(sal)

2 keep(dense_rank first order by cnt desc) sal 3 from (

4 select sal, count(*) cnt

5 from emp

6 where deptno=20

7 group by sal

8)

1 select sal

2 from emp

3 where deptno = 20

4 group by sal

5 having count(*) >= all (select count(*)

6 from emp

7 where deptno = 20

8 group by sal)

1 select sal,

2 dense_rank()over(order by cnt desc) as rnk 3 from (

4 select sal,count(*) as cnt

5 from emp

6 where deptno = 20

7 group by sal

```
8 ) x


SAL RNK
----- ----------
3000 1
800 2
1100 2
```

2975 2

```
<b>select sal, count(*) cnt from emp where deptno=20
    group by sal</b>
    SAL CNT
    ----- ----------
    800 1
    1100 1
    2975 1
```

```
3000 2
```

```
keep(dense_rank first order by cnt desc)
```

What this does is extremely convenient for finding the mode. The KEEP clause determines which SAL will be returned by MAX by looking at the value of CNT returned by the inline view. Working from right to left, the values for CNT are ordered in descending order, then the first is kept of all the values for CNT returned in DENSE_RANK order. Looking at the result set from the inline view, you can see that 3000 has the highest CNT of 2. The MAX(SAL) returned is the greatest SAL that has the greatest CNT, in this case 3000.

See Also

Chapter 11, the section on "Finding Knight Values," for a deeper discussion of Oracle's KEEP extension of aggregate functions.

MySQL and PostgreSQL

The subquery returns the number of times each SAL occurs. The outer query returns any SAL that has a number of occurrences greater than or equal to all of the counts returned by the subquery (or to put it another way, the outer query returns the most common salaries in DEPTNO 20).

```
<b>
    select sal
    from emp
    where deptno = 20
    order by sal</b>
    SAL
    ----------
    800
    1100
    2975
    3000
    3000
1 select avg(sal)
    2 from (
    3 select sal, 4 count(*) over( ) total, 5 cast(count(*) over( ) as decimal)/2
mid, 6 ceil(cast(count(*) over( ) as decimal)/2) next, 7 row_number() over (
order by sal) rn
```

8 from emp

9 where deptno = 20

10) x

11 where (mod(total,2) = 0

12 and rn in (mid, mid+1) 13)

14 or (mod(total,2) = 1

15 and rn = next 16)

1 select avg(sal)

2 from (

3 select e.sal 4 from emp e, emp d 5 where e.deptno = d.deptno 6 and e.deptno = 20

7 group by e.sal 8 having sum(case when e.sal = d.sal then 1 else 0 end) 9 >= abs(sum(sign(e.sal - d.sal))) 10)

1 select median(sal)

2 from emp

3 where deptno=20

1 select percentile_cont(0.5) 2 within group(order by sal)

3 from emp

4 where deptno=20

1 select avg(sal)

2 from (

3 select sal, 4 count(*)over( ) total, 5 cast(count(*)over( ) as decimal)/2 mid, 6 ceiling(cast(count(*)over( ) as decimal)/2) next, 7 <a name="idx-CHP-7-0335"></a>row_number()over(order by sal) rn

8 from emp

```
9 where deptno = 20

10 ) x

11 where ( <a name="idx-CHP-7-0336"></a>total%2 = 0

12 and rn in ( mid, mid+1 ) 13 )

14 or ( total%2 = 1

15 and rn = next 16 )
```

<b>

```
select sal,

count(*)over() total, cast(count(*)over() as decimal)/2 mid,
ceil(cast(count(*)over() as decimal)/2) next, row_number()over(order by
sal) rn from emp

where deptno = 20</b>

SAL TOTAL MID NEXT RN

---- ----- ---- ---- ----

800 5 2.5 3 1

1100 5 2.5 3 2

2975 5 2.5 3 3

3000 5 2.5 3 4

3000 5 2.5 3 5
```

```
select avg(sal)

   from (

   select sal,

   count(*)over() total, ceil(cast(count(*)over() as decimal)/2) next,
row_number()over(order by sal) rn from emp

   where deptno = 20

   ) x

   where rn = next

<b>

   select sal,

   count(*)over() total, cast(count(*)over() as decimal)/2 mid,
ceil(cast(count(*)over() as decimal)/2) next, row_number()over(order by
sal) rn from emp

   where deptno = 30</b>

   SAL TOTAL MID NEXT RN

   ---- ----- ---- ---- ----

   950 6 3 3 1

   1250 6 3 3 2

   1250 6 3 3 3

   1500 6 3 3 4

   1600 6 3 3 5
```

2850 6 3 3 6

<b>

```
   select e.sal,
   sum(case when e.sal=d.sal then 1 else 0 end) as cnt1, abs(sum(sign(e.sal - d.sal))) as cnt2
   from emp e, emp d where e.deptno = d.deptno and e.deptno = 20
   group by e.sal</b>
   SAL CNT1 CNT2
   ---- ---- ----
   800 1 4
   1100 1 2
   2975 1 0
```

3000 4 6

Oracle

If you are on Oracle Database 10g or Oracle9i Database, you can leave the work of computing a median to functions supplied by Oracle. If you are running Oracle8i Database, you can use the DB2 solution. Otherwise you must use the PostgreSQL solution. While the MEDIAN function obviously computes a median, it may not be at all obvious that PERCENTILE_CONT does so as well. The argument passed to PERCENTILE_CONT, 0.5, is a percentile value. The clause, WITHIN GROUP (ORDER BY SAL), determines which sorted rows PERCENTILE_CONT will search (remember, a median is the middle value from a set of ordered values). The value returned is the value from the sorted rows that falls into the given percentile (in this case, 0.5, which is the middle because the boundary values are 0 and 1).

```
select (sum(
   case when deptno = 10 then sal end)/sum(sal)
)*100 as pct
```

4 from emp

1 select distinct (d10/total)*100 as pct 2 from (

   3 select deptno, 4 sum(sal)over( ) total, 5 sum(sal)over(partition by deptno) d10

6 from emp

7) x

8 where deptno=10

<b>

select sum(case when deptno = 10 then sal end) as d10, sum(sal)

from emp</b>

D10 SUM(SAL) ---- ---------

8750 29025

```
select (cast(
   sum(case when deptno = 10 then sal end) as decimal)/sum(sal) )*100 as pct from emp

select distinct
   cast(d10 as decimal)/total*100 as pct from (
   select deptno, sum(sal)over() total, sum(sal)over(partition by deptno) d10
   from emp
   ) x
   where deptno=10

<b>
   select deptno, sum(sal)over() total, sum(sal)over(partition by deptno) d10
   from emp</b>
   DEPTNO TOTAL D10
   ------- --------- ---------
   10 29025 8750
   10 29025 8750
   10 29025 8750
   20 29025 10875
   20 29025 10875
```

20 29025 10875

20 29025 10875

20 29025 10875

30 29025 9400

30 29025 9400

30 29025 9400

30 29025 9400

30 29025 9400

30 29025 9400

<b>

    select deptno, sum(sal)over( ) total, sum(sal)over(partition by deptno)
d10

    from emp

    where deptno=10</b>

    DEPTNO TOTAL D10

    ------ --------- ---------

    10 8750 8750

    10 8750 8750

10 8750 8750

Because window functions are applied after the WHERE clause, the value for TOTAL represents the sum of all salaries in DEPTNO 10 only. But to solve the problem you want the TOTAL to represent the sum of all salaries, period. That's why the filter on DEPTNO must happen outside of inline view X.

```
select avg(coalesce(comm,0)) as avg_comm
```

2 from emp

```
   3 where deptno=30
<b>
   select avg(comm) from emp where deptno=30</b>
   AVG(COMM) ---------
   550
<b>
   select ename, comm from emp where deptno=30
   order by comm desc</b>
   ENAME COMM
   ---------- ---------
   BLAKE
   JAMES
   MARTIN 1400
   WARD 500
   ALLEN 300
   TURNER 0
```

shows that only four of the six employees can earn a commission. The sum of all commissions in DEPTNO 30 is 2200, and the average should be

2200/6, not 2200/4. By excluding the COALESCE function, you answer the question, "What is the average commission of employees in DEPTNO 30 who can earn a commission?" rather than "What is the average commission of all employees in DEPTNO 30?" When working with aggregates, remember to treat NULLs accordingly.

```
1 select avg(sal)
```

2 from emp

3 where sal not in (

4 (select min(sal) from emp), 5 (select max(sal) from emp) 6)

1 select avg(sal)

2 from (

3 select sal, min(sal)over() min_sal, max(sal)over( ) max_sal

4 from emp

```
   5 ) x

   6 where sal not in (min_sal,max_sal)
```

select (sum(sal)-min(sal)-max(sal))/(count(*)-2) from emp

<b>

```
   select sal, min(sal)over() min_sal, max(sal)over( ) max_sal from
emp</b>

   SAL MIN_SAL MAX_SAL

   --------- --------- ---------

   800 800 5000

   1600 800 5000

   1250 800 5000

   2975 800 5000

   1250 800 5000

   2850 800 5000

   2450 800 5000

   3000 800 5000

   5000 800 5000

   1500 800 5000

   1100 800 5000
```

950 800 5000

3000 800 5000

1300 800 5000

You can access the high and low salary at every row, so finding which salaries are highest and/or lowest is trivial. The outer query filters the rows returned from inline view X such that any salary that matches either MIN_SAL or MAX_SAL is excluded from the average.

```
1 select cast(

   2 replace(

   3 translate( 'paul123f321', 4 repeat('#',26), 5
'abcdefghijklmnopqrstuvwxyz'),'#','') 6 as integer ) as num
```

7 from t1

1 select cast(

2 replace(

3 translate('paul123f321', 4 'abcdefghijklmnopqrstuvwxyz', 5 rpad('#',26,'#')),'#','') 6 as integer) as num

7 from t1

<b>

```
   select translate( 'paul123f321', 'abcdefghijklmnopqrstuvwxyz', rpad('#',26,'#')) as num from t1</b>

   NUM

   -----------

   ####123#321
```

<b>

```
   select replace(

   translate('paul123f321', replace(translate( 'paul123f321', '0123456789', rpad('#',10,'#')),'#',''), rpad('#',length('paul123f321'),'#')),'#','') as num from t1</b>

   NUM

   -----------

   123321
```

<b>

```
   select translate( 'paul123f321', '0123456789', rpad('#',10,'#')) from t1</b>

   TRANSLATE('

   -----------

   paul###f###
```

<b>

```
   select replace(translate( 'paul123f321', '0123456789', rpad('#',10,'#')),'#','')
from t1</b>

   REPLA

   -----

   paulf

<b>

   select translate('paul123f321', replace(translate( 'paul123f321',
'0123456789', rpad('#',10,'#')),'#',''), rpad('#',length('paul123f321'),'#')) from
t1</b>

   TRANSLATE('

   -----------

   ####123#321
```

At this point, stop and examine the outermost call to TRANSLATE. The second parameter to RPAD (or the second parameter to REPEAT for DB2) is the length of the original string. This is convenient to use since no character can occur enough times to be greater than the string it is part of. Now that all non-numeric characters are replaced by instances of "#", the last step is to use REPLACE to remove all instances of "#". Now you are left with a number.

<b>

```
create view V (id,amt,trx) as

select 1, 100, 'PR' from t1 union all select 2, 100, 'PR' from t1 union all
select 3, 50, 'PY' from t1 union all select 4, 100, 'PR' from t1 union all
select 5, 200, 'PY' from t1 union all select 6, 50, 'PY' from t1



select * from V</b>

ID AMT TR

-- ---------- --

1 100 PR

2 100 PR

3 50 PY

4 100 PR

5 200 PY
```

6 50 PY

```
TRX_TYPE AMT BALANCE

    -------- ---------- ----------

    PURCHASE 100 100

    PURCHASE 100 200

    PAYMENT 50 150

    PURCHASE 100 250

    PAYMENT 200 50

    PAYMENT 50 0

1 select case when trx = 'PY'

    2 then 'PAYMENT'

    3 else 'PURCHASE'

    4 end trx_type, 5 amt,

    6 sum(

    7 case when trx = 'PY'

    8 then -amt else amt
```

9 end

10) over (order by id,amt) as balance

11 from V

1 select case when v1.trx = 'PY'

2 then 'PAYMENT'

3 else 'PURCHASE'

4 end as trx_type, 5 v1.amt, 6 (select sum(

7 case when v2.trx = 'PY'

8 then -v2.amt else v2.amt

9 end

10)

11 from V v2

12 where v2.id <= v1.id) as balance

13 from V v1

```
<b>

   select case when trx = 'PY'

   then 'PAYMENT'

   else 'PURCHASE'

   end trx_type, case when trx = 'PY'

   then -amt else amt end as amt from V</b>

   TRX_TYPE AMT

   -------- ---------

   PURCHASE 100

   PURCHASE 100

   PAYMENT -50

   PURCHASE 100

   PAYMENT -200

   PAYMENT -50
```

After evaluating the transaction type, the values for AMT are then added to or subtracted from the running total. For an explanation on how the window function, SUM OVER, or the scalar subquery creates the running total see recipe "Calculating a Running Total."

Chapter 8. Date Arithmetic

This chapter introduces techniques for performing simple date arithmetic. Recipes cover common tasks like adding days to dates, finding the number of business days between dates, and finding the difference between dates in days.

Being able to successfully manipulate dates with your RDBMS's built-in functions can greatly improve your productivity. For all the recipes in this chapter, I try to take advantage of each RDBMS's built-in functions. In addition, I have chosen to use one date format for all the recipes, "DD-MON-YYYY". I chose to do this because I believe it will benefit those of you who work with one RDBMS and want to learn others. Seeing one standard format will help you focus on the different techniques and functions provided by each RDBMS without having to worry about default date formats.

This chapter focuses on basic date arithmetic. You'll find more advanced date recipes in the following chapter. The recipes presented in this chapter use simple date data types. If you are using more complex date data types you will need to adjust the solutions accordingly.

```
HD_MINUS_5D HD_PLUS_5D HD_MINUS_5M HD_PLUS_5M
HD_MINUS_5Y HD_PLUS_5Y

    ----------- ----------- ----------- ----------- ----------- -----------

    04-JUN-1981 14-JUN-1981 09-JAN-1981 09-NOV-1981 09-JUN-1976
09-JUN-1986

    12-NOV-1981 22-NOV-1981 17-JUN-1981 17-APR-1982 17-NOV-1976
17-NOV-1986

    18-JAN-1982 28-JAN-1982 23-AUG-1981 23-JUN-1982 23-JAN-1977
23-JAN-1987

1 select hiredate -5 day as hd_minus_5D,

    2 hiredate +5 day as hd_plus_5D,

    3 hiredate -5 month as hd_minus_5M, 4 hiredate +5 month as
hd_plus_5M,

    5 hiredate -5 year as hd_minus_5Y,

    6 hiredate +5 year as hd_plus_5Y
```

7 from emp

8 where deptno = 10

1 select hiredate-5 as hd_minus_5D,

2 hiredate+5 as hd_plus_5D,

3 add_months(hiredate,-5) as hd_minus_5M, 4 add_months(hiredate,5) as hd_plus_5M, 5 add_months(hiredate,-5*12) as hd_minus_5Y, 6 add_months(hiredate,5*12) as hd_plus_5Y

7 from emp

8 where deptno = 10

1 select hiredate - interval '5 day' as hd_minus_5D,

2 hiredate + interval '5 day' as hd_plus_5D, 3 hiredate - interval '5 month' as hd_minus_5M, 4 hiredate + interval '5 month' as hd_plus_5M, 5 hiredate - interval '5 year' as hd_minus_5Y, 6 hiredate + interval '5 year' as hd_plus_5Y

7 from emp

8 where deptno=10

1 select hiredate - interval 5 day as hd_minus_5D,

2 hiredate + interval 5 day as hd_plus_5D, 3 hiredate - interval 5 month as hd_minus_5M, 4 hiredate + interval 5 month as hd_plus_5M, 5 hiredate - interval 5 year as hd_minus_5Y, 6 hiredate + interval 5 year as hd_plus_5Y

7 from emp

8 where deptno=10

1 select date_add(hiredate,interval -5 day) as hd_minus_5D, 2 date_add(hiredate,interval 5 day) as hd_plus_5D, 3 date_add(hiredate,interval -5 month) as hd_minus_5M, 4 date_add(hiredate,interval 5 month) as hd_plus_5M, 5 date_add(hiredate,interval -5 year) as hd_minus_5Y, 6 date_add(hiredate,interval 5 year) as hd_plus_5DY

7 from emp

8 where deptno=10

1 select dateadd(day,-5,hiredate) as hd_minus_5D,

2 dateadd(day,5,hiredate) as hd_plus_5D, 3 dateadd(month,-5,hiredate) as hd_minus_5M, 4 dateadd(month,5,hiredate) as hd_plus_5M, 5 dateadd(year,-5,hiredate) as hd_minus_5Y, 6 dateadd(year,5,hiredate) as hd_plus_5Y

```
7 from emp
   8 where deptno = 10
```

Discussion

The Oracle solution takes advantage of the fact that integer values represent days when performing date arithmetic. However, that's true only of arithmetic with DATE types. Oracle9 i Database introduced TIMESTAMP types. For those, you should use the INTERVAL solution shown for PostgreSQL. Beware too, of passing TIMESTAMPs to old-style date functions such as ADD_MONTHS. By doing so, you can lose any fractional seconds that such TIMESTAMP values may contain.

The INTERVAL keyword and the string literals that go with it represent ISO-standard SQL syntax. The standard requires that interval values be enclosed within single quotes. PostgreSQL (and Oracle9 i Database and later) complies with the standard. MySQL deviates somewhat by omitting support for the quotes.

```
select days(ward_hd) - days(allen_hd) from (
   select hiredate as ward_hd
```

4 from emp

5 where ename = 'WARD'

6) x, 7 (

8 select hiredate as allen_hd

```
9 from emp
10 where ename = 'ALLEN'
11 ) y
```

```
select ward_hd - allen_hd
  from (
select hiredate as ward_hd
```

4 from emp

5 where ename = 'WARD'

6) x, 7 (

8 select hiredate as allen_hd

```
from emp
    where ename = 'ALLEN'
    ) y
select datediff(day,allen_hd,ward_hd)
from (
    select hiredate as ward_hd
```

4 from emp

5 where ename = 'WARD'

6) x, 7 (

8 select hiredate as allen_hd

9 from emp

```
   10 where ename = 'ALLEN'

   11 ) y

<b>

   select ward_hd, allen_hd from (

   select hiredate as ward_hd from emp where ename = 'WARD'

   ) y,

   (

   select hiredate as allen_hd from emp where ename = 'ALLEN'

   ) x</b>

   WARD_HD ALLEN_HD

   ----------- ----------

   22-FEB-1981 20-FEB-1981
```

You'll notice a Cartesian product is created, because there is no join specified between X and Y. In this case, the lack of a join is harmless as the cardinalities for X and Y are both 1, thus the result set will ultimately have one row (obviously, because 1x1=1). To get the difference in days, simply subtract one of the two values returned from the other using methods appropriate for your database.

```
select sum(case when dayname(jones_hd+t500.id day -1 day)
in ( 'Saturday','Sunday' )
```

3 then 0 else 1

4 end) as days

5 from (

6 select max(case when ename = 'BLAKE'

7 then hiredate

8 end) as blake_hd, 9 max(case when ename = 'JONES'

10 then hiredate

11 end) as jones_hd

12 from emp

13 where ename in ('BLAKE','JONES') 14) x,

15 t500

16 where t500.id <= blake_hd-jones_hd+1

1 select sum(case when date_format(

2 date_add(jones_hd, 3 interval t500.id-1 DAY),'%a') 4 in ('Sat','Sun')

5 then 0 else 1

```
6 end) as days
7 from (
8 select max(case when ename = 'BLAKE'
```

9 then hiredate

10 end) as blake_hd, 11 max(case when ename = 'JONES'

12 then hiredate

13 end) as jones_hd

14 from emp

15 where ename in ('BLAKE','JONES') 16) x,

17 t500

18 where t500.id <= datediff(blake_hd,jones_hd)+1

1 select sum(case when to_char(jones_hd+t500.id-1,'DY') 2 in ('SAT','SUN')

3 then 0 else 1

4 end) as days

5 from (

6 select max(case when ename = 'BLAKE'

7 then hiredate

8 end) as blake_hd, 9 max(case when ename = 'JONES'

10 then hiredate

11 end) as jones_hd

12 from emp

13 where ename in ('BLAKE','JONES') 14) x,

15 t500

16 where t500.id <= blake_hd-jones_hd+1

1 select sum(case when trim(to_char(jones_hd+t500.id-1,'DAY')) 2 in ('SATURDAY','SUNDAY')

3 then 0 else 1

4 end) as days

5 from (

6 select max(case when ename = 'BLAKE'

7 then hiredate

8 end) as blake_hd, 9 max(case when ename = 'JONES'

10 then hiredate

11 end) as jones_hd

12 from emp

13 where ename in ('BLAKE','JONES') 14) x,

15 t500

16 where t500.id <= blake_hd-jones_hd+1

1 select sum(case when datename(dw,jones_hd+t500.id-1) 2 in ('SATURDAY','SUNDAY')

3 then 0 else 1

4 end) as days

5 from (

6 select <a name="idx-CHP-8-0373"></a>max(case when ename = 'BLAKE'

7 then hiredate

8 end) as blake_hd, 9 max(case when ename = 'JONES'

10 then hiredate

11 end) as jones_hd

12 from emp

13 where ename in ('BLAKE','JONES') 14) x,

15 t500

```
16 where t500.id <= datediff(day,jones_hd-blake_hd)+1
```

<b>

```
select case when ename = 'BLAKE'
then hiredate
end as blake_hd,
case when ename = 'JONES'
then hiredate
end as jones_hd
from emp
where ename in ( 'BLAKE','JONES' )</b>
BLAKE_HD JONES_HD
----------- -----------
02-APR-1981
01-MAY-1981
```

<b>

```
select max(case when ename = 'BLAKE'
then hiredate
end) as blake_hd, max(case when ename = 'JONES'
```

```
    then hiredate

    end) as jones_hd

    from emp

    where ename in ( 'BLAKE','JONES' )</b>

    BLAKE_HD JONES_HD

    ----------- -----------

    01-MAY-1981 02-APR-1981

<b>

    select x.*, t500.*, jones_hd+t500.id-1

    from (

    select max(case when ename = 'BLAKE'

    then hiredate

    end) as blake_hd, max(case when ename = 'JONES'

    then hiredate

    end) as jones_hd

    from emp

    where ename in ( 'BLAKE','JONES' ) ) x,

    t500

    where t500.id <= blake_hd-jones_hd+1</b>

    BLAKE_HD JONES_HD ID JONES_HD+T5
```

```
----------- ----------- ---------- -----------

01-MAY-1981 02-APR-1981 1 02-APR-1981

01-MAY-1981 02-APR-1981 2 03-APR-1981

01-MAY-1981 02-APR-1981 3 04-APR-1981

01-MAY-1981 02-APR-1981 4 05-APR-1981

01-MAY-1981 02-APR-1981 5 06-APR-1981

01-MAY-1981 02-APR-1981 6 07-APR-1981

01-MAY-1981 02-APR-1981 7 08-APR-1981

01-MAY-1981 02-APR-1981 8 09-APR-1981

01-MAY-1981 02-APR-1981 9 10-APR-1981

01-MAY-1981 02-APR-1981 10 11-APR-1981

01-MAY-1981 02-APR-1981 11 12-APR-1981

01-MAY-1981 02-APR-1981 12 13-APR-1981

01-MAY-1981 02-APR-1981 13 14-APR-1981

01-MAY-1981 02-APR-1981 14 15-APR-1981

01-MAY-1981 02-APR-1981 15 16-APR-1981

01-MAY-1981 02-APR-1981 16 17-APR-1981

01-MAY-1981 02-APR-1981 17 18-APR-1981

01-MAY-1981 02-APR-1981 18 19-APR-1981

01-MAY-1981 02-APR-1981 19 20-APR-1981
```

```
01-MAY-1981 02-APR-1981 20 21-APR-1981

01-MAY-1981 02-APR-1981 21 22-APR-1981

01-MAY-1981 02-APR-1981 22 23-APR-1981

01-MAY-1981 02-APR-1981 23 24-APR-1981

01-MAY-1981 02-APR-1981 24 25-APR-1981

01-MAY-1981 02-APR-1981 25 26-APR-1981

01-MAY-1981 02-APR-1981 26 27-APR-1981

01-MAY-1981 02-APR-1981 27 28-APR-1981

01-MAY-1981 02-APR-1981 28 29-APR-1981

01-MAY-1981 02-APR-1981 29 30-APR-1981

01-MAY-1981 02-APR-1981 30 01-MAY-1981
```

If you examine the WHERE clause, you'll notice that you add 1 to the difference between BLAKE_HD and JONES_HD to generate the required 30 rows (otherwise, you would get 29 rows). You'll also notice that you subtract 1 from T500.ID in the SELECT list of the outer query, since the values for ID start at 1 and adding 1 to JONES_HD would cause JONES_HD to be excluded from the final count.

Once you generate the number of rows required for the result set, use a CASE expression to "flag" whether or not each of the days returned are weekdays or weekends (return a 1 for a weekday and a 0 for a weekend). The final step is to use the aggregate function SUM to tally up the number of 1s to get the final answer.

```
select mnth, mnth/12
  from (
  select (year(max_hd) - year(min_hd))*12 +
  (month(max_hd) - month(min_hd)) as mnth
  from (
  select min(hiredate) as min_hd, max(hiredate) as max_hd
```

7 from emp

8) x

9) y

1 select months_between(max_hd,min_hd), 2 months_between(max_hd,min_hd)/12

3 from (

4 select min(hiredate) min_hd, max(hiredate) max_hd

5 from emp

6) x

1 select mnth, mnth/12

2 from (

3 select (extract(year from max_hd) 4 extract(year from min_hd)) * 12

5 +

6 (extract(month from max_hd) 7 extract(month from min_hd)) as mnth
8 from (

9 select min(hiredate) as min_hd, max(hiredate) as max_hd

10 from emp

11) x

12) y

1 select datediff(month,min_hd,max_hd), 2 datediff(month,min_hd,max_hd)/12

3 from (

4 select min(hiredate) min_hd, max(hiredate) max_hd

5 from emp

```
   6 ) x
```

<b>

```
   select min(hiredate) as min_hd, max(hiredate) as max_hd from emp</b>

   MIN_HD MAX_HD

   ----------- -----------

   17-DEC-1980 12-JAN-1983
```

<b>

```
   select year(max_hd) as max_yr, year(min_hd) as min_yr, month(max_hd)
as max_mon, month(min_hd) as min_mon from (

   select min(hiredate) as min_hd, max(hiredate) as max_hd from emp

   ) x</b>

   MAX_YR MIN_YR MAX_MON MIN_MON

   ------ ---------- ---------- ----------
```

1983 1980 1 12

<b>

```
select min(hiredate) as min_hd, max(hiredate) as max_hd from emp</b>

MIN_HD MAX_HD

----------- -----------

17-DEC-1980 12-JAN-1983
```

The functions supplied by Oracle and SQL Server (MONTHS_BETWEEN and DATEDIFF, respectively) will return the number of months between two given dates. To find the year, divide the number of months by 12.

```
select dy*24 hr, dy*24*60 min, dy*24*60*60 sec from (
    select ( days(max(case when ename = 'WARD'
```

4 then hiredate

5 end)) -

6 days(max(case when ename = 'ALLEN'

7 then hiredate

8 end))

9) as dy

10 from emp

11) x

1 select datediff(day,allen_hd,ward_hd)*24 hr, 2 datediff(day,allen_hd,ward_hd)*24*60 min, 3 datediff(day,allen_hd,ward_hd)*24*60*60 sec 4 from (

5 select max(case when ename = 'WARD'

6 then hiredate

7 end) as ward_hd, 8 max(case when ename = 'ALLEN'

9 then hiredate

10 end) as allen_hd

11 from emp

12) x

1 select dy*24 as hr, dy*24*60 as min, dy*24*60*60 as sec 2 from (

3 select (max(case when ename = 'WARD'

4 then hiredate

5 end) -

6 max(case when ename = 'ALLEN'

7 then hiredate

8 end)) as dy

9 from emp

```
   10 ) x

<b>

   select max(case when ename = 'WARD'

   then hiredate

   end) as ward_hd, max(case when ename = 'ALLEN'

   then hiredate

   end) as allen_hd from emp</b>

   WARD_HD ALLEN_HD

   ----------- -----------

   22-FEB-1981 20-FEB-1981
```

Multiply the number of days between WARD_HD and ALLEN_HD by 24 (hours in a day), 1440 (minutes in a day), and 86400 (seconds in a day).

```
with x (start_date,end_date)
  as (
  select start_date,
  start_date + 1 year end_date
  from (
  select (current_date
  dayofyear(current_date) day)
  +1 day as start_date
```

9 from t1

10) tmp

11 union all

12 select start_date + 1 day, end_date

13 from x

14 where start_date + 1 day < end_date 15)

16 select dayname(start_date),count(*)

```
from x
   group by dayname(start_date)
select date_format(
   date_add(
   cast(
   concat(year(current_date),'-01-01') as date),
   interval t500.id-1 day), '%W') day,
   count(*)
```

```
from t500
   where t500.id <= datediff(
   cast(
   concat(year(current_date)+1,'-01-01') as date),
   cast(
   concat(year(current_date),'-01-01') as date))
   group by date_format(
   date_add(
   cast(
   concat(year(current_date),'-01-01') as date),
   interval t500.id-1 day), '%W')
with x as (
   select level lvl
```

3 from dual

4 connect by level <= (

5 add_months(trunc(sysdate,'y'),12)-trunc(sysdate,'y') 6)

7)

8 select to_char(trunc(sysdate,'y')+lvl-1,'DAY'), count(*)

9 from x

```
   10 group by to_char(trunc(sysdate,'y')+lvl-1,'DAY')
```

```
1 select to_char(trunc(sysdate,'y')+rownum-1,'DAY'), 2 count(*)
```

3 from t500

4 where rownum <= (add_months(trunc(sysdate,'y'),12) 5 - trunc(sysdate,'y')) 6 group by to_char(trunc(sysdate,'y')+rownum-1,'DAY')

1 select to_char(

2 cast(

3 date_trunc('year',current_date) 4 as date) + gs.id-1,'DAY'), 5 count(*)

6 from generate_series(1,366) gs(id) 7 where gs.id <= (cast 8 (date_trunc('year',current_date) +

9 interval '12 month' as date) -

10 cast(date_trunc('year',current_date) 11 as date))

12 group by to_char(

13 cast(

14 date_trunc('year',current_date) 15 as date) + gs.id-1,'DAY')

1 with x (start_date,end_date)

2 as (

3 select start_date, 4 dateadd(year,1,start_date) end_date 5 from (

6 select cast(

7 cast(year(getdate( )) as varchar) + '-01-01'

8 as datetime) start_date

9 from t1

10) tmp

```
union all
select dateadd(day,1,start_date), end_date
```

13 from x

14 where dateadd(day,1,start_date) < end_date 15)

16 select datename(dw,start_date),count(*)

17 from x

18 group by datename(dw,start_date) 19 OPTION (MAXRECURSION 366)

<b>

select (current_date

dayofyear(current_date) day)

+1 day as start_date

```
   from t1</b>


   START_DATE
   -------------
   01-JAN-2005
<b>
   select start_date,
   start_date + 1 year end_date from (
   select (current_date
   dayofyear(current_date) day)
```

+1 day as start_date

from t1

```
<a name="idx-CHP-8-0394"></a>) tmp</b>

START_DATE END_DATE

----------- ------------

01-JAN-2005 01-JAN-2006
```

<b>

```
with x (start_date,end_date) as (

select start_date,

start_date + 1 year end_date from (

select (current_date -

dayofyear(current_date) day)
```

+1 day as start_date

from t1

```
) tmp

union all

select start_date + 1 day, end_date from x

where start_date + 1 day < end_date )

select * from x</b>

START_DATE END_DATE

----------- -----------

01-JAN-2005 01-JAN-2006

02-JAN-2005 01-JAN-2006

03-JAN-2005 01-JAN-2006

…

29-JAN-2005 01-JAN-2006

30-JAN-2005 01-JAN-2006

31-JAN-2005 01-JAN-2006

…

01-DEC-2005 01-JAN-2006

02-DEC-2005 01-JAN-2006
```

```
   03-DEC-2005 01-JAN-2006

   …

   29-DEC-2005 01-JAN-2006

   30-DEC-2005 01-JAN-2006

   31-DEC-2005 01-JAN-2006
```

<b>

```
   with x (start_date,end_date) as (

   select start_date,

   start_date + 1 year end_date from (

   select (<a name="idx-CHP-8-0395"></a><a name="idx-CHP-8-0396">
</a>current_date -

   dayofyear(current_date) day)
```

+1 day as start_date

from t1

```
) tmp

union all

select start_date + 1 day, end_date from x

where start_date + 1 day < end_date )

select dayname(start_date),count(*) from x

group by dayname(start_date)</b>

START_DATE COUNT(*)

---------- ----------

FRIDAY 52

MONDAY 52

SATURDAY 53

SUNDAY 52

THURSDAY 52

TUESDAY 52

WEDNESDAY 52
```

<b>

```
select concat(year(current_date),'-01-01') from t1</b>
```

```
    START_DATE
    -----------
    01-JAN-2005
<b>
    select date_format(
    date_add(
    cast(
    concat(year(current_date),'-01-01') as date),
    <a name="idx-CHP-8-0399"></a>interval t500.id-1 day), '%W') day
    from t500
    where t500.id <= datediff(
    cast(
    concat(year(current_date)+1,'-01-01') as date),
    cast(
    concat(year(current_date),'-01-01') as date))</b>

    DAY
    -----------
    01-JAN-2005
```

```
   02-JAN-2005

   03-JAN-2005

   …

   29-JAN-2005

   30-JAN-2005

   31-JAN-2005

   …

   01-DEC-2005

   02-DEC-2005

   03-DEC-2005

   …

   29-DEC-2005

   30-DEC-2005

   31-DEC-2005
```

<b>

```
   select date_format(

   date_add(

   cast(

   concat(year(current_date),'-01-01') as date),

   interval t500.id-1 day), '%W') day,
   count(*)

   from t500

   where t500.id <= datediff(

   cast(

   concat(year(current_date)+1,'-01-01') as date),

   cast(

   concat(year(current_date),'-01-01') as date))

   group by date_format(

   date_add(

   cast(

   concat(year(current_date),'-01-01') as date),

   <a name="idx-CHP-8-0400"></a>interval t500.id-1 day), '%W')</b>
```

```
DAY COUNT(*)

--------- ----------

FRIDAY 52

MONDAY 52

SATURDAY 53

SUNDAY 52

THURSDAY 52
```

```
TUESDAY 52

WEDNESDAY 52
```

<b>

```
/* Oracle 9i and later */

with x as (

select level lvl

from dual

connect by level <= (

add_months(trunc(sysdate,'y'),12)-trunc(sysdate,'y') )

)

select trunc(sysdate,'y')+lvl-1

from x</b>
```

<b>

```
/* Oracle 8i and earlier */

select trunc(sysdate,'y')+rownum-1 start_date from t500

where rownum <= (add_months(trunc(sysdate,'y'),12) - trunc(sysdate,'y'))
```

</b>

```
START_DATE

-----------

01-JAN-2005

02-JAN-2005
```

```
03-JAN-2005

…

29-JAN-2005

30-JAN-2005

31-JAN-2005

…

01-DEC-2005

02-DEC-2005

03-DEC-2005

…

29-DEC-2005

30-DEC-2005

31-DEC-2005
```

<b>

```
/* Oracle 9i and later */

with x as (

select level lvl

from dual

connect by level <= (

add_months(trunc(sysdate,'y'),12)-trunc(sysdate,'y') )
)

select to_char(trunc(sysdate,'y')+lvl-1,'DAY'), count(*) from x

group by to_char(trunc(sysdate,'y')+lvl-1,'DAY')

/* Oracle 8i and earlier */

select to_char(trunc(sysdate,'y')+rownum-1,'DAY') start_date, count(*)

from t500

where rownum <= (add_months(trunc(sysdate,'y'),12) - trunc(sysdate,'y'))
group by to_char(trunc(sysdate,'y')+rownum-1,'DAY')</b>

START_DATE COUNT(*)

---------- ----------

FRIDAY 52

MONDAY 52

SATURDAY 53

SUNDAY 52

THURSDAY 52

TUESDAY 52

WEDNESDAY 52

<b>

select cast(

date_trunc('year',current_date) as date) as start_date from t1</b>
```

```
   START_DATE

   ----------

   01-JAN-2005
```

<b>

```
   select cast( date_trunc('year',current_date) as date) + gs.id-1 as start_date
from generate_series (1,366) gs(id) where gs.id <= (cast (
date_trunc('year',current_date) +

   interval '12 month' as date) -

   cast(date_trunc('year',current_date) as date))</b>
```

```
   START_DATE

   -----------

   01-JAN-2005

   02-JAN-2005

   03-JAN-2005

   …

   29-JAN-2005

   30-JAN-2005

   31-JAN-2005

   …

   01-DEC-2005
   02-DEC-2005

   03-DEC-2005

   …

   29-DEC-2005

   30-DEC-2005

   31-DEC-2005

<b>

   select to_char(

   cast(

   date_trunc('year',current_date) as date) + gs.id-1,'DAY') as start_dates,
count(*)

   from generate_series(1,366) gs(id) where gs.id <= (cast (
date_trunc('year',current_date) +

   <a name="idx-CHP-8-0406"></a>interval '12 month' as date) -

   cast(date_trunc('year',current_date) as date))

   group by to_char(

   cast(

   date_trunc('year',current_date) as date) + gs.id-1,'DAY')</b>

   START_DATE COUNT(*)

   ---------- ----------

   FRIDAY 52
   MONDAY 52

   SATURDAY 53

   SUNDAY 52

   THURSDAY 52

   TUESDAY 52

   WEDNESDAY 52

<b>

   select cast(

   cast(year(getdate()) as varchar) + '-01-01'

   as datetime) start_date from t1</b>


   START_DATE

   -----------

   01-JAN-2005

<b>

   select start_date,

   dateadd(year,1,start_date) end_date from (

   select cast(

   cast(year(getdate( )) as varchar) + '-01-01'

   as datetime) start_date from t1
   ) tmp</b>

   START_DATE END_DATE
   ----------- -----------
   01-JAN-2005 01-JAN-2006
```
<b>

```
with x (start_date,end_date) as (
select start_date,
dateadd(year,1,start_date) end_date from (
select cast(
cast(year(getdate( )) as varchar) + '-01-01'
as datetime) start_date from t1
) tmp
union all
select dateadd(day,1,start_date), end_date from x
where dateadd(day,1,start_date) < end_date )
select * from x
OPTION (MAXRECURSION 366)</b>
START_DATE END_DATE
----------- -----------
```

```
01-JAN-2005 01-JAN-2006
02-JAN-2005 01-JAN-2006
03-JAN-2005 01-JAN-2006
…
29-JAN-2005 01-JAN-2006
30-JAN-2005 01-JAN-2006
31-JAN-2005 01-JAN-2006
…
01-DEC-2005 01-JAN-2006
02-DEC-2005 01-JAN-2006
03-DEC-2005 01-JAN-2006
…
29-DEC-2005 01-JAN-2006
30-DEC-2005 01-JAN-2006
31-DEC-2005 01-JAN-2006
```

<b>

```
with x(start_date,end_date) as (
select start_date,
dateadd(year,1,start_date) end_date from (
select cast(
    cast(year(getdate( )) as varchar) + '-01-01'

    as datetime) start_date from t1

    ) tmp

    union all

    select dateadd(day,1,start_date), end_date from x

    where dateadd(day,1,start_date) < end_date )

    select datename(dw,start_date), count(*) from x

    group by datename(dw,start_date) OPTION (MAXRECURSION 366)<a
name="idx-CHP-8-0409"></a></b>

    START_DATE COUNT(*)

    --------- ----------

    FRIDAY 52

    MONDAY 52

    SATURDAY 53

    SUNDAY 52

    THURSDAY 52

    TUESDAY 52

    WEDNESDAY 52
```

1 select x.*,

2 days(x.next_hd) - days(x.hiredate) diff 3 from (

4 select e.deptno, e.ename, e.hiredate, 5 (select min(d.hiredate) from emp d 6 where d.hiredate > e.hiredate) next_hd

7 from emp e

8 where e.deptno = 10

9) x

1 select x.*,

2 datediff(day,x.hiredate,x.next_hd) diff 3 from (

4 select e.deptno, e.ename, e.hiredate, 5 (select min(d.hiredate) from emp d 6 where d.hiredate > e.hiredate) next_hd

```
7 from emp e
   8 where e.deptno = 10
   9 ) x
2 datediff(x.next_hd, x.hiredate) diff
1 select ename, hiredate, next_hd,
```

2 next_hd - hiredate diff

3 from (

4 select deptno, ename, hiredate, 5 lead(hiredate)over(order by hiredate) next_hd

6 from emp

7)

8 where deptno=10

1 select x.*,

2 x.next_hd - x.hiredate as diff 3 from (

4 select e.deptno, e.ename, e.hiredate, 5 (select min(d.hiredate) from emp d 6 where d.hiredate > e.hiredate) as next_hd

7 from emp e

```
8 where e.deptno = 10

9 ) x
```

<b>

```
select ename, hiredate from emp

where deptno=10

order by 2</b>

ENAME HIREDATE

------ -----------

CLARK 09-JUN-1981

KING 17-NOV-1981

MILLER 23-JAN-1982
```

<b>

```
insert into emp (empno,ename,deptno,hiredate) values
(1,'ant',10,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,hiredate) values
(2,'joe',10,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,hiredate) values
(3,'jim',10,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,hiredate) values
(4,'choi',10,to_date('17-NOV-1981'))
```

```
select ename, hiredate from emp

where deptno=10

order by 2</b>

ENAME HIREDATE

------ -----------

CLARK 09-JUN-1981

ant 17-NOV-1981

joe 17-NOV-1981

KING 17-NOV-1981

jim 17-NOV-1981

choi 17-NOV-1981

MILLER 23-JAN-1982
```

<b>

```
select ename, hiredate, next_hd, next_hd - hiredate diff from (

select deptno, ename, hiredate, lead(hiredate)over(order by hiredate)
next_hd from emp

where deptno=10

)</b>


ENAME HIREDATE NEXT_HD DIFF

------ ----------- ----------- ----------
```

```
   CLARK 09-JUN-1981 17-NOV-1981 161

   ant 17-NOV-1981 17-NOV-1981 0

   joe 17-NOV-1981 17-NOV-1981 0

   KING 17-NOV-1981 17-NOV-1981 0

   jim 17-NOV-1981 17-NOV-1981 0

   choi 17-NOV-1981 23-JAN-1982 67

   MILLER 23-JAN-1982 (null) (null)
```

<b>

```
   select ename, hiredate, next_hd, next_hd - hiredate diff from (

   select deptno, ename, hiredate, lead(hiredate,cnt-rn+1)over(order by
hiredate) next_hd from (

   select deptno,ename,hiredate, count(*)over(partition by hiredate) cnt,
row_number( )over(partition by hiredate order by empno) rn from emp

   where deptno=10</b> )

   )


   ENAME HIREDATE NEXT_HD DIFF

   ------ ----------- ----------- ----------

   CLARK 09-JUN-1981 17-NOV-1981 161

   ant 17-NOV-1981 23-JAN-1982 67

   joe 17-NOV-1981 23-JAN-1982 67
```

```
    jim 17-NOV-1981 23-JAN-1982 67

    choi 17-NOV-1981 23-JAN-1982 67

    KING 17-NOV-1981 23-JAN-1982 67

MILLER 23-JAN-1982 (null) (null)

<b>

    select deptno,ename,hiredate, count(*)over(partition by hiredate) cnt,
row_number( )over(partition by hiredate order by empno) rn from emp

    where deptno=10</b>

    DEPTNO ENAME HIREDATE CNT RN

    ------ ------ ----------- ---------- ----------

    10 CLARK 09-JUN-1981 1 1

    10 ant 17-NOV-1981 5 1

    10 joe 17-NOV-1981 5 2

    10 jim 17-NOV-1981 5 3

    10 choi 17-NOV-1981 5 4

    10 KING 17-NOV-1981 5 5
```

10 MILLER 23-JAN-1982 1 1

<b>

```
select deptno, ename, hiredate, cnt-rn+1 distance_to_miller,
lead(hiredate,cnt-rn+1)over(order by hiredate) next_hd from (

select deptno,ename,hiredate, count(*)over(partition by hiredate) cnt,
row_number( )over(partition by hiredate order by empno) rn from emp

where deptno=10

)</b>
```

```
DEPTNO ENAME HIREDATE DISTANCE_TO_MILLER NEXT_HD

------ ------ ----------- ------------------ -----------

10 CLARK 09-JUN-1981 1 17-NOV-1981

10 ant 17-NOV-1981 5 23-JAN-1982

10 joe 17-NOV-1981 4 23-JAN-1982

10 jim 17-NOV-1981 3 23-JAN-1982

10 choi 17-NOV-1981 2 23-JAN-1982
```

```
10 KING 17-NOV-1981 1 23-JAN-1982
   10 MILLER 23-JAN-1982 1 (null)
```

As you can see, by passing the appropriate distance to jump ahead to, the LEAD function performs the subtraction on the correct dates.

Chapter 9. Date Manipulation

This chapter introduces recipes for searching and modifying dates. Queries involving dates are very common. Thus, you need to know how to think when working with dates, and you need to have a good understanding of the functions that your RDBMS platform provides for manipulating them. The recipes in this chapter form an important foundation for future work as you move on to more complex queries involving not only dates, but times too.

Before getting into the recipes, I want to reinforce the concept (that I mentioned in the Preface) of using these solutions as guidelines to solving your specific problems. Try to think "big picture." For example, if a recipe solves a problem for the current month, keep in mind that you may be able to use the recipe for any month (with minor modifications), not just the month used in the recipe. Again, I want you to use these recipes as guidelines, not as the absolute final option. There's no possible way a book can contain an answer for all your problems, but if you understand what is presented here, modifying these solutions to fit your needs is trivial. I also urge you to consider alternative versions of the solutions I've provided. For instance, if I solve a problem using one particular function provided by your RDBMS, it is worth the time and effort to find out if there is an alternativemaybe one that is more or less efficient than what is presented here. Knowing what options you have will make you a better SQL programmer.

> The recipes presented in this chapter use simple date data types. If you are using more complex date data types you will need to adjust the solutions accordingly.

Recipe 9.1. Determining if a Year Is a Leap Year

Problem

You want to determine whether or not the current year is a leap year.

Solution

If you've worked on SQL for some time, there's no doubt that you've come across several techniques for solving this problem. Just about all the solutions I've encountered work well, but the one presented in this recipe is probably the simplest. This solution simply checks the last day of February; if it is the 29th then the current year is a leap year.

DB2

Use the recursive WITH clause to return each day in February. Use the aggregate function MAX to determine the last day in February.

```
with x (dy,mth)
    as (
select dy, month(dy)
  from (
select (current_date -
         dayofyear(current_date) days +1 days)
          +1 months as dy
  from t1
       ) tmp1
 union all
select dy+1 days, mth
  from x
 where month(dy+1 day) = mth
)
select max(day(dy))
  from x
```

Oracle

Use the function LAST_DAY to find the last day in February:

```
select to_char(
         last_day(add_months(trunc(sysdate,'y'),1)),
        'DD')
  from t1
```

PostgreSQL

Use the function GENERATE_SERIES to return each day in February, then use the aggregate function MAX to find the last day in February:

```
select max(to_char(tmp2.dy+x.id,'DD')) as dy
  from (
select dy, to_char(dy,'MM') as mth
  from (
select cast(cast(
            date_trunc('year',current_date) as date)
                       + interval '1 month' as date) as dy
  from t1
       ) tmp1
       ) tmp2, generate_series (0,29) x(id)
 where to_char(tmp2.dy+x.id,'MM') = tmp2.mth
```

MySQL

Use the function LAST_DAY to find the last day in February:

```
select day(
         last_day(
         date_add(
         date_add(
         date_add(current_date,
                  interval -dayofyear(current_date) day),
                  interval 1 day),
                  interval 1 month))) dy
  from t1
```

SQL Server

Use the recursive WITH clause to return each day in February. Use the aggregate function MAX to determine the last day in February:

```
with x (dy,mth)
    as (
select dy, month(dy)
  from (
select dateadd(mm,1,(getdate( )-datepart(dy,getdate( )))+1) dy
  from t1
       ) tmp1
 union all
select dateadd(dd,1,dy), mth
  from x
 where month(dateadd(dd,1,dy)) = mth
)
select max(day(dy))
  from x
```

Discussion

DB2

The inline view TMP1 in the recursive view X returns the first day in February by:

1. Starting with the current date
2. Using DAYOFYEAR to determine the number of days into the current year that the current date represents
3. Subtracting that number of days from the current date to get December 31 of the prior year, and then adding one to get to January 1 of the current year
4. Adding one month to get to February 1

The result of all this math is shown below:

```
 select (current_date
          dayofyear(current_date) days +1 days) +1 months as dy
   from t1

DY
-----------
01-FEB-2005
```

The next step is to return the month of the date returned by inline view TMP1 by using the MONTH function:

```
select dy, month(dy) as mth
  from (
select (current_date
          dayofyear(current_date) days +1 days) +1 months as dy
  from t1
       ) tmp1

DY          MTH
----------- ---
01-FEB-2005   2
```

The results presented thus far provide the start point for the recursive operation that generates each day in February. To return each day in February, repeatedly add one day to DY until you are no longer in the month of February. A portion of the results of the WITH operation is shown below:

```
  with x (dy,mth)
    as (
select dy, month(dy)
  from (
select (current_date -
         dayofyear(current_date) days +1 days) +1 months as dy
  from t1
       ) tmp1
 union all
 select dy+1 days, mth
   from x
  where month(dy+1 day) = mth
 )
 select dy,mth
   from x
```

```
DY          MTH
----------- ---
01-FEB-2005   2
…
10-FEB-2005   2
…
28-FEB-2005   2
```

The final step is to use the MAX function on the DY column to return the last day in February; if it is the 29th, you are in a leap year.

Oracle

The first step is to find the beginning of the year using the TRUNC function:

```
select trunc(sysdate,'y')
  from t1

DY
-----------
01-JAN-2005
```

Because the first day of the year is January 1st, the next step is to add one month to get to February 1st:

```
select add_months(trunc(sysdate,'y'),1) dy
  from t1

DY
-----------
01-FEB-2005
```

The next step is to use the LAST_DAY function to find the last day in February:

```
select last_day(add_months(trunc(sysdate,'y'),1)) dy
  from t1

DY
-----------
28-FEB-2005
```

The final step (which is optional) is to use TO_CHAR to return either 28 or 29.

PostgreSQL

The first step is to examine the results returned by inline view TMP1. Use the DATE_TRUNC function to find the beginning of the current year and cast that result as a DATE:

```
select cast(date_trunc('year',current_date) as date) as dy
  from t1

DY
-----------
01-JAN-2005
```

The next step is to add one month to the first day of the current year to get the first day in February, casting the result as a date:

```
select cast(cast(
            date_trunc('year',current_date) as date)
                       + interval '1 month' as date) as dy
  from t1

DY
-----------
01-FEB-2005
```

Next, return DY from inline view TMP1 along with the numeric month of DY. Return the numeric month by using the TO_CHAR function:

```
select dy, to_char(dy,'MM') as mth
   from (
 select cast(cast(
             date_trunc('year',current_date) as date)
                        + interval '1 month' as date) as dy
   from t1
        ) tmp1

DY          MTH
----------- ---
01-FEB-2005   2
```

The results shown thus far comprise the result set of inline view TMP2. Your next step is to use the extremely useful function GENERATE_SERIES to return 29 rows (values 1 through 29). Every row returned by GENERATE_SERIES (aliased X) is added to DY from inline view TMP2. Partial results are shown below:

```
select tmp2.dy+x.id as dy, tmp2.mth
  from (
select dy, to_char(dy,'MM') as mth
  from (
select cast(cast(
            date_trunc('year',current_date) as date)
                       + interval '1 month' as date) as dy
  from t1
       ) tmp1
       ) tmp2, generate_series (0,29) x(id)
 where to_char(tmp2.dy+x.id,'MM') = tmp2.mth
```

```
DY          MTH
----------- ---
01-FEB-2005  02
…
10-FEB-2005  02
…
28-FEB-2005  02
```

The final step is to use the MAX function to return the last day in February. The function TO_CHAR is applied to that value and will return either 28 or 29.

MySQL

The first step is to find the first day of the current year by subtracting from the current date the number of days it is into the year, and then adding one day. Do all of this with the DATE_ADD function:

```
select date_add(
       date_add(current_date,
                interval -dayofyear(current_date) day),
                interval 1 day) dy
  from t1

DY
-----------
01-JAN-2005
```

Then add one month again using the DATE_ADD function:

```
select date_add(
       date_add(
       date_add(current_date,
                interval -dayofyear(current_date) day),
                interval 1 day),
                interval 1 month) dy
  from t1

DY
-----------
01-FEB-2005
```

Now that you've made it to February, use the LAST_DAY function to find the last day of the month:

```
select last_day(
       date_add(
       date_add(
       date_add(current_date,
                interval -dayofyear(current_date) day),
                interval 1 day),
                interval 1 month)) dy
```

```
  from t1

DY
-----------
28-FEB-2005
```

The final step (which is optional) is to use the DAY function to return either a 28 or 29.

SQL Server

This solution uses the recursive WITH clause to generate each day in February. The first step is to find the first day of February. To do this, find the first day of the current year by subtracting from the current date the number of days it is into the year, and then adding one day. Once you have the first day of the current year, use the DATEADD function to add one month to advance to the first day of February:

```
select dateadd(mm,1,(getdate()-datepart(dy,getdate()))+1) dy
  from t1

DY
-----------
01-FEB-2005
```

Next, return the first day of February along with the numeric month for February:

```
select dy, month(dy) mth
  from (
select dateadd(mm,1,(getdate()-datepart(dy,getdate()))+1) dy
  from t1
       ) tmp1

DY          MTH
----------- ---
01-FEB-2005   2
```

Then use the recursive capabilities of the WITH clause to repeatedly add one day to DY from inline view TMP1 until you are no longer in February (partial results shown below):

```
  with x (dy,mth)
    as (
select dy, month(dy)
  from (
select dateadd(mm,1,(getdate()-datepart(dy,getdate()))+1) dy
  from t1
       ) tmp1
 union all
select dateadd(dd,1,dy), mth
  from x
 where month(dateadd(dd,1,dy)) = mth
 )
select dy,mth from x
```

```
DY          MTH
----------- ---
01-FEB-2005  02
…
10-FEB-2005  02
…
28-FEB-2005  02
```

Now that you can return each day in February, the final step is to use the MAX function to see if the last day is the 28th or 29th. As an optional last step, you can use the DAY function to return a 28 or 29, rather than a date.

Recipe 9.2. Determining the Number of Days in a Year

Problem

You want to count the number of days in the current year.

Solution

The number of days in the current year is the difference between the first day of the next year and the first day of the current year (in days). For each solution the steps are:

1. Find the first day of the current year.
2. Add one year to that date (to get the first day of the next year).
3. Subtract the current year from the result of Step 2.

The solutions differ only in the built-in functions that you use to perform these steps.

DB2

Use the function DAYOFYEAR to help find the first day of the current year, and use DAYS to find the number of days in the current year:

```
select days((curr_year + 1 year)) - days(curr_year)
  from (
select (current_date -
        dayofyear(current_date) day +
         1 day) curr_year
  from t1
       ) x
```

Oracle

Use the function TRUNC to find the beginning of the current year, and use ADD_ MONTHS to then find the beginning of next year:

```
select add_months(trunc(sysdate,'y'),12) - trunc(sysdate,'y')
  from dual
```

PostgreSQL

Use the function DATE_TRUNC to find the beginning of the current year. Then use interval arithmetic to determine the beginning of next year:

```
select cast((curr_year + interval '1 year') as date) - curr_year
          from (
        select cast(date_trunc('year',current_date) as date) as curr_year
          from t1
               ) x
```

MySQL

Use ADDDATE to help find the beginning of the current year. Use DATEDIFF and interval arithmetic to determine the number of days in the year:

```
select datediff((curr_year + interval 1 year),curr_year)
          from (
        select adddate(current_date,-dayofyear(current_date)+1) curr_year
          from t1
               ) x
```

SQL Server

Use the function DATEADD to find the first day of the current year. Use DATEDIFF to return the number of days in the current year:

```
select datediff(d,curr_year,dateadd(yy,1,curr_year))
          from (
        select dateadd(d,-datepart(dy,getdate())+1,getdate()) curr_year
          from t1
               ) x
```

Discussion

DB2

The first step is to find the first day of the current year. Use DAYOFYEAR to determine how many days you are into the current year. Subtract that value from the current date to get the last day of last year, and then add 1:

```
select (current_date
        dayofyear(current_date) day +
         1 day) curr_year
  from t1

CURR_YEAR
-----------
01-JAN-2005
```

Now that you have the first day of the current year, just add one year to it; this gives you the first day of next year. Then subtract the beginning of the current year from the beginning of next year.

Oracle

The first step is to find the first day of the current year, which you can easily do by invoking the built-in TRUNC function and passing 'Y' as the second argument (thereby truncating the date to the beginning of the year):

```
select select trunc(sysdate,'y') curr_year
  from dual

CURR_YEAR
-----------
01-JAN-2005
```

Then add one year to arrive at the first day of the next year. Finally, subtract the two dates to find the number of days in the current year.

PostgreSQL

Begin by finding the first day of the current year. To do that, invoke the DATE_ TRUNC function as follows:

```
select cast(date_trunc('year',current_date) as date) as curr_year
  from t1

CURR_YEAR
-----------
01-JAN-2005
```

You can then easily add a year to compute the first day of next year. Then all you need to do is to subtract the two dates. Be sure to subtract the earlier date from the later date. The result will be the number of days in the current year.

MySQL

Your first step is to find the first day of the current year. Use DAYOFYEAR to find how many days you are into the current year. Subtract that value from the current date, and add 1:

```
select adddate(current_date,-dayofyear(current_date)+1) curr_year
  from t1

CURR_YEAR
-----------
01-JAN-2005
```

Now that you have the first day of the current year, your next step is to add one year to it to get the first day of next year. Then subtract the beginning of the current year from the beginning of the next year. The result is the number of days in the current year.

SQL Server

Your first step is to find the first day of the current year. Use DATEADD and DATEPART to subtract from the current date the number of days into the year the current date is, and add 1:

```
select dateadd(d,-datepart(dy,getdate())+1,getdate()) curr_year
  from t1

CURR_YEAR
-----------
01-JAN-2005
```

Now that you have the first day of the current year, your next step is to add one year to it get the first day of the next year. Then subtract the beginning of the current year from the beginning of the next year. The result is the number of days in the current year.

```
<b>

   1 select hour( current_timestamp ) hr, 2 minute( current_timestamp ) min,
3 second( current_timestamp ) sec, 4 day( current_timestamp ) dy,

   5 month( current_timestamp ) mth, 6 year( current_timestamp ) yr

   7 from t1</b>



   HR MIN SEC DY MTH YR

   ---- ----- ----- ----- ----- -----
```

20 28 36 15 6 2005

<b>

1 select to_number(to_char(sysdate,'hh24')) hour, 2 to_number(to_char(sysdate,'mi')) min, 3 to_number(to_char(sysdate,'ss')) sec, 4 to_number(to_char(sysdate,'dd')) day, 5 to_number(to_char(sysdate,'mm')) mth, 6 to_number(to_char(sysdate,'yyyy')) year 7 from dual</b>

```
HOUR MIN SEC DAY MTH YEAR

---- ----- ----- ----- ----- -----
```

20 28 36 15 6 2005

<b>

1 select to_number(to_char(current_timestamp,'hh24'),'99') as hr, 2 to_number(to_char(current_timestamp,'mi'),'99') as min, 3 to_number(to_char(current_timestamp,'ss'),'99') as sec, 4 to_number(to_char(current_timestamp,'dd'),'99') as day, 5 to_number(to_char(current_timestamp,'mm'),'99') as mth, 6 to_number(to_char(current_timestamp,'yyyy'),'9999') as yr 7 from t1</b>

HR MIN SEC DAY MTH YR

---- ----- ----- ----- ----- -----

20 28 36 15 6 2005

<b>

```
   1 select date_format(current_timestamp,'%k') hr, 2
date_format(current_timestamp,'%i') min, 3
date_format(current_timestamp,'%s') sec, 4
date_format(current_timestamp,'%d') dy, 5
date_format(current_timestamp,'%m') mon, 6
date_format(current_timestamp,'%Y') yr 7 from t1</b>
```

```
   HR MIN SEC DAY MTH YR

   ---- ----- ----- ----- ----- -----
```

20 28 36 15 6 2005

<b>

1 select datepart(hour, getdate()) hr, 2 datepart(minute,getdate()) min, 3 datepart(second,getdate()) sec, 4 datepart(day, getdate()) dy,

5 datepart(month, getdate()) mon, 6 datepart(year, getdate()) yr

7 from t1</b>

HR MIN SEC DAY MTH YR

---- ----- ----- ----- ----- -----

```
20 28 36 15 6 2005
```

Discussion

There's nothing fancy in these solutions; just take advantage of what you're already paying for. Take the time to learn the date functions available to you. This recipe only scratches the surface of the functions presented in each solution. You'll find that each of the functions takes many more arguments and can return more information than what this recipe provides you.

Recipe 9.4. Determining the First and Last Day of a Month

Problem

You want to determine the first and last days for the current month.

Solution

The solutions presented here are for finding first and last days for the current month. Using the current month is arbitrary. With a bit of adjustment, you can make the solutions work for any month.

DB2

Use the DAY function to return the number of days into the current month the current date represents. Subtract this value from the current date, and then add 1 to get the first of the month. To get the last day of the month, add one month to the current date, then subtract from it the value returned by the DAY function as applied to the current date:

```
select (current_date - day(current_date) day +1 day) firstday,
       (current_date +1 month -day(current_date) day) lastday
  from t1
```

Oracle

Use the function TRUNC to find the first of the month, and the function LAST_DAY to find the last day of the month:

```
select trunc(sysdate,'mm') firstday,
       last_day(sysdate) lastday
  from dual
```

Using TRUNC as decribed here will result in the loss of any time-of-day component, whereas LAST_DAY will preserve the time of day.

PostgreSQL

Use the DATE_TRUNC function to truncate the current date to the first of the current month. Once you have the first day of the month, add one month and subtract one day to find the end of the current month:

```
select firstday,
       cast(firstday + interval '1 month'
                     - interval '1 day' as date) as lastday
  from (
select cast(date_trunc('month',current_date) as date) as firstday
  from t1
       ) x
```

MySQL

Use the DATE_ADD and DAY functions to find the number of days into the month the current date is. Then subtract that value from the current date and add 1 to find the first of the month. To find the last day of the current month, use the LAST_DAY function:

```
select date_add(current_date,
                interval -day(current_date)+1 day) firstday,
       last_day(current_date) lastday
  from t1
```

SQL Server

Use the DATEADD and DAY functions to find the number of days into the month represented by the current date. Then subtract that value from the current date and add 1 to find the first of the month. To get the last day of the month, add one month to the current date, and then subtract from that result the value returned by the DAY function applied to the current date, again using the functions DAY and DATEADD:

```
select dateadd(day,-day(getdate( ))+1,getdate( )) firstday,
       dateadd(day,
               -day(getdate( )),
               dateadd(month,1,getdate( ))) lastday
  from t1
```

Discussion

DB2

To find the first day of the month, use the DAY function. The DAY function conveniently returns the day of the month for the date passed. If you subtract the value returned by DAY(CURRENT_DATE) from the current date, you get the last day of the prior month; add one day to get the first day of the current month. To find the last day of the month, add one month to the current date. That will get you the same number of days into the following month as you are into the current month (the math will still work out if the following month is shorter than the current). Then subtract the value returned by DAY(CURRENT_DATE) to get the last day of the current month.

Oracle

To find the first day of the current month, use the TRUNC function with "mm" as the second argument to "truncate" the current date down to the first of the month. To find the last day of the current month, simply use the LAST_DAY function.

PostgreSQL

To find the first day of the current month, use the DATE_TRUNC function with "month" as the second argument to "truncate" the current date down to the first of the month. To find the last day of the current month, add one month to the first day of the month, and then subtract one day.

MySQL

To find the first day of the month, use the DAY function. The DAY function conveniently returns the day of the month for the date passed. If you subtract the value returned by DAY(CURRENT_DATE) from the current date, you get the last day of the prior month; add one day to get the first day of the current month. To find the last day of the current month, simply use the LAST_DAY function.

SQL Server

To find the first day of the month, use the DAY function. The DAY function conveniently returns the day of the month for the date passed. If you subtract the value returned by DAY(GETDATE( )) from the current date, you get the last day of the prior month; add one day to get the first day of the current month. To find the last day of the current month, use the DATEADD function. Add one month to the current date, then subtract from it the value returned by DAY(GETDATE( )) to get the last day of the current month.

```
with x (dy,yr)
  as (
select dy, year(dy) yr
  from (
select (current_date -
dayofyear(current_date) days +1 days) as dy
```

7 from t1

8) tmp1

9 union all

10 select dy+1 days, yr

11 from x

12 where year(dy +1 day) = yr 13)

14 select dy

15 from x

16 where dayname(dy) = 'Friday'

```
1 with x
  2 as (
  3 select trunc(sysdate,'y')+level-1 dy
```

4 from t1

5 connect by level <=

6 add_months(trunc(sysdate,'y'),12)-trunc(sysdate,'y') 7)

8 select *

9 from x

```
   10 where to_char( dy, 'dy') = 'fri'

1 select cast(date_trunc('year',current_date) as date) 2 + x.id as dy

   3 from generate_series (

   4 0,

   5 ( select cast(

   6 cast(

   7 date_trunc('year',current_date) as date) 8 + interval '1 years' as date) 9 -
cast(

   10 date_trunc('year',current_date) as date) )-1

   11 ) x(id)

   12 where to_char(

   13 cast(

   14 date_trunc('year',current_date) 15 as date)+x.id,'dy') = 'fri'
```

1 select dy

2 from (

3 select adddate(x.dy,interval t500.id-1 day) dy 4 from (

5 select dy, year(dy) yr 6 from (

7 select adddate(

8 adddate(current_date, 9 interval -dayofyear(current_date) day), 10 interval 1 day) dy

11 from t1

12) tmp1

13) x,

14 t500

15 where year(adddate(x.dy,interval t500.id-1 day)) = x.yr 16) tmp2

17 where dayname(dy) = 'Friday'

1 with x (dy,yr)

2 as (

3 select dy, year(dy) yr 4 from (

5 select getdate()-datepart(dy,getdate())+1 dy

6 from t1

7) tmp1

```
union all
   select dateadd(dd,1,dy), yr
```

10 from x

11 where year(dateadd(dd,1,dy)) = yr 12)

13 select x.dy

14 from x

15 where datename(dw,x.dy) = 'Friday'

16 option (maxrecursion 400)

<b>

select (current_date dayofyear(current_date) days +1 days) as dy from t1</b>

DY

01-JAN-2005

<b>

with x (dy,yr)

as (

select dy, year(dy) yr from (

select (current_date dayofyear(current_date) days +1 days) as dy from t1

) tmp1

union all

select dy+1 days, yr from x

where year(dy +1 day) = yr)

select dy

from x</b>

```
   DY
   -----------
   01-JAN-2005
   …
   15-FEB-2005
   …
   22-NOV-2005
   …
   31-DEC-2005
<b>select trunc(sysdate,'y') dy
   from t1</b>
   DY
   -----------
   01-JAN-2005
<b>
   with x
   as (
   select trunc(sysdate,'y')+level-1 dy from t1
   connect by level <=
   add_months(trunc(sysdate,'y'),12)-trunc(sysdate,'y') )
```

```
select *

from x</b>


DY

-----------

01-JAN-2005

…

15-FEB-2005

…

22-NOV-2005

…

31-DEC-2005
```

<b>

```
select cast(

cast(

date_trunc('year',current_date) as date) + interval '1 years' as date) -cast(

date_trunc('year',current_date) as date)-1 as cnt from t1</b>

CNT

---

364
```

<b>

```
select cast(date_trunc('year',current_date) as date) + x.id as dy

from generate_series (

0,

( select cast(

cast(

date_trunc('year',current_date) as date) + interval '1 years' as date) -cast(

date_trunc('year',current_date) as date) )-1

) x(id)</b>

DY

-----------

01-JAN-2005

…

15-FEB-2005

…

22-NOV-2005

…

31-DEC-2005
```

<b>

```
select adddate(
   adddate(current_date, interval -dayofyear(current_date) day), interval 1
day ) dy from t1</b>

   DY

   -----------

   01-JAN-2005

<b>

   select adddate(x.dy,interval t500.id-1 day) dy from (

   select dy, year(dy) yr from (

   select adddate(

   adddate(current_date, interval -dayofyear(current_date) day), interval 1
day ) dy from t1

   ) tmp1

   ) x,

   t500

   where year(adddate(x.dy,interval t500.id-1 day)) = x.yr</b>

   DY

   -----------

   01-JAN-2005

   …

   15-FEB-2005

   …
   22-NOV-2005

   …

   31-DEC-2005

<b>

   select getdate()-datepart(dy,getdate( ))+1 dy from t1</b>

   DY

   -----------

   01-JAN-2005

<b>

   with x (dy,yr)

   as (

   select dy, year(dy) yr from (

   select getdate()-datepart(dy,getdate( ))+1 dy from t1

   ) tmp1

   union all

   select dateadd(dd,1,dy), yr from x

   where year(dateadd(dd,1,dy)) = yr )

   select x.dy

   from x

   option (maxrecursion 400)</b>
```

```
DY
-----------
01-JAN-2005
…
15-FEB-2005
…
22-NOV-2005
…
31-DEC-2005
```

Finally, use the DATENAME function to keep only rows that are Fridays. For this solution to work, you must set MAXRECURSION to at least 366 (the filter on the year portion of the current year, in recursive view X, guarantees you will never generate more than 366 rows).

Recipe 9.6. Determining the Date of the First and Last Occurrence of a Specific Weekday in a Month

Problem

You want to find, for example, the first and last Mondays of the current month.

Solution

The choice to use Monday and the current month is arbitrary; you can use the solutions presented in this recipe for any weekday and any month. Because each weekday is seven days apart from itself, once you have the first instance of a weekday, you can add 7 days to get the second and 14 days to get the third. Likewise, if you have the last instance of a weekday in a month, you can subtract 7 days to get the third and subtract 14 days to get the second.

DB2

Use the recursive WITH clause to generate each day in the current month and use a CASE expression to flag all Mondays. The first and last Mondays will be the earliest and latest of the flagged dates:

```
with x (dy,mth,is_monday)
      as (
select dy,month(dy),
       case when dayname(dy)='Monday'
             then 1 else 0
       end
  from (
select (current_date-day(current_date) day +1 day) dy
  from t1
       ) tmp1
 union all
select (dy +1 day), mth,
       case when dayname(dy +1 day)='Monday'
            then 1 else 0
       end
  from x
 where month(dy +1 day) = mth
)
select min(dy) first_monday, max(dy) last_monday
  from x
 where is_monday = 1
```

Oracle

Use the functions NEXT_DAY and LAST_DAY, together with a bit of clever date arithmetic, to find the first and last Mondays of the current month:

```
select next_day(trunc(sysdate,'mm')-1,'MONDAY') first_monday,
               next_day(last_day(trunc(sysdate,'mm'))-7,'MONDAY') last_monday
          from dual
```

PostgreSQL

Use the function DATE_TRUNC to find the first day of the month. Once you have the first day of the month, you can use simple arithmetic involving the numeric values of weekdays (SunSat is 17) to find the first and last Mondays of the current month:

```
select first_monday,
       case to_char(first_monday+28,'mm')
            when mth then first_monday+28
                     else first_monday+21
       end as last_monday
  from (
select case sign(cast(to_char(dy,'d') as integer)-2)
            when 0
            then dy
            when -1
            then dy+abs(cast(to_char(dy,'d') as integer)-2)
            when 1
            then (7-(cast(to_char(dy,'d') as integer)-2))+dy
       end as first_monday,
       mth
  from (
select cast(date_trunc('month',current_date) as date) as dy,
       to_char(current_date,'mm') as mth
  from t1
       ) x
       ) y
```

MySQL

Use the ADDDATE function to find the first day of the month. Once you have the first day of the month, you can use simple arithmetic on the numeric values of weekdays (SunSat is 06) to find the first and last Mondays of the current month:

```
select first_monday,
       case month(adddate(first_monday,28))
            when mth then adddate(first_monday,28)
                     else adddate(first_monday,21)
       end last_monday
 from (
select case sign(dayofweek(dy)-2)
            when 0 then dy
            when -1 then adddate(dy,abs(dayofweek(dy)-2))
            when 1 then adddate(dy,(7-(dayofweek(dy)-2)))
       end first_monday,
       mth
  from (
select adddate(adddate(current_date,-day(current_date)),1) dy,
       month(current_date) mth
  from t1
       ) x
       ) y
```

SQL Server

Use the recursive WITH clause to generate each day in the current month, and then use a CASE expression to flag all Mondays. The first and last Mondays will be the earliest and latest of the flagged dates:

```
with x (dy,mth,is_monday)
    as (
select dy,mth,
       case when datepart(dw,dy) = 2
            then 1 else 0
       end
  from (
select dateadd(day,1,dateadd(day,-day(getdate( )),getdate( ))) dy,
       month(getdate( )) mth
  from t1
       ) tmp1
 union all
select dateadd(day,1,dy),
       mth,
       case when datepart(dw,dateadd(day,1,dy)) = 2
            then 1 else 0
       end
  from x
 where month(dateadd(day,1,dy)) = mth
)
select min(dy) first_monday,
       max(dy) last_monday
  from x
 where is_monday = 1
```

Discussion

DB2 and SQL Server

DB2 and SQL Server use different functions to solve this problem, but the technique is exactly the same. If you eyeball both solutions you'll see the only difference between the two is the way dates are added. This discussion will cover both solutions, using the DB2 solution's code to show the results of intermediate steps.

If you do not have access to the recursive WITH clause in the version of SQL Server or DB2 that you are running, you can use the PostgreSQL technique instead.

The first step in finding the first and last Mondays of the current month is to return the first day of the month. Inline view TMP1 in recursive view X finds the first day of the current month by first finding the current date, specifically, the day of the month for the current date. The day of the month for the current date represents how many days into the month you are (e.g., April 10th is the 10th day of the April). If you subtract this day of the month value from the current date, you end up at the last day of the previous month (e.g., subtracting 10 from April 10th puts you at the last day of March). After this subtraction, simply add one day to arrive at the first day of the current month:

```
select (current_date-day(current_date) day +1 day) dy
  from t1

DY
-----------
01-JUN-2005
```

Next, find the month for the current date using the MONTH function and a simple CASE expression to determine whether or not the first day of the month is a Monday:

```
select dy, month(dy) mth,
        case when dayname(dy)='Monday'
             then 1 else 0
        end is_monday
  from  (
select  (current_date-day(current_date) day +1 day) dy
  from  t1
        ) tmp1

DY          MTH  IS_MONDAY
----------- --- ----------
01-JUN-2005   6          0
```

Then use the recursive capabilities of the WITH clause to repeatedly add one day to the first day of the month until you're no longer in the current month. Along the way, you will use a CASE expression to determine which days in the month are Mondays (Mondays will be flagged with "1"). A portion of the output from recursive view X is shown below:

```
with x (dy,mth,is_monday)
     as (
 select dy,month(dy) mth,
        case when dayname(dy)='Monday'
             then 1 else 0
        end is_monday
   from (
 select (current_date-day(current_date) day +1 day) dy
   from t1
        ) tmp1
  union all
 select (dy +1 day), mth,
        case when dayname(dy +1 day)='Monday'
             then 1 else 0
        end
   from x
  where month(dy +1 day) = mth
 )
 select *
   from x
```

```
DY          MTH  IS_MONDAY
----------- --- ----------
01-JUN-2005   6          0
02-JUN-2005   6          0
03-JUN-2005   6          0
04-JUN-2005   6          0
05-JUN-2005   6          0
06-JUN-2005   6          1
07-JUN-2005   6          0
08-JUN-2005   6          0
…
```

Only Mondays will have a value of 1 for IS_MONDAY, so the final step is to use the aggregate functions MIN and MAX on rows where IS_MONDAY is 1 to find the first and last Mondays of the month.

Oracle

The function NEXT_DAY makes this problem easy to solve. To find the first Monday of the current month, first return the last day of the prior month via some date arithmetic involving the TRUNC function:

```
select trunc(sysdate,'mm')-1 dy
  from dual

DY
-----------
31-MAY-2005
```

Then use the NEXT_DAY function to find the first Monday that comes after the last day of the previous month (i.e., the first Monday of the current month):

```
select next_day(trunc(sysdate,'mm')-1,'MONDAY') first_monday
  from dual

FIRST_MONDAY
------------
06-JUN-2005
```

To find the last Monday of the current month, start by returning the first day of the current month by using the TRUNC function:

```
select trunc(sysdate,'mm') dy
  from dual

DY
-----------
01-JUN-2005
```

The next step is to find the last week (the last seven days) of the month. Use the LAST_DAY function to find the last day of the month, and then subtract seven days:

```
select last_day(trunc(sysdate,'mm'))-7 dy
  from dual

DY
-----------
23-JUN-2005
```

If it isn't immediately obvious, you go back seven days from the last day of the month to ensure that you will have at least one of any weekday left in the month. The last step is to use the function NEXT_DAY to find the next (and last) Monday of the month:

```
select next_day(last_day(trunc(sysdate,'mm'))-7,'MONDAY') last_monday
  from dual

LAST_MONDAY
-----------
27-JUN-2005
```

PostgreSQL and MySQL

PostgreSQL and MySQL also share the same solution approach. The difference is in the functions that you invoke. Despite their lengths, the respective queries are extremely simple; little overhead is involved in finding the first and last Mondays of the current month.

The first step is to find the first day of the current month. The next step is to find the first Monday of the month. Since there is no function to find the next date for a given weekday, you need to use a little arithmetic. The CASE expression beginning on line 7 (of either solution) evaluates the difference between the numeric value for the weekday of the first day of the month and the numeric value corresponding to Monday. Given that the function TO_CHAR (PostgresSQL), when called with the 'D' or 'd' format, and the function DAYOFWEEK (MySQL) will return a numeric value from 1 to 7 representing days Sunday to Saturday; Monday is always represented by 2. The first test evaluated by CASE is the SIGN of the numeric value of the first day of the month (whatever it may be) minus the numeric value of Monday (2). If the result is 0, then the first day of the month falls on a Monday and that is the first Monday of the month. If the result is1, then the first day of the month falls on a Sunday and to find the first Monday of the month simply add the difference in days between 2 and 1 (numeric values of Monday and Sunday, respectively) to the first day of the month.

If you are having trouble understanding how this works, forget the weekday names and just do the math. For example, say you happen to be starting on a Tuesday and you are looking for the next Friday. When using TO_CHAR with the 'd' format, or DAYOFWEEK, Friday is 6 and Tuesday is 3. To get to 6 from 3, simply take the difference (63 = 3) and add it to the smaller value ((63) + 3 = 6). So, regardless of the actual dates, if the numeric value of the day you are starting from is less than the numeric value of the day you are searching for, adding the difference between the two dates to the date you are starting from will get you to the date you are searching for.

If the result from SIGN is 1, then the first day of the month falls between Tuesday and Saturday (inclusive). When the first day of the month has a numeric value greater than 2 (Monday), subtract from 7 the difference between the numeric value of the first day of the month and the numeric value of Monday (2), and then add that value to the first day of the month. You will have arrived at the day of the week that you are after, in this case Monday.

Again, if you are having trouble understanding how this works, forget the weekday names and just do the math. For example, suppose you want to find the next Tuesday and you are starting from Friday. Tuesday (3) is less than Friday (6). To get to 3 from 6 subtract the difference between the two values from 7 (7(|36|) = 4) and add the result (4) to the start day Friday. (The vertical bars in |3-6| generate the absolute value of that difference.) Here, you're not adding 4 to 6 (which will give you 10), you are adding four days to Friday, which will give you the next Tuesday.

The idea behind the CASE expression is to create a sort of a "next day" function for PostgreSQL and MySQL. If you do not start with the first day of the month, the value for DY will be the value returned by CURRENT_DATE and the result of the CASE expression will return the date of the next Monday starting from the current date (unless CURRENT_DATE is a Monday, then that date will be returned).

Now that you have the first Monday of the month, add either 21 or 28 days to find the last Monday of the month. The CASE expression in lines 25 determines whether to add 21 or 28 days by checking to see whether 28 days takes you into the next month. The CASE expression does this through the following process:

1. It adds 28 to the value of FIRST_MONDAY.
2. Using either TO_CHAR (PostgreSQL) or MONTH, the CASE expression extracts the name of the current month from result of FIRST_MONDAY + 28.
3. The result from Step 2 is compared to the value MTH from the inline view. The value MTH is the name of the current month as derived from CURRENT_ DATE. If the two month values match, then the month is large enough for you to need to add 28 days, and the CASE expression returns FIRST_MONDAY + 28. If the two month values do not match, then you do not have room to add 28 days, and the CASE expression returns FIRST_MONDAY + 21 days instead. It is convenient that our months are such that 28 and 21 are the only two possible values you need worry about adding.

You can extend the solution by adding 7 and 14 days to find the second and third Mondays of the month, respectively.

```
with x(dy,dm,mth,dw,wk)

   as (

   select (current_date -day(current_date) day +1 day) dy,
day((current_date -day(current_date) day +1 day)) dm,
month(current_date) mth, dayofweek(current_date -day(current_date) day
+1 day) dw, week_iso(current_date -day(current_date) day +1 day) wk
from t1
```

9 union all

10 select dy+1 day, day(dy+1 day), mth, 11 dayofweek(dy+1 day), week_iso(dy+1 day)

12 from x

13 where month(dy+1 day) = mth 14)

15 select max(case dw when 2 then dm end) as Mo, 16 max(case dw when 3 then dm end) as Tu, 17 max(case dw when 4 then dm end) as We, 18 max(case dw when 5 then dm end) as Th, 19 max(case dw when 6 then dm end) as Fr, 20 max(case dw when 7 then dm end) as Sa, 21 max(case dw when 1 then dm end) as Su 22 from x

23 group by wk

24 order by wk

1 with x

2 as (

3 select *

4 from (

5 select to_char(trunc(sysdate,'mm')+level-1,'iw') wk, 6 to_char(trunc(sysdate,'mm')+level-1,'dd') dm, 7 to_number(to_char(trunc(sysdate,'mm')+level-1,'d')) dw, 8 to_char(trunc(sysdate,'mm')+level-1,'mm') curr_mth, 9 to_char(sysdate,'mm') mth

10 from dual

11 connect by level <= 31

12)

13 where curr_mth = mth 14)

15 select max(case dw when 2 then dm end) Mo, 16 max(case dw when 3 then dm end) Tu, 17 max(case dw when 4 then dm end) We, 18 max(case dw when 5 then dm end) Th, 19 max(case dw when 6 then dm end) Fr, 20 max(case dw when 7 then dm end) Sa, 21 max(case dw when 1 then dm end) Su 22 from x

23 group by wk

24 order by wk

1 select max(case dw when 2 then dm end) as Mo, 2 max(case dw when 3 then dm end) as Tu, 3 max(case dw when 4 then dm end) as We, 4 max(case dw when 5 then dm end) as Th, 5 max(case dw when 6 then dm end) as Fr, 6 max(case dw when 7 then dm end) as Sa, 7 max(case dw when 1 then dm end) as Su 8 from (

9 select *

10 from (

11 select cast(date_trunc('month',current_date) as date)+x.id, 12 to_char(

13 cast(

14 date_trunc('month',current_date) 15 as date)+x.id,'iw') as wk, 16 to_char(

17 cast(

18 date_trunc('month',current_date) 19 as date)+x.id,'dd') as dm, 20 cast(

21 to_char(

22 cast(

23 date_trunc('month',current_date) 24 as date)+x.id,'d') as integer) as dw, 25 to_char(

26 cast(

27 date_trunc('month',current_date) 28 as date)+x.id,'mm') as curr_mth, 29 to_char(current_date,'mm') as mth 30 from generate_series (0,31) x(id) 31) x

32 where mth = curr_mth 33) y

34 group by wk

35 order by wk

1 select max(case dw when 2 then dm end) as Mo, 2 max(case dw when 3 then dm end) as Tu, 3 max(case dw when 4 then dm end) as We, 4 max(case dw when 5 then dm end) as Th, 5 max(case dw when 6 then dm end) as Fr, 6 max(case dw when 7 then dm end) as Sa, 7 max(case dw when 1 then dm end) as Su 8 from (

9 select date_format(dy,'%u') wk, 10 date_format(dy,'%d') dm, 11 date_format(dy,'%w')+1 dw 12 from (

13 select adddate(x.dy,t500.id-1) dy, 14 x.mth

15 from (

16 select adddate(current_date,-dayofmonth(current_date)+1) dy, 17 date_format(

18 adddate(current_date, 19 -dayofmonth(current_date)+1), 20 '%m') mth

21 from t1

22) x,

```
t500
where t500.id <= 31
and date_format(adddate(x.dy,t500.id-1),'%m') = x.mth
) y
) z
group by wk
```

29 order by wk

```
1 with x(dy,dm,mth,dw,wk)
   2 as (
   3 select dy,
   4 day(dy) dm,
   5 datepart(m,dy) mth,
   6 datepart(dw,dy) dw,
   7 case when datepart(dw,dy) = 1
   8 then datepart(ww,dy)-1
   9 else datepart(ww,dy)
```

10 end wk

11 from (

12 select dateadd(day,-day(getdate())+1,getdate( )) dy

13 from t1

14) x

15 union all

16 select dateadd(d,1,dy), day(dateadd(d,1,dy)), mth, 17 datepart(dw,dateadd(d,1,dy)), 18 case when datepart(dw,dateadd(d,1,dy)) = 1

19 then datepart(wk,dateadd(d,1,dy))-1

20 else datepart(wk,dateadd(d,1,dy)) 21 end

22 from x

23 where datepart(m,dateadd(d,1,dy)) = mth 24)

25 select max(case dw when 2 then dm end) as Mo, 26 max(case dw when 3 then dm end) as Tu, 27 max(case dw when 4 then dm end) as We, 28 max(case dw when 5 then dm end) as Th, 29 max(case dw when 6 then dm end) as Fr, 30 max(case dw when 7 then dm end) as Sa, 31 max(case dw when 1 then dm end) as Su 32 from x

33 group by wk

34 order by wk

<b>

```
   select (current_date -day(current_date) day +1 day) dy, day((current_date
-day(current_date) day +1 day)) dm, month(current_date) mth,
dayofweek(current_date -day(current_date) day +1 day) dw,
week_iso(current_date -day(current_date) day +1 day) wk from t1</b>
```

```
   DY DM MTH DW WK

   ----------- -- --- ---------- --

   01-JUN-2005 01 06 4 22
```

<b>

```
   with x(dy,dm,mth,dw,wk) as (

   select (current_date -day(current_date) day +1 day) dy, day((current_date
-day(current_date) day +1 day)) dm, month(current_date) mth,
dayofweek(current_date -day(current_date) day +1 day) dw,
week_iso(current_date -day(current_date) day +1 day) wk from t1

   union all

   select dy+1 day, day(dy+1 day), mth, dayofweek(dy+1 day),
week_iso(dy+1 day) from x

   where month(dy+1 day) = mth )

   select *

   from x</b>
```

```
DY DM MTH DW WK

----------- -- --- ---------- --

01-JUN-2005 01 06 4 22

02-JUN-2005 02 06 5 22

…

21-JUN-2005 21 06 3 25

22-JUN-2005 22 06 4 25

…

30-JUN-2005 30 06 5 26
```

<b>

```
with x(dy,dm,mth,dw,wk) as (

select (current_date -day(current_date) day +1 day) dy, day((current_date -day(current_date) day +1 day)) dm, month(current_date) mth, dayofweek(current_date -day(current_date) day +1 day) dw, week_iso(current_date -day(current_date) day +1 day) wk from t1

union all

select dy+1 day, day(dy+1 day), mth, dayofweek(dy+1 day), week_iso(dy+1 day) from x

where month(dy+1 day) = mth )

select wk,
```

case dw when 2 then dm end as Mo, case dw when 3 then dm end as Tu, case dw when 4 then dm end as We, case dw when 5 then dm end as Th, case dw when 6 then dm end as Fr, case dw when 7 then dm end as Sa, case dw when 1 then dm end as Su from x</b>

```
WK MO TU WE TH FR SA SU

-- -- -- -- -- -- -- --

22 01

22 02

22 03

22 04

22 05

23 06

23 07

23 08

23 09

23 10

23 11
```

23 12

<b>

with x(dy,dm,mth,dw,wk) as (

select (current_date -day(current_date) day +1 day) dy, day((current_date -day(current_date) day +1 day)) dm, month(current_date) mth, dayofweek(current_date -day(current_date) day +1 day) dw, week_iso(current_date -day(current_date) day +1 day) wk from t1

union all

select dy+1 day, day(dy+1 day), mth, dayofweek(dy+1 day), week_iso(dy+1 day) from x

where month(dy+1 day) = mth)

select max(case dw when 2 then dm end) as Mo, max(case dw when 3 then dm end) as Tu, max(case dw when 4 then dm end) as We, max(case dw when 5 then dm end) as Th, max(case dw when 6 then dm end) as Fr, max(case dw when 7 then dm end) as Sa, max(case dw when 1 then dm end) as Su from x

group by wk

order by wk</b>

```
MO TU WE TH FR SA SU

-- -- -- -- -- -- --
```

01 02 03 04 05

06 07 08 09 10 11 12

13 14 15 16 17 18 19

20 21 22 23 24 25 26

27 28 29 30

<b>

```
   select trunc(sysdate,'mm') dy, to_char(trunc(sysdate,'mm'),'dd') dm,
to_char(sysdate,'mm') mth, to_number(to_char(trunc(sysdate,'mm'),'d')) dw,
to_char(trunc(sysdate,'mm'),'iw') wk from dual</b>
```

```
   DY DM MT DW WK

   ----------- -- -- ---------- --

   01-JUN-2005 01 06 4 22
```

<b>

```
   with x

   as (

   select *

   from (

   select trunc(sysdate,'mm')+level-1 dy, to_char(trunc(sysdate,'mm')+level-
1,'iw') wk, to_char(trunc(sysdate,'mm')+level-1,'dd') dm,
to_number(to_char(trunc(sysdate,'mm')+level-1,'d')) dw,
to_char(trunc(sysdate,'mm')+level-1,'mm') curr_mth, to_char(sysdate,'mm')
mth from dual

   connect by level <= 31

   )

   where curr_mth = mth
   )

   select *

   from x</b>



   DY WK DM DW CU MT

   ----------- -- -- ---------- -- --

   01-JUN-2005 22 01 4 06 06

   02-JUN-2005 22 02 5 06 06

   …

   21-JUN-2005 25 21 3 06 06

   22-JUN-2005 25 22 4 06 06

   …

   30-JUN-2005 26 30 5 06 06

<b>

   with x

   as (

   select *

   from (

   select trunc(sysdate,'mm')+level-1 dy, to_char(trunc(sysdate,'mm')+level-
1,'iw') wk, to_char(trunc(sysdate,'mm')+level-1,'dd') dm,
to_number(to_char(trunc(sysdate,'mm')+level-1,'d')) dw,
to_char(trunc(sysdate,'mm')+level-1,'mm') curr_mth, to_char(sysdate,'mm') mth from dual

   connect by level <= 31

   )

   where curr_mth = mth

   )

   select wk,

   case dw when 2 then dm end as Mo, case dw when 3 then dm end as Tu, case dw when 4 then dm end as We, case dw when 5 then dm end as Th, case dw when 6 then dm end as Fr, case dw when 7 then dm end as Sa, case dw when 1 then dm end as Su from x</b>


   WK MO TU WE TH FR SA SU

   -- -- -- -- -- -- -- --

   22 01

   22 02

   22 03

   22 04

   22 05

   23 06

   23 07

   23 08
```

23 09

23 10

23 11

23 12

```
<b>

   with x

   as (

   select *

   from (

   select to_char(trunc(sysdate,'mm')+level-1,'iw') wk,
to_char(trunc(sysdate,'mm')+level-1,'dd') dm,
to_number(to_char(trunc(sysdate,'mm')+level-1,'d')) dw,
to_char(trunc(sysdate,'mm')+level-1,'mm') curr_mth, to_char(sysdate,'mm')
mth from dual

   connect by level <= 31

   )

   where curr_mth = mth

   )

   select max(case dw when 2 then dm end) Mo, max(case dw when 3 then
dm end) Tu, max(case dw when 4 then dm end) We, max(case dw when 5
then dm end) Th, max(case dw when 6 then dm end) Fr, max(case dw when
7 then dm end) Sa, max(case dw when 1 then dm end) Su from x

   group by wk

   order by wk</b>
```

MO TU WE TH FR SA SU

-- -- -- -- -- -- --

01 02 03 04 05

06 07 08 09 10 11 12

13 14 15 16 17 18 19

20 21 22 23 24 25 26

27 28 29 30

<b>

```
   select cast(date_trunc('month',current_date) as date)+x.id as dy, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'iw') as wk, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'dd') as dm, cast(

   to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'d') as integer) as dw,
to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'mm') as curr_mth,
to_char(current_date,'mm') as mth from generate_series (0,31) x(id)</b>

   DY WK DM DW CU MT

   ----------- -- -- ---------- -- --

   01-JUN-2005 22 01 4 06 06

   02-JUN-2005 22 02 5 06 06

   …

   21-JUN-2005 25 21 3 06 06
   22-JUN-2005 25 22 4 06 06

   …

   30-JUN-2005 26 30 5 06 06
```

<b>

```
   select case dw when 2 then dm end as Mo, case dw when 3 then dm end
as Tu, case dw when 4 then dm end as We, case dw when 5 then dm end as
Th, case dw when 6 then dm end as Fr, case dw when 7 then dm end as Sa,
case dw when 1 then dm end as Su from (

   select *

   from (

   select cast(date_trunc('month',current_date) as date)+x.id, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'iw') as wk, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'dd') as dm, cast(

   to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'d') as integer) as dw,
to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'mm') as curr_mth,
to_char(current_date,'mm') as mth from generate_series (0,31) x(id) ) x
   where mth = curr_mth

   ) y</b>


   WK MO TU WE TH FR SA SU

   -- -- -- -- -- -- -- --

   22 01

   22 02

   22 03

   22 04

   22 05

   23 06

   23 07

   23 08

   23 09

   23 10

   23 11
```

23 12

<b>

```
   select max(case dw when 2 then dm end) as Mo, max(case dw when 3 then dm end) as Tu, max(case dw when 4 then dm end) as We, max(case dw when 5 then dm end) as Th, max(case dw when 6 then dm end) as Fr, max(case dw when 7 then dm end) as Sa, max(case dw when 1 then dm end) as Su from (

   select *

   from (

   select cast(date_trunc('month',current_date) as date)+x.id, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'iw') as wk, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'dd') as dm, cast(

   to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'d') as integer) as dw, to_char(

   cast(

   date_trunc('month',current_date) as date)+x.id,'mm') as curr_mth, to_char(current_date,'mm') as mth from generate_series (0,31) x(id) ) x

   where mth = curr_mth
```

```
) y
group by wk
order by wk</b>

MO TU WE TH FR SA SU
-- -- -- -- -- -- --
```

01 02 03 04 05

06 07 08 09 10 11 12

13 14 15 16 17 18 19

20 21 22 23 24 25 26

27 28 29 30

```
<b>

   select adddate(current_date,-dayofmonth(current_date)+1) dy,
date_format(

   adddate(current_date,

   -dayofmonth(current_date)+1), '%m') mth

   from t1</b>



   DY MT

   ----------- --

   01-JUN-2005 06

<b>

   select date_format(dy,'%u') wk, date_format(dy,'%d') dm,
date_format(dy,'%w')+1 dw from (

   select adddate(x.dy,t500.id-1) dy, x.mth

   from (

   select adddate(current_date,-dayofmonth(current_date)+1) dy,
date_format(

   adddate(current_date,

   -dayofmonth(current_date)+1), '%m') mth

   from t1
   ) x,

   t500

   where t500.id <= 31

   and date_format(adddate(x.dy,t500.id-1),'%m') = x.mth ) y</b>


   WK DM DW

   -- -- ----------

   22 01 4
```

22 02 5

…

25 21 3

25 22 4

…

26 30 5

<b>

```
   select case dw when 2 then dm end as Mo, case dw when 3 then dm end
as Tu, case dw when 4 then dm end as We, case dw when 5 then dm end as
Th, case dw when 6 then dm end as Fr, case dw when 7 then dm end as Sa,
case dw when 1 then dm end as Su from (

   select date_format(dy,'%u') wk, date_format(dy,'%d') dm,
date_format(dy,'%w')+1 dw from (

   select adddate(x.dy,t500.id-1) dy, x.mth

   from (

   select adddate(current_date,-dayofmonth(current_date)+1) dy,
date_format(

   adddate(current_date,

   -dayofmonth(current_date)+1), '%m') mth

   from t1

   ) x,

   t500

   where t500.id <= 31

   and date_format(adddate(x.dy,t500.id-1),'%m') = x.mth ) y

   ) z</b>
```

```
   WK MO TU WE TH FR SA SU
```

-- -- -- -- -- -- -- --

22 01

22 02

22 03

22 04

22 05

23 06

23 07

23 08

23 09

23 10

23 11

23 12

<b>

```
   select max(case dw when 2 then dm end) as Mo, max(case dw when 3
then dm end) as Tu, max(case dw when 4 then dm end) as We, max(case dw
when 5 then dm end) as Th, max(case dw when 6 then dm end) as Fr,
max(case dw when 7 then dm end) as Sa, max(case dw when 1 then dm
end) as Su from (

   select date_format(dy,'%u') wk, date_format(dy,'%d') dm,
date_format(dy,'%w')+1 dw from (

   select adddate(x.dy,t500.id-1) dy, x.mth

   from (

   select adddate(current_date,-dayofmonth(current_date)+1) dy,
date_format(

   adddate(current_date,

   -dayofmonth(current_date)+1), '%m') mth

   from t1

   ) x,

   t500

   where t500.id <= 31

   and date_format(adddate(x.dy,t500.id-1),'%m') = x.mth ) y

   ) z

   group by wk
```

```
order by wk</b>

MO TU WE TH FR SA SU
-- -- -- -- -- -- --
```

01 02 03 04 05

06 07 08 09 10 11 12

13 14 15 16 17 18 19

20 21 22 23 24 25 26

27 28 29 30

<b>

```
select dy,
day(dy) dm,
datepart(m,dy) mth,
datepart(dw,dy) dw,
case when datepart(dw,dy) = 1
then datepart(ww,dy)-1
else datepart(ww,dy)
end wk
from (
select dateadd(day,-day(getdate())+1,getdate()) dy from t1
) x</b>
```

```
DY DM MTH DW WK
----------- -- --- ---------- --
01-JUN-2005 1 6 4 23
```

<b>

```
with x(dy,dm,mth,dw,wk) as (
   select dy,

   day(dy) dm,

   datepart(m,dy) mth,

   datepart(dw,dy) dw,

   case when datepart(dw,dy) = 1

   then datepart(ww,dy)-1

   else datepart(ww,dy)

   end wk

   from (

   select dateadd(day,-day(getdate( ))+1,getdate( )) dy from t1

   ) x

   union all

   select dateadd(d,1,dy), day(dateadd(d,1,dy)), mth,
datepart(dw,dateadd(d,1,dy)), case when datepart(dw,dateadd(d,1,dy)) = 1

   then datepart(wk,dateadd(d,1,dy))-1

   else datepart(wk,dateadd(d,1,dy)) end

   from x

   where datepart(m,dateadd(d,1,dy)) = mth )

   select *

   from x</b>
```

```
DY DM MTH DW WK

----------- -- --- ---------- --

01-JUN-2005 01 06 4 23

02-JUN-2005 02 06 5 23

…

21-JUN-2005 21 06 3 26

22-JUN-2005 22 06 4 26

…

30-JUN-2005 30 06 5 27
```

<b>

```
with x(dy,dm,mth,dw,wk) as (

select dy,

day(dy) dm,

datepart(m,dy) mth,

datepart(dw,dy) dw,

case when datepart(dw,dy) = 1

then datepart(ww,dy)-1

else datepart(ww,dy)

end wk

from (
select dateadd(day,-day(getdate( ))+1,getdate( )) dy from t1

) x

union all

select dateadd(d,1,dy), day(dateadd(d,1,dy)), mth,
datepart(dw,dateadd(d,1,dy)), case when datepart(dw,dateadd(d,1,dy)) = 1

then datepart(wk,dateadd(d,1,dy))-1

else datepart(wk,dateadd(d,1,dy)) end

from x

where datepart(m,dateadd(d,1,dy)) = mth )

select case dw when 2 then dm end as Mo, case dw when 3 then dm end
as Tu, case dw when 4 then dm end as We, case dw when 5 then dm end as
Th, case dw when 6 then dm end as Fr, case dw when 7 then dm end as Sa,
case dw when 1 then dm end as Su from x</b>
```

```
WK MO TU WE TH FR SA SU

-- -- -- -- -- -- -- --

22 01

22 02

22 03

22 04

22 05

23 06
```

23 07

23 08

23 09

23 10

23 11

23 12

<b>

```
   with x(dy,dm,mth,dw,wk) as (

   select dy,

   day(dy) dm,

   datepart(m,dy) mth,

   datepart(dw,dy) dw,

   case when datepart(dw,dy) = 1

   then datepart(ww,dy)-1

   else datepart(ww,dy)

   end wk

   from (

   select dateadd(day,-day(getdate( ))+1,getdate( )) dy from t1

   ) x

   union all

   select dateadd(d,1,dy), day(dateadd(d,1,dy)), mth, datepart(dw,dateadd(d,1,dy)), case when datepart(dw,dateadd(d,1,dy)) = 1

   then datepart(wk,dateadd(d,1,dy))-1

   else datepart(wk,dateadd(d,1,dy)) end

   from x
```

where datepart(m,dateadd(d,1,dy)) = mth)

select max(case dw when 2 then dm end) as Mo, max(case dw when 3 then dm end) as Tu, max(case dw when 4 then dm end) as We, max(case dw when 5 then dm end) as Th, max(case dw when 6 then dm end) as Fr, max(case dw when 7 then dm end) as Sa, max(case dw when 1 then dm end) as Su from x

group by wk

order by wk</b>

MO TU WE TH FR SA SU

-- -- -- -- -- -- --

01 02 03 04 05

06 07 08 09 10 11 12

13 14 15 16 17 18 19

20 21 22 23 24 25 26

27 28 29 30

```
QTR Q_START Q_END

    --- ----------- -----------

    1 01-JAN-2005 31-MAR-2005

    2 01-APR-2005 30-JUN-2005

    3 01-JUL-2005 30-SEP-2005
```

4 01-OCT-2005 31-DEC-2005

```
1 select quarter(dy-1 day) QTR,
  2 dy-3 month Q_start,
```

3 dy-1 day Q_end

4 from (

5 select (current_date -

6 (dayofyear(current_date)-1) day 7 + (rn*3) month) dy 8 from (

9 select row_number( )over( ) rn 10 from emp

11 fetch first 4 rows only

12) x

13) y

1 select rownum qtr,

2 add_months(trunc(sysdate,'y'),(rownum-1)*3) q_start, 3 add_months(trunc(sysdate,'y'),rownum*3)-1 q_end

4 from emp

5 where rownum <= 4

1 select to_char(dy,'Q') as QTR,

2 date(

3 date_trunc('month',dy)-(2*interval '1 month') 4) as Q_start,

5 dy as Q_end

6 from (

7 select date(dy+((rn*3) * interval '1 month'))-1 as dy 8 from (

9 select rn, date(date_trunc('year',current_date)) as dy 10 from generate_series(1,4) gs(rn) 11) x

12) y

1 select quarter(adddate(dy,-1)) QTR,

2 <a name="idx-CHP-9-0506"></a>date_add(dy,interval -3 month) Q_start, 3 adddate(dy,-1) Q_end 4 from (

5 select date_add(dy,interval (3*id) month) dy 6 from (

7 select id,

8 adddate(current_date,-dayofyear(current_date)+1) dy

```
from t500
where id <= 4
) x
) y
```

```
with x (dy,cnt)
as (
select dateadd(d,-(datepart(dy,getdate( ))-1),getdate( )),
1
from t1
```

6 union all

7 select dateadd(m,3,dy), cnt+1

8 from x

9 where cnt+1 <= 4

10)

11 select datepart(q,dateadd(d,-1,dy)) QTR, 1 dateadd(m,-3,dy) Q_start, 13 dateadd(d,-1,dy) Q_end 14 from x

15 order by 1

<b>

```
   select row_number()over() rn from emp

   fetch first 4 rows only</b>

   RN

   --

   1

   2

   3

   4
```

<b>

```
   select (current_date (dayofyear(current_date)-1) day + (rn*3) month) dy
from (

   select row_number()over() rn from emp

   fetch first 4 rows only ) x</b>



   DY

   -----------

   01-APR-2005

   01-JUL-2005
   01-OCT-2005

   01-JAN-2005
```

<b>

```
   select date(dy+((rn*3) * interval '1 month'))-1 as dy from (

   select rn, date(date_trunc('year',current_date)) as dy from
generate_series(1,4) gs(rn) ) x</b>
```

```
   DY

   -----------

   31-MAR-2005

   30-JUN-2005

   30-SEP-2005

   31-DEC-2005
```

<b>

```
   select date_add(dy,interval (3*id) month) dy from (

   select id,

   adddate(current_date,-dayofyear(current_date)+1) dy from t500

   where id <= 4

   ) x</b>
```

```
DY

   -----------
```

```
    01-APR-2005

    01-JUL-2005

    01-OCT-2005

    01-JAN-2005

<b>

    with x (dy,cnt) as (

    select dateadd(d,-(datepart(dy,getdate())-1),getdate()), 1

    from t1

    union all

    select dateadd(m,3,dy), cnt+1

    from x

    where cnt+1 <= 4

    )

    select dy

    from x</b>

    DY

    -----------

    01-APR-2005

    01-JUL-2005

    01-OCT-2005
```

```
 01-JAN-2005
```

The values for DY are one day after the end of each quarter. To get the end of each quarter, simply subtract one day from DY by using the DATEADD function. To find the start of each quarter, use the DATEADD function to subtract three months from DY. Use the DATEPART function on the end date for each quarter to determine which quarter the start and end dates belong to.

<b>

select 20051 as yrq from t1 union all select 20052 as yrq from t1 union all select 20053 as yrq from t1 union all select 20054 as yrq from t1</b>
YRQ

20051

20052

20053

20054

1 select (q_end-2 month) q_start,

2 (q_end+1 month)-1 day q_end 3 from (

4 select date(substr(cast(yrq as char(4)),1,4) ||'-'||

5 rtrim(cast(mod(yrq,10)*3 as char(2))) ||'-1') q_end 6 from (

7 select 20051 yrq from t1 union all 8 select 20052 yrq from t1 union all
9 select 20053 yrq from t1 union all

10 select 20054 yrq from t1

11) x

12) y

1 select add_months(q_end,-2) q_start,

2 last_day(q_end) q_end 3 from (

4 select to_date(substr(yrq,1,4)||mod(yrq,10)*3,'yyyymm') q_end 5 from (

6 select 20051 yrq from dual union all 7 select 20052 yrq from dual union all 8 select 20053 yrq from dual union all

9 select 20054 yrq from dual

10) x

11) y

1 select date(q_end-(2*interval '1 month')) as q_start, 2 date(q_end+interval '1 month'-interval '1 day') as q_end 3 from (

4 select to_date(substr(yrq,1,4)||mod(yrq,10)*3,'yyyymm') as q_end 5 from (

6 select 20051 as yrq from t1 union all 7 select 20052 as yrq from t1 union all 8 select 20053 as yrq from t1 union all 9 select 20054 as yrq from t1

10) x

11) y

1 select date_add(

2 adddate(q_end,-day(q_end)+1), 3 interval -2 month) q_start,

4 q_end

```
from (
select last_day(
str_to_date(
concat(
substr(yrq,1,4),mod(yrq,10)*3),'<a name="idx-CHP-9-0519"></a>%Y%m')) q_end
from (
select 20051 as yrq from t1 union all
select 20052 as yrq from t1 union all
select 20053 as yrq from t1 union all
select 20054 as yrq from t1
) x
) y
```

```
select dateadd(m,-2,q_end) q_start,
dateadd(d,-1,dateadd(m,1,q_end)) q_end
from (
select cast(substring(cast(yrq as varchar),1,4)+'-'+
cast(yrq%10*3 as varchar)+'-1' as datetime) q_end
from (
select 20051 as yrq from t1 union all
select 20052 as yrq from t1 union all
select 20052 as yrq from t1 union all
select 20054 as yrq from t1
) x
) y
```

<b>

```
select substr(cast(yrq as char(4)),1,4) yr, mod(yrq,10)*3 mth from (

select 20051 yrq from t1 union all select 20052 yrq from t1 union all
select 20053 yrq from t1 union all select 20054 yrq from t1

) x</b>

YR MTH

---- ------

2005 3

2005 6

2005 9
```

2005 12

<b>

    select date(substr(cast(yrq as char(4)),1,4) ||'-'||

    rtrim(cast(mod(yrq,10)*3 as char(2))) ||'-1') q_end from (

    select 20051 yrq from t1 union all select 20052 yrq from t1 union all select 20053 yrq from t1 union all select 20054 yrq from t1

) x</b>

```
Q_END

-----------

01-MAR-2005

01-JUN-2005

01-SEP-2005

01-DEC-2005
```

<b>

    select substr(yrq,1,4) yr, mod(yrq,10)*3 mth from (

    select 20051 yrq from dual union all select 20052 yrq from dual union all select 20053 yrq from dual union all select 20054 yrq from dual) x</b>

```
YR MTH

---- ------
```

2005 3

2005 6

2005 9

2005 12

<b>

```
   select to_date(substr(yrq,1,4)||mod(yrq,10)*3,'yyyymm') q_end from (

   select 20051 yrq from dual union all select 20052 yrq from dual union all
select 20053 yrq from dual union all select 20054 yrq from dual ) x</b>

   Q_END

   -----------

   01-MAR-2005

   01-JUN-2005

   01-SEP-2005

   01-DEC-2005
```

<b>

```
   select substr(yrq,1,4) yr, mod(yrq,10)*3 mth from (

   select 20051 yrq from dual union all select 20052 yrq from dual union all
select 20053 yrq from dual union all select 20054 yrq from dual ) x</b>

   YR MTH

   ---- -------

   2005 3

   2005 6

   2005 9
```

2005 12

```
<b>

   select <a name="idx-CHP-9-0527">
</a>to_date(substr(yrq,1,4)||mod(yrq,10)*3,'yyyymm') q_end from (

   select 20051 yrq from dual union all select 20052 yrq from dual union all
select 20053 yrq from dual union all select 20054 yrq from dual ) x</b>



   Q_END

   -----------

   01-MAR-2005

   01-JUN-2005

   01-SEP-2005

   01-DEC-2005

<b>

   select substr(yrq,1,4) yr, mod(yrq,10)*3 mth from (

   select 20051 yrq from dual union all select 20052 yrq from dual union all
select 20053 yrq from dual union all select 20054 yrq from dual ) x</b>



   YR MTH

   ---- ------

   2005 3
```

2005 6

2005 9

2005 12

```
<b>

    select last_day(

    str_to_date(

    concat(

    substr(yrq,1,4),mod(yrq,10)*3),'<a name="idx-CHP-9-0533">
</a>%Y%m')) q_end from (

    select 20051 as yrq from t1 union all select 20052 as yrq from t1 union
all select 20053 as yrq from t1 union all select 20054 as yrq from t1

    ) x</b>



    Q_END

    -----------

    31-MAR-2005

    30-JUN-2005

    30-SEP-2005

    31-DEC-2005

<b>

    select substring(yrq,1,4) yr, yrq%10*3 mth from (

    select 20051 yrq from dual union all select 20052 yrq from dual union all
select 20053 yrq from dual union all select 20054 yrq from dual ) x</b>
```

```
YR MTH
---- ------
2005 3
2005 6
2005 9
```

2005 12

```
<b>

   select cast(substring(cast(yrq as varchar),1,4)+'-'+

   cast(yrq%10*3 as varchar)+'-1' as datetime) q_end from (

   select 20051 yrq from t1 union all select 20052 yrq from t1 union all
select 20053 yrq from t1 union all select 20054 yrq from t1

   ) x</b>



   Q_END

   -----------

   01-MAR-2005

   01-JUN-2005

   01-SEP-2005

   01-DEC-2005
```

The values for Q_END are the first day of the last month of each quarter. To get to the last day of the month add one month to Q_END and subtract one day using the DATEADD function. To find the start date for each quarter subtract two months from Q_END using the DATEADD function.

```
<b>
    select distinct
    extract(year from hiredate) as year from emp</b>

    YEAR
    -----
    1980
    1981
    1982
    1983
MTH NUM_HIRED
    ----------- ----------
    01-JAN-1981 0
    01-FEB-1981 2
    01-MAR-1981 0
    01-APR-1981 1
    01-MAY-1981 1
    01-JUN-1981 1
    01-JUL-1981 0
    01-AUG-1981 0
```

```
01-SEP-1981 2

01-OCT-1981 0

01-NOV-1981 1

01-DEC-1981 2
```

```
1 with x (start_date,end_date)

2 as (

3 select (min(hiredate) 4 dayofyear(min(hiredate)) day +1 day) start_date,
5 (max(hiredate)

6 dayofyear(max(hiredate)) day +1 day) +1 year end_date 7 from emp
```

8 union all

9 select start_date +1 month, end_date

10 from x

11 where (start_date +1 month) < end_date 12)

13 select x.start_date mth, count(e.hiredate) num_hired 14 from x left join emp e 15 on (x.start_date = (e.hiredate-(day(hiredate)-1) day)) 16 group by x.start_date

17 order by 1

1 with x

2 as (

3 select add_months(start_date,level-1) start_date 4 from (

5 select min(trunc(hiredate,'y')) start_date, 6 add_months(max(trunc(hiredate,'y')),12) end_date

7 from emp

8)

9 connect by level <= months_between(end_date,start_date) 10)

11 select x.start_date MTH, count(e.hiredate) num_hired 12 from x, emp e

13 where x.start_date = trunc(e.hiredate(+),'mm') 14 group by x.start_date

15 order by 1

1 with x

2 as (

3 select add_months(start_date,level-1) start_date 4 from (

5 select min(trunc(hiredate,'y')) start_date, 6 add_months(max(trunc(hiredate,'y')),12) end_date

7 from emp

8)

9 connect by level <= months_between(end_date,start_date) 10)

11 select x.start_date MTH, count(e.hiredate) num_hired 12 from x left join emp e 13 on (x.start_date = trunc(e.hiredate,'mm')) 14 group by x.start_date

15 order by 1

```
create view v

   as

   select cast(

   extract(year from age(last_month,first_month))*12-1

   as integer) as mths from (

   select cast(date_trunc('year',min(hiredate)) as date) as first_month,
cast(cast(date_trunc('year',max(hiredate)) as date) + interval '1 year'

   as date) as last_month from emp

   ) x



   1 select y.mth, count(e.hiredate) as num_hired 2 from (

   3 select cast(e.start_date + (x.id * interval '1 month') 4 as date) as mth

   5 from generate_series (0,(select mths from v)) x(id), 6 ( select cast(

   7 date_trunc('year',min(hiredate)) 8 as date) as start_date 9 from emp ) e

   10 ) y left join emp e 11 on (y.mth = date_trunc('month',e.hiredate)) 12
group by y.mth
```

13 order by 1

1 select z.mth, count(e.hiredate) num_hired 2 from (

3 select date_add(min_hd,interval t500.id-1 month) mth 4 from (

5 select min_hd, date_add(max_hd,interval 11 month) max_hd 6 from (

7 select adddate(min(hiredate),-dayofyear(min(hiredate))+1) min_hd, 8 adddate(max(hiredate),-dayofyear(max(hiredate))+1) max_hd

9 from emp

10) x

11) y,

12 t500

13 where date_add(min_hd,interval t500.id-1 month) <= max_hd 14) z left join emp e 15 on (z.mth = adddate(

16 date_add(

17 last_day(e.hiredate),interval -1 month),1)) 18 group by z.mth

19 order by 1

1 with x (start_date,end_date)

2 as (

3 select (min(hiredate) 4 datepart(dy,min(hiredate))+1) start_date, 5 dateadd(yy,1,

6 (max(hiredate)

7 datepart(dy,max(hiredate))+1)) end_date 8 from emp

9 union all

10 select dateadd(mm,1,start_date), end_date

11 from x

12 where dateadd(mm,1,start_date) < end_date 13)

14 select x.start_date mth, count(e.hiredate) num_hired 15 from x left join emp e 16 on (x.start_date =

17 dateadd(dd,-day(e.hiredate)+1,e.hiredate)) 18 group by x.start_date

19 order by 1

<b>

```
   select (min(hiredate) dayofyear(min(hiredate)) day +1 day) start_date,
(max(hiredate)

   dayofyear(max(hiredate)) day +1 day) +1 year end_date from emp</b>



   START_DATE END_DATE

   ----------- -----------

   01-JAN-1980 01-JAN-1984
```

<b>

```
   with x (start_date,end_date) as (

   select (min(hiredate) dayofyear(min(hiredate)) day +1 day) start_date,
(max(hiredate)

   dayofyear(max(hiredate)) day +1 day) +1 year end_date from emp

   union all

   select start_date +1 month, end_date from x

   where (start_date +1 month) < end_date )

   select *

   from x</b>
   START_DATE END_DATE

   ----------- -----------

   01-JAN-1980 01-JAN-1984

   01-FEB-1980 01-JAN-1984

   01-MAR-1980 01-JAN-1984

   …

   01-OCT-1983 01-JAN-1984

   01-NOV-1983 01-JAN-1984

   01-DEC-1983 01-JAN-1984
```

<b>

```
   select min(trunc(hiredate,'y')) start_date,
add_months(max(trunc(hiredate,'y')),12) end_date from emp</b>
```

```
   START_DATE END_DATE

   ----------- -----------

   01-JAN-1980 01-JAN-1984
```

<b>

```
   with x as (

   select add_months(start_date,level-1) start_date from (

   select min(trunc(hiredate,'y')) start_date,
add_months(max(trunc(hiredate,'y')),12) end_date from emp
```

```
   )

   connect by level <= months_between(end_date,start_date) )

   select *

   from x</b>


   START_DATE

   -----------

   01-JAN-1980

   01-FEB-1980

   01-MAR-1980

   …

   01-OCT-1983

   01-NOV-1983

   01-DEC-1983

<b>

   select cast(date_trunc('year',min(hiredate)) as date) as first_month,
cast(cast(date_trunc('year',max(hiredate)) as date) + interval '1 year'

   as date) as last_month from emp</b>


   FIRST_MONTH LAST_MONTH

   ----------- -----------
   01-JAN-1980 01-JAN-1984

<b>

   select cast(

   extract(year from age(last_month,first_month))*12-1

   as integer) as mths from (

   select cast(date_trunc('year',min(hiredate)) as date) as first_month,
cast(cast(date_trunc('year',max(hiredate)) as date) + interval '1 year'

   as date) as last_month from emp

   ) x</b>


   MTHS

   ----

   47

<b>

   select cast(e.start_date + (x.id * interval '1 month') as date) as mth

   from generate_series (0,(select mths from v)) x(id), ( select cast(

   date_trunc('year',min(hiredate)) as date) as start_date from emp

   ) e</b>


   MTH

   -----------
   01-JAN-1980

   01-FEB-1980

   01-MAR-1980

   …

   01-OCT-1983

   01-NOV-1983

   01-DEC-1983
```

<b>

```
   select adddate(min(hiredate),-dayofyear(min(hiredate))+1) min_hd,
adddate(max(hiredate),-dayofyear(max(hiredate))+1) max_hd from
emp</b>
```

```
   MIN_HD MAX_HD

   ----------- -----------

   01-JAN-1980 01-JAN-1983
```

<b>

```
   select min_hd, date_add(max_hd,interval 11 month) max_hd from (

   select adddate(min(hiredate),-dayofyear(min(hiredate))+1) min_hd,
adddate(max(hiredate),-dayofyear(max(hiredate))+1) max_hd from emp

   ) x</b>
```

```
MIN_HD MAX_HD

----------- -----------

01-JAN-1980 01-DEC-1983
```

<b>

```
select date_add(min_hd,interval t500.id-1 month) mth from (

select min_hd, date_add(max_hd,interval 11 month) max_hd from (

select adddate(min(hiredate),-dayofyear(min(hiredate))+1) min_hd,
adddate(max(hiredate),-dayofyear(max(hiredate))+1) max_hd from emp

) x

) y,

t500

where date_add(min_hd,interval t500.id-1 month) <= max_hd</b> MTH

-----------

01-JAN-1980

01-FEB-1980

01-MAR-1980

…

01-OCT-1983

01-NOV-1983

01-DEC-1983
```

<b>

```
select (min(hiredate) -
datepart(dy,min(hiredate))+1) start_date, dateadd(yy,1,
(max(hiredate) -
datepart(dy,max(hiredate))+1)) end_date from emp</b>

START_DATE END_DATE
----------- -----------
01-JAN-1980 01-JAN-1984
```

<b>

```
with x (start_date,end_date) as (
select (min(hiredate) -
datepart(dy,min(hiredate))+1) start_date, dateadd(yy,1,
(max(hiredate) -
datepart(dy,max(hiredate))+1)) end_date from emp
union all
select dateadd(mm,1,start_date), end_date from x
where dateadd(mm,1,start_date) < end_date )
select *
from x</b>
```

```
START_DATE END_DATE

----------- -----------

01-JAN-1980 01-JAN-1984

01-FEB-1980 01-JAN-1984

01-MAR-1980 01-JAN-1984

…

01-OCT-1983 01-JAN-1984

01-NOV-1983 01-JAN-1984

01-DEC-1983 01-JAN-1984
```

At this point, you have all the months you need. Simply outer join to EMP.HIREDATE. Because the day for each START_DATE is the first of the month, truncate EMP.HIREDATE to the first day of the month. The final step is to use the aggregate function COUNT on EMP.HIREDATE.

```
1 select ename
```

2 from emp

3 where monthname(hiredate) in ('February','December') 4 or dayname(hiredate) = 'Tuesday'

1 select ename

2 from emp

3 where rtrim(to_char(hiredate,'month')) in ('february','december') 4 or rtrim(to_char(hiredate,'day')) = 'tuesday'

1 select ename

2 from emp

3 where datename(m,hiredate) in ('February','December') 4 or datename(dw,hiredate) = 'Tuesday'

<b>

select ename,datename(m,hiredate) mth,datename(dw,hiredate) dw from emp

where deptno = 10</b>

ENAME MTH DW

------ --------- -----------

CLARK June Tuesday

KING November Tuesday MILLER January Saturday

Once you know what the function(s) return, finding rows using the functions shown in each of the solutions is easy.

```
MSG
    ----------------------------------------------------
    JAMES was hired on the same month and weekday as FORD
    SCOTT was hired on the same month and weekday as JAMES
    SCOTT was hired on the same month and weekday as FORD
1 select a.ename ||
    2 ' was hired on the same month and weekday as '||
    3 b.ename msg
```

4 from emp a, emp b

5 where (dayofweek(a.hiredate),monthname(a.hiredate)) =

6 (dayofweek(b.hiredate),monthname(b.hiredate)) 7 and a.empno < b.empno 8 order by a.ename

1 select a.ename ||

2 ' was hired on the same month and weekday as '||

3 b.ename as msg

4 from emp a, emp b

5 where to_char(a.hiredate,'DMON') =

6 to_char(b.hiredate,'DMON') 7 and a.empno < b.empno 8 order by a.ename

1 select concat(a.ename,

2 ' was hired on the same month and weekday as ', 3 b.ename) msg

4 from emp a, emp b

5 where date_format(a.hiredate,'%w%M') =

6 date_format(b.hiredate,'%w%M') 7 and a.empno < b.empno 8 order by a.ename

1 select a.ename +

2 ' was hired on the same month and weekday as '+

3 b.ename msg

4 from emp a, emp b

5 where datename(dw,a.hiredate) = datename(dw,b.hiredate) 6 and datename(m,a.hiredate) = datename(m,b.hiredate) 7 and a.empno < b.empno 8 order by a.ename

<b>

select a.ename as scott, a.hiredate as scott_hd, b.ename as other_emps, b.hiredate as other_hds from emp a, emp b

where a.ename = 'SCOTT'

and a.empno != b.empno</b>

```
SCOTT SCOTT_HD OTHER_EMPS OTHER_HDS

---------- ----------- ---------- -----------

SCOTT 09-DEC-1982 SMITH 17-DEC-1980

SCOTT 09-DEC-1982 ALLEN 20-FEB-1981

SCOTT 09-DEC-1982 WARD 22-FEB-1981

SCOTT 09-DEC-1982 JONES 02-APR-1981

SCOTT 09-DEC-1982 MARTIN 28-SEP-1981

SCOTT 09-DEC-1982 BLAKE 01-MAY-1981

SCOTT 09-DEC-1982 CLARK 09-JUN-1981

SCOTT 09-DEC-1982 KING 17-NOV-1981

SCOTT 09-DEC-1982 TURNER 08-SEP-1981

SCOTT 09-DEC-1982 ADAMS 12-JAN-1983
SCOTT 09-DEC-1982 JAMES 03-DEC-1981

SCOTT 09-DEC-1982 FORD 03-DEC-1981

SCOTT 09-DEC-1982 MILLER 23-JAN-1982
```

<b>

```
select a.ename as emp1, a.hiredate as emp1_hd, b.ename as emp2,
b.hiredate as emp2_hd from emp a, emp b

where to_char(a.hiredate,'DMON') =

to_char(b.hiredate,'DMON') and a.empno != b.empno order by 1</b>
```

```
EMP1 EMP1_HD EMP2 EMP2_HD

---------- ----------- ---------- -----------

FORD 03-DEC-1981 SCOTT 09-DEC-1982

FORD 03-DEC-1981 JAMES 03-DEC-1981

JAMES 03-DEC-1981 SCOTT 09-DEC-1982

JAMES 03-DEC-1981 FORD 03-DEC-1981


SCOTT 09-DEC-1982 JAMES 03-DEC-1981

SCOTT 09-DEC-1982 FORD 03-DEC-1981
```

<b>

```
select a.ename as emp1, b.ename as emp2

from emp a, emp b
```

```
where to_char(a.hiredate,'DMON') =

to_char(b.hiredate,'DMON') and a.empno < b.empno order by 1</b>


EMP1 EMP2

---------- ----------

JAMES FORD

SCOTT JAMES

SCOTT FORD
```

The final step is to simply concatenate the result set to form the message.

```
<b>
    select *
    from emp_project</b>
    EMPNO ENAME PROJ_ID PROJ_START PROJ_END
    ----- ---------- ------- ----------- -----------
    7782 CLARK 1 16-JUN-2005 18-JUN-2005
    7782 CLARK 4 19-JUN-2005 24-JUN-2005
    7782 CLARK 7 22-JUN-2005 25-JUN-2005
    7782 CLARK 10 25-JUN-2005 28-JUN-2005
    7782 CLARK 13 28-JUN-2005 02-JUL-2005
    7839 KING 2 17-JUN-2005 21-JUN-2005
    7839 KING 8 23-JUN-2005 25-JUN-2005
    7839 KING 14 29-JUN-2005 30-JUN-2005
    7839 KING 11 26-JUN-2005 27-JUN-2005
    7839 KING 5 20-JUN-2005 24-JUN-2005
    7934 MILLER 3 18-JUN-2005 22-JUN-2005
    7934 MILLER 12 27-JUN-2005 28-JUN-2005
    7934 MILLER 15 30-JUN-2005 03-JUL-2005
    7934 MILLER 9 24-JUN-2005 27-JUN-2005
```

7934 MILLER 6 21-JUN-2005 23-JUN-2005

```
EMPNO ENAME MSG
    ----- ---------- --------------------------------
    7782 CLARK project 7 overlaps project 4
    7782 CLARK project 10 overlaps project 7
    7782 CLARK project 13 overlaps project 10
    7839 KING project 8 overlaps project 5
    7839 KING project 5 overlaps project 2
    7934 MILLER project 12 overlaps project 9
    7934 MILLER project 6 overlaps project 3
1 select a.empno,a.ename,
    2 'project '||b.proj_id||
    3 ' overlaps project '||a.proj_id as msg 4 from emp_project a,
```

5 emp_project b

6 where a.empno = b.empno 7 and b.proj_start >= a.proj_start 8 and b.proj_start <= a.proj_end 9 and a.proj_id != b.proj_id

1 select a.empno,a.ename,

2 concat('project ',b.proj_id, 3 ' overlaps project ',a.proj_id) as msg 4 from emp_project a,

5 emp_project b

6 where a.empno = b.empno 7 and b.proj_start >= a.proj_start 8 and b.proj_start <= a.proj_end 9 and a.proj_id != b.proj_id

1 select a.empno,a.ename,

2 'project '+b.proj_id+

3 ' overlaps project '+a.proj_id as msg 4 from emp_project a,

5 emp_project b

6 where a.empno = b.empno 7 and b.proj_start >= a.proj_start 8 and b.proj_start <= a.proj_end 9 and a.proj_id != b.proj_id

<b>

select a.ename,

a.proj_id as a_id,

a.proj_start as a_start, a.proj_end as a_end, b.proj_id as b_id,

b.proj_start as b_start from emp_project a,

emp_project b

where a.ename = 'KING'

and a.empno = b.empno and a.proj_id != b.proj_id order by 2</b>

ENAME A_ID A_START A_END B_ID B_START

------ ----- ----------- ----------- ----- -----------

KING 2 17-JUN-2005 21-JUN-2005 8 23-JUN-2005

KING 2 17-JUN-2005 21-JUN-2005 14 29-JUN-2005

KING 2 17-JUN-2005 21-JUN-2005 11 26-JUN-2005

KING 2 17-JUN-2005 21-JUN-2005 5 20-JUN-2005

KING 5 20-JUN-2005 24-JUN-2005 2 17-JUN-2005

KING 5 20-JUN-2005 24-JUN-2005 8 23-JUN-2005

```
    KING 5 20-JUN-2005 24-JUN-2005 11 26-JUN-2005
    KING 5 20-JUN-2005 24-JUN-2005 14 29-JUN-2005
    KING 8 23-JUN-2005 25-JUN-2005 2 17-JUN-2005
    KING 8 23-JUN-2005 25-JUN-2005 14 29-JUN-2005
    KING 8 23-JUN-2005 25-JUN-2005 5 20-JUN-2005
    KING 8 23-JUN-2005 25-JUN-2005 11 26-JUN-2005
    KING 11 26-JUN-2005 27-JUN-2005 2 17-JUN-2005
    KING 11 26-JUN-2005 27-JUN-2005 8 23-JUN-2005
    KING 11 26-JUN-2005 27-JUN-2005 14 29-JUN-2005
    KING 11 26-JUN-2005 27-JUN-2005 5 20-JUN-2005
    KING 14 29-JUN-2005 30-JUN-2005 2 17-JUN-2005
    KING 14 29-JUN-2005 30-JUN-2005 8 23-JUN-2005
    KING 14 29-JUN-2005 30-JUN-2005 5 20-JUN-2005
    KING 14 29-JUN-2005 30-JUN-2005 11 26-JUN-2005
and b.proj_start >= a.proj_start
    and b.proj_start <= a.proj_end
<b>
    select empno,
    ename,
    proj_id,
proj_start,

proj_end,

case

when lead(proj_start,1)over(order by proj_start) between proj_start and
proj_end then lead(proj_id)over(order by proj_start) when
lead(proj_start,2)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) when
lead(proj_start,3)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) when
lead(proj_start,4)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) end is_overlap

from emp_project

where ename = 'KING'</b>

EMPNO ENAME PROJ_ID PROJ_START PROJ_END IS_OVERLAP

----- ------ ------- ----------- ----------- ----------

7839 KING 2 17-JUN-2005 21-JUN-2005 5

7839 KING 5 20-JUN-2005 24-JUN-2005 8

7839 KING 8 23-JUN-2005 25-JUN-2005

7839 KING 11 26-JUN-2005 27-JUN-2005
```

7839 KING 14 29-JUN-2005 30-JUN-2005

<b>

```
   select empno,ename,

   'project '||is_overlap||

   ' overlaps project '||proj_id msg from (

   select empno,

   ename,

   proj_id,

   proj_start,

   proj_end,

   case

   when lead(proj_start,1)over(order by proj_start) between proj_start and
proj_end then lead(proj_id)over(order by proj_start) when
lead(proj_start,2)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) when
lead(proj_start,3)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) when
lead(proj_start,4)over(order by proj_start) between proj_start and proj_end
then lead(proj_id)over(order by proj_start) end is_overlap

   from emp_project

   where ename = 'KING'

   )
   where is_overlap is not null</b>

   EMPNO ENAME MSG

   ----- ------ -------------------------------

   7839 KING project 5 overlaps project 2

   7839 KING project 8 overlaps project 5

<b>

   select empno,ename,

   'project '||is_overlap||

   ' overlaps project '||proj_id msg from (

   select empno,

   ename,

   proj_id,

   proj_start,

   proj_end,

   case

   when lead(proj_start,1)over(partition by ename order by proj_start)
between proj_start and proj_end then lead(proj_id)over(partition by ename
order by proj_start) when lead(proj_start,2)over(partition by ename order
by proj_start) between proj_start and proj_end then
lead(proj_id)over(partition by ename order by proj_start) when
lead(proj_start,3)over(partition by ename order by proj_start) between
proj_start and proj_end then lead(proj_id)over(partition by ename order by
proj_start) when lead(proj_start,4)over(partition by ename order by
proj_start) between proj_start and proj_end then lead(proj_id)over(partition
by ename order by proj_start) end is_overlap

   from emp_project

   )

   where is_overlap is not null</b>

   EMPNO ENAME MSG

   ----- ------ -------------------------------

   7782 CLARK project 7 overlaps project 4

   7782 CLARK project 10 overlaps project 7

   7782 CLARK project 13 overlaps project 10

   7839 KING project 5 overlaps project 2

   7839 KING project 8 overlaps project 5

   7934 MILLER project 6 overlaps project 3

   7934 MILLER project 12 overlaps project 9
```

Chapter 10. Working with Ranges

This chapter is about "everyday" queries that involve ranges. Ranges are common in everyday life. For example, projects that we work on range over consecutive periods of time. In SQL, it's often necessary to search for ranges, or to generate ranges, or to otherwise manipulate range-based data. The queries you'll read about here are slightly more involved than the queries found in the preceding chapters, but they are just as common, and they'll begin to give you a sense of what SQL can really do for you when you learn to take full advantage of it.

```
select *
    from V

    PROJ_ID PROJ_START PROJ_END
    ------- ----------- -----------
    1 01-JAN-2005 02-JAN-2005
    2 02-JAN-2005 03-JAN-2005
    3 03-JAN-2005 04-JAN-2005
    4 04-JAN-2005 05-JAN-2005
    5 06-JAN-2005 07-JAN-2005
    6 16-JAN-2005 17-JAN-2005
    7 17-JAN-2005 18-JAN-2005
    8 18-JAN-2005 19-JAN-2005
    9 19-JAN-2005 20-JAN-2005
    10 21-JAN-2005 22-JAN-2005
    11 26-JAN-2005 27-JAN-2005
    12 27-JAN-2005 28-JAN-2005
    13 28-JAN-2005 29-JAN-2005
    14 29-JAN-2005 30-JAN-2005
PROJ_ID PROJ_START PROJ_END
```

```
------- ----------- -----------
      1 01-JAN-2005 02-JAN-2005
      2 02-JAN-2005 03-JAN-2005
      3 03-JAN-2005 04-JAN-2005
      6 16-JAN-2005 17-JAN-2005
      7 17-JAN-2005 18-JAN-2005
      8 18-JAN-2005 19-JAN-2005
     11 26-JAN-2005 27-JAN-2005
     12 27-JAN-2005 28-JAN-2005
     13 28-JAN-2005 29-JAN-2005
```

```
select v1.proj_id,
       v1.proj_start,
       v1.proj_end
  from V v1, V v2
 where v1.proj_end = v2.proj_start
```

```
select proj_id, proj_start, proj_end
  from (
select proj_id, proj_start, proj_end,
       lead(proj_start)over(order by proj_id) next_proj_start
  from V
       )
 where next_proj_start = proj_end
```

<b>

    select v1.proj_id as v1_id, v1.proj_end as v1_end, v2.proj_start as
v2_begin,

v2.proj_id as v2_id

from v v1, v v2

where v1.proj_id in (1, 4)</b>

```
V1_ID V1_END V2_BEGIN V2_ID
----- ----------- ----------- ----------
1 02-JAN-2005 01-JAN-2005 1
1 02-JAN-2005 02-JAN-2005 2
1 02-JAN-2005 03-JAN-2005 3
1 02-JAN-2005 04-JAN-2005 4
1 02-JAN-2005 06-JAN-2005 5
1 02-JAN-2005 16-JAN-2005 6
1 02-JAN-2005 17-JAN-2005 7
1 02-JAN-2005 18-JAN-2005 8
1 02-JAN-2005 19-JAN-2005 9
1 02-JAN-2005 21-JAN-2005 10
1 02-JAN-2005 26-JAN-2005 11
1 02-JAN-2005 27-JAN-2005 12
1 02-JAN-2005 28-JAN-2005 13
1 02-JAN-2005 29-JAN-2005 14
```

```
    4 05-JAN-2005 01-JAN-2005 1

    4 05-JAN-2005 02-JAN-2005 2

    4 05-JAN-2005 03-JAN-2005 3

    4 05-JAN-2005 04-JAN-2005 4

    4 05-JAN-2005 06-JAN-2005 5

    4 05-JAN-2005 16-JAN-2005 6

    4 05-JAN-2005 17-JAN-2005 7

    4 05-JAN-2005 18-JAN-2005 8

    4 05-JAN-2005 19-JAN-2005 9

    4 05-JAN-2005 21-JAN-2005 10

    4 05-JAN-2005 26-JAN-2005 11

    4 05-JAN-2005 27-JAN-2005 12

    4 05-JAN-2005 28-JAN-2005 13

    4 05-JAN-2005 29-JAN-2005 14

<b>

    select *

    from V

    where proj_id <= 5</b>

    PROJ_ID PROJ_START PROJ_END

    ------- ---------- -----------
```

```
   1 01-JAN-2005 02-JAN-2005

   2 02-JAN-2005 03-JAN-2005

   3 03-JAN-2005 04-JAN-2005

   4 04-JAN-2005 05-JAN-2005

   5 06-JAN-2005 07-JAN-2005
```

<b>

```
   select distinct

   v1.proj_id,

   v1.proj_start,
```

v1.proj_end

```
   from V v1, V v2

   where v1.proj_end = v2.proj_start or v1.proj_start = v2.proj_end</b>

   PROJ_ID PROJ_START PROJ_END

   ------- ----------- -----------

   1 01-JAN-2005 02-JAN-2005

   2 02-JAN-2005 03-JAN-2005

   3 03-JAN-2005 04-JAN-2005

   4 04-JAN-2005 05-JAN-2005

<b>

   select *

   from (

   select proj_id, proj_start, proj_end, lead(proj_start)over(order by proj_id)
next_proj_start from v

   )

   where proj_id in ( 1, 4 )</b>

   PROJ_ID PROJ_START PROJ_END NEXT_PROJ_START

   ------- ----------- ----------- ---------------

   1 01-JAN-2005 02-JAN-2005 02-JAN-2005

   4 04-JAN-2005 05-JAN-2005 06-JAN-2005
```

<b>

```
select *

from V

where proj_id <= 5</b>

PROJ_ID PROJ_START PROJ_END

------- ----------- -----------

1 01-JAN-2005 02-JAN-2005

2 02-JAN-2005 03-JAN-2005

3 03-JAN-2005 04-JAN-2005

4 04-JAN-2005 05-JAN-2005

5 06-JAN-2005 07-JAN-2005
```

<b>

```
select proj_id, proj_start, proj_end from (

select proj_id, proj_start, proj_end, lead(proj_start)over(order by proj_id)
next_start from V

where proj_id <= 5

)

where proj_end = next_start</b>

PROJ_ID PROJ_START PROJ_END

------- ----------- -----------

1 01-JAN-2005 02-JAN-2005
```

```
   2 02-JAN-2005 03-JAN-2005

   3 03-JAN-2005 04-JAN-2005
```

<b>

```
   select proj_id, proj_start, proj_end from (

   select proj_id, proj_start, proj_end, lead(proj_start)over(order by proj_id)
next_start, lag(proj_end)over(order by proj_id) last_end from V

   where proj_id <= 5

   )

   where proj_end = next_start or proj_start = last_end</b>

   PROJ_ID PROJ_START PROJ_END

   ------- ----------- -----------

   1 01-JAN-2005 02-JAN-2005

   2 02-JAN-2005 03-JAN-2005

   3 03-JAN-2005 04-JAN-2005

   4 04-JAN-2005 05-JAN-2005
```

Now PROJ_ID 4 is included in the final result set, and only the evil PROJ_ID 5 is excluded. Please consider your exact requirements when applying these recipes to your code.

```
DEPTNO ENAME SAL HIREDATE DIFF

  ------ ---------- ---------- ----------- ----------

  10 CLARK 2450 09-JUN-1981 -2550
```

10 KING 5000 17-NOV-1981 3700

10 MILLER 1300 23-JAN-1982 N/A 20 SMITH 800 17-DEC-1980 -2175

20 JONES 2975 02-APR-1981 -25

20 FORD 3000 03-DEC-1981 0

20 SCOTT 3000 09-DEC-1982 1900

20 ADAMS 1100 12-JAN-1983 N/A 30 ALLEN 1600 20-FEB-1981 350

30 WARD 1250 22-FEB-1981 -1600

30 BLAKE 2850 01-MAY-1981 1350

30 TURNER 1500 08-SEP-1981 250

30 MARTIN 1250 28-SEP-1981 300

30 JAMES 950 03-DEC-1981 N/A

1 select deptno, ename, hiredate, sal,

2 coalesce(cast(sal-next_sal as char(10)), 'N/A') as diff 3 from (

4 select e.deptno,

5 e.ename,

6 e.hiredate,

7 e.sal,

8 (select min(sal) from emp d 9 where d.deptno=e.deptno 10 and d.hiredate =

11 (select min(hiredate) from emp d 12 where e.deptno=d.deptno 13 and d.hiredate > e.hiredate)) as next_sal

14 from emp e

15) x

1 select deptno, ename, sal, hiredate,

2 lpad(nvl(to_char(sal-next_sal), 'N/A'), 10) diff 3 from (

4 select deptno, ename, sal, hiredate, 5 lead(sal)over(partition by deptno 6 order by hiredate) next_sal

7 from emp

8)

<b>

select e.deptno,

e.ename,

e.hiredate,

e.sal,

(select min(hiredate) from emp d where e.deptno=d.deptno and d.hiredate > e.hiredate) as next_hire from emp e

order by 1</b>

```
DEPTNO ENAME HIREDATE SAL NEXT_HIRE

------ ---------- ----------- ---------- -----------

10 CLARK 09-JUN-1981 2450 17-NOV-1981

10 KING 17-NOV-1981 5000 23-JAN-1982

10 MILLER 23-JAN-1982 1300

20 SMITH 17-DEC-1980 800 02-APR-1981

20 ADAMS 12-JAN-1983 1100

20 FORD 03-DEC-1981 3000 09-DEC-1982

20 SCOTT 09-DEC-1982 3000 12-JAN-1983
```

20 JONES 02-APR-1981 2975 03-DEC-1981

30 ALLEN 20-FEB-1981 1600 22-FEB-1981

30 BLAKE 01-MAY-1981 2850 08-SEP-1981

30 MARTIN 28-SEP-1981 1250 03-DEC-1981

30 JAMES 03-DEC-1981 950

30 TURNER 08-SEP-1981 1500 28-SEP-1981

30 WARD 22-FEB-1981 1250 01-MAY-1981

```
<b>

   select e.deptno,

   e.ename,

   e.hiredate,

   e.sal,

   (select min(sal) from emp d where d.deptno=e.deptno and d.hiredate =

   (select min(hiredate) from emp d where e.deptno=d.deptno and d.hiredate
> e.hiredate)) as next_sal from emp e

   order by 1</b>
```

```
   DEPTNO ENAME HIREDATE SAL NEXT_SAL

   ------ ---------- ----------- ---------- ----------

   10 CLARK 09-JUN-1981 2450 5000

   10 KING 17-NOV-1981 5000 1300

   10 MILLER 23-JAN-1982 1300

   20 SMITH 17-DEC-1980 800 2975

   20 ADAMS 12-JAN-1983 1100

   20 FORD 03-DEC-1981 3000 3000

   20 SCOTT 09-DEC-1982 3000 1100
```

```
20 JONES 02-APR-1981 2975 3000

30 ALLEN 20-FEB-1981 1600 1250

30 BLAKE 01-MAY-1981 2850 1500

30 MARTIN 28-SEP-1981 1250 950

30 JAMES 03-DEC-1981 950

30 TURNER 08-SEP-1981 1500 1250
```

30 WARD 22-FEB-1981 1250 2850

<b>

select deptno, ename, hiredate, sal, coalesce(cast(sal-next_sal as char(10)), 'N/A') as diff from (

select e.deptno,

e.ename,

e.hiredate,

e.sal,

(select min(sal) from emp d where d.deptno=e.deptno and d.hiredate =

(select min(hiredate) from emp d where e.deptno=d.deptno and d.hiredate > e.hiredate)) as next_sal from emp e

) x

order by 1</b>

DEPTNO ENAME HIREDATE SAL DIFF

------ ---------- ----------- ---------- ---------

10 CLARK 09-JUN-1981 2450 -2550

10 KING 17-NOV-1981 5000 3700

10 MILLER 23-JAN-1982 1300 N/A

20 SMITH 17-DEC-1980 800 -2175

20 ADAMS 12-JAN-1983 1100 N/A 20 FORD 03-DEC-1981 3000 0

20 SCOTT 09-DEC-1982 3000 1900

20 JONES 02-APR-1981 2975 -25

30 ALLEN 20-FEB-1981 1600 350

30 BLAKE 01-MAY-1981 2850 1350

30 MARTIN 28-SEP-1981 1250 300

30 JAMES 03-DEC-1981 950 N/A 30 TURNER 08-SEP-1981 1500 250

30 WARD 22-FEB-1981 1250 -1600

<b>

```
   select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) next_sal from emp</b>
```

```
   DEPTNO ENAME SAL HIREDATE NEXT_SAL

   ------ ---------- ---------- ----------- ----------

   10 CLARK 2450 09-JUN-1981 5000

   10 KING 5000 17-NOV-1981 1300

   10 MILLER 1300 23-JAN-1982

   20 SMITH 800 17-DEC-1980 2975

   20 JONES 2975 02-APR-1981 3000

   20 FORD 3000 03-DEC-1981 3000

   20 SCOTT 3000 09-DEC-1982 1100

   20 ADAMS 1100 12-JAN-1983

   30 ALLEN 1600 20-FEB-1981 1250

   30 WARD 1250 22-FEB-1981 2850

   30 BLAKE 2850 01-MAY-1981 1500

   30 TURNER 1500 08-SEP-1981 1250

   30 MARTIN 1250 28-SEP-1981 950
```

30 JAMES 950 03-DEC-1981

<b>

```
   select deptno,ename,sal,hiredate, sal-next_sal diff from (

   select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) next_sal from emp

   )</b>
```

```
   DEPTNO ENAME SAL HIREDATE DIFF

   ------ ---------- ---------- ----------- ----------

   10 CLARK 2450 09-JUN-1981 -2550

   10 KING 5000 17-NOV-1981 3700

   10 MILLER 1300 23-JAN-1982

   20 SMITH 800 17-DEC-1980 -2175

   20 JONES 2975 02-APR-1981 -25

   20 FORD 3000 03-DEC-1981 0

   20 SCOTT 3000 09-DEC-1982 1900

   20 ADAMS 1100 12-JAN-1983

   30 ALLEN 1600 20-FEB-1981 350

   30 WARD 1250 22-FEB-1981 -1600

   30 BLAKE 2850 01-MAY-1981 1350
```

30 TURNER 1500 08-SEP-1981 250

30 MARTIN 1250 28-SEP-1981 300

30 JAMES 950 03-DEC-1981

<b>

```
   select deptno,ename,sal,hiredate, nvl(to_char(sal-next_sal),'N/A') diff
from (

   select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order
by hiredate) next_sal from emp

   )</b>
```

```
   DEPTNO ENAME SAL HIREDATE DIFF

   ------ ---------- ---------- ----------- ---------------

   10 CLARK 2450 09-JUN-1981 -2550
```

10 KING 5000 17-NOV-1981 3700

10 MILLER 1300 23-JAN-1982 N/A 20 SMITH 800 17-DEC-1980 -2175

20 JONES 2975 02-APR-1981 -25

20 FORD 3000 03-DEC-1981 0

20 SCOTT 3000 09-DEC-1982 1900

20 ADAMS 1100 12-JAN-1983 N/A 30 ALLEN 1600 20-FEB-1981 350

30 WARD 1250 22-FEB-1981 -1600

30 BLAKE 2850 01-MAY-1981 1350

30 TURNER 1500 08-SEP-1981 250

30 MARTIN 1250 28-SEP-1981 300

30 JAMES 950 03-DEC-1981 N/A

<b>

select deptno,ename,sal,hiredate, lpad(nvl(to_char(sal-next_sal),'N/A'),10) diff from (

select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) next_sal from emp

)</b>

DEPTNO ENAME SAL HIREDATE DIFF

------ ---------- ---------- ----------- ----------

10 CLARK 2450 09-JUN-1981 -2550

10 KING 5000 17-NOV-1981 3700

10 MILLER 1300 23-JAN-1982 N/A 20 SMITH 800 17-DEC-1980 -2175

20 JONES 2975 02-APR-1981 -25

20 FORD 3000 03-DEC-1981 0

20 SCOTT 3000 09-DEC-1982 1900

20 ADAMS 1100 12-JAN-1983 N/A 30 ALLEN 1600 20-FEB-1981 350

30 WARD 1250 22-FEB-1981 -1600

30 BLAKE 2850 01-MAY-1981 1350

30 TURNER 1500 08-SEP-1981 250

30 MARTIN 1250 28-SEP-1981 300

30 JAMES 950 03-DEC-1981 N/A

<b>

select deptno,ename,sal,hiredate, lpad(nvl(to_char(sal-next_sal),'N/A'),10) diff from (

select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) next_sal from emp

where deptno=10 and empno > 10

)</b>

DEPTNO ENAME SAL HIREDATE DIFF

------ ------ ----- ----------- ----------

10 CLARK 2450 09-JUN-1981 -2550

10 KING 5000 17-NOV-1981 3700

10 MILLER 1300 23-JAN-1982 N/A

<b>

insert into emp (empno,ename,deptno,sal,hiredate) values (1,'ant',10,1000,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,sal,hiredate) values (2,'joe',10,1500,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,sal,hiredate) values (3,'jim',10,1600,to_date('17-NOV-1981'))

insert into emp (empno,ename,deptno,sal,hiredate) values (4,'jon',10,1700,to_date('17-NOV-1981'))

select deptno,ename,sal,hiredate, lpad(nvl(to_char(sal-next_sal),'N/A'),10) diff from (

select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) next_sal from emp

where deptno=10

)</b>

DEPTNO ENAME SAL HIREDATE DIFF

------ ------ ----- ----------- ----------

10 CLARK 2450 09-JUN-1981 1450

10 ant 1000 17-NOV-1981 -500

```
10 joe 1500 17-NOV-1981 -3500

10 KING 5000 17-NOV-1981 3400

10 jim 1600 17-NOV-1981 -100
```

10 jon 1700 17-NOV-1981 400

```
10 MILLER 1300 23-JAN-1982 N/A
```

<b>

```
select deptno,ename,sal,hiredate, lpad(nvl(to_char(sal-next_sal),'N/A'),10) diff from (

select deptno,ename,sal,hiredate, lead(sal,cnt-rn+1)over(partition by deptno order by hiredate) next_sal from (

select deptno,ename,sal,hiredate, count(*)over(partition by deptno,hiredate) cnt, row_number( )over(partition by deptno,hiredate order by sal) rn from emp

where deptno=10

)

)</b>
```

```
DEPTNO ENAME SAL HIREDATE DIFF

------ ------ ----- ----------- ----------

10 CLARK 2450 09-JUN-1981 1450

10 ant 1000 17-NOV-1981 -300

10 joe 1500 17-NOV-1981 200

10 jim 1600 17-NOV-1981 300

10 jon 1700 17-NOV-1981 400
```

10 KING 5000 17-NOV-1981 3700

```
10 MILLER 1300 23-JAN-1982 N/A
```

<b>

select deptno,ename,sal,hiredate, count(*)over(partition by deptno,hiredate) cnt, row_number( )over(partition by deptno,hiredate order by sal) rn from emp

where deptno=10</b>

```
DEPTNO ENAME SAL HIREDATE CNT RN

------ ------ ----- ----------- ---------- ----------

10 CLARK 2450 09-JUN-1981 1 1

10 ant 1000 17-NOV-1981 5 1

10 joe 1500 17-NOV-1981 5 2

10 jim 1600 17-NOV-1981 5 3

10 jon 1700 17-NOV-1981 5 4

10 KING 5000 17-NOV-1981 5 5
```

10 MILLER 1300 23-JAN-1982 1 1

<b>

```
   select deptno,ename,sal,hiredate, lead(sal)over(partition by deptno order by hiredate) incorrect, cnt-rn+1 distance,

   lead(sal,cnt-rn+1)over(partition by deptno order by hiredate) correct from (

   select deptno,ename,sal,hiredate, count(*)over(partition by deptno,hiredate) cnt, row_number( )over(partition by deptno,hiredate order by sal) rn

   from emp

   where deptno=10

   )</b>
```

```
   DEPTNO ENAME SAL HIREDATE INCORRECT DISTANCE CORRECT

   ------ ------ ----- ----------- ---------- ---------- ----------

   10 CLARK 2450 09-JUN-1981 1000 1 1000

   10 ant 1000 17-NOV-1981 1500 5 1300

   10 joe 1500 17-NOV-1981 1600 4 1300

   10 jim 1600 17-NOV-1981 1700 3 1300

   10 jon 1700 17-NOV-1981 5000 2 1300

   10 KING 5000 17-NOV-1981 1300 1 1300
```

```
10 MILLER 1300 23-JAN-1982 1
```

Now you can clearly see the effect that you have when you pass the correct distance to LEAD OVER. The rows for INCORRECT represent the values returned by LEAD OVER using a default distance of one. The rows for CORRECT represent the values returned by LEAD OVER using the proper distance for each employee with a duplicate HIREDATE to MILLER. At this point, all that is left is to find the difference between CORRECT and SAL for each row, which has already been shown.

```
<b>
    select *
    from V</b>
    PROJ_ID PROJ_START PROJ_END
    ------- ----------- -----------
    1 01-JAN-2005 02-JAN-2005
    2 02-JAN-2005 03-JAN-2005
    3 03-JAN-2005 04-JAN-2005
    4 04-JAN-2005 05-JAN-2005
    5 06-JAN-2005 07-JAN-2005
    6 16-JAN-2005 17-JAN-2005
    7 17-JAN-2005 18-JAN-2005
    8 18-JAN-2005 19-JAN-2005
    9 19-JAN-2005 20-JAN-2005
    10 21-JAN-2005 22-JAN-2005
    11 26-JAN-2005 27-JAN-2005
    12 27-JAN-2005 28-JAN-2005
    13 28-JAN-2005 29-JAN-2005
```

14 29-JAN-2005 30-JAN-2005

```
PROJ_GRP PROJ_START PROJ_END
   -------- ----------- -----------
   1 01-JAN-2005 05-JAN-2005
   2 06-JAN-2005 07-JAN-2005
   3 16-JAN-2005 20-JAN-2005
   4 21-JAN-2005 22-JAN-2005
```

5 26-JAN-2005 30-JAN-2005

```
create view v2
   as
   select a.*,
   case
   when (
   select b.proj_id from V b
   where a.proj_start = b.proj_end )
   is not null then 0 else 1
   end as flag
   from V a
<b>
   select *
   from V2</b>
   PROJ_ID PROJ_START PROJ_END FLAG
   ------- ----------- ----------- ----------
   1 01-JAN-2005 02-JAN-2005 1
   2 02-JAN-2005 03-JAN-2005 0
   3 03-JAN-2005 04-JAN-2005 0
```

```
4 04-JAN-2005 05-JAN-2005 0

5 06-JAN-2005 07-JAN-2005 1

6 16-JAN-2005 17-JAN-2005 1

7 17-JAN-2005 18-JAN-2005 0

8 18-JAN-2005 19-JAN-2005 0

9 19-JAN-2005 20-JAN-2005 0

10 21-JAN-2005 22-JAN-2005 1

11 26-JAN-2005 27-JAN-2005 1

12 27-JAN-2005 28-JAN-2005 0

13 28-JAN-2005 29-JAN-2005 0
```

14 29-JAN-2005 30-JAN-2005 0

```
1 select proj_grp,
   2 min(proj_start) as proj_start, 3 max(proj_end) as proj_end 4 from (
   5 select a.proj_id,a.proj_start,a.proj_end, 6 (select sum(b.flag)
```

7 from V2 b

8 where b.proj_id <= a.proj_id) as proj_grp

9 from V2 a

10) x

11 group by proj_grp

1 select proj_grp, min(proj_start), max(proj_end) 2 from (

3 select proj_id,proj_start,proj_end, 4 sum(flag)over(order by proj_id) proj_grp 5 from (

6 select proj_id,proj_start,proj_end,

7 case when

8 lag(proj_end)over(order by proj_id) = proj_start 9 then 0 else 1

10 end flag

11 from V

12)

13)

14 group by proj_grp

```
<b>

   select a.proj_id,a.proj_start,a.proj_end, (select sum(b.flag) from v2 b

   where b.proj_id <= a.proj_id) as proj_grp from v2 a</b>

   PROJ_ID PROJ_START PROJ_END PROJ_GRP

   ------- ----------- ----------- ----------

   1 01-JAN-2005 02-JAN-2005 1

   2 02-JAN-2005 03-JAN-2005 1

   3 03-JAN-2005 04-JAN-2005 1

   4 04-JAN-2005 05-JAN-2005 1

   5 06-JAN-2005 07-JAN-2005 2

   6 16-JAN-2005 17-JAN-2005 3

   7 17-JAN-2005 18-JAN-2005 3

   8 18-JAN-2005 19-JAN-2005 3

   9 19-JAN-2005 20-JAN-2005 3

   10 21-JAN-2005 22-JAN-2005 4

   11 26-JAN-2005 27-JAN-2005 5

   12 27-JAN-2005 28-JAN-2005 5

   13 28-JAN-2005 29-JAN-2005 5
```

14 29-JAN-2005 30-JAN-2005 5

<b>

```
select proj_id,proj_start,proj_end, lag(proj_end)over(order by proj_id)
prior_proj_end from V</b>

PROJ_ID PROJ_START PROJ_END PRIOR_PROJ_END

------- ----------- ----------- --------------

1 01-JAN-2005 02-JAN-2005

2 02-JAN-2005 03-JAN-2005 02-JAN-2005

3 03-JAN-2005 04-JAN-2005 03-JAN-2005

4 04-JAN-2005 05-JAN-2005 04-JAN-2005

5 06-JAN-2005 07-JAN-2005 05-JAN-2005

6 16-JAN-2005 17-JAN-2005 07-JAN-2005

7 17-JAN-2005 18-JAN-2005 17-JAN-2005

8 18-JAN-2005 19-JAN-2005 18-JAN-2005

9 19-JAN-2005 20-JAN-2005 19-JAN-2005

10 21-JAN-2005 22-JAN-2005 20-JAN-2005

11 26-JAN-2005 27-JAN-2005 22-JAN-2005

12 27-JAN-2005 28-JAN-2005 27-JAN-2005

13 28-JAN-2005 29-JAN-2005 28-JAN-2005
```

14 29-JAN-2005 30-JAN-2005 29-JAN-2005

```
<b>

   select proj_id,proj_start,proj_end, sum(flag)over(order by proj_id)
proj_grp from (

   select proj_id,proj_start,proj_end, case when

   lag(proj_end)over(order by proj_id) = proj_start then 0 else 1

   end flag

   from V

   )</b>



   PROJ_ID PROJ_START PROJ_END PROJ_GRP

   ------- ----------- ----------- ----------

   1 01-JAN-2005 02-JAN-2005 1

   2 02-JAN-2005 03-JAN-2005 1

   3 03-JAN-2005 04-JAN-2005 1

   4 04-JAN-2005 05-JAN-2005 1

   5 06-JAN-2005 07-JAN-2005 2

   6 16-JAN-2005 17-JAN-2005 3

   7 17-JAN-2005 18-JAN-2005 3

   8 18-JAN-2005 19-JAN-2005 3
```

```
9 19-JAN-2005 20-JAN-2005 3

10 21-JAN-2005 22-JAN-2005 4

11 26-JAN-2005 27-JAN-2005 5

12 27-JAN-2005 28-JAN-2005 5

13 28-JAN-2005 29-JAN-2005 5
```

```
14 29-JAN-2005 30-JAN-2005 5
```

Now that each row has been placed into a group, simply use the aggregate functions MIN and MAX on PROJ_START and PROJ_END respectively, and group by the values created in the PROJ_GRP running total column.

```
YR CNT

    ---- ----------

    1980 1

    1981 10

    1982 2

    1983 1

    1984 0

    1985 0

    1986 0

    1987 0

    1988 0
```

1989 0

```
select x.yr, coalesce(y.cnt,0) cnt
  from (
  select year(min(hiredate)over( )) -
  mod(year(min(hiredate)over( )),10) +
  row_number( )over( )-1 yr from emp fetch first 10 rows only ) x
```

8 left join

9 (

10 select year(hiredate) yr1, count(*) cnt

11 from emp

12 group by year(hiredate) 13) y

14 on (x.yr = y.yr1)

1 select x.yr, coalesce(cnt,0) cnt

2 from (

3 select extract(year from min(hiredate)over( )) -

4 mod(extract(year from min(hiredate)over( )),10) +

5 rownum-1 yr

```
6 from emp
7 where rownum <= 10
8 ) x,
9 (
10 select to_number(to_char(hiredate,'YYYY')) yr, count(*) cnt
```

11 from emp

12 group by to_number(to_char(hiredate,'YYYY')) 13) y

14 where x.yr = y.yr(+)

1 select x.yr, coalesce(cnt,0) cnt

2 from (

3 select extract(year from min(hiredate)over( )) -

4 mod(extract(year from min(hiredate)over( )),10) +

5 rownum-1 yr

6 from emp

7 where rownum <= 10

8) x

```
left join
(
select to_number(to_char(hiredate,'YYYY')) yr, count(*) cnt
```

12 from emp

13 group by to_number(to_char(hiredate,'YYYY')) 14) y

15 on (x.yr = y.yr)

1 select y.yr, coalesce(x.cnt,0) as cnt

2 from (

3 select <a name="idx-CHP-10-0607"></a>min_year-mod(cast(min_year as int),10)+rn as yr 4 from (

5 select (select min(extract(year from hiredate)) 6 from emp) as min_year, 7 id-1 as rn

8 from t10

9) a

10) y

11 left join

12 (

13 select extract(year from hiredate) as yr, count(*) as cnt

```
from emp
 group by extract(year from hiredate)
 ) x
 on ( y.yr = x.yr )
select x.yr, coalesce(y.cnt,0) cnt
 from (
 select top (10)
 (year(min(hiredate)over( )) -
 year(min(hiredate)over( ))%10)+
 row_number( )over(order by hiredate)-1 yr
```

7 from emp

8) x

9 left join

10 (

11 select year(hiredate) yr, count(*) cnt

12 from emp

13 group by year(hiredate) 14) y

15 on (x.yr = y.yr)

<b>

select year(min(hiredate)over( )) -

mod(year(min(hiredate)over( )),10) +

row_number( )over( )-1 yr, year(min(hiredate)over( )) min_year, mod(year(min(hiredate)over( )),10) mod_yr, row_number( )over( )-1 rn from emp fetch first 10 rows only</b>

```
YR MIN_YEAR MOD_YR RN

---- ---------- ---------- ----------

1980 1980 0 0

1981 1980 0 1

1982 1980 0 2

1983 1980 0 3

1984 1980 0 4

1985 1980 0 5

1986 1980 0 6

1987 1980 0 7

1988 1980 0 8
```

1989 1980 0 9

```
<b>

select min_year-mod(min_year,10)+rn as yr, min_year,

mod(min_year,10) as mod_yr rn

from (

select (select min(extract(year from hiredate)) from emp) as min_year, id-1 as rn

from t10

) x</b>
```

```
YR MIN_YEAR MOD_YR RN

---- ---------- ---------- ----------

1980 1980 0 0

1981 1980 0 1

1982 1980 0 2

1983 1980 0 3

1984 1980 0 4

1985 1980 0 5

1986 1980 0 6
```

1987 1980 0 7

1988 1980 0 8

1989 1980 0 9

```
<b>

    select year(hiredate) yr, count(*) cnt from emp

    group by year(hiredate)</b>

    YR CNT

    ----- ----------

    1980 1

    1981 10

    1982 2
```

1983 1

For the final solution, outer join inline view Y to inline view X so that every year is returned even if there are no employees hired.

Recipe 10.5. Generating Consecutive Numeric Values

Problem

You would like to have a "row source generator" available to you in your queries. Row source generators are useful for queries that require pivoting. For example, you want to return a result set such as the following, up to any number of rows that you specify:

```
ID
        ---
          1
          2
          3
          4
          5
          6
          7
          8
          9
         10
        …
```

If your RDBMS provides built-in functions for returning rows dynamically, you do not need to create a pivot table in advance with a fixed number of rows. That's why a dynamic row generator can be so handy. Otherwise, you must use a traditional pivot table with a fixed number of rows (that may not always be enough) to generate rows when needed.

Solution

This solution shows how to return 10 rows of increasing numbers starting from 1. You can easily adapt the solution to return any number of rows.

The ability to return increasing values from 1 opens the door to many other solutions. For example, you can generate numbers to add to dates in order to generate sequences of days. You can also use such numbers to parse through strings.

DB2 and SQL Server

Use the recursive WITH clause to generate a sequence of rows with incrementing values. Use a one-row table such as T1 to kick off the row generation; the WITH clause does the rest:

```
with x (id)
as (
select 1
  from t1
 union all
select id+1
  from x
 where id+1 <= 10
)
select * from x
```

Following is a second, alternative solution for DB2 only. Its advantage is that it does not require table T1:

```
with x (id)
as (
values (1)
 union all
select id+1
  from x
 where id+1 <= 10
)
select * from x
```

Oracle

Use the recursive CONNECT BY clause (Oracle9 *i* Database or later). In Oracle 9 *i* Database, you must either wrap the CONNECT BY solution in an inline view or place it in the WITH clause:

```
with x
as (
select level id
  from dual
  connect by level <= 10
)
select * from x
```

In Oracle Database 10 *g* or later, you can generate rows using the MODEL clause:

```
select array id
  from dual
 model
   dimension by (0 idx)
   measures(1 array)
   rules iterate (10) (
     array[iteration_number] = iteration_number+1
   )
```

PostgreSQL

Use the very handy function GENERATE_SERIES, which is designed for the express purpose of generating rows:

```
select id
  from generate_series (1, 10) x(id)
```

Discussion

DB2 and SQL Server

The recursive WITH clause increments ID (which starts at 1) until the WHERE clause is satisfied. To kick things off you must generate one row having the value 1. You can do this by selecting 1 from a one-row table or, in the case of DB2, by using the VALUES clause to create a one-row result set.

Oracle

The solution places the CONNECT BY subquery into the WITH clause. Rows will continue to be returned unless short-circuited by the WHERE clause. Oracle will increment the pseudo-column LEVEL automatically, so there's no need for you to do so.

In the MODEL clause solution, there is an explicit ITERATE command that allows you to generate multiple rows. Without the ITERATE clause, only one row will be returned, since DUAL has only one row. For example:

```
select array id
  from dual
model
  dimension by (0 idx)
  measures(1 array)
  rules ( )

 ID
 --
  1
```

The MODEL clause not only allows you array access to rows, it allows you to easily "create" or return rows that are not in the table you are selecting against. In this solution, IDX is the array index (location of a specific value in the array) and ARRAY (aliased ID) is the "array" of rows. The first row defaults to 1 and can be referenced with ARRAY[0]. Oracle provides the function ITERATION_NUMBER so you can track the number of times you've iterated. The solution iterates 10 times, causing ITERATION_NUMBER to go from 0 to 9. Adding 1 to each of those values yields the results 1 through 10.

It may be easier to visualize what's happening with the model clause if you execute the following query:

```
select 'array['||idx||'] = '||array as output
  from dual
 model
   dimension by (0 idx)
   measures(1 array)
   rules iterate (10) (
     array[iteration_number] = iteration_number+1
   )

OUTPUT
------------------
array[0] = 1
array[1] = 2
array[2] = 3
array[3] = 4
array[4] = 5
array[5] = 6
array[6] = 7
array[7] = 8
array[8] = 9
array[9] = 10
```

PostgreSQL

All the work is done by the function GENERATE_SERIES. The function accepts three parameters, all numeric values. The first parameter is the start value, the second parameter is the ending value, and the third parameter is an optional "step" value (how much each value is incremented by). If you do not pass a third parameter, the increment defaults to 1.

The GENERATE_SERIES function is flexible enough so that you do not have to hardcode parameters. For example, if you wanted to return five rows starting from value 10 and ending with value 30, incrementing by 5 such that the result set is the following:

```
ID
        ---
         10
         15
         20
         25
         30
```

you can be creative and do something like this:

```
select id
          from generate_series(
                 (select min(deptno) from emp),
                 (select max(deptno) from emp),
                 5
               ) x(id)
```

Notice here that the actual values passed to GENERATE_SERIES are not known when the query is written. Instead, they are generated by subqueries when the main query executes.

Chapter 11. Advanced Searching

In a very real sense, this entire book so far has been about searching. You've seen all sorts of queries that use joins and WHERE clauses and grouping techniques to search out and return the results that you need. Some types of searching operations, though, stand apart from others in that they represent a different way of thinking about searching. Perhaps you're displaying a result set one page at a time. Half of that problem is to identify (search for) the entire set of records that you want to display. The other half of that problem is to repeatedly search for the next page to display as a user cycles through the records on a display. Your first thought may not be to think of pagination as a searching problem, but it *can* be thought of that way, and it can be solved that way; that is the type of searching solution this chapter is all about.

<b>

```
select sal from (
select row_number( ) over (order by sal) as rn, sal
from emp ) x
where rn between 1 and 5
```

</b>

```
SAL
----
800
950
1100
1250
1250
```

<b>

```
select sal from (
select row_number( ) over (order by sal) as rn, sal
from emp ) x
where rn between 6 and 10
```

</b>

```
   SAL

   -----

   1300

   1500

   1600

   2450

   2850
```

<b>

select sal from emp order by sal limit 5 offset 0</b>

```
   SAL

   -----

   800

   950

   1100

   1250

   1250
```

<b>

select sal from emp order by sal limit 5 offset 5</b>

```
   SAL
```

```
-----
1300
1500
1600
2450
2850
```

<b>

```
select row_number( ) over (order by sal) as rn, sal
from emp</b>
RN SAL
-- ----------
1 800
2 950
3 1100
4 1250
5 1250
6 1300
7 1500
8 1600
9 2450
```

```
10 2850

11 2975

12 3000

13 3000
```

14 5000

```
<b>

   select sal from (

   select sal, rownum rn from (

   select sal from emp order by sal )

   )

   where rn between 6 and 10</b>

   SAL

   -----

   1300

   1500

   1600

   2450

   2850
```

Using ROWNUM forces you into writing an extra level of subquery. The innermost subquery sorts rows by salary. The next outermost subquery applies row numbers to those rows, and, finally, the very outermost SELECT returns the data you are after.

MySQL and PostgreSQL

The OFFSET clause added to the SELECT clause makes scrolling through results intuitive and easy. Specifying OFFSET 0 will start you at the first row, OFFSET 5 at the sixth row, and OFFSET 10 at the eleventh row. The LIMIT clause restricts the number of rows returned. By combining the two clauses you can easily specify where in a result set to start returning rows and how many to return.

```
ENAME
    --------
    ADAMS
    ALLEN
    BLAKE
    CLARK
    FORD
    JAMES
    JONES
    KING
    MARTIN
    MILLER
    SCOTT
    SMITH
    TURNER
    WARD
ENAME
    ----------
    ADAMS
    BLAKE
```

```
FORD

JONES

MARTIN

SCOTT

TURNER
```

1 select ename

2 from (

3 select row_number( ) over (order by ename) rn, 4 ename

5 from emp

6) x

7 where mod(rn,2) = 1

1 select x.ename

2 from (

3 select a.ename, 4 (select count(*)

5 from emp b

6 where b.ename <= a.ename) as rn

7 from emp a

```
8 ) x
9 where mod(x.rn,2) = 1
```

<b>

```
select row_number( ) over (order by ename) rn, ename from emp</b>
RN ENAME
-- --------
1 ADAMS
2 ALLEN
3 BLAKE
4 CLARK
5 FORD
6 JAMES
7 JONES
8 KING
9 MARTIN
10 MILLER
11 SCOTT
12 SMITH
```

13 TURNER

14 WARD

<b>

select a.ename, (select count(*) from emp b where b.ename <= a.ename) as rn from emp a</b>

```
ENAME RN

---------- ----------

ADAMS 1

ALLEN 2

BLAKE 3

CLARK 4

FORD 5

JAMES 6

JONES 7

KING 8

MARTIN 9

MILLER 10

SCOTT 11

SMITH 12

TURNER 13

WARD 14
```

The final step is to use the modulo function on the generated rank to skip rows.

<b>

```
select e.ename, d.deptno, d.dname, d.loc from dept d, emp e

where d.deptno = e.deptno and (e.deptno = 10 or e.deptno = 20) order by 2</b>

ENAME DEPTNO DNAME LOC

------- ---------- -------------- -----------

CLARK 10 ACCOUNTING NEW YORK

KING 10 ACCOUNTING NEW YORK

MILLER 10 ACCOUNTING NEW YORK

SMITH 20 RESEARCH DALLAS

ADAMS 20 RESEARCH DALLAS

FORD 20 RESEARCH DALLAS

SCOTT 20 RESEARCH DALLAS

JONES 20 RESEARCH DALLAS
```

<b>

```
select e.ename, d.deptno, d.dname, d.loc from dept d left join emp e on (d.deptno = e.deptno) where e.deptno = 10

or e.deptno = 20

order by 2</b>

ENAME DEPTNO DNAME LOC

------- ---------- ------------ -----------
```

```
    CLARK 10 ACCOUNTING NEW YORK

    KING 10 ACCOUNTING NEW YORK

    MILLER 10 ACCOUNTING NEW YORK

    SMITH 20 RESEARCH DALLAS

    ADAMS 20 RESEARCH DALLAS

    <a name="idx-CHP-11-0632"></a>FORD 20 RESEARCH DALLAS

    SCOTT 20 RESEARCH DALLAS

    JONES 20 RESEARCH DALLAS

ENAME DEPTNO DNAME LOC

    ------- ---------- ------------ ---------

    CLARK 10 ACCOUNTING NEW YORK

    KING 10 ACCOUNTING NEW YORK

    MILLER 10 ACCOUNTING NEW YORK

    SMITH 20 RESEARCH DALLAS

    JONES 20 RESEARCH DALLAS

    SCOTT 20 RESEARCH DALLAS

    ADAMS 20 RESEARCH DALLAS

    FORD 20 RESEARCH DALLAS

    30 SALES CHICAGO
```

40 OPERATIONS BOSTON

1 select e.ename, d.deptno, d.dname, d.loc

2 from dept d left join emp e 3 on (d.deptno = e.deptno 4 and (e.deptno=10 or e.deptno=20))

5 order by 2

```
1 select e.ename, d.deptno, d.dname, d.loc
  2 from dept d
```

3 left join

4 (select ename, deptno

5 from emp

6 where deptno in (10, 20) 7) e on (e.deptno = d.deptno)

8 order by 2

```
select e.ename, d.deptno, d.dname, d.loc

   from dept d, emp e

   where d.deptno = e.deptno (+) and d.deptno = case when e.deptno(+) =
10 then e.deptno(+) when e.deptno(+) = 20 then e.deptno(+) end

   <a name="idx-CHP-11-0634"></a> order by 2

select e.ename, d.deptno, d.dname, d.loc

   from dept d, emp e

   where d.deptno = e.deptno (+) and d.deptno =
decode(e.deptno(+),10,e.deptno(+), 20,e.deptno(+))

   order by 2

select e.ename, d.deptno, d.dname, d.loc

   from dept d,

   ( select ename, deptno from emp

   where deptno in ( 10, 20 ) ) e

   where d.deptno = e.deptno (+) order by 2
```

Discussion

DB2, MySQL, PostgreSQL, and SQL Server

Two solutions are given for these products. The first moves the OR condition into the JOIN clause, making it part of the join condition. By doing that, you can filter the rows returned from EMP without losing DEPTNOs 30 and 40 from DEPT.

The second solution moves the filtering into an inline view. Inline view E filters on EMP.DEPTNO and returns EMP rows of interest. These are then outer joined to DEPT. Because DEPT is the anchor table in the outer join, all departments, including 30 and 40, are returned.

Oracle

Use the CASE and DECODE functions as a workaround for what seems to be a bug in the older outer-join syntax. The solution using inline view E works by first finding the rows of interest in table EMP, and then outer joining to DEPT.

```
select *
   from V

   TEST1 TEST2
   ----- ----------
   20 20
   50 25
   20 20
   60 30
   70 90
   80 130
   90 70
   100 50
   110 55
   120 60
   130 80
```

140 70

```
TEST1 TEST2
 ----- ---------
 20 20
 70 90
```

80 130

```
TEST1 TEST2
    ----- ---------
    20 20
    20 20
    70 90
    80 130
    90 70
```

130 80

```
select distinct v1.*
   from V v1, V v2
   where v1.test1 = v2.test2
   and v1.test2 = v2.test1
   and v1.test1 <= v1.test2
select v1.*
   from V v1, V v2
   where v1.test1 = v2.test2
   and v1.test2 = v2.test1

   TEST1 TEST2
   ----- ----------
   20 20
   20 20
   20 20
   20 20
   90 70
   130 80
```

70 90

80 130

The use of DISTINCT ensures that duplicate rows are removed from the final result set. The final filter in the WHERE clause (and V1.TEST1 <= V1.TEST2) will ensure that only one pair of reciprocals (where TEST1 is the smaller or equal value) is returned.

```
1 select ename,sal
   2 from (
   3 select ename, sal, 4 dense_rank() over (order by sal desc) dr
```

5 from emp

```
   6 ) x

   7 where dr <= 5

1 select ename,sal

   2 from (

   3 select (select count(distinct b.sal)
```

4 from emp b

5 where a.sal <= b.sal) as rnk, 6 a.sal,

7 a.ename

8 from emp a

```
9 )
10 where rnk <= 5
```

<b>

```
select ename, sal, dense_rank( ) over (order by sal desc) dr from emp</b>
ENAME SAL DR
------- ------ ----------
KING 5000 1
SCOTT 3000 2
FORD 3000 2
JONES 2975 3
BLAKE 2850 4
CLARK 2450 5
<a name="idx-CHP-11-0645"></a>ALLEN 1600 6
TURNER 1500 7
MILLER 1300 8
WARD 1250 9
MARTIN 1250 9
ADAMS 1100 10
```

```
JAMES 950 11

SMITH 800 12
```

<b>

```
select (select count(distinct b.sal) from emp b where a.sal <= b.sal) as
rnk, a.sal,

a.ename

from emp a</b>

RNK SAL ENAME

--- ------ -------

1 5000 KING

2 3000 SCOTT

2 3000 FORD

3 2975 JONES

4 2850 BLAKE

5 2450 CLARK

6 1600 ALLEN

7 1500 TURNER

8 1300 MILLER

9 1250 WARD

9 1250 MARTIN

10 1100 ADAMS
```

11 950 JAMES

12 800 SMITH

The final step is to return only rows where RNK is less than or equal to five.

1 select ename

2 from (

3 select ename, sal, 4 min(sal)over( ) min_sal, 5 max(sal)over( ) max_sal

6 from emp

7) x

8 where sal in (min_sal,max_sal)

1 select ename

2 from emp

3 where sal in ((select min(sal) from emp), 4 (select max(sal) from emp))

<b>

select ename, sal, min(sal)over( ) min_sal, max(sal)over( ) max_sal from emp</b>

```
ENAME SAL MIN_SAL MAX_SAL

------- ------ ---------- ----------

SMITH 800 800 5000

ALLEN 1600 800 5000

WARD 1250 800 5000

JONES 2975 800 5000

MARTIN 1250 800 5000

BLAKE 2850 800 5000

CLARK 2450 800 5000

SCOTT 3000 800 5000

KING 5000 800 5000

TURNER 1500 800 5000

ADAMS 1100 800 5000

JAMES 950 800 5000
```

```
FORD 3000 800 5000

MILLER 1300 800 5000
```

Given this result set, all that's left is to return rows where SAL equals MIN_SAL or MAX_SAL.

MySQL and PostgreSQL

This solution uses two subqueries in one IN list to find the lowest and highest salaries from EMP. The rows returned by the outer query are the ones having salaries that match the values returned by either subquery.

```
ENAME SAL HIREDATE

    ---------- ---------- ---------

    SMITH 800 17-DEC-80

    ALLEN 1600 20-FEB-81

    WARD 1250 22-FEB-81

    JONES 2975 02-APR-81

    BLAKE 2850 01-MAY-81

    CLARK 2450 09-JUN-81

    TURNER 1500 08-SEP-81

    MARTIN 1250 28-SEP-81

    KING 5000 17-NOV-81

    JAMES 950 03-DEC-81

    FORD 3000 03-DEC-81

    MILLER 1300 23-JAN-82

    SCOTT 3000 09-DEC-82

    ADAMS 1100 12-JAN-83
```

```
1 select ename, sal, hiredate

    2 from (

    3 select a.ename, a.sal, a.hiredate, 4 (select min(hiredate) from emp b 5
where b.hiredate > a.hiredate 6 and b.sal > a.sal ) as next_sal_grtr, 7 (select
min(hiredate) from emp b 8 where b.hiredate > a.hiredate) as next_hire
```

9 from emp a

10) x

11 where next_sal_grtr = next_hire

1 select ename, sal, hiredate

2 from (

3 select ename, sal, hiredate, 4 lead(sal)over(order by hiredate) next_sal

5 from emp

```
6 )

7 where sal < next_sal
```

<b>

```
select a.ename, a.sal, a.hiredate, (select min(hiredate) from emp b where b.hiredate > a.hiredate and b.sal > a.sal ) as next_sal_grtr, (select min(hiredate) from emp b where b.hiredate > a.hiredate) as next_hire from emp a</b>
```

```
ENAME SAL HIREDATE NEXT_SAL_GRTR NEXT_HIRE

------- ------ --------- ------------- ---------

SMITH 800 17-DEC-80 20-FEB-81 20-FEB-81

ALLEN 1600 20-FEB-81 02-APR-81 22-FEB-81

WARD 1250 22-FEB-81 02-APR-81 02-APR-81

JONES 2975 02-APR-81 17-NOV-81 01-MAY-81

MARTIN 1250 28-SEP-81 17-NOV-81 17-NOV-81

BLAKE 2850 01-MAY-81 17-NOV-81 09-JUN-81

CLARK 2450 09-JUN-81 17-NOV-81 08-SEP-81

SCOTT 3000 09-DEC-82 12-JAN-83

KING 5000 17-NOV-81 03-DEC-81

TURNER 1500 08-SEP-81 17-NOV-81 28-SEP-81
```

```
ADAMS 1100 12-JAN-83

JAMES 950 03-DEC-81 23-JAN-82 23-JAN-82

FORD 3000 03-DEC-81 23-JAN-82

MILLER 1300 23-JAN-82 09-DEC-82 09-DEC-82
```

<b>

select ename, sal, hiredate, lead(sal)over(order by hiredate) next_sal from emp</b>

```
ENAME SAL HIREDATE NEXT_SAL

------- ------ --------- ----------

SMITH 800 17-DEC-80 1600

ALLEN 1600 20-FEB-81 1250

WARD 1250 22-FEB-81 2975

JONES 2975 02-APR-81 2850

BLAKE 2850 01-MAY-81 2450

CLARK 2450 09-JUN-81 1500

TURNER 1500 08-SEP-81 1250

MARTIN 1250 28-SEP-81 5000

KING 5000 17-NOV-81 950

JAMES 950 03-DEC-81 3000

FORD 3000 03-DEC-81 1300
```

```
   MILLER 1300 23-JAN-82 3000

   SCOTT 3000 09-DEC-82 1100

   ADAMS 1100 12-JAN-83
```

```
select ename, sal, hiredate

   from (

   select ename, sal, hiredate, lead(sal,cnt-rn+1)over(order by hiredate)
next_sal from (

   select ename,sal,hiredate, count(*)over(partition by hiredate) cnt,
row_number( )over(partition by hiredate order by empno) rn from emp

   )

   )

   where sal < next_sal
```

The idea behind this solution is to find the distance from the current row to the row it should be compared with. For example, if there are five duplicates, the first of the five needs to leap five rows to get to its correct LEAD OVER row. The value for CNT represents, for each employee with a duplicate HIREDATE, how many duplicates there are in total for their HIREDATE. The value for RN represents a ranking for the employees in DEPTNO 10. The rank is partitioned by HIREDATE so only employees with a HIREDATE that another employee has will have a value greater than one. The ranking is sorted by EMPNO (this is arbitrary). Now that you now how many total duplicates there are and you have a ranking of each duplicate, the distance to the next HIREDATE is simply the total number of duplicates minus the current rank plus one (CNT-RN+1).

See Also

For additional examples of using LEAD OVER in the presence of duplicates (and a more thorough discussion of the technique above): Chapter 8, the section on "Determining the Date Difference Between the Current Record and the Next Record" and Chapter 10, the section on "Finding Differences Between Rows in the Same Group or Partition."

```
ENAME SAL FORWARD REWIND

    ---------- ---------- ---------- ----------

    SMITH 800 950 5000

    JAMES 950 1100 800

    ADAMS 1100 1250 950

    WARD 1250 1250 1100

    MARTIN 1250 1300 1250

    MILLER 1300 1500 1250

    TURNER 1500 1600 1300

    ALLEN 1600 2450 1500

    CLARK 2450 2850 1600

    BLAKE 2850 2975 2450

    JONES 2975 3000 2850

    SCOTT 3000 3000 2975

    FORD 3000 5000 3000

    KING 5000 800 3000
```

```
1 select e.ename, e.sal,

    2 coalesce(

    3 (select min(sal) from emp d where d.sal > e.sal), 4 (select min(sal) from
emp) 5 ) as forward, 6 coalesce(
```

7 (select max(sal) from emp d where d.sal < e.sal), 8 (select max(sal) from emp) 9) as rewind

10 from emp e

11 order by 2

1 select ename,sal,

2 nvl(lead(sal)over(order by sal),min(sal)over()) forward, 3 nvl(lag(sal)over(order by sal),max(sal)over()) rewind

4 from emp

<b>

select ename,sal, lead(sal)over(order by sal) forward, lag(sal)over(order by sal) rewind from emp</b>

```
ENAME SAL FORWARD REWIND

---------- ---------- ---------- ----------

SMITH 800 950

JAMES 950 1100 800

ADAMS 1100 1250 950

WARD 1250 1250 1100

MARTIN 1250 1300 1250

MILLER 1300 1500 1250

TURNER 1500 1600 1300

ALLEN 1600 2450 1500

CLARK 2450 2850 1600

BLAKE 2850 2975 2450

JONES 2975 3000 2850

SCOTT 3000 3000 2975

FORD 3000 5000 3000

KING 5000 3000
```

<b>

```
select ename,sal, nvl(lead(sal)over(order by sal),min(sal)over( )) forward,
nvl(lag(sal)over(order by sal),max(sal)over( )) rewind from emp</b>

ENAME SAL FORWARD REWIND

---------- ---------- ---------- ----------

SMITH 800 950 5000

JAMES 950 1100 800

ADAMS 1100 1250 950

WARD 1250 1250 1100

MARTIN 1250 1300 1250

MILLER 1300 1500 1250

TURNER 1500 1600 1300

ALLEN 1600 2450 1500

CLARK 2450 2850 1600

BLAKE 2850 2975 2450

JONES 2975 3000 2850

SCOTT 3000 3000 2975

FORD 3000 5000 3000

KING 5000 800 3000
```

<b>

```
select ename,sal, lead(sal,3)over(order by sal) forward,
lag(sal,5)over(order by sal) rewind from emp</b>

ENAME SAL FORWARD REWIND

---------- ---------- ---------- ----------

SMITH 800 1250

JAMES 950 1250

ADAMS 1100 1300

WARD 1250 1500

MARTIN 1250 1600

MILLER 1300 2450 800

TURNER 1500 2850 950

ALLEN 1600 2975 1100

CLARK 2450 3000 1250

BLAKE 2850 3000 1250

JONES 2975 5000 1300

SCOTT 3000 1500

FORD 3000 1600

KING 5000 2450
```

```
RNK SAL
    --- -------
    1 800
    2 950
    3 1100
    4 1250
    4 1250
    5 1300
    6 1500
    7 1600
    8 2450
    9 2850
    10 2975
    11 3000
    11 3000
```

12 5000

1 select dense_rank() over(order by sal) rnk, sal

2 from emp

1 select (select count(distinct b.sal)

2 from emp b

3 where b.sal <= a.sal) as rnk, 4 a.sal

5 from emp a

Discussion

DB2, Oracle, and SQL Server

The window function DENSE_RANK OVER does all the legwork here. In parentheses following the OVER keyword you place an ORDER BY clause to specify the order in which rows are ranked. The solution uses ORDER BY SAL, so rows from EMP are ranked in ascending order of salary.

MySQL and PostgreSQL

The output from the scalar subquery solution is similar to that of DENSE_RANK because the driving predicate in the scalar subquery is on SAL.

```
JOB
   ---------
   ANALYST
   CLERK
   MANAGER
   PRESIDENT
   SALESMAN
```

1 select job

2 from (

3 select job, 4 row_number( )over(partition by job order by job) rn

5 from emp

```
   6 ) x

   7 where rn = 1

select distinct job

   from emp

select job

   from emp group by job

<b>

   select job, row_number()over(partition by job order by job) rn from emp
</b>


   JOB RN

   --------- ----------

   ANALYST 1

   ANALYST 2

   CLERK 1

   CLERK 2

   CLERK 3

   CLERK 4

   MANAGER 1
   MANAGER 2
   MANAGER 3
   PRESIDENT 1
   SALESMAN 1
   SALESMAN 2
   SALESMAN 3
   SALESMAN 4
```

select distinct job select distinct job, deptno from emp from emp

```
JOB JOB DEPTNO
--------- --------- ----------
ANALYST ANALYST 20
CLERK CLERK 10
MANAGER CLERK 20
PRESIDENT CLERK 30
SALESMAN MANAGER 10
MANAGER 20
MANAGER 30
PRESIDENT 10
SALESMAN 30
```

By adding DEPTNO to the SELECT list, what you return is each DISTINCT pair of JOB/DEPTNO values from table EMP.

The second solution uses GROUP BY to suppress duplicates. While using GROUP BY this way is not uncommon, keep in mind that GROUP BY and DISTINCT are two very different clauses that are not interchangeable. I've included GROUP BY in this solution for completeness, as you will no doubt come across it at some point.

```
DEPTNO ENAME SAL HIREDATE LATEST_SAL

 ------ ---------- ---------- ----------- ----------

 10 MILLER 1300 23-JAN-1982 1300

 10 KING 5000 17-NOV-1981 1300

 10 CLARK 2450 09-JUN-1981 1300

 20 ADAMS 1100 12-JAN-1983 1100

 20 SCOTT 3000 09-DEC-1982 1100

 20 FORD 3000 03-DEC-1981 1100

 20 JONES 2975 02-APR-1981 1100

 20 SMITH 800 17-DEC-1980 1100

 30 JAMES 950 03-DEC-1981 950

 30 MARTIN 1250 28-SEP-1981 950

 30 TURNER 1500 08-SEP-1981 950

 30 BLAKE 2850 01-MAY-1981 950

 30 WARD 1250 22-FEB-1981 950
```

```
30 ALLEN 1600 20-FEB-1981 950
```

```
select deptno,
   ename,
   sal,
   hiredate,
   max(latest_sal)over(partition by deptno) latest_sal
from (
   select deptno,
   ename,
   sal,
   hiredate,
```

11 case

12 when hiredate = max(hiredate)over(partition by deptno) 13 then sal else 0

14 end latest_sal

```
15 from emp
16 ) x
17 order by 1, 4 desc
1 select e.deptno,
2 e.ename,
3 e.sal,
4 e.hiredate,
5 (select max(d.sal)
```

6 from emp d

7 where d.deptno = e.deptno 8 and d.hiredate =

9 (select max(f.hiredate)

10 from emp f

11 where f.deptno = e.deptno)) as latest_sal

12 from emp e

13 order by 1, 4 desc

1 select deptno,

2 ename,

3 sal,

4 hiredate,

5 max(sal)

6 keep(dense_rank last order by hiredate) 7 over(partition by deptno) latest_sal

8 from emp

```
9 order by 1, 4 desc
```

<b>

```
select deptno,
ename,
sal,
hiredate,
case
when hiredate = max(hiredate)over(partition by deptno) then sal else 0
end latest_sal
from emp
```

</b>

```
DEPTNO ENAME SAL HIREDATE LATEST_SAL
------ --------- ----------- ----------- ----------
10 CLARK 2450 09-JUN-1981 0
10 KING 5000 17-NOV-1981 0
10 MILLER 1300 23-JAN-1982 1300
20 SMITH 800 17-DEC-1980 0
```

```
20 ADAMS 1100 12-JAN-1983 1100

20 FORD 3000 03-DEC-1981 0

20 SCOTT 3000 09-DEC-1982 0

20 JONES 2975 02-APR-1981 0

30 ALLEN 1600 20-FEB-1981 0

30 BLAKE 2850 01-MAY-1981 0

30 MARTIN 1250 28-SEP-1981 0

30 JAMES 950 03-DEC-1981 950

30 TURNER 1500 08-SEP-1981 0
```

30 WARD 1250 22-FEB-1981 0

<b>

```
select deptno,
ename,
sal,
hiredate,
max(latest_sal)over(partition by deptno) latest_sal from (
select deptno,
ename,
sal,
hiredate,
case
when hiredate = max(hiredate)over(partition by deptno) then sal else 0
end latest_sal
from emp
) x
order by 1, 4 desc </b>

DEPTNO ENAME SAL HIREDATE LATEST_SAL
```

```
------- --------- ---------- ----------- ----------

10 MILLER 1300 23-JAN-1982 1300

10 KING 5000 17-NOV-1981 1300

10 CLARK 2450 09-JUN-1981 1300

20 ADAMS 1100 12-JAN-1983 1100

20 SCOTT 3000 09-DEC-1982 1100

20 FORD 3000 03-DEC-1981 1100

20 JONES 2975 02-APR-1981 1100

20 SMITH 800 17-DEC-1980 1100

30 JAMES 950 03-DEC-1981 950

30 MARTIN 1250 28-SEP-1981 950

30 TURNER 1500 08-SEP-1981 950

30 BLAKE 2850 01-MAY-1981 950

30 WARD 1250 22-FEB-1981 950
```

30 ALLEN 1600 20-FEB-1981 950

<b>

```
    select e.deptno, e.ename,

    e.sal,

    e.hiredate,

    (select max(f.hiredate) from emp f

    where f.deptno = e.deptno) as last_hire from emp e

    order by 1, 4 desc </b>


    DEPTNO ENAME SAL HIREDATE LAST_HIRE

    ------ ---------- ---------- ----------- -----------

    10 MILLER 1300 23-JAN-1982 23-JAN-1982

    10 KING 5000 17-NOV-1981 23-JAN-1982

    10 CLARK 2450 09-JUN-1981 23-JAN-1982

    20 ADAMS 1100 12-JAN-1983 12-JAN-1983

    20 SCOTT 3000 09-DEC-1982 12-JAN-1983

    20 FORD 3000 03-DEC-1981 12-JAN-1983

    20 JONES 2975 02-APR-1981 12-JAN-1983

    20 SMITH 800 17-DEC-1980 12-JAN-1983
```

```
30 JAMES 950 03-DEC-1981 03-DEC-1981

30 MARTIN 1250 28-SEP-1981 03-DEC-1981

30 TURNER 1500 08-SEP-1981 03-DEC-1981

30 BLAKE 2850 01-MAY-1981 03-DEC-1981

30 WARD 1250 22-FEB-1981 03-DEC-1981
```

30 ALLEN 1600 20-FEB-1981 03-DEC-1981

<b>

```
select e.deptno, e.ename,

e.sal,

e.hiredate,

(select max(d.sal) from emp d

where d.deptno = e.deptno and d.hiredate =

(select max(f.hiredate) from emp f

where f.deptno = e.deptno)) as latest_sal from emp e

order by 1, 4 desc </b>


DEPTNO ENAME SAL HIREDATE LATEST_SAL

------ ---------- ---------- ----------- ----------

10 MILLER 1300 23-JAN-1982 1300

10 KING 5000 17-NOV-1981 1300

10 CLARK 2450 09-JUN-1981 1300

20 ADAMS 1100 12-JAN-1983 1100

20 SCOTT 3000 09-DEC-1982 1100

20 FORD 3000 03-DEC-1981 1100
```

```
20 JONES 2975 02-APR-1981 1100

20 SMITH 800 17-DEC-1980 1100

30 JAMES 950 03-DEC-1981 950

30 MARTIN 1250 28-SEP-1981 950

30 TURNER 1500 08-SEP-1981 950

30 BLAKE 2850 01-MAY-1981 950

30 WARD 1250 22-FEB-1981 950
```

30 ALLEN 1600 20-FEB-1981 950

<b>

```
select deptno,
ename,
sal,
hiredate,
max(sal) over(partition by deptno) latest_sal from emp
order by 1, 4 desc </b>
```

```
DEPTNO ENAME SAL HIREDATE LATEST_SAL
------ ---------- ---------- ----------- ----------
10 MILLER 1300 23-JAN-1982 5000
10 KING 5000 17-NOV-1981 5000
10 CLARK 2450 09-JUN-1981 5000
20 ADAMS 1100 12-JAN-1983 3000
20 SCOTT 3000 09-DEC-1982 3000
20 FORD 3000 03-DEC-1981 3000
20 JONES 2975 02-APR-1981 3000
20 SMITH 800 17-DEC-1980 3000
```

```
30 JAMES 950 03-DEC-1981 2850

30 MARTIN 1250 28-SEP-1981 2850

30 TURNER 1500 08-SEP-1981 2850

30 BLAKE 2850 01-MAY-1981 2850

30 WARD 1250 22-FEB-1981 2850
```

30 ALLEN 1600 20-FEB-1981 2850

<b>

select deptno,

ename,

sal,

hiredate,

max(sal)

keep(dense_rank last order by hiredate) over(partition by deptno) latest_sal from emp

order by 1, 4 desc </b>

```
DEPTNO ENAME SAL HIREDATE LATEST_SAL

------ ---------- ---------- ----------- ----------

10 MILLER 1300 23-JAN-1982 1300

10 KING 5000 17-NOV-1981 1300

10 CLARK 2450 09-JUN-1981 1300

20 ADAMS 1100 12-JAN-1983 1100

20 SCOTT 3000 09-DEC-1982 1100

20 FORD 3000 03-DEC-1981 1100

20 JONES 2975 02-APR-1981 1100
```

```
20 SMITH 800 17-DEC-1980 1100

30 JAMES 950 03-DEC-1981 950

30 MARTIN 1250 28-SEP-1981 950

30 TURNER 1500 08-SEP-1981 950

30 BLAKE 2850 01-MAY-1981 950

30 WARD 1250 22-FEB-1981 950
```

30 ALLEN 1600 20-FEB-1981 950

```
<b>

select deptno,

ename,

sal,

hiredate,

max(sal)

keep(dense_rank first order by hiredate desc) over(partition by deptno)
latest_sal from emp

order by 1, 4 desc </b>
```

```
DEPTNO ENAME SAL HIREDATE LATEST_SAL

------ ---------- ---------- ----------- ----------

10 MILLER 1300 23-JAN-1982 1300

10 KING 5000 17-NOV-1981 1300

10 CLARK 2450 09-JUN-1981 1300

20 ADAMS 1100 12-JAN-1983 1100

20 SCOTT 3000 09-DEC-1982 1100

20 FORD 3000 03-DEC-1981 1100
```

```
20 JONES 2975 02-APR-1981 1100

20 SMITH 800 17-DEC-1980 1100

30 JAMES 950 03-DEC-1981 950

30 MARTIN 1250 28-SEP-1981 950

30 TURNER 1500 08-SEP-1981 950

30 BLAKE 2850 01-MAY-1981 950

30 WARD 1250 22-FEB-1981 950
```

30 ALLEN 1600 20-FEB-1981 950

```
ID ORDER_DATE PROCESS_DATE
 -- ----------- ------------
 1 25-SEP-2005 27-SEP-2005
 2 26-SEP-2005 28-SEP-2005
```

3 27-SEP-2005 29-SEP-2005

```
ID ORDER_DATE PROCESS_DATE VERIFIED SHIPPED
 -- ----------- ------------ ----------- -----------
 1 25-SEP-2005 27-SEP-2005
 1 25-SEP-2005 27-SEP-2005 28-SEP-2005
 1 25-SEP-2005 27-SEP-2005 28-SEP-2005 29-SEP-2005
 2 26-SEP-2005 28-SEP-2005
 2 26-SEP-2005 28-SEP-2005 29-SEP-2005
 2 26-SEP-2005 28-SEP-2005 29-SEP-2005 30-SEP-2005
 3 27-SEP-2005 29-SEP-2005
 3 27-SEP-2005 29-SEP-2005 30-SEP-2005
```

3 27-SEP-2005 29-SEP-2005 30-SEP-2005 01-OCT-2005

```
with <a name="idx-CHP-11-0691"></a>nrows(n) as (
   select 1 from t1 union all select n+1 from nrows where n+1 <= 3
   )
   select id,
   order_date,
   process_date, case when nrows.n >= 2
   then process_date+1
```

10 else null

11 end as verified, 12 case when nrows.n = 3

13 then process_date+2

14 else null

15 end as shipped

16 from (

17 select nrows.n id, 18 getdate()+nrows.n as order_date, 19 getdate()+nrows.n+2 as process_date

20 from nrows

21) orders, nrows

22 order by 1

1 with nrows as (

2 select level n

3 from dual

4 connect by level <= 3

5)

6 select id,

7 order_date,

8 process_date, 9 case when nrows.n >= 2

10 then process_date+1

11 else null

12 end as verified, 13 case when nrows.n = 3

14 then process_date+2

15 else null

16 end as shipped

17 from (

18 select nrows.n id, 19 sysdate+nrows.n as order_date, 20 sysdate+nrows.n+2 as process_date

21 from nrows

22) orders, nrows

1 select id,

2 order_date,

3 process_date, 4 case when gs.n >= 2

5 then process_date+1

6 else null

7 end as verified, 8 case when gs.n = 3

9 then process_date+2

10 else null

11 end as shipped

12 from (

13 select gs.id, 14 current_date+gs.id as order_date, 15 current_date+gs.id+2 as process_date 16 from generate_series(1,3) gs (id) 17) orders,

18 generate_series(1,3)gs(n)

with nrows(n) as (

select 1 from t1 union all select n+1 from nrows where n+1 <= 3

)

select nrows.n id, <a name="idx-CHP-11-0694"></a>getdate()+nrows.n as order_date, getdate()+nrows.n+2 as process_date from nrows

ID ORDER_DATE PROCESS_DATE

-- ----------- ------------

1 25-SEP-2005 27-SEP-2005

2 26-SEP-2005 28-SEP-2005

3 27-SEP-2005 29-SEP-2005

```
with nrows(n) as (

   select 1 from t1 union all select n+1 from nrows where n+1 <= 3

   )

   select nrows.n, orders.*

   from (

   select nrows.n id, getdate()+nrows.n as order_date, getdate()+nrows.n+2
as process_date from nrows

   ) orders, nrows order by 2,1



   N ID ORDER_DATE PROCESS_DATE

   --- --- ----------- ------------

   1 1 25-SEP-2005 27-SEP-2005

   2 1 25-SEP-2005 27-SEP-2005

   3 1 25-SEP-2005 27-SEP-2005

   1 2 26-SEP-2005 28-SEP-2005

   2 2 26-SEP-2005 28-SEP-2005

   3 2 26-SEP-2005 28-SEP-2005

   1 3 27-SEP-2005 29-SEP-2005

   2 3 27-SEP-2005 29-SEP-2005
```

3 3 27-SEP-2005 29-SEP-2005

```
with nrows(n) as (
   select 1 from t1 union all select n+1 from nrows where n+1 <= 3
   )
   select id,
   order_date,
   process_date,
   case when nrows.n >= 2
   then process_date+1
   else null

   end as verified, case when nrows.n = 3
   then process_date+2
   else null
   end as shipped from (
   select nrows.n id, getdate()+nrows.n as order_date, getdate()+nrows.n+2
as process_date from nrows
   ) orders, nrows order by 1


   ID ORDER_DATE PROCESS_DATE VERIFIED SHIPPED
```

```
-- ----------- ------------ ----------- -----------

1 25-SEP-2005 27-SEP-2005

1 25-SEP-2005 27-SEP-2005 28-SEP-2005

1 25-SEP-2005 27-SEP-2005 28-SEP-2005 29-SEP-2005

2 26-SEP-2005 28-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005 30-SEP-2005

3 27-SEP-2005 29-SEP-2005

3 27-SEP-2005 29-SEP-2005 30-SEP-2005
```

3 27-SEP-2005 29-SEP-2005 30-SEP-2005 01-OCT-2005

```
with nrows as (
   select level n
   from dual
   connect by level <= 3
   )
   select nrows.n id, sysdate+nrows.n order_date, sysdate+nrows.n+2
process_date from nrows


   ID ORDER_DATE PROCESS_DATE
   -- ----------- ------------
   1 25-SEP-2005 27-SEP-2005
   2 26-SEP-2005 28-SEP-2005
```

3 27-SEP-2005 29-SEP-2005

```
with nrows as (

   select level n

   from dual

   connect by level <= 3

   )

   select nrows.n, orders.*

   from (

   select nrows.n id, sysdate+nrows.n order_date, sysdate+nrows.n+2
process_date from nrows

   ) orders, nrows

   N ID ORDER_DATE PROCESS_DATE

   --- --- ----------- ------------

   1 1 25-SEP-2005 27-SEP-2005

   2 1 25-SEP-2005 27-SEP-2005

   3 1 25-SEP-2005 27-SEP-2005

   1 2 26-SEP-2005 28-SEP-2005

   2 2 26-SEP-2005 28-SEP-2005

   3 2 26-SEP-2005 28-SEP-2005

   1 3 27-SEP-2005 29-SEP-2005
```

2 3 27-SEP-2005 29-SEP-2005

3 3 27-SEP-2005 29-SEP-2005

```
with nrows as (
   select level n
   from dual
   connect by level <= 3
   )
   select id,
   order_date,
   process_date,
   case when nrows.n >= 2
   then process_date+1
   else null
   end as verified, case when nrows.n = 3
   then process_date+2
   else null
   end as shipped from (
   select nrows.n id, sysdate+nrows.n order_date, sysdate+nrows.n+2
process_date from nrows
   ) orders, nrows
   ID ORDER_DATE PROCESS_DATE VERIFIED SHIPPED
```

```
-- ----------- ------------ ----------- -----------

1 25-SEP-2005 27-SEP-2005

1 25-SEP-2005 27-SEP-2005 28-SEP-2005

1 25-SEP-2005 27-SEP-2005 28-SEP-2005 29-SEP-2005

2 26-SEP-2005 28-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005 30-SEP-2005

3 27-SEP-2005 29-SEP-2005

3 27-SEP-2005 29-SEP-2005 30-SEP-2005
```

3 27-SEP-2005 29-SEP-2005 30-SEP-2005 01-OCT-2005

```
select gs.id,

   current_date+gs.id as order_date, current_date+gs.id+2 as process_date
from generate_series(1,3) gs (id)

   ID ORDER_DATE PROCESS_DATE

   -- ----------- ------------

   1 25-SEP-2005 27-SEP-2005

   2 26-SEP-2005 28-SEP-2005
```

3 27-SEP-2005 29-SEP-2005

```
select gs.n,

   orders.*

   from (

   select gs.id,

   current_date+gs.id as order_date, current_date+gs.id+2 as process_date
from generate_series(1,3) gs (id) ) orders,

   generate_series(1,3)gs(n)

   N ID ORDER_DATE PROCESS_DATE

   --- --- ----------- ------------

   1 1 25-SEP-2005 27-SEP-2005

   2 1 25-SEP-2005 27-SEP-2005

   3 1 25-SEP-2005 27-SEP-2005

   1 2 26-SEP-2005 28-SEP-2005

   2 2 26-SEP-2005 28-SEP-2005

   3 2 26-SEP-2005 28-SEP-2005

   1 3 27-SEP-2005 29-SEP-2005

   2 3 27-SEP-2005 29-SEP-2005
```

3 3 27-SEP-2005 29-SEP-2005

```
select id,
    order_date,
    process_date,
    case when gs.n >= 2
    then process_date+1
    else null
    end as verified, case when gs.n = 3
    then process_date+2
    else null
    end as shipped from (
    select gs.id,
    current_date+gs.id as order_date, current_date+gs.id+2 as process_date
from generate_series(1,3) gs(id) ) orders,
    generate_series(1,3)gs(n)
```

```
    ID ORDER_DATE PROCESS_DATE VERIFIED SHIPPED
    -- ----------- ------------ ----------- -----------
    1 25-SEP-2005 27-SEP-2005
    1 25-SEP-2005 27-SEP-2005 28-SEP-2005
    1 25-SEP-2005 27-SEP-2005 28-SEP-2005 29-SEP-2005
```

```
2 26-SEP-2005 28-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005

2 26-SEP-2005 28-SEP-2005 29-SEP-2005 30-SEP-2005

3 27-SEP-2005 29-SEP-2005

3 27-SEP-2005 29-SEP-2005 30-SEP-2005
```

3 27-SEP-2005 29-SEP-2005 30-SEP-2005 01-OCT-2005

The final result set expresses the complete order process from the day the order was received to the day it should be shipped.

Chapter 12. Reporting and Warehousing

This chapter introduces queries you may find helpful for creating reports. These typically involve reporting-specific formatting considerations along with different levels of aggregation. Another focus of this chapter is on transposing or pivoting result sets, converting rows into columns. Pivoting is an extremely useful technique for solving a variety of problems. As your comfort level increases with pivoting, you'll undoubtedly find uses for it outside of what are presented in this chapter.

```
DEPTNO CNT
 ------ ----------
 10 3
 20 5
```

30 6

```
DEPTNO_10 DEPTNO_20 DEPTNO_30

   --------- ---------- ----------
```

3 5 6

```
select sum(case when deptno=10 then 1 else 0 end) as deptno_10,
sum(case when deptno=20 then 1 else 0 end) as deptno_20,
sum(case when deptno=30 then 1 else 0 end) as deptno_30
```

4 from emp

<b>

```
   select deptno,

   case when deptno=10 then 1 else 0 end as deptno_10, case when deptno=20 then 1 else 0 end as deptno_20, case when deptno=30 then 1 else 0 end as deptno_30

   from emp

   order by 1</b>
```

```
   DEPTNO DEPTNO_10 DEPTNO_20 DEPTNO_30

   ------ ---------- ---------- ----------

   10 1 0 0

   10 1 0 0

   10 1 0 0

   20 0 1 0

   20 0 1 0

   20 0 1 0

   20 0 1 0

   30 0 0 1

   30 0 0 1

   30 0 0 1
```

30 0 0 1

30 0 0 1

30 0 0 1

<b>

select deptno,

sum(case when deptno=10 then 1 else 0 end) as deptno_10, sum(case when deptno=20 then 1 else 0 end) as deptno_20, sum(case when deptno=30 then 1 else 0 end) as deptno_30

from emp

group by deptno</b>

DEPTNO DEPTNO_10 DEPTNO_20 DEPTNO_30

------ ---------- ---------- ----------

10 3 0 0

20 0 5 0

30 0 0 6

<b>

```
   select sum(case when deptno=10 then 1 else 0 end) as deptno_10,
sum(case when deptno=20 then 1 else 0 end) as deptno_20, sum(case when
deptno=30 then 1 else 0 end) as deptno_30

   from emp</b>

   DEPTNO_10 DEPTNO_20 DEPTNO_30

   --------- ---------- ----------
```

3 5 6

```
select max(case when deptno=10 then empcount else null end) as
deptno_10

   max(case when deptno=20 then empcount else null end) as deptno_20,
max(case when deptno=10 then empcount else null end) as deptno_30

   from (

   select deptno, count(*) as empcount from emp

   group by deptno

   ) x

DEPTNO_10 DEPTNO_20 DEPTNO_30

   --------- ---------- ----------
```

```
3 NULL NULL

NULL 5 NULL

   NULL NULL 6

DEPTNO_10 DEPTNO_20 DEPTNO_30

   --------- ---------- ----------
```

```
JOB ENAME
    --------- ----------
    ANALYST SCOTT
    ANALYST FORD
    CLERK SMITH
    CLERK ADAMS
    CLERK MILLER
    CLERK JAMES
    MANAGER JONES
    MANAGER CLARK
    MANAGER BLAKE
    PRESIDENT KING
    SALESMAN ALLEN
    SALESMAN MARTIN
    SALESMAN TURNER
    SALESMAN WARD
CLERKS ANALYSTS MGRS PREZ SALES
    ------ -------- ----- ---- ------
    MILLER FORD CLARK KING TURNER
    JAMES SCOTT BLAKE MARTIN
```

ADAMS JONES WARD

SMITH ALLEN

1 select max(case when job='CLERK'

2 then ename else null end) as clerks, 3 max(case when job='ANALYST'

4 then ename else null end) as analysts, 5 max(case when job='MANAGER'

6 then ename else null end) as mgrs, 7 max(case when job='PRESIDENT'

8 then ename else null end) as prez, 9 max(case when job='SALESMAN'

10 then ename else null end) as sales 11 from (

12 select job,

13 ename,

14 row_number()over(partition by job order by ename) rn

15 from emp

16) x

17 group by rn

1 select max(case when job='CLERK'

2 then ename else null end) as clerks, 3 max(case when job='ANALYST'

4 then ename else null end) as analysts, 5 max(case when job='MANAGER'

6 then ename else null end) as mgrs, 7 max(case when job='PRESIDENT'

8 then ename else null end) as prez, 9 max(case when job='SALESMAN'

10 then ename else null end) as sales 11 from (

12 select e.job,

13 e.ename,

14 (select count(*) from emp d 15 where e.job=d.job and e.empno < d.empno) as rnk

16 from emp e

17) x

18 group by rnk

<b>

```
    select job,

    ename,

    row_number()over(partition by job order by ename) rn from emp</b>


    JOB ENAME RN

    --------- ---------- ----------

    ANALYST FORD 1

    ANALYST SCOTT 2

    CLERK ADAMS 1

    CLERK JAMES 2

    CLERK MILLER 3

    CLERK SMITH 4

    MANAGER BLAKE 1

    MANAGER CLARK 2

    MANAGER JONES 3

    PRESIDENT KING 1

    SALESMAN ALLEN 1
```

```
   SALESMAN MARTIN 2

   SALESMAN TURNER 3

   SALESMAN WARD 4

<b>

   select max(case when job='CLERK'

   then ename else null end) as clerks, max(case when job='ANALYST'

   then ename else null end) as analysts, max(case when job='MANAGER'

   then ename else null end) as mgrs, max(case when job='PRESIDENT'

   then ename else null end) as prez, max(case when job='SALESMAN'

   then ename else null end) as sales from emp</b>


   CLERKS ANALYSTS MGRS PREZ SALES

   ---------- ---------- ---------- ---------- ----------

   SMITH SCOTT JONES KING WARD

<b>

   select rn,

   case when job='CLERK'

   then ename else null end as clerks, case when job='ANALYST'

   then ename else null end as analysts, case when job='MANAGER'

   then ename else null end as mgrs, case when job='PRESIDENT'
   then ename else null end as prez, case when job='SALESMAN'

   then ename else null end as sales from (

   Select job,

   ename,

   row_number()over(partition by job order by ename) rn from emp

   ) x</b>
```

```
RN CLERKS ANALYSTS MGRS PREZ SALES

-- ---------- ---------- ---------- ---------- ----------

1 FORD

2 SCOTT

1 ADAMS

2 JAMES

3 MILLER

4 SMITH

1 BLAKE

2 CLARK

3 JONES

1 KING

1 ALLEN
```

2 MARTIN

3 TURNER

4 WARD

```
<b>
    select max(case when job='CLERK'
    then ename else null end) as clerks, max(case when job='ANALYST'
    then ename else null end) as analysts, max(case when job='MANAGER'
    then ename else null end) as mgrs, max(case when job='PRESIDENT'
    then ename else null end) as prez, max(case when job='SALESMAN'
    then ename else null end) as sales from (
    Select job,
    ename,
    row_number()over(partition by job order by ename) rn from emp
    ) x
    group by rn</b>
    CLERKS ANALYSTS MGRS PREZ SALES
    ------ -------- ----- ---- ------
    MILLER FORD CLARK KING TURNER
    JAMES SCOTT BLAKE MARTIN
    ADAMS JONES WARD
    SMITH ALLEN
```

```
<b>

   select deptno dno, job, max(case when deptno=10

   then ename else null end) as d10, max(case when deptno=20

   then ename else null end) as d20, max(case when deptno=30

   then ename else null end) as d30, max(case when job='CLERK'

   then ename else null end) as clerks, max(case when job='ANALYST'

   then ename else null end) as anals, max(case when job='MANAGER'

   then ename else null end) as mgrs, max(case when job='PRESIDENT'

   then ename else null end) as prez, max(case when job='SALESMAN'

   then ename else null end) as sales from (

   Select deptno,

   job,

   ename,

   row_number()over(partition by job order by ename) rn_job,
row_number()over(partition by job order by ename) rn_deptno from emp

   ) x

   group by deptno, job, rn_deptno, rn_job order by 1</b>

   DNO JOB D10 D20 D30 CLERKS ANALS MGRS PREZ SALES

   --- --------- ------ ----- ------ ------ ----- ----- ---- ------

   10 CLERK MILLER MILLER

   10 MANAGER CLARK CLARK
```

```
10 PRESIDENT KING KING

20 ANALYST FORD FORD

20 ANALYST SCOTT SCOTT

20 CLERK ADAMS ADAMS

20 CLERK SMITH SMITH

20 MANAGER JONES JONES

30 CLERK JAMES JAMES

30 MANAGER BLAKE BLAKE

30 SALESMAN ALLEN ALLEN

30 SALESMAN MARTIN MARTIN

30 SALESMAN TURNER TURNER
```

30 SALESMAN WARD WARD

<b>

```
   select e.job,

   e.ename,

   (select count(*) from emp d where e.job=d.job and e.empno < d.empno)
as rnk from emp e</b>

   JOB ENAME RNK

   --------- ---------- ----------

   CLERK SMITH 3

   SALESMAN ALLEN 3

   SALESMAN WARD 2

   MANAGER JONES 2

   SALESMAN MARTIN 1

   MANAGER BLAKE 1

   MANAGER CLARK 0

   ANALYST SCOTT 1

   PRESIDENT KING 0

   SALESMAN TURNER 0

   CLERK ADAMS 2

   CLERK JAMES 1
```

```
ANALYST FORD 0

CLERK MILLER 0
```

<b>

```
select max(case when job='CLERK'

then ename else null end) as clerks, max(case when job='ANALYST'

then ename else null end) as analysts, max(case when job='MANAGER'

then ename else null end) as mgrs, max(case when job='PRESIDENT'

then ename else null end) as prez, max(case when job='SALESMAN'

then ename else null end) as sales from emp</b>
```

```
CLERKS ANALYSTS MGRS PREZ SALES

---------- ---------- ---------- ---------- ----------

SMITH SCOTT JONES KING WARD
```

<b>

```
select rnk,

case when job='CLERK'

then ename else null end as clerks, case when job='ANALYST'

then ename else null end as analysts, case when job='MANAGER'

then ename else null end as mgrs, case when job='PRESIDENT'

then ename else null end as prez, case when job='SALESMAN'
then ename else null end as sales from (

Select e.job,

e.ename,

(select count(*) from emp d where e.job=d.job and e.empno < d.empno)
as rnk from emp e

) x</b>



RNK CLERKS ANALYSTS MGRS PREZ SALES

--- ------ -------- ----- ---- ----------

3 SMITH

3 ALLEN

2 WARD

2 JONES

1 MARTIN

1 BLAKE

0 CLARK

1 SCOTT

0 KING

0 TURNER

2 ADAMS

1 JAMES
```

0 FORD

0 MILLER

```
<b>

   select max(case when job='CLERK'

   then ename else null end) as clerks, max(case when job='ANALYST'

   then ename else null end) as analysts, max(case when job='MANAGER'

   then ename else null end) as mgrs, max(case when job='PRESIDENT'

   then ename else null end) as prez, max(case when job='SALESMAN'

   then ename else null end) as sales from (

   Select e.job,

   e.ename,

   (select count(*) from emp d where e.job=d.job and e.empno < d.empno)
as rnk from emp e

   ) x

   group by rnk</b>

   CLERKS ANALYSTS MGRS PREZ SALES

   ------ -------- ----- ---- ------

   MILLER FORD CLARK KING TURNER

   JAMES SCOTT BLAKE MARTIN

   ADAMS JONES WARD

   SMITH ALLEN
```

```
DEPTNO_10 DEPTNO_20 DEPTNO_30
---------- ---------- ----------
```

3 5 6

```
DEPTNO COUNTS_BY_DEPT
    ------ --------------
    10 3
    20 5
```

30 6

```
select dept.deptno,
    case dept.deptno
    when 10 then emp_cnts.deptno_10
    when 20 then emp_cnts.deptno_20
    when 30 then emp_cnts.deptno_30
```

6 end as counts_by_dept

7 from (

8 select sum(case when deptno=10 then 1 else 0 end) as deptno_10, 9 sum(case when deptno=20 then 1 else 0 end) as deptno_20, 10 sum(case when deptno=30 then 1 else 0 end) as deptno_30

11 from emp

```
12 ) emp_cnts,

13 (select deptno from dept where deptno <= 30) dept
```

<b>

```
select sum(case when deptno=10 then 1 else 0 end) as deptno_10, sum(case when deptno=20 then 1 else 0 end) as deptno_20, sum(case when deptno=30 then 1 else 0 end) as deptno_30

from emp</b>

DEPTNO_10 DEPTNO_20 DEPTNO_30

--------- ---------- ----------
```

3 5 6

<b>

select dept.deptno, emp_cnts.deptno_10, emp_cnts.deptno_20, emp_cnts.deptno_30

from (

Select sum(case when deptno=10 then 1 else 0 end) as deptno_10, sum(case when deptno=20 then 1 else 0 end) as deptno_20, sum(case when deptno=30 then 1 else 0 end) as deptno_30

from emp

) emp_cnts,

(select deptno from dept where deptno <= 30) dept</b>

DEPTNO DEPTNO_10 DEPTNO_20 DEPTNO_30

------ ---------- ---------- ---------

10 3 5 6

20 3 5 6

30 3 5 6

<b>

```
   select dept.deptno, case dept.deptno

   when 10 then emp_cnts.deptno_10

   when 20 then emp_cnts.deptno_20

   when 30 then emp_cnts.deptno_30

   end as counts_by_dept from (

   Select sum(case when deptno=10 then 1 else 0 end) as deptno_10,
sum(case when deptno=20 then 1 else 0 end) as deptno_20, sum(case when
deptno=30 then 1 else 0 end) as deptno_30

   from emp

   ) emp_cnts,

   (select deptno from dept where deptno <= 30) dept</b>

   DEPTNO COUNTS_BY_DEPT

   ------ --------------

   10 3

   20 5
```

30 6

```
EMPS
    ----------
    CLARK
    MANAGER
    2450

    KING
    PRESIDENT
    5000

    MILLER
    CLERK
    1300
1 select case rn
    2 when 1 then ename
```

3 when 2 then job

4 when 3 then cast(sal as char(4))

5 end emps

```
6 from (

7 select e.ename,e.job,e.sal, 8 row_number()over(partition by e.empno 9 order by e.empno) rn 10 from emp e, 11 (select *

12 from emp where job='CLERK') four_rows 13 where e.deptno=10

14 ) x
```

<b>

```
select e.ename,e.job,e.sal, row_number()over(partition by e.empno order by e.empno) rn from emp e where e.deptno=10</b>
```

```
ENAME JOB SAL RN

---------- --------- ---------- ----------

CLARK MANAGER 2450 1

KING PRESIDENT 5000 1

MILLER CLERK 1300 1
```

<b>

```
select e.ename,e.job,e.sal, row_number()over(partition by e.empno order by e.empno) rn from emp e, (select *

from emp where job='CLERK') four_rows where e.deptno=10</b>
```

```
ENAME JOB SAL RN

---------- --------- ---------- ----------

CLARK MANAGER 2450 1
CLARK MANAGER 2450 2

CLARK MANAGER 2450 3

CLARK MANAGER 2450 4

KING PRESIDENT 5000 1

KING PRESIDENT 5000 2

KING PRESIDENT 5000 3

KING PRESIDENT 5000 4

MILLER CLERK 1300 1

MILLER CLERK 1300 2

MILLER CLERK 1300 3

MILLER CLERK 1300 4
```

<b>

```
select case rn when 1 then ename when 2 then joB

when 3 then cast(sal as char(4)) end emps

from (

Select e.ename,e.job,e.sal, row_number()over(partition by e.empno order by e.empno) rn from emp e, (select *

from emp where job='CLERK') four_rows where e.deptno=10

) x</b>

EMPS
```

```
----------

CLARK

MANAGER

2450


KING

PRESIDENT

5000


MILLER

CLERK

1300
```

```
DEPTNO ENAME
 ------ ---------
```

10 CLARK

KING

MILLER

20 SMITH

ADAMS

FORD

SCOTT

JONES

30 ALLEN

BLAKE

MARTIN

JAMES

TURNER

WARD

1 select case when empno=min_empno

```
2 then deptno else null
3 end deptno,
```

4 ename

5 from (

6 select deptno, 7 min(empno)over(partition by deptno) min_empno, 8 empno,

9 ename

10 from emp

11) x

1 select to_number(

2 decode(lag(deptno)over(order by deptno), 3 deptno,null,deptno) 4) deptno, ename 5 from emp

<b>

select deptno, min(empno)over(partition by deptno) min_empno, empno,

ename

from emp</b>

```
DEPTNO MIN_EMPNO EMPNO ENAME

------ ---------- ---------- ----------

10 7782 7782 CLARK

10 7782 7839 KING

10 7782 7934 MILLER

20 7369 7369 SMITH

20 7369 7876 ADAMS

20 7369 7902 FORD

20 7369 7788 SCOTT

20 7369 7566 JONES

30 7499 7499 ALLEN
```

```
   30 7499 7698 BLAKE

   30 7499 7654 MARTIN

   30 7499 7900 JAMES

   30 7499 7844 TURNER

   30 7499 7521 WARD

<b>

   select case when empno=min_empno then deptno else null end deptno,
ename

   from (

   Select deptno, min(empno)over(partition by deptno) min_empno, empno,

   ename

   from emp

   ) x</b>

   DEPTNO ENAME

   ------ ----------
```

10 CLARK

KING

MILLER

20 SMITH

ADAMS

FORD

SCOTT

JONES

30 ALLEN

BLAKE

```
MARTIN

JAMES

TURNER

WARD
```

Select lag(deptno)over(order by deptno) lag_deptno, deptno,

```
ename

from emp


LAG_DEPTNO DEPTNO ENAME

---------- ---------- ----------

10 CLARK

10 10 KING

10 10 MILLER

10 20 SMITH

20 20 ADAMS

20 20 FORD

20 20 SCOTT
```

```
   20 20 JONES

   20 30 ALLEN

   30 30 BLAKE

   30 30 MARTIN

   30 30 JAMES

   30 30 TURNER

   30 30 WARD
```

<b>

```
   select to_number(

   decode(lag(deptno)over(order by deptno), deptno,null,deptno) ) deptno,
ename from emp</b>

   DEPTNO ENAME

   ------ ----------
```

10 CLARK

KING

MILLER

20 SMITH

ADAMS

FORD

SCOTT

JONES

30 ALLEN

BLAKE

MARTIN

JAMES

TURNER

WARD

<b>

```
select deptno, sum(sal) as sal from emp

group by deptno</b>

DEPTNO SAL

------ ----------

10 8750

20 10875
```

30 9400

```
1 select d20_sal - d10_sal as d20_10_diff,
```

2 d20_sal - d30_sal as d20_30_diff

3 from (

4 select sum(case when deptno=10 then sal end) as d10_sal, 5 sum(case when deptno=20 then sal end) as d20_sal, 6 sum(case when deptno=30 then sal end) as d30_sal

7 from emp

8) totals_by_dept

<b>

select case when deptno=10 then sal end as d10_sal, case when deptno=20 then sal end as d20_sal, case when deptno=30 then sal end as d30_sal from emp</b>

```
D10_SAL D20_SAL D30_SAL

------- ---------- ----------

800

1600

1250

2975

1250

2850

2450

3000

5000

1500

1100

950
```

```
   3000

   1300
```

<b>

```
   select sum(case when deptno=10 then sal end) as d10_sal, sum(case
when deptno=20 then sal end) as d20_sal, sum(case when deptno=30 then
sal end) as d30_sal from emp</b>
```

```
   D10_SAL D20_SAL D30_SAL

   ------- ---------- ----------
```

8750 10875 9400

The final step is to simply wrap the above SQL in an inline view and perform the subtractions.

```
GRP EMPNO ENAME
--- ---------- -------
1 7369 SMITH
1 7499 ALLEN
1 7521 WARD
1 7566 JONES
1 7654 MARTIN
2 7698 BLAKE
2 7782 CLARK
2 7788 SCOTT
2 7839 KING
2 7844 TURNER
3 7876 ADAMS
3 7900 JAMES
3 7902 FORD
```

3 7934 MILLER

1 select ceil(row_number()over(order by empno)/5.0) grp, 2 empno,

 3 ename

4 from emp

1 select ceil(rnk/5.0) as grp,

2 empno, ename 3 from (

4 select e.empno, e.ename, 5 (select count(*) from emp d 6 where e.empno > d.empno)+1 as rnk

7 from emp e

8) x

9 order by grp

<b>

```
    select row_number( )over(order by empno) rn, empno,

    ename

    from emp</b>

    RN EMPNO ENAME

    -- ---------- ----------

    1 7369 SMITH

    2 7499 ALLEN

    3 7521 WARD

    4 7566 JONES

    5 7654 MARTIN

    6 7698 BLAKE

    7 7782 CLARK

    8 7788 SCOTT

    9 7839 KING

    10 7844 TURNER

    11 7876 ADAMS

    12 7900 JAMES
```

13 7902 FORD

14 7934 MILLER

<b>

```
select row_number( )over(order by empno) rn, row_number( )over(order by empno)/5.0 division, ceil(row_number( )over(order by empno)/5.0) grp, empno,

ename

from emp</b>

RN DIVISION GRP EMPNO ENAME

-- ---------- --- ----- ----------

1 .2 1 7369 SMITH

2 .4 1 7499 ALLEN

3 .6 1 7521 WARD

4 .8 1 7566 JONES
```

5 1 1 7654 MARTIN

6 1.2 2 7698 BLAKE

7 1.4 2 7782 CLARK

8 1.6 2 7788 SCOTT

9 1.8 2 7839 KING

10 2 2 7844 TURNER

```
11 2.2 3 7876 ADAMS

12 2.4 3 7900 JAMES

13 2.6 3 7902 FORD

14 2.8 3 7934 MILLER
```

<b>

```
select (select count(*) from emp d where e.empno < d.empno)+1 as rnk, e.empno, e.ename from emp e

order by 1</b>

RNK EMPNO ENAME

--- ---------- ----------

1 7934 MILLER

2 7902 FORD

3 7900 JAMES

4 7876 ADAMS

5 7844 TURNER

6 7839 KING

7 7788 SCOTT

8 7782 CLARK

9 7698 BLAKE
```

```
10 7654 MARTIN

11 7566 JONES

12 7521 WARD

13 7499 ALLEN
```

14 7369 SMITH

```
<b>

    select rnk,

    rnk/5.0 as division, ceil(rnk/5.0) as grp, empno, ename

    from (

    Select e.empno, e.ename, (select count(*) from emp d where e.empno <
d.empno)+1 as rnk from emp e

    ) x

    order by 1</b>

    RNK DIVISION GRP EMPNO ENAME

    --- ---------- --- ----- -------

    1 .2 1 7934 MILLER

    2 .4 1 7902 FORD

    3 .6 1 7900 JAMES

    4 .8 1 7876 ADAMS
```

5 1 1 7844 TURNER

6 1.2 2 7839 KING

7 1.4 2 7788 SCOTT

8 1.6 2 7782 CLARK

9 1.8 2 7698 BLAKE

10 2 2 7654 MARTIN

11 2.2 3 7566 JONES

12 2.4 3 7521 WARD

13 2.6 3 7499 ALLEN

14 2.8 3 7369 SMITH

```
GRP EMPNO ENAME
    --- ----- ---------
    1 7369 SMITH
    1 7499 ALLEN
    1 7521 WARD
    1 7566 JONES
    2 7654 MARTIN
    2 7698 BLAKE
    2 7782 CLARK
    2 7788 SCOTT
    3 7839 KING
    3 7844 TURNER
    3 7876 ADAMS
    4 7900 JAMES
    4 7902 FORD
```

4 7934 MILLER

```
1 select mod(row_number( )over(order by empno),4)+1 grp, 2 empno,
  3 ename
  4 from emp
```

5 order by 1

1 select ntile(4)over(order by empno) grp, 2 empno,

    3 ename

4 from emp

1 select mod(count(*),4)+1 as grp,

2 e.empno,

3 e.ename

4 from emp e, emp d 5 where e.empno >= d.empno 6 group by e.empno,e.ename

7 order by 1

<b>

```
select row_number( )over(order by empno) grp, empno,

ename

from emp</b>

GRP EMPNO ENAME

--- ----- ------

1 7369 SMITH

2 7499 ALLEN

3 7521 WARD

4 7566 JONES

5 7654 MARTIN

6 7698 BLAKE

7 7782 CLARK

8 7788 SCOTT

9 7839 KING

10 7844 TURNER

11 7876 ADAMS

12 7900 JAMES
```

13 7902 FORD

14 7934 MILLER

<b>

```
select mod(row_number( )over(order by empno),4) grp, empno,
ename
from emp</b>
GRP EMPNO ENAME
--- ----- ------
1 7369 SMITH
2 7499 ALLEN
3 7521 WARD
0 7566 JONES
1 7654 MARTIN
2 7698 BLAKE
3 7782 CLARK
0 7788 SCOTT
1 7839 KING
2 7844 TURNER
3 7876 ADAMS
0 7900 JAMES
```

1 7902 FORD

2 7934 MILLER

<b>

```
select e.empno, e.ename,

d.empno,

d.ename

from emp e, emp d</b>

EMPNO ENAME EMPNO ENAME

----- ---------- ---------- ---------

7369 SMITH 7369 SMITH

7369 SMITH 7499 ALLEN

7369 SMITH 7521 WARD

7369 SMITH 7566 JONES

7369 SMITH 7654 MARTIN

7369 SMITH 7698 BLAKE

7369 SMITH 7782 CLARK

7369 SMITH 7788 SCOTT

7369 SMITH 7839 KING

7369 SMITH 7844 TURNER

7369 SMITH 7876 ADAMS
```

```
7369 SMITH 7900 JAMES

7369 SMITH 7902 FORD
```

7369 SMITH 7934 MILLER

…

<b>

```
select e.empno, e.ename,

d.empno,

d.ename

from emp e, emp d where e.empno >= d.empno</b>
```

```
EMPNO ENAME EMPNO ENAME

----- ---------- ---------- ----------

7934 MILLER 7934 MILLER

7934 MILLER 7902 FORD

7934 MILLER 7900 JAMES

7934 MILLER 7876 ADAMS

7934 MILLER 7844 TURNER

7934 MILLER 7839 KING

7934 MILLER 7788 SCOTT

7934 MILLER 7782 CLARK

7934 MILLER 7698 BLAKE

7934 MILLER 7654 MARTIN
```

```
7934 MILLER 7566 JONES

7934 MILLER 7521 WARD

7934 MILLER 7499 ALLEN
```

7934 MILLER 7369 SMITH

…

7499 ALLEN 7499 ALLEN

7499 ALLEN 7369 SMITH

7369 SMITH 7369 SMITH

<b>

    select count(*) as grp, e.empno,

    e.ename

    from emp e, emp d where e.empno >= d.empno group by
e.empno,e.ename order by 1</b>

```
GRP EMPNO ENAME

--- ---------- ----------

1 7369 SMITH

2 7499 ALLEN

3 7521 WARD

4 7566 JONES

5 7654 MARTIN

6 7698 BLAKE

7 7782 CLARK

8 7788 SCOTT

9 7839 KING

10 7844 TURNER

11 7876 ADAMS

12 7900 JAMES
```

13 7902 FORD

14 7934 MILLER

<b>

```
select mod(count(*),4)+1 as grp, e.empno,

e.ename

from emp e, emp d where e.empno >= d.empno group by
e.empno,e.ename order by 1</b>

GRP EMPNO ENAME

--- ---------- ---------

1 7900 JAMES

1 7566 JONES

1 7788 SCOTT

2 7369 SMITH

2 7902 FORD

2 7654 MARTIN

2 7839 KING

3 7499 ALLEN

3 7698 BLAKE

3 7934 MILLER

3 7844 TURNER

4 7521 WARD
```

4 7782 CLARK

4 7876 ADAMS

```
DEPTNO CNT
    ------ ----------
    10 ***
    20 *****
    30 ******
1 select deptno,
    2 repeat('*',count(*)) cnt 3 from emp
```

4 group by deptno

1 select deptno,

2 lpad('*',count(*),'*') as cnt 3 from emp

4 group by deptno

1 select deptno,

    2 replicate('*',count(*)) cnt 3 from emp

4 group by deptno

<b>

```
select deptno, count(*) from emp group by deptno</b>

DEPTNO COUNT(*) ------ ----------

10 3

20 5
```

30 6

<b>

```
   select deptno, lpad('*',count(*),'*') as cnt from emp group by deptno</b>

   DEPTNO CNT

   ------ ----------

   10 ***

   20 *****

   30 ******
```

<b>

```
   select deptno, lpad('*',count(*)::integer,'*') as cnt from emp group by
deptno</b>

   DEPTNO CNT

   ------ ----------

   10 ***

   20 *****

   30 ******
```

This CAST is necessary because PostgreSQL requires the numeric argument to LPAD to be an integer.

D10 D20 D30

--- --- ---

```
*

* *

* *

* * *

* * *

* * *
```

```
1 select max(deptno_10) d10,

   2 max(deptno_20) d20, 3 max(deptno_30) d30

   4 from (

   5 select row_number( )over(partition by deptno order by empno) rn, 6
case when deptno=10 then '*' else null end deptno_10, 7 case when
deptno=20 then '*' else null end deptno_20, 8 case when deptno=30 then '*'
else null end deptno_30
```

9 from emp

10) x

11 group by rn

12 order by 1 desc, 2 desc, 3 desc

1 select max(deptno_10) as d10,

2 max(deptno_20) as d20, 3 max(deptno_30) as d30

4 from (

5 select case when e.deptno=10 then '*' else null end deptno_10, 6 case when e.deptno=20 then '*' else null end deptno_20, 7 case when e.deptno=30 then '*' else null end deptno_30, 8 (select count(*) from emp d 9 where e.deptno=d.deptno and e.empno < d.empno) as rnk

10 from emp e

11) x

12 group by rnk

13 order by 1 desc, 2 desc, 3 desc

<b>

select row_number( )over(partition by deptno order by empno) rn, case when deptno=10 then '*' else null end deptno_10, case when deptno=20 then '*' else null end deptno_20, case when deptno=30 then '*' else null end deptno_30

from emp</b>

```
RN DEPTNO_10 DEPTNO_20 DEPTNO_30

-- ---------- ---------- ---------

1 *

2 *

3 *

1 *

2 *

3 *

4 *

5 *

1 *

2 *
```

```
   3 *

   4 *

   5 *

   6 *
```

<b>

```
   select max(deptno_10) d10, max(deptno_20) d20, max(deptno_30) d30

   from (

   Select row_number( )over(partition by deptno order by empno) rn, case when deptno=10 then '*' else null end deptno_10, case when deptno=20 then '*' else null end deptno_20, case when deptno=30 then '*' else null end deptno_30

   from emp

   ) x

   group by rn

   order by 1 desc, 2 desc, 3 desc</b>
```

D10 D20 D30

--- --- ---

```
*

* *

* *

* * *

* * *

* * *
```

<b>

select case when e.deptno=10 then '*' else null end deptno_10, case when e.deptno=20 then '*' else null end deptno_20, case when e.deptno=30 then '*' else null end deptno_30, (select count(*) from emp d where e.deptno=d.deptno and e.empno < d.empno) as rnk from emp e</b>

```
DEPTNO_10 DEPTNO_20 DEPTNO_30 RNK

---------- ---------- ---------- ----------

* 4

* 5

* 4

* 3

* 3
* 2

* 2

* 2

* 1

* 1

* 1

* 0

* 0

* 0
```

<b>

select max(deptno_10) as d10, max(deptno_20) as d20, max(deptno_30) as d30

from (

Select case when e.deptno=10 then '*' else null end deptno_10, case when e.deptno=20 then '*' else null end deptno_20, case when e.deptno=30 then '*' else null end deptno_30, (select count(*) from emp d where e.deptno=d.deptno and e.empno < d.empno) as rnk from emp e

) x

group by rnk

order by 1 desc, 2 desc, 3 desc</b>

D10 D20 D30

--- --- ---

*

* *

* *

* * *

* * *

* * *

```
DEPTNO ENAME JOB SAL DEPT_STATUS JOB_STATUS

    ------ ------ --------- ----- -------------- --------------

    10 MILLER CLERK 1300 LOW SAL IN DEPT TOP SAL IN JOB

    10 CLARK MANAGER 2450 LOW SAL IN JOB

    10 KING PRESIDENT 5000 TOP SAL IN DEPT TOP SAL IN JOB

    20 SCOTT ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

    20 FORD ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

    20 SMITH CLERK 800 LOW SAL IN DEPT LOW SAL IN JOB

    20 JONES MANAGER 2975 TOP SAL IN JOB

    30 JAMES CLERK 950 LOW SAL IN DEPT

    30 MARTIN SALESMAN 1250 LOW SAL IN JOB

    30 WARD SALESMAN 1250 LOW SAL IN JOB

    30 ALLEN SALESMAN 1600 TOP SAL IN JOB

    30 BLAKE MANAGER 2850 TOP SAL IN DEPT
```

```
Select ename,max(sal)

    from emp

    <a name="idx-CHP-12-0730"></a>group by ename
```

```
1 select deptno,ename,job,sal,

    2 case when sal = max_by_dept 3 then 'TOP SAL IN DEPT'

    4 when sal = min_by_dept 5 then 'LOW SAL IN DEPT'
```

```
6 end dept_status,

7 case when sal = max_by_job 8 then 'TOP SAL IN JOB'

9 when sal = min_by_job

10 then 'LOW SAL IN JOB'
```

11 end job_status

12 from (

13 select deptno,ename,job,sal, 14 max(sal)over(partition by deptno) max_by_dept, 15 max(sal)over(partition by job) max_by_job, 16 min(sal)over(partition by deptno) min_by_dept, 17 min(sal)over(partition by job) min_by_job

18 from emp

19) emp_sals

20 where sal in (max_<a name="idx-CHP-12-0732"></a>by_dept,max_<a name="idx-CHP-12-0733"></a>by_job, 21 min_by_dept,min_by_job)

1 select deptno,ename,job,sal,

2 case when sal = max_by_dept 3 then 'TOP SAL IN DEPT'

4 when sal = min_by_dept 5 then 'LOW SAL IN DEPT'

6 end as dept_status,

7 case when sal = max_by_job 8 then 'TOP SAL IN JOB'

9 when sal = min_by_job

10 then 'LOW SAL IN JOB'

11 end as job_status

12 from (

13 select e.deptno,e.ename,e.job,e.sal, 14 (select max(sal) from emp d 15 where d.deptno = e.deptno) as max_by_dept, 16 (select max(sal) from emp d 17 where d.job = e.job) as max_by_job, 18 (select min(sal) from emp d 19 where d.deptno = e.deptno) as min_by_dept, 20 (select min(sal) from emp d 21 where d.job = e.job) as min_by_job

22 from emp e

23) x

24 where sal in (max_by_dept,max_by_job, 25 min_by_dept,min_by_job)

<b>

select deptno,ename,job,sal, max(sal)over(partition by deptno) maxDEPT, max(sal)over(partition by job) maxJOB, min(sal)over(partition by deptno) minDEPT, min(sal)over(partition by job) minJOB

from emp</b>

```
DEPTNO ENAME JOB SAL MAXDEPT MAXJOB MINDEPT MINJOB

------ ------ --------- ----- ------- ------ ------- ------

10 MILLER CLERK 1300 5000 1300 1300 800

10 CLARK MANAGER 2450 5000 2975 1300 2450

10 KING PRESIDENT 5000 5000 5000 1300 5000

20 SCOTT ANALYST 3000 3000 3000 800 3000

20 FORD ANALYST 3000 3000 3000 800 3000

20 SMITH CLERK 800 3000 1300 800 800

20 JONES MANAGER 2975 3000 2975 800 2450

20 ADAMS CLERK 1100 3000 1300 800 800
```

```
30 JAMES CLERK 950 2850 1300 950 800

30 MARTIN SALESMAN 1250 2850 1600 950 1250

30 TURNER SALESMAN 1500 2850 1600 950 1250

30 WARD SALESMAN 1250 2850 1600 950 1250

30 ALLEN SALESMAN 1600 2850 1600 950 1250

30 BLAKE MANAGER 2850 2850 2975 950 2450
```

<b>

```
select deptno,ename,job,sal, case when sal = max_by_dept then 'TOP SAL IN DEPT'

when sal = min_by_dept

then 'LOW SAL IN DEPT'

end dept_status,

case when sal = max_by_job then 'TOP SAL IN JOB'

when sal = min_by_job

then 'LOW SAL IN JOB'

end job_status

from (

select deptno,ename,job,sal, max(sal)over(partition by deptno) max_by_dept, max(sal)over(partition by job) max_by_job, min(sal)over(partition by deptno) min_by_dept, min(sal)over(partition by job) min_by_job from emp

) x
```

```
   where sal in (max_by_dept,max_by_job, min_by_dept,min_by_job)</b>

   DEPTNO ENAME JOB SAL DEPT_STATUS JOB_STATUS

   ------ ------ --------- ----- -------------- --------------

   10 MILLER CLERK 1300 LOW SAL IN DEPT TOP SAL IN JOB

   10 CLARK MANAGER 2450 LOW SAL IN JOB

   10 KING PRESIDENT 5000 TOP SAL IN DEPT TOP SAL IN JOB

   20 SCOTT ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

   20 FORD ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

   20 SMITH CLERK 800 LOW SAL IN DEPT LOW SAL IN JOB

   20 JONES MANAGER 2975 TOP SAL IN JOB

   30 JAMES CLERK 950 LOW SAL IN DEPT

   30 MARTIN SALESMAN 1250 LOW SAL IN JOB

   30 WARD SALESMAN 1250 LOW SAL IN JOB

   30 ALLEN SALESMAN 1600 TOP SAL IN JOB

   30 BLAKE MANAGER 2850 TOP SAL IN DEPT

<b>

   select e.deptno,e.ename,e.job,e.sal, (select max(sal) from emp d where d.deptno = e.deptno) as maxDEPT, (select max(sal) from emp d where d.job = e.job) as maxJOB, (select min(sal) from emp d where d.deptno = e.deptno) as minDEPT, (select min(sal) from emp d where d.job = e.job) as minJOB

   from emp e</b>
```

```
DEPTNO ENAME JOB SAL MAXDEPT MAXJOB MINDEPT
MINJOB

------ ------ --------- ----- ------- ------ ------- ------

20 SMITH CLERK 800 3000 1300 800 800

30 ALLEN SALESMAN 1600 2850 1600 950 1250

30 WARD SALESMAN 1250 2850 1600 950 1250

20 JONES MANAGER 2975 3000 2975 800 2450

30 MARTIN SALESMAN 1250 2850 1600 950 1250

30 BLAKE MANAGER 2850 2850 2975 950 2450

10 CLARK MANAGER 2450 5000 2975 1300 2450

20 SCOTT ANALYST 3000 3000 3000 800 3000

10 KING PRESIDENT 5000 5000 5000 1300 5000

30 TURNER SALESMAN 1500 2850 1600 950 1250

20 ADAMS CLERK 1100 3000 1300 800 800

30 JAMES CLERK 950 2850 1300 950 800

20 FORD ANALYST 3000 3000 3000 800 3000

10 MILLER CLERK 1300 5000 1300 1300 800
```

<b>

```
select deptno,ename,job,sal, case when sal = max_by_dept then 'TOP
SAL IN DEPT'
```

```
when sal = min_by_dept

then 'LOW SAL IN DEPT'

end as dept_status,

case when sal = max_by_job then 'TOP SAL IN JOB'

when sal = min_by_job

then 'LOW SAL IN JOB'

end as job_status

from (

select e.deptno,e.ename,e.job,e.sal, (select max(sal) from emp d where d.deptno = e.deptno) as max_<a name="idx-CHP-12-0738"></a>by_dept, (select max(sal) from emp d where d.job = e.job) as max_<a name="idx-CHP-12-0739"></a>by_job, (select min(sal) from emp d where d.deptno = e.deptno) as min_by_dept, (select min(sal) from emp d where d.job = e.job) as min_by_job from emp e

) x

where sal in (max_by_dept,max_by_job, min_by_dept,min_by_job)</b>

DEPTNO ENAME JOB SAL DEPT_STATUS JOB_STATUS

------ ------ --------- ----- -------------- -------------

10 CLARK MANAGER 2450 LOW SAL IN JOB

10 KING PRESIDENT 5000 TOP SAL IN DEPT TOP SAL IN JOB

10 MILLER CLERK 1300 LOW SAL IN DEPT TOP SAL IN JOB

20 SMITH CLERK 800 LOW SAL IN DEPT LOW SAL IN JOB
```

```
20 FORD ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

20 SCOTT ANALYST 3000 TOP SAL IN DEPT TOP SAL IN JOB

20 JONES MANAGER 2975 TOP SAL IN JOB

30 ALLEN SALESMAN 1600 TOP SAL IN JOB

30 BLAKE MANAGER 2850 TOP SAL IN DEPT

30 MARTIN SALESMAN 1250 LOW SAL IN JOB

30 JAMES CLERK 950 LOW SAL IN DEPT

30 WARD SALESMAN 1250 LOW SAL IN JOB
```

```
JOB SAL
    --------- ----------
    ANALYST 6000
    CLERK 4150
    MANAGER 8275
    PRESIDENT 5000
    SALESMAN 5600
    TOTAL 29025
1 select case grouping(job)
```

2 when 0 then job

3 else 'TOTAL'

4 end job,

5 sum(sal) sal

6 from emp

7 group by rollup(job)

1 select coalesce(job,'TOTAL') job, 2 sum(sal) sal 3 from emp

4 group by job with rollup

```
1 select job, sum(sal) as sal
  2 from emp
  3 group by job
```

4 union all

5 select 'TOTAL', sum(sal)

6 from emp

<b>

```
select job, sum(sal) sal from emp
group by job</b>
JOB SAL
--------- -----
ANALYST 6000
CLERK 4150
MANAGER 8275
PRESIDENT 5000
SALESMAN 5600
```

<b>

```
select job, sum(sal) sal from emp
group by rollup(job)</b>
JOB SAL
--------- -------
ANALYST 6000
CLERK 4150
MANAGER 8275
```

```
PRESIDENT 5000

SALESMAN 5600

29025
```

<b>

```
select case grouping(job) when 0 then job else 'TOTAL'

end job,

sum(sal) sal from emp

group by rollup(job)</b>

JOB SAL

--------- ----------

ANALYST 6000

CLERK 4150

MANAGER 8275

PRESIDENT 5000

SALESMAN 5600

TOTAL 29025
```

<b>

```
select job, sum(sal) sal from emp

group by job</b>

JOB SAL
```

```
    --------- -----
    ANALYST 6000
    CLERK 4150
    MANAGER 8275
    PRESIDENT 5000
    SALESMAN 5600
<b>
    select job, sum(sal) sal from emp
    group by job with rollup</b>
    JOB SAL
    --------- -------
    ANALYST 6000
    CLERK 4150
    MANAGER 8275
    PRESIDENT 5000
    SALESMAN 5600
    29025
<b>
    select coalesce(job,'TOTAL') job, sum(sal) sal from emp
    group by job with rollup</b>
```

```
   JOB SAL

   --------- ----------

   ANALYST 6000

   CLERK 4150

   MANAGER 8275

   PRESIDENT 5000

   SALESMAN 5600

   TOTAL 29025
```

<b>

```
   select job, sum(sal) sal from emp

   group by job</b>

   JOB SAL

   --------- -----

   ANALYST 6000

   CLERK 4150

   MANAGER 8275

   PRESIDENT 5000

   SALESMAN 5600
```

<b>

```
   select job, sum(sal) as sal from emp
```

```
group by job union all

select 'TOTAL', sum(sal) from emp</b>

JOB SAL

--------- -------

ANALYST 6000

CLERK 4150

MANAGER 8275

PRESIDENT 5000

SALESMAN 5600

TOTAL 29025
```

```
DEPTNO JOB CATEGORY SAL
 ------ --------- -------------------- -------
 10 CLERK TOTAL BY DEPT AND JOB 1300
 10 MANAGER TOTAL BY DEPT AND JOB 2450
 10 PRESIDENT TOTAL BY DEPT AND JOB 5000
 20 CLERK TOTAL BY DEPT AND JOB 1900
 30 CLERK TOTAL BY DEPT AND JOB 950
 30 SALESMAN TOTAL BY DEPT AND JOB 5600
 30 MANAGER TOTAL BY DEPT AND JOB 2850
 20 MANAGER TOTAL BY DEPT AND JOB 2975
 20 ANALYST TOTAL BY DEPT AND JOB 6000
 CLERK TOTAL BY JOB 4150
 ANALYST TOTAL BY JOB 6000
 MANAGER TOTAL BY JOB 8275
 PRESIDENT TOTAL BY JOB 5000
 SALESMAN TOTAL BY JOB 5600
 10 TOTAL BY DEPT 8750
 30 TOTAL BY DEPT 9400
```

20 TOTAL BY DEPT 10875

GRAND TOTAL FOR TABLE 29025

1 select deptno,

2 job,

3 case cast(grouping(deptno) as char(1))||

4 cast(grouping(job) as char(1)) 5 when '00' then 'TOTAL BY DEPT AND JOB'

6 when '10' then 'TOTAL BY JOB'

7 when '01' then 'TOTAL BY DEPT'

8 when '11' then 'TOTAL FOR TABLE'

9 end category,

10 sum(sal)

11 from emp

12 group by cube(deptno,job) 13 order by grouping(job),grouping(deptno)

1 select deptno,

2 job,

3 case grouping(deptno)||grouping(job) 4 when '00' then 'TOTAL BY DEPT AND JOB'

5 when '10' then 'TOTAL BY JOB'

6 when '01' then 'TOTAL BY DEPT'

7 when '11' then 'GRAND TOTAL <a name="idx-CHP-12-0755"></a>FOR TABLE'

8 end category,

9 sum(sal) sal

10 from emp

11 group by cube(deptno,job) 12 order by grouping(job),grouping(deptno)

1 select deptno,

2 job,

3 case cast(grouping(deptno)as char(1))+

4 cast(grouping(job)as char(1)) 5 when '00' then 'TOTAL BY DEPT AND JOB'

6 when '10' then 'TOTAL BY JOB'

7 when '01' then 'TOTAL BY DEPT'

8 when '11' then 'GRAND TOTAL FOR TABLE'

9 end category,

10 sum(sal) sal

11 from emp

12 group by deptno,job with cube 13 order by grouping(job),grouping(deptno)

1 select deptno, job,

2 'TOTAL BY DEPT AND JOB' as category, 3 sum(sal) as sal

4 from emp

5 group by deptno, job

6 union all

7 select null, job, 'TOTAL BY JOB', sum(sal) 8 from emp

9 group by job

10 union all

11 select deptno, null, 'TOTAL BY DEPT', sum(sal) 12 from emp

13 group by deptno

14 union all

15 select null,null,'GRAND TOTAL FOR TABLE', sum(sal)

16 from emp

<b>

```
select deptno, job, sum(sal) sal from emp

group by deptno, job</b>

DEPTNO JOB SAL

------ --------- -------

10 CLERK 1300

10 MANAGER 2450

10 PRESIDENT 5000

20 CLERK 1900

20 ANALYST 6000

20 MANAGER 2975

30 CLERK 950

30 MANAGER 2850
```

30 SALESMAN 5600

```
<b>

    select deptno,

    job,

    sum(sal) sal

    from emp

    group by cube(deptno,job)</b>

    DEPTNO JOB SAL

    ------ --------- -------

    29025

    CLERK 4150

    ANALYST 6000

    MANAGER 8275

    SALESMAN 5600

    PRESIDENT 5000

    10 8750

    10 CLERK 1300

    10 MANAGER 2450

    10 PRESIDENT 5000
```

```
20 10875

20 CLERK 1900

20 ANALYST 6000

20 MANAGER 2975

30 9400

30 CLERK 950

30 MANAGER 2850
```

30 SALESMAN 5600

<b>

```
select deptno,

job,

grouping(deptno) is_deptno_subtotal, grouping(job) is_job_subtotal, sum(sal) sal

from emp

group by cube(deptno,job) order by 3,4</b>

DEPTNO JOB IS_DEPTNO_SUBTOTAL IS_JOB_SUBTOTAL SAL

------ --------- ------------------ -------------- -------

10 CLERK 0 0 1300

10 MANAGER 0 0 2450

10 PRESIDENT 0 0 5000

20 CLERK 0 0 1900

30 CLERK 0 0 950

30 SALESMAN 0 0 5600

30 MANAGER 0 0 2850

20 MANAGER 0 0 2975

20 ANALYST 0 0 6000

10 0 1 8750
```

20 0 1 10875

30 0 1 9400

CLERK 1 0 4150

ANALYST 1 0 6000

MANAGER 1 0 8275

PRESIDENT 1 0 5000

SALESMAN 1 0 5600

1 1 29025

```
<b>

   select deptno,

   job,

   case grouping(deptno)||grouping(job) when '00' then 'TOTAL BY DEPT
AND JOB'

   when '10' then 'TOTAL BY JOB'

   when '01' then 'TOTAL BY DEPT'

   when '11' then 'GRAND TOTAL FOR TABLE'

   end category,

   sum(sal) sal

   from emp

   group by cube(deptno,job) order by grouping(job),grouping(deptno)</b>

   DEPTNO JOB CATEGORY SAL

   ------ --------- --------------------- -------

   10 CLERK TOTAL BY DEPT AND JOB 1300

   10 MANAGER TOTAL BY DEPT AND JOB 2450

   10 PRESIDENT TOTAL BY DEPT AND JOB 5000

   20 CLERK TOTAL BY DEPT AND JOB 1900

   30 CLERK TOTAL BY DEPT AND JOB 950
```

```
30 SALESMAN TOTAL BY DEPT AND JOB 5600

30 MANAGER TOTAL BY DEPT AND JOB 2850

20 MANAGER TOTAL BY DEPT AND JOB 2975

20 ANALYST TOTAL BY DEPT AND JOB 6000

CLERK TOTAL BY JOB 4150

ANALYST TOTAL BY JOB 6000

MANAGER TOTAL BY JOB 8275

PRESIDENT TOTAL BY JOB 5000

SALESMAN TOTAL BY JOB 5600

10 TOTAL BY DEPT 8750

30 TOTAL BY DEPT 9400
```

20 TOTAL BY DEPT 10875

GRAND TOTAL <a name="idx-CHP-12-0759"></a>FOR TABLE 29025

<b>

```
select deptno,

job,

case grouping(deptno)||grouping(job) when '00' then 'TOTAL BY DEPT AND JOB'

when '10' then 'TOTAL BY JOB'

when '01' then 'TOTAL BY DEPT'

when '11' then 'GRAND TOTAL FOR TABLE'

end category,

sum(sal) sal

from emp

group by grouping sets ((deptno),(job),(deptno,job),( ))</b>
```

```
DEPTNO JOB CATEGORY SAL

------ --------- -------------------- -------

10 CLERK TOTAL BY DEPT AND JOB 1300

20 CLERK TOTAL BY DEPT AND JOB 1900

30 CLERK TOTAL BY DEPT AND JOB 950
```

```
20 ANALYST TOTAL BY DEPT AND JOB 6000

10 MANAGER TOTAL BY DEPT AND JOB 2450

20 MANAGER TOTAL BY DEPT AND JOB 2975

30 MANAGER TOTAL BY DEPT AND JOB 2850

30 SALESMAN TOTAL BY DEPT AND JOB 5600

10 PRESIDENT TOTAL BY DEPT AND JOB 5000

CLERK TOTAL BY JOB 4150

ANALYST TOTAL BY JOB 6000

MANAGER TOTAL BY JOB 8275

SALESMAN TOTAL BY JOB 5600

PRESIDENT TOTAL BY JOB 5000

10 TOTAL BY DEPT 8750

20 TOTAL BY DEPT 10875
```

30 TOTAL BY DEPT 9400

GRAND TOTAL <a name="idx-CHP-12-0761"></a>FOR TABLE 29025

/* no grand total */

<b>

select deptno,

job,

case grouping(deptno)||grouping(job) when '00' then 'TOTAL BY DEPT AND JOB'

when '10' then 'TOTAL BY JOB'

when '01' then 'TOTAL BY DEPT'

when '11' then 'GRAND TOTAL FOR TABLE'

end category,

sum(sal) sal

from emp

group by grouping sets ((deptno),(job),(deptno,job))</b>

DEPTNO JOB CATEGORY SAL

------ --------- --------------------- ----------

10 CLERK TOTAL BY DEPT AND JOB 1300

20 CLERK TOTAL BY DEPT AND JOB 1900

30 CLERK TOTAL BY DEPT AND JOB 950

20 ANALYST TOTAL BY DEPT AND JOB 6000

10 MANAGER TOTAL BY DEPT AND JOB 2450

20 MANAGER TOTAL BY DEPT AND JOB 2975

30 MANAGER TOTAL BY DEPT AND JOB 2850

30 SALESMAN TOTAL BY DEPT AND JOB 5600

10 PRESIDENT TOTAL BY DEPT AND JOB 5000

CLERK TOTAL BY JOB 4150

ANALYST TOTAL BY JOB 6000

ANAGER TOTAL BY JOB 8275

SALESMAN TOTAL BY JOB 5600

PRESIDENT TOTAL BY JOB 5000

10 TOTAL BY DEPT 8750

20 TOTAL BY DEPT 10875

30 TOTAL BY DEPT 9400

/* no <a name="idx-CHP-12-0764"></a>subtotals by DEPTNO */

```
   <b>

   select deptno,

   job,

   case grouping(deptno)||grouping(job) when '00' then 'TOTAL BY DEPT AND JOB'

   when '10' then 'TOTAL BY JOB'

   when '01' then 'TOTAL BY DEPT'

   when '11' then 'GRAND TOTAL FOR TABLE'

   end category,

   sum(sal) sal

   from emp

   group by grouping sets ((job),(deptno,job),( )) order by 3</b>

   DEPTNO JOB CATEGORY SAL

   ------ --------- --------------------- ----------

   GRAND TOTAL FOR TABLE 29025

   10 CLERK TOTAL BY DEPT AND JOB 1300

   20 CLERK TOTAL BY DEPT AND JOB 1900
   30 CLERK TOTAL BY DEPT AND JOB 950

   20 ANALYST TOTAL BY DEPT AND JOB 6000

   20 MANAGER TOTAL BY DEPT AND JOB 2975

   30 MANAGER TOTAL BY DEPT AND JOB 2850

   30 SALESMAN TOTAL BY DEPT AND JOB 5600

   10 PRESIDENT TOTAL BY DEPT AND JOB 5000

   10 MANAGER TOTAL BY DEPT AND JOB 2450

   CLERK TOTAL BY JOB 4150

   SALESMAN TOTAL BY JOB 5600

   PRESIDENT TOTAL BY JOB 5000

   MANAGER TOTAL BY JOB 8275

   ANALYST TOTAL BY JOB 6000
```

<b>

```
   select deptno, job, 'TOTAL BY DEPT AND JOB' as category, sum(sal)
as sal

   from emp

   group by deptno, job</b>

   DEPTNO JOB CATEGORY SAL

   ------ --------- --------------------- -------

   10 CLERK TOTAL BY DEPT AND JOB 1300

   10 MANAGER TOTAL BY DEPT AND JOB 2450
```

```
10 PRESIDENT TOTAL BY DEPT AND JOB 5000

20 CLERK TOTAL BY DEPT AND JOB 1900

20 ANALYST TOTAL BY DEPT AND JOB 6000

20 MANAGER TOTAL BY DEPT AND JOB 2975

30 CLERK TOTAL BY DEPT AND JOB 950

30 MANAGER TOTAL BY DEPT AND JOB 2850

30 SALESMAN TOTAL BY DEPT AND JOB 5600
```

<b>

```
select deptno, job, 'TOTAL BY DEPT AND JOB' as category, sum(sal) as sal

from emp

group by deptno, job union all

select null, job, 'TOTAL BY JOB', sum(sal) from emp

group by job</b>
```

```
DEPTNO JOB CATEGORY SAL

------ --------- --------------------- -------

10 CLERK TOTAL BY DEPT AND JOB 1300

10 MANAGER TOTAL BY DEPT AND JOB 2450

10 PRESIDENT TOTAL BY DEPT AND JOB 5000

20 CLERK TOTAL BY DEPT AND JOB 1900

20 ANALYST TOTAL BY DEPT AND JOB 6000
```

```
   20 MANAGER TOTAL BY DEPT AND JOB 2975

   30 CLERK TOTAL BY DEPT AND JOB 950

   30 MANAGER TOTAL BY DEPT AND JOB 2850

   30 SALESMAN TOTAL BY DEPT AND JOB 5600

   ANALYST TOTAL BY JOB 6000

   CLERK TOTAL BY JOB 4150

   MANAGER TOTAL BY JOB 8275

   PRESIDENT TOTAL BY JOB 5000

   SALESMAN TOTAL BY JOB 5600
```

<b>

```
   select deptno, job, 'TOTAL BY DEPT AND JOB' as category, sum(sal)
as sal

   from emp

   group by deptno, job union all

   select null, job, 'TOTAL BY JOB', sum(sal) from emp

   group by job

   union all

   select deptno, null, 'TOTAL BY DEPT', sum(sal) from emp

group by deptno</b>
```

```
   DEPTNO JOB CATEGORY SAL
```

```
------ --------- -------------------- -------

10 CLERK TOTAL BY DEPT AND JOB 1300

10 MANAGER TOTAL BY DEPT AND JOB 2450

10 PRESIDENT TOTAL BY DEPT AND JOB 5000

20 CLERK TOTAL BY DEPT AND JOB 1900

20 ANALYST TOTAL BY DEPT AND JOB 6000

20 MANAGER TOTAL BY DEPT AND JOB 2975

30 CLERK TOTAL BY DEPT AND JOB 950

30 MANAGER TOTAL BY DEPT AND JOB 2850

30 SALESMAN TOTAL BY DEPT AND JOB 5600

ANALYST TOTAL BY JOB 6000

CLERK TOTAL BY JOB 4150

MANAGER TOTAL BY JOB 8275

PRESIDENT TOTAL BY JOB 5000

SALESMAN TOTAL BY JOB 5600

10 TOTAL BY DEPT 8750

20 TOTAL BY DEPT 10875
```

30 TOTAL BY DEPT 9400

```
<b>

   select deptno, job, 'TOTAL BY DEPT AND JOB' as category, sum(sal)
as sal

   from emp

   group by deptno, job union all

   select null, job, 'TOTAL BY JOB', sum(sal) from emp

   group by job

   union all

   select deptno, null, 'TOTAL BY DEPT', sum(sal) from emp

   group by deptno

   union all

   select null,null, 'GRAND TOTAL <a name="idx-CHP-12-0765">
</a>FOR TABLE', sum(sal) from emp</b>

   DEPTNO JOB CATEGORY SAL

   ------ --------- --------------------- -------

   10 CLERK TOTAL BY DEPT AND JOB 1300

   10 MANAGER TOTAL BY DEPT AND JOB 2450

   10 PRESIDENT TOTAL BY DEPT AND JOB 5000

   20 CLERK TOTAL BY DEPT AND JOB 1900
```

```
20 ANALYST TOTAL BY DEPT AND JOB 6000

20 MANAGER TOTAL BY DEPT AND JOB 2975

30 CLERK TOTAL BY DEPT AND JOB 950

30 MANAGER TOTAL BY DEPT AND JOB 2850

30 SALESMAN TOTAL BY DEPT AND JOB 5600

ANALYST TOTAL BY JOB 6000

CLERK TOTAL BY JOB 4150

MANAGER TOTAL BY JOB 8275

PRESIDENT TOTAL BY JOB 5000

SALESMAN TOTAL BY JOB 5600

10 TOTAL BY DEPT 8750

20 TOTAL BY DEPT 10875
```

30 TOTAL BY DEPT 9400

GRAND TOTAL FOR TABLE 29025

```
DEPTNO JOB SAL

    ------ --------- -------

    29025

    CLERK 4150

    ANALYST 6000

    MANAGER 8275

    SALESMAN 5600

    PRESIDENT 5000

    10 8750

    10 CLERK 1300

    10 MANAGER 2450

    10 PRESIDENT 5000

    20 10875

    20 CLERK 1900

    20 ANALYST 6000

    20 MANAGER 2975

    30 9400

    30 CLERK 950

    30 MANAGER 2850
```

```
30 SALESMAN 5600

DEPTNO JOB SAL DEPTNO_SUBTOTALS JOB_SUBTOTALS

 ------ --------- ------- ---------------- -------------
```

```
29025 1 1
CLERK 4150 1 0
ANALYST 6000 1 0
MANAGER 8275 1 0
SALESMAN 5600 1 0
PRESIDENT 5000 1 0
10 8750 0 1
10 CLERK 1300 0 0
10 MANAGER 2450 0 0
10 PRESIDENT 5000 0 0
20 10875 0 1
20 CLERK 1900 0 0
20 ANALYST 6000 0 0
20 MANAGER 2975 0 0
30 9400 0 1
30 CLERK 950 0 0
30 MANAGER 2850 0 0
```

```
30 SALESMAN 5600 0 0

1 select deptno, job, sum(sal) sal,

   2 grouping(deptno) deptno_subtotals, 3 grouping(job) job_subtotals
```

4 from emp

5 group by cube(deptno,job)

1 select deptno, job, sum(sal) sal,

2 grouping(deptno) deptno_subtotals, 3 grouping(job) job_subtotals

```
4 from emp
   5 group by deptno,job with cube
```

This recipe is meant to highlight the use of CUBE and GROUPING when working with subtotals. As of the time of this writing, PostgreSQL and MySQL support neither CUBE nor GROUPING.

Discussion

If DEPTNO_SUBTOTALS is 1, then the value in SAL represents a subtotal by DEPTNO created by CUBE. If JOB_SUBTOTALS is 1, then the value in SAL represents a subtotal by JOB created by CUBE. If both JOB_SUBTOTALS and DEPTNO_ SUBTOTALS are 1, then the value in SAL represents a grand total of all salaries created by CUBE. Rows with 0 for both DEPTNO_SUBTOTALS and JOB_SUBTOTALS represent rows created by regular aggregation (the sum of SAL for each DEPTNO/JOB combination).

```
ENAME IS_CLERK IS_SALES IS_MGR IS_ANALYST IS_PREZ
    ------ -------- -------- ------ ---------- -------
    KING 0 0 0 0 1
    SCOTT 0 0 0 1 0
    FORD 0 0 0 1 0
    JONES 0 0 1 0 0
    BLAKE 0 0 1 0 0
    CLARK 0 0 1 0 0
    ALLEN 0 1 0 0 0
    WARD 0 1 0 0 0
    MARTIN 0 1 0 0 0
    TURNER 0 1 0 0 0
    SMITH 1 0 0 0 0
    MILLER 1 0 0 0 0
    ADAMS 1 0 0 0 0
    JAMES 1 0 0 0 0
1 select ename,
    2 case when job = 'CLERK'
```

3 then 1 else 0

4 end as is_clerk, 5 case when job = 'SALESMAN'

6 then 1 else 0

7 end as is_sales, 8 case when job = 'MANAGER'

9 then 1 else 0

10 end as is_mgr, 11 case when job = 'ANALYST'

12 then 1 else 0

13 end as is_analyst, 14 case when job = 'PRESIDENT'

15 then 1 else 0

16 end as is_prez

17 from emp

18 order by 2,3,4,5,6

<b>

```
select ename,
job,
case when job = 'CLERK'
then 1 else 0
end as is_clerk, case when job = 'SALESMAN'
then 1 else 0
end as is_sales, case when job = 'MANAGER'
then 1 else 0
end as is_mgr,
case when job = 'ANALYST'
then 1 else 0
end as is_analyst, case when job = 'PRESIDENT'
then 1 else 0
end as is_prez
from emp
order by 2</b>
```

```
ENAME JOB IS_CLERK IS_SALES IS_MGR IS_ANALYST IS_PREZ

------ --------- -------- -------- ------ ---------- -------

SCOTT ANALYST 0 0 0 1 0

FORD ANALYST 0 0 0 1 0

SMITH CLERK 1 0 0 0 0

ADAMS CLERK 1 0 0 0 0

MILLER CLERK 1 0 0 0 0

JAMES CLERK 1 0 0 0 0

JONES MANAGER 0 0 1 0 0

CLARK MANAGER 0 0 1 0 0

BLAKE MANAGER 0 0 1 0 0

KING PRESIDENT 0 0 0 0 1

ALLEN SALESMAN 0 1 0 0 0

MARTIN SALESMAN 0 1 0 0 0

TURNER SALESMAN 0 1 0 0 0

WARD SALESMAN 0 1 0 0 0
```

```
D10 D20 D30 CLERKS MGRS PREZ ANALS SALES
    ---------- ---------- ---------- ------ ----- ---- ----- ------
    SMITH SMITH
    ALLEN ALLEN
    WARD WARD
    JONES JONES
    MARTIN MARTIN
    BLAKE BLAKE
    CLARK CLARK
    SCOTT SCOTT
    KING KING
    TURNER TURNER
    ADAMS ADAMS
    JAMES JAMES
    FORD FORD
    MILLER MILLER
```

1 select case deptno when 10 then ename end as d10, 2 case deptno when 20 then ename end as d20, 3 case deptno when 30 then ename end as d30, 4 case job when 'CLERK' then ename end as clerks, 5 case job when 'MANAGER' then ename end as mgrs, 6 case job when 'PRESIDENT' then ename end as prez, 7 case job when 'ANALYST' then ename end as anals, 8 case job when 'SALESMAN' then ename end as sales

9 from emp

<b>

select max(case deptno when 10 then ename end) d10, max(case deptno when 20 then ename end) d20, max(case deptno when 30 then ename end) d30, max(case job when 'CLERK' then ename end) clerks, max(case job when 'MANAGER' then ename end) mgrs, max(case job when 'PRESIDENT' then ename end) prez, max(case job when 'ANALYST' then ename end) anals, max(case job when 'SALESMAN' then ename end) sales from (

select deptno, job, ename, row_number()over(partition <a name="idx-CHP-12-0773"></a>by deptno order by empno) rn from emp

) x

group by rn</b>

```
D10 D20 D30 CLERKS MGRS PREZ ANALS SALES

---------- ---------- ---------- ------ ----- ---- ----- ------

CLARK SMITH ALLEN SMITH CLARK ALLEN

KING JONES WARD JONES KING WARD

MILLER SCOTT MARTIN MILLER SCOTT MARTIN

ADAMS BLAKE ADAMS BLAKE

FORD TURNER FORD TURNER

JAMES JAMES
```

```
<b>
    select trx_id,
    trx_date,
    trx_cnt
    from trx_log</b>
    TRX_ID TRX_DATE TRX_CNT
    ------ -------------------- ----------
    1 28-JUL-2005 19:03:07 44
    2 28-JUL-2005 19:03:08 18
    3 28-JUL-2005 19:03:09 23
    4 28-JUL-2005 19:03:10 29
    5 28-JUL-2005 19:03:11 27
    6 28-JUL-2005 19:03:12 45
    7 28-JUL-2005 19:03:13 45
    8 28-JUL-2005 19:03:14 32
    9 28-JUL-2005 19:03:15 41
    10 28-JUL-2005 19:03:16 15
    11 28-JUL-2005 19:03:17 24
    12 28-JUL-2005 19:03:18 47
    13 28-JUL-2005 19:03:19 37
```

```
14 28-JUL-2005 19:03:20 48

15 28-JUL-2005 19:03:21 46

16 28-JUL-2005 19:03:22 44

17 28-JUL-2005 19:03:23 36

18 28-JUL-2005 19:03:24 41

19 28-JUL-2005 19:03:25 33
```

```
20 28-JUL-2005 19:03:26 19

GRP TRX_START TRX_END TOTAL

   --- -------------------- ------------------- ----------

   1 28-JUL-2005 19:03:07 28-JUL-2005 19:03:11 141

   2 28-JUL-2005 19:03:12 28-JUL-2005 19:03:16 178

   3 28-JUL-2005 19:03:17 28-JUL-2005 19:03:21 202

   4 28-JUL-2005 19:03:22 28-JUL-2005 19:03:26 173

1 select ceil(trx_id/5.0) as grp,

   2 min(trx_date) as trx_start, 3 max(trx_date) as trx_end, 4 sum(trx_cnt)
as total
```

5 from trx_log

```
   6 group by ceil(trx_id/5.0)
<b>
   select trx_id,
   trx_date,
   trx_cnt,
   trx_id/5.0 as val,
   ceil(trx_id/5.0) as grp
   from trx_log</b>
   TRX_ID TRX_DATE TRX_CNT VAL GRP
   ------ -------------------- ------- ------ ---
   1 28-JUL-2005 19:03:07 44 .20 1
   2 28-JUL-2005 19:03:08 18 .40 1
   3 28-JUL-2005 19:03:09 23 .60 1
   4 28-JUL-2005 19:03:10 29 .80 1
   5 28-JUL-2005 19:03:11 27 1.00 1
   6 28-JUL-2005 19:03:12 45 1.20 2
   7 28-JUL-2005 19:03:13 45 1.40 2
   8 28-JUL-2005 19:03:14 32 1.60 2
   9 28-JUL-2005 19:03:15 41 1.80 2

   10 28-JUL-2005 19:03:16 15 2.00 2

   11 28-JUL-2005 19:03:17 24 2.20 3

   12 28-JUL-2005 19:03:18 47 2.40 3

   13 28-JUL-2005 19:03:19 37 2.60 3

   14 28-JUL-2005 19:03:20 48 2.80 3

   15 28-JUL-2005 19:03:21 46 3.00 3

   16 28-JUL-2005 19:03:22 44 3.20 4

   17 28-JUL-2005 19:03:23 36 3.40 4

   18 28-JUL-2005 19:03:24 41 3.60 4

   19 28-JUL-2005 19:03:25 33 3.80 4

   20 28-JUL-2005 19:03:26 19 4.00 4

<b>

   select ceil(trx_id/5.0) as grp, min(trx_date) as trx_start, max(trx_date) as trx_end, sum(trx_cnt) as total

   from trx_log

   group <a name="idx-CHP-12-0778"></a>by ceil(trx_id/5.0)</b> GRP TRX_START TRX_END TOTAL

   --- -------------------- -------------------- ----------

   1 28-JUL-2005 19:03:07 28-JUL-2005 19:03:11 141

   2 28-JUL-2005 19:03:12 28-JUL-2005 19:03:16 178
```

```
    3 28-JUL-2005 19:03:17 28-JUL-2005 19:03:21 202

    4 28-JUL-2005 19:03:22 28-JUL-2005 19:03:26 173
```

<b>

```
    select trx_date,trx_cnt,

    to_number(to_char(trx_date,'hh24')) hr, ceil(to_number(to_char(trx_date-
1/24/60/60,'miss'))/5.0) grp from trx_log</b>



    TRX_DATE TRX_CNT HR GRP

    -------------------- ---------- ---------- ----------

    28-JUL-2005 19:03:07 44 19 62

    28-JUL-2005 19:03:08 18 19 62

    28-JUL-2005 19:03:09 23 19 62

    28-JUL-2005 19:03:10 29 19 62

    28-JUL-2005 19:03:11 27 19 62

    28-JUL-2005 19:03:12 45 19 63

    28-JUL-2005 19:03:13 45 19 63

    28-JUL-2005 19:03:14 32 19 63

    28-JUL-2005 19:03:15 41 19 63

    28-JUL-2005 19:03:16 15 19 63

    28-JUL-2005 19:03:17 24 19 64

    28-JUL-2005 19:03:18 47 19 64
```

```
28-JUL-2005 19:03:19 37 19 64

28-JUL-2005 19:03:20 48 19 64

28-JUL-2005 19:03:21 46 19 64

28-JUL-2005 19:03:22 44 19 65

28-JUL-2005 19:03:23 36 19 65

28-JUL-2005 19:03:24 41 19 65

28-JUL-2005 19:03:25 33 19 65

28-JUL-2005 19:03:26 19 19 65
```

<b>

```
select hr,grp,sum(trx_cnt) total from (

select trx_date,trx_cnt,

to_number(to_char(trx_date,'hh24')) hr, ceil(to_number(to_char(trx_date-1/24/60/60,'miss'))/5.0) grp from trx_log

) x

group <a name="idx-CHP-12-0781"></a>by hr,grp</b> HR GRP TOTAL

-- ---------- ----------

19 62 141

19 63 178

19 64 202
```

19 65 173

<b>

select trx_id, trx_date, trx_cnt, sum(trx_cnt)over(partition by ceil(trx_id/5.0) order by trx_date

range between unbounded preceding and current row) runing_total, sum(trx_cnt)over(partition by ceil(trx_id/5.0)) total, case when mod(trx_id,5.0) = 0 then 'X' end grp_end from trx_log</b>

```
TRX_ID TRX_DATE TRX_CNT RUNING_TOTAL TOTAL GRP_END

------ -------------------- ---------- ------------ ---------- -------

1 28-JUL-2005 19:03:07 44 44 141

2 28-JUL-2005 19:03:08 18 62 141

3 28-JUL-2005 19:03:09 23 85 141

4 28-JUL-2005 19:03:10 29 114 141

5 28-JUL-2005 19:03:11 27 141 141 X

6 28-JUL-2005 19:03:12 45 45 178

7 28-JUL-2005 19:03:13 45 90 178

8 28-JUL-2005 19:03:14 32 122 178

9 28-JUL-2005 19:03:15 41 163 178

10 28-JUL-2005 19:03:16 15 178 178 X

11 28-JUL-2005 19:03:17 24 24 202
```

```
12 28-JUL-2005 19:03:18 47 71 202

13 28-JUL-2005 19:03:19 37 108 202

14 28-JUL-2005 19:03:20 48 156 202

15 28-JUL-2005 19:03:21 46 202 202 X

16 28-JUL-2005 19:03:22 44 44 173

17 28-JUL-2005 19:03:23 36 80 173

18 28-JUL-2005 19:03:24 41 121 173

19 28-JUL-2005 19:03:25 33 154 173

20 28-JUL-2005 19:03:26 19 173 173 X
```

Recipe 12.18. Performing Aggregations over Different Groups/Partitions Simultaneously

Problem

You want to aggregate over different dimensions at the same time. For example, you want to return a result set that lists each employee's name, his department, the number of employees in his department (himself included), the number of employees that have the same job as he does (himself included in this count as well), and the total number of employees in the EMP table. The result set should look like the following:

```
ENAME  DEPTNO DEPTNO_CNT JOB       JOB_CNT   TOTAL
        ------ ------ ---------- --------- -------- ------
        MILLER     10          3 CLERK            4     14
        CLARK      10          3 MANAGER          3     14
        KING       10          3 PRESIDENT        1     14
        SCOTT      20          5 ANALYST          2     14
        FORD       20          5 ANALYST          2     14
        SMITH      20          5 CLERK            4     14
        JONES      20          5 MANAGER          3     14
        ADAMS      20          5 CLERK            4     14
        JAMES      30          6 CLERK            4     14
        MARTIN     30          6 SALESMAN         4     14
        TURNER     30          6 SALESMAN         4     14
        WARD       30          6 SALESMAN         4     14
        ALLEN      30          6 SALESMAN         4     14
        BLAKE      30          6 MANAGER          3     14
```

Solution

Window functions make this problem quite easy to solve. If you do not have window functions available to you, you can use scalar subqueries.

DB2, Oracle, and SQL Server

Use the COUNT OVER window function while specifying different partitions, or groups of data on which to perform aggregation:

```
select ename,
               deptno,
               count(*)over(partition by deptno) deptno_cnt,
               job,
               count(*)over(partition by job) job_cnt,
               count(*)over() total
          from emp
```

PostgreSQL and MySQL

Use scalar subqueries in your SELECT list to perform the aggregate count operations on different groups of rows:

```
select e.ename,
                e.deptno,
                (select count(*) from emp d
                  where d.deptno = e.deptno) as deptno_cnt,
                job,
                (select count(*) from emp d
                  where d.job = e.job) as job_cnt,
                (select count(*) from emp) as total
           from emp e
```

Discussion

DB2, Oracle, and SQL Server

This example really shows off the power and convenience of window functions. By simply specifying different partitions or groups of data to aggregate, you can create immensely detailed reports without having to self join over and over, and without having to write cumbersome and perhaps poorly performing subqueries in your SELECT list. All the work is done by the window function COUNT OVER. To understand the output, focus on the OVER clause for a moment for each COUNT operation:

```
count(*)over(partition by deptno)

        count(*)over(partition by job)

        count(*)over()
```

Remember the main parts of the OVER clause: the partition, specified by PARTITION BY: and the frame or window, specified by ORDER BY. Look at the first COUNT, which partitions by DEPTNO. The rows in table EMP will be grouped by DEPTNO and the COUNT operation will be performed on all the rows in each group. Since there is no frame or window clause specified (no ORDER BY), all the rows in the group are counted. The PARTITION BY clause finds all the unique DEPTNO values, and then the COUNT function counts the number of rows having each value. In the specific example of COUNT(*)OVER(PARTITION BY DEPTNO), The PARTITION BY clause identifies the partitions or groups to be values 10, 20, and 30.

The same processing is applied to the second COUNT, which partitions by JOB. The last count does not partition by anything, and simply has an empty parenthesis. An empty parenthesis implies "the whole table." So, whereas the two prior COUNTs aggregate values based on the defined groups or partitions, the final COUNT counts all rows in table EMP.

Keep in mind that window functions are applied after the WHERE clause. If you were to filter the result set in some way, for example, excluding all employees in DEPTNO 10, the value for TOTAL would not be 14, it would be 11. To filter results after window functions have been evaluated, you must make your windowing query into an inline view and then filter on the results from that view.

PostgreSQL and MySQL

For every row returned by the main query (rows from EMP E), use multiple scalar subqueries in the SELECT list to perform different counts for each DEPTNO and JOB. To get the TOTAL, simply use another scalar subquery to get the count of all employees in table EMP.

```
HIREDATE SAL SPENDING_PATTERN
    ----------- ------- ----------------
    17-DEC-1980 800 800
    20-FEB-1981 1600 2400
    22-FEB-1981 1250 3650
    02-APR-1981 2975 5825
    01-MAY-1981 2850 8675
    09-JUN-1981 2450 8275
    08-SEP-1981 1500 1500
    28-SEP-1981 1250 2750
    17-NOV-1981 5000 7750
    03-DEC-1981 950 11700
    03-DEC-1981 3000 11700
    23-JAN-1982 1300 10250
    09-DEC-1982 3000 3000
    12-JAN-1983 1100 4100
1 select hiredate,
    2 sal,
    3 sum(sal)over(order by days(hiredate)
```

4 range between 90 preceding

5 and current row) spending_pattern

6 from emp e

```
1 select hiredate,
  2 sal,
  3 sum(sal)over(order by hiredate
```

4 range between 90 preceding

5 and current row) spending_pattern

6 from emp e

```
1 select e.hiredate,

   2 e.sal,

   3 (select sum(sal) from emp d 4 where <a name="idx-CHP-12-0789">
</a>d.hiredate between e.hiredate-90

   5 and e.hiredate) as spending_pattern 6 from emp e
```

7 order by 1

<b>

select distinct

dense_rank( )<a name="idx-CHP-12-0792"></a>over(order by e.hiredate) window, e.hiredate current_hiredate, d.hiredate hiredate_within_90_days, d.sal sals_used_for_sum from emp e,

emp d

where d.hiredate between e.hiredate-90 and e.hiredate</b>

```
WINDOW CURRENT_HIREDATE HIREDATE_WITHIN_90_DAYS SALS_USED_FOR_SUM

------ ---------------- ----------------------- -----------------

1 17-DEC-1980 17-DEC-1980 800

2 20-FEB-1981 17-DEC-1980 800

2 20-FEB-1981 20-FEB-1981 1600

3 22-FEB-1981 17-DEC-1980 800

3 22-FEB-1981 20-FEB-1981 1600

3 22-FEB-1981 22-FEB-1981 1250

4 02-APR-1981 20-FEB-1981 1600

4 02-APR-1981 22-FEB-1981 1250

4 02-APR-1981 02-APR-1981 2975

5 01-MAY-1981 20-FEB-1981 1600
```

```
5 01-MAY-1981 22-FEB-1981 1250

5 01-MAY-1981 02-APR-1981 2975

5 01-MAY-1981 01-MAY-1981 2850

6 09-JUN-1981 02-APR-1981 2975

6 09-JUN-1981 01-MAY-1981 2850

6 09-JUN-1981 09-JUN-1981 2450

7 08-SEP-1981 08-SEP-1981 1500

8 28-SEP-1981 08-SEP-1981 1500

8 28-SEP-1981 28-SEP-1981 1250

9 17-NOV-1981 08-SEP-1981 1500

9 17-NOV-1981 28-SEP-1981 1250

9 17-NOV-1981 17-NOV-1981 5000

10 03-DEC-1981 08-SEP-1981 1500

10 03-DEC-1981 28-SEP-1981 1250

10 03-DEC-1981 17-NOV-1981 5000

10 03-DEC-1981 03-DEC-1981 950

10 03-DEC-1981 03-DEC-1981 3000

11 23-JAN-1982 17-NOV-1981 5000

11 23-JAN-1982 03-DEC-1981 950

11 23-JAN-1982 03-DEC-1981 3000
```

```
11 23-JAN-1982 23-JAN-1982 1300

12 09-DEC-1982 09-DEC-1982 3000

13 12-JAN-1983 09-DEC-1982 3000
```

13 12-JAN-1983 12-JAN-1983 1100

```
<b>

   select current_hiredate, sum(sals_used_for_sum) spending_pattern from (

   select distinct

   dense_rank()<a name="idx-CHP-12-0793"></a>over(order by
e.hiredate) window, e.hiredate current_hiredate, d.hiredate
hiredate_within_90_days, d.sal sals_used_for_sum from emp e,

   emp d

   where d.hiredate between e.hiredate-90 and e.hiredate ) x

   group by current_hiredate</b>

   CURRENT_HIREDATE SPENDING_PATTERN

   ---------------- ----------------

   17-DEC-1980 800

   20-FEB-1981 2400

   22-FEB-1981 3650

   02-APR-1981 5825

   01-MAY-1981 8675

   09-JUN-1981 8275

   08-SEP-1981 1500

   28-SEP-1981 2750
```

```
17-NOV-1981 7750

03-DEC-1981 11700

23-JAN-1982 10250

09-DEC-1982 3000

12-JAN-1983 4100
```

<b>

```
select e.hiredate, e.sal,

sum(d.sal) as spending_pattern from emp e, emp d where d.hiredate

between e.hiredate-90 and e.hiredate group by e.hiredate,e.sal order by
```
1</b>\

```
HIREDATE SAL SPENDING_PATTERN

----------- ----- ----------------

17-DEC-1980 800 800

20-FEB-1981 1600 2400

22-FEB-1981 1250 3650

02-APR-1981 2975 5825

01-MAY-1981 2850 8675

09-JUN-1981 2450 8275

08-SEP-1981 1500 1500

28-SEP-1981 1250 2750

17-NOV-1981 5000 7750
```

```
03-DEC-1981 950 11700

03-DEC-1981 3000 11700

23-JAN-1982 1300 10250

09-DEC-1982 3000 3000

12-JAN-1983 1100 4100
```

<b>

```
select e.hiredate, e.sal,

d.sal,

d.hiredate

from emp e, emp d</b>

HIREDATE SAL SAL HIREDATE

----------- ----- ----- -----------

17-DEC-1980 800 800 17-DEC-1980

17-DEC-1980 800 1600 20-FEB-1981

17-DEC-1980 800 1250 22-FEB-1981

17-DEC-1980 800 2975 02-APR-1981

17-DEC-1980 800 1250 28-SEP-1981

17-DEC-1980 800 2850 01-MAY-1981

17-DEC-1980 800 2450 09-JUN-1981

17-DEC-1980 800 3000 09-DEC-1982
```

```
17-DEC-1980 800 5000 17-NOV-1981

17-DEC-1980 800 1500 08-SEP-1981

17-DEC-1980 800 1100 12-JAN-1983

17-DEC-1980 800 950 03-DEC-1981

17-DEC-1980 800 3000 03-DEC-1981

17-DEC-1980 800 1300 23-JAN-1982

20-FEB-1981 1600 800 17-DEC-1980

20-FEB-1981 1600 1600 20-FEB-1981

20-FEB-1981 1600 1250 22-FEB-1981

20-FEB-1981 1600 2975 02-APR-1981

20-FEB-1981 1600 1250 28-SEP-1981

20-FEB-1981 1600 2850 01-MAY-1981

20-FEB-1981 1600 2450 09-JUN-1981

20-FEB-1981 1600 3000 09-DEC-1982

20-FEB-1981 1600 5000 17-NOV-1981

20-FEB-1981 1600 1500 08-SEP-1981

20-FEB-1981 1600 1100 12-JAN-1983

20-FEB-1981 1600 950 03-DEC-1981

20-FEB-1981 1600 3000 03-DEC-1981

20-FEB-1981 1600 1300 23-JAN-1982
```

```
<b>

   select e.hiredate, e.sal,

   d.sal sal_to_sum, d.hiredate within_90_days from emp e, emp d where
d.hiredate

   between e.hiredate-90 and e.hiredate order by 1</b> HIREDATE SAL
SAL_TO_SUM WITHIN_90_DAYS

   ----------- ----- ---------- --------------

   17-DEC-1980 800 800 17-DEC-1980

   20-FEB-1981 1600 800 17-DEC-1980

   20-FEB-1981 1600 1600 20-FEB-1981

   22-FEB-1981 1250 800 17-DEC-1980

   22-FEB-1981 1250 1600 20-FEB-1981

   22-FEB-1981 1250 1250 22-FEB-1981

   02-APR-1981 2975 1600 20-FEB-1981

   02-APR-1981 2975 1250 22-FEB-1981

   02-APR-1981 2975 2975 02-APR-1981

   01-MAY-1981 2850 1600 20-FEB-1981

   01-MAY-1981 2850 1250 22-FEB-1981

   01-MAY-1981 2850 2975 02-APR-1981

   01-MAY-1981 2850 2850 01-MAY-1981

   09-JUN-1981 2450 2975 02-APR-1981
```

```
09-JUN-1981 2450 2850 01-MAY-1981
09-JUN-1981 2450 2450 09-JUN-1981
08-SEP-1981 1500 1500 08-SEP-1981
28-SEP-1981 1250 1500 08-SEP-1981
28-SEP-1981 1250 1250 28-SEP-1981
17-NOV-1981 5000 1500 08-SEP-1981
17-NOV-1981 5000 1250 28-SEP-1981
17-NOV-1981 5000 5000 17-NOV-1981
03-DEC-1981 950 1500 08-SEP-1981
03-DEC-1981 950 1250 28-SEP-1981
03-DEC-1981 950 5000 17-NOV-1981
03-DEC-1981 950 950 03-DEC-1981
03-DEC-1981 950 3000 03-DEC-1981
03-DEC-1981 3000 1500 08-SEP-1981
03-DEC-1981 3000 1250 28-SEP-1981
03-DEC-1981 3000 5000 17-NOV-1981
03-DEC-1981 3000 950 03-DEC-1981
03-DEC-1981 3000 3000 03-DEC-1981
23-JAN-1982 1300 5000 17-NOV-1981
23-JAN-1982 1300 950 03-DEC-1981
```

```
   23-JAN-1982 1300 3000 03-DEC-1981

   23-JAN-1982 1300 1300 23-JAN-1982

   09-DEC-1982 3000 3000 09-DEC-1982

   12-JAN-1983 1100 3000 09-DEC-1982

   12-JAN-1983 1100 1100 12-JAN-1983

select e.hiredate,

   e.sal,

   sum(d.sal) as spending_pattern from emp e, emp d where d.hiredate

   between e.hiredate-90 and e.hiredate group by e.hiredate,e.sal order by 1

select e.hiredate,

   e.sal,

   (select sum(sal) from emp d where d.hiredate between e.hiredate-90

   and e.hiredate) as spending_pattern from emp e

   order by 1


   HIREDATE SAL SPENDING_PATTERN

   ----------- ----- ----------------

   17-DEC-1980 800 800

   20-FEB-1981 1600 2400

   22-FEB-1981 1250 3650
```

```
02-APR-1981 2975 5825

01-MAY-1981 2850 8675

09-JUN-1981 2450 8275

08-SEP-1981 1500 1500

28-SEP-1981 1250 2750

17-NOV-1981 5000 7750

03-DEC-1981 950 11700

03-DEC-1981 3000 11700

23-JAN-1982 1300 10250

09-DEC-1982 3000 3000

12-JAN-1983 1100 4100
```

```
DEPTNO MGR SAL

    ------ ---------- ----------

    10 7782 1300

    10 7839 2450

    10 3750

    20 7566 6000

    20 7788 1100

    20 7839 2975

    20 7902 800

    20 10875

    30 7698 6550

    30 7839 2850
```

30 9400

24025

```
MGR DEPT10 DEPT20 DEPT30 TOTAL
   ---- ---------- ---------- ---------- ----------
   7566 0 6000 0
   7698 0 0 6550
   7782 1300 0 0
   7788 0 1100 0
   7839 2450 2975 2850
   7902 0 800 0
```

3750 10875 9400 24025

1 select mgr,

2 sum(case deptno when 10 then sal else 0 end) dept10, 3 sum(case deptno when 20 then sal else 0 end) dept20, 4 sum(case deptno when 30 then sal else 0 end) dept30, 5 sum(case flag when '11' then sal else null end) total 6 from (

7 select deptno,mgr,sum(sal) sal, 8 cast(grouping(deptno) as char(1))||

9 cast(grouping(mgr) as char(1)) flag 10 from emp

11 where mgr is not null

12 group by rollup(deptno,mgr) 13) x

14 group by mgr

1 select mgr,

2 sum(case deptno when 10 then sal else 0 end) dept10, 3 sum(case deptno when 20 then sal else 0 end) dept20, 4 sum(case deptno when 30 then sal else 0 end) dept30, 5 sum(case flag when '11' then sal else null end) total 6 from (

7 select deptno,mgr,sum(sal) sal, 8 cast(grouping(deptno) as char(1))+

9 cast(grouping(mgr) as char(1)) flag 10 from emp

11 where mgr is not null

12 group by deptno,mgr with rollup 13) x

14 group by mgr

```
select deptno,mgr,sum(sal) sal
  from emp
  where mgr is not null group by mgr,deptno order by 1,2

  DEPTNO MGR SAL
  ------ ---------- ----------
  10 7782 1300
  10 7839 2450
  20 7566 6000
  20 7788 1100
  20 7839 2975
  20 7902 800
  30 7698 6550
```

30 7839 2850

```
select deptno,mgr,sum(sal) sal
    from emp
    where mgr is not null group by deptno,mgr with rollup
    DEPTNO MGR SAL
    ------ ---------- ----------
    10 7782 1300
    10 7839 2450
    10 3750
    20 7566 6000
    20 7788 1100
    20 7839 2975
    20 7902 800
    20 10875
    30 7698 6550
    30 7839 2850
```

30 9400

24025

```
select deptno,mgr,sum(sal) sal,
   cast(grouping(deptno) as char(1))+
   cast(grouping(mgr) as char(1)) flag from emp
   where mgr is not null group by deptno,mgr with rollup
   DEPTNO MGR SAL FLAG
   ------ ---------- ---------- ----
   10 7782 1300 00
   10 7839 2450 00
   10 3750 01
   20 7566 6000 00
   20 7788 1100 00
   20 7839 2975 00
   20 7902 800 00
   20 10875 01
   30 7698 6550 00
   30 7839 2850 00
   30 9400 01
```

24025 11

select mgr,

sum(case deptno when 10 then sal else 0 end) dept10, sum(case deptno when 20 then sal else 0 end) dept20, sum(case deptno when 30 then sal else 0 end) dept30, sum(case flag when '11' then sal else null end) total from (

```
select deptno,mgr,sum(sal) sal, cast(grouping(deptno) as char(1))+

cast(grouping(mgr) as char(1)) flag from emp

where mgr is not null group by deptno,mgr with rollup ) x

group by mgr order by coalesce(mgr,9999)

MGR DEPT10 DEPT20 DEPT30 TOTAL

---- ---------- ---------- ---------- ----------

7566 0 6000 0

7698 0 0 6550

7782 1300 0 0

7788 0 1100 0

7839 2450 2975 2850

7902 0 800 0
```

3750 10875 9400 24025

<b>

```
select empno,mgr from emp order by 2</b>

EMPNO MGR

---------- ----------

7788 7566

7902 7566

7499 7698

7521 7698

7900 7698

7844 7698

7654 7698

7934 7782

7876 7788

7566 7839

7782 7839

7698 7839
```

7369 7902

7839

If you look carefully, you will see that each value for MGR is also an EMPNO, meaning the manager of each employee in table EMP is also an employee in table EMP and not stored somewhere else. The relationship between MGR and EMPNO is a parentchild relationship in that the value for MGR is the most immediate parent for a given EMPNO (it is also possible that the manager for a specific employee can have a manager herself, and those managers can in turn have managers, and so on, creating an n-tier hierarchy). If an employee has no manager, then MGR is NULL.

```
EMPS_AND_MGRS

    ------------------------------

    FORD works for JONES

    SCOTT works for JONES

    JAMES works for BLAKE

    TURNER works for BLAKE

    MARTIN works for BLAKE

    WARD works for BLAKE

    ALLEN works for BLAKE

    MILLER works for CLARK

    ADAMS works for SCOTT

    CLARK works for KING

    BLAKE works for KING

    JONES works for KING

    SMITH works for FORD
```

```
1 select a.ename || ' works for ' || b.ename as emps_and_mgrs 2 from emp a, emp b 3 where a.mgr = b.empno
```

```
1 select concat(a.ename, ' works for ',b.ename) as emps_and_mgrs 2 from emp a, emp b 3 where a.mgr = b.empno
```

```
1 select a.ename + ' works for ' + b.ename as emps_and_mgrs 2 from emp a, emp b 3 where a.mgr = b.empno
```

<b>

```
select a.empno, b.empno from emp a, emp b</b>

EMPNO MGR

----- ----------

7369 7369

7369 7499

7369 7521

7369 7566

7369 7654

7369 7698

7369 7782

7369 7788

7369 7839

7369 7844

7369 7876

7369 7900

7369 7902

7369 7934

7499 7369

7499 7499
```

7499 7521

7499 7566

7499 7654

7499 7698

7499 7782

7499 7788

7499 7839

7499 7844

7499 7876

7499 7900

7499 7902

7499 7934

<b>

```
1 select a.empno, b.empno mgr 2 from emp a, emp b 3 where a.mgr = b.empno</b>

EMPNO MGR

---------- ----------

7902 7566

7788 7566

7900 7698

7844 7698

7654 7698

7521 7698

7499 7698

7934 7782

7876 7788

7782 7839

7698 7839

7566 7839
```

7369 7902

<b>

```
select a.ename, (select b.ename from emp b

where b.empno = a.mgr) as mgr from emp a</b>

ENAME MGR

---------- ----------

SMITH FORD

ALLEN BLAKE

WARD BLAKE

JONES KING

MARTIN BLAKE

BLAKE KING

CLARK KING

SCOTT JONES

KING

TURNER BLAKE

ADAMS SCOTT

JAMES BLAKE

FORD JONES
```

MILLER CLARK

<b>

/* ANSI */

select a.ename, b.ename mgr from emp a left join emp b on (a.mgr = b.empno)

/* Oracle */

select a.ename, b.ename mgr from emp a, emp b where a.mgr = b.empno (+)</b>

```
ENAME MGR

---------- ----------

FORD JONES

SCOTT JONES

JAMES BLAKE

TURNER BLAKE

MARTIN BLAKE

WARD BLAKE

ALLEN BLAKE

MILLER CLARK

ADAMS SCOTT

CLARK KING

BLAKE KING
```

JONES KING

SMITH FORD

KING

Recipe 13.2. Expressing a Child-Parent-Grandparent Relationship

Problem

Employee CLARK works for KING and to express that relationship you can use the first recipe in this chapter. What if employee CLARK was in turn a manager for another employee? Consider the following query:

```
select ename,empno,mgr
  from emp
 where ename in ('KING','CLARK','MILLER')

ENAME        EMPNO     MGR
--------- -------- -------
CLARK         7782    7839
KING          7839
MILLER        7934    7782
```

As you can see, employee MILLER works for CLARK who in turn works for KING. You want to express the full hierarchy from MILLER to KING. You want to return the following result set:

```
LEAF___BRANCH___ROOT
        ---------------------
        MILLER-->CLARK-->KING
```

However, the single self-join approach from the previous recipe will not suffice to show the entire relationship from top to bottom. You could write a query that does two self joins, but what you really need is a general approach for traversing such hierarchies.

Solution

This recipe differs from the first recipe because there is now a three-tier relationship, as the title suggests. If your RDBMS does not supply functionality for traversing tree-structured data, then you can solve this problem using the technique from , but you must add an additional self join. DB2, SQL Server, and Oracle offer functions for expressing hierarchies. Thus self joins on those RDBMSs aren't necessary, though they certainly work.

DB2 and SQL Server

Use the recursive WITH clause to find MILLER's manager, CLARK, then CLARK's manager, KING. The SQL Server string concatenation operator + is used in this solution:

```
with  x (tree,mgr,depth)
      as  (
select  cast(ename as varchar(100)),
        mgr, 0
  from  emp
 where  ename = 'MILLER'
```

```
  union  all
 select  cast(x.tree+'-->'+e.ename as varchar(100)),
         e.mgr, x.depth+1
   from  emp e, x
  where x.mgr = e.empno
)
select tree leaf___branch___root
  from x
 where depth = 2
```

The only modification necessary for this solution to work on DB2 is to use DB2's concatenation operator, ||. Otherwise, the solution will work as is, on DB2 as well as SQL Server.

Oracle

Use the function SYS_CONNECT_BY_PATH to return MILLER, MILLER's manager, CLARK, then CLARK's manager, KING. Use the CONNECT BY clause to walk the tree:

```
select ltrim(
          sys_connect_by_path(ename,'-->'),
        '-->') leaf___branch___root
  from emp
 where level = 3
 start with ename = 'MILLER'
connect by prior mgr = empno
```

PostgreSQL and MySQL

Self join on table EMP twice to return MILLER, MILLER's manager, CLARK, then CLARK's manager, KING. The following solution uses PostgreSQL's concatenation operator, the double vertical-bar (||):

```
select a.ename||'-->'||b.ename
                ||'-->'||c.ename as leaf___branch___root
  from emp a, emp b, emp c
 where a.ename = 'MILLER'
   and a.mgr = b.empno
   and b.mgr = c.empno
```

For MySQL users, simply use the CONCAT function; this solution will work for PostgreSQL as well.

Discussion

DB2 and SQL Server

The approach here is to start at the leaf node and walk your way up to the root (as useful practice, try walking in the other direction). The upper part of the UNION ALL simply finds the row for employee MILLER (the leaf node). The lower part of the UNION ALL finds the employee who is MILLER's manager, then finds that person's manager, and this process of finding the "manager's manager" repeats until processing stops at the highest-level manager (the root node). The value for DEPTH starts at 0 and increments automatically by 1 each time a manager is found. DEPTH is a value that DB2 maintains for you when you execute a recursive query.

For an interesting and in-depth introduction to the WITH clause with focus on its use recursively, see Jonathan Gennick's article "Understanding the WITH Clause" at http://gennick.com/with.htm.

Next, the second query of the UNION ALL joins the recursive view X to table EMP, to define the parentchild relationship. The query at this point, using SQL Server's concatenation operator, is as follows:

```
  with x (tree,mgr,depth)
    as (
select cast(ename as varchar(100)),
       mgr, 0
  from emp
 where ename = 'MILLER'
 union all
select cast(x.tree+'-->'+e.ename as varchar(100)),
       e.mgr, x.depth+1
  from emp e, x
 where x.mgr = e.empno
)
select tree leaf___branch___root
  from x

TREE            DEPTH
---------- ----------
MILLER              0
CLARK               1
KING                2
```

At this point, the heart of the problem has been solved; starting from MILLER, return the full hierarchical relationship from bottom to top. What's left then is merely formatting. Since the tree traversal is recursive, simply concatenate the current ENAME from EMP to the one before it, which gives you the following result set:

```
  with x (tree,mgr,depth)
    as (
select  cast(ename as varchar(100)),
        mgr, 0
  from emp
 where ename = 'MILLER'
 union all
select cast(x.tree+'-->'+e.ename as varchar(100)),
       e.mgr, x.depth+1
  from emp e, x
 where x.mgr = e.empno
)
select depth, tree
  from x

DEPTH TREE
----- ---------------------------
```

```
    0 MILLER
    1 MILLER-->CLARK
    2 MILLER-->CLARK-->KING
```

The final step is to keep only the last row in the hierarchy. There are several ways to do this, but the solution uses DEPTH to determine when the root is reached (obviously, if CLARK has a manager other than KING, the filter on DEPTH would have to change; for a more generic solution that requires no such filter, see the next recipe).

Oracle

The CONNECT BY clause does all the work in the Oracle solution. Starting with MILLER, you walk all the way to KING without the need for any joins. The expression in the CONNECT BY clause defines the relationship of the data and how the tree will be walked:

```
 select ename
   from emp
  start with ename = 'MILLER'
connect by prior mgr = empno

ENAME
--------
MILLER
CLARK
KING
```

The keyword PRIOR lets you access values from the previous record in the hierarchy. Thus, for any given EMPNO you can use PRIOR MGR to access that employee's manager number. When you see a clause such as CONNECT BY PRIOR MGR = EMPNO, think of that clause as expressing a join between, in this case, parent and child.

> For more on CONNECT BY and related features, see the following Oracle Technology Network articles: "Querying Hierarchies: Top-of-the-Line Support" at http://www.oracle.com/technology/oramag/webcolumns/2003/techarticles/gennick_connectby.html, and "New CONNECT BY Features in Oracle Database 10g"at http://www.oracle.com/technology/oramag/webcolumns/2003/techarticles/gennick_connectby_10g.html.

At this point you have successfully displayed the full hierarchy starting from MILLER and ending at KING. The problem is for the most part solved. All that remains is the formatting. Use the function SYS_CONNECT_BY_PATH to append each ENAME to the one before it:

```
 select sys_connect_by_path(ename,'-->') tree
   from emp
  start with ename = 'MILLER'
connect by prior mgr = empno

TREE
---------------------------
-->MILLER
-->MILLER-->CLARK
-->MILLER-->CLARK-->KING
```

Because you are interested in only the complete hierarchy, you can filter on the pseudo-column LEVEL (a more generic approach is shown in the next recipe):

```
 select sys_connect_by_path(ename,'-->') tree
   from emp
  where level = 3
  start with ename = 'MILLER'
connect by prior mgr = empno

TREE
---------------------------
-->MILLER-->CLARK-->KING
```

The final step is to use the LTRIM function to remove the leading "-->" from the result set.

PostgreSQL and MySQL

Without built-in support for hierarchical queries, you must self join *n* times to return the whole tree (where *n* is the number of nodes between the leaf and the root, including the root itself; in this example, relative to MILLER, CLARK is a branch node and KING is the root node, so the distance is two nodes, and *n* = 2). This solution simply uses the technique from the previous recipe and adds one more self join:

```
select a.ename as leaf,
       b.ename as branch,
       c.ename as root
  from emp a, emp b, emp c
 where a.ename = 'MILLER'
   and a.mgr = b.empno
   and b.mgr = c.empno

LEAF      BRANCH      ROOT
--------- ----------  -----
MILLER    CLARK       KING
```

The next and last step is to format the output using the || concatenation operator for PostgreSQL or the CONCAT function for MySQL. The drawback to this kind of query is that if the hierarchy changesfor example, if there is another node between CLARK and KINGthe query would need to have yet another join to return the whole tree. This is why it is such an advantage to have and use built-in functions for hierarchies.

```
EMP_TREE
    -----------------------------
    KING
    KING - BLAKE
    KING - BLAKE - ALLEN
    KING - BLAKE - JAMES
    KING - BLAKE - MARTIN
    KING - BLAKE - TURNER
    KING - BLAKE - WARD
    KING - CLARK
    KING - CLARK - MILLER
    KING - JONES
    KING - JONES - FORD
    KING - JONES - FORD - SMITH
    KING - JONES - SCOTT
    KING - JONES - SCOTT - ADAMS
```

```
1 with x (ename,empno)
    2 as (
    3 select cast(ename as varchar(100)),empno 4 from emp
    5 where mgr is null
```

6 union all

7 select cast(x.ename||' - '||e.ename as varchar(100)), 8 e.empno

9 from emp e, x 10 where e.mgr = x.empno 11)

12 select ename as emp_tree 13 from x

14 order by 1

1 select ltrim(

2 sys_connect_by_path(ename,' - '), 3 ' - ') emp_tree 4 from emp

```
5 start with mgr is null
6 connect by prior empno=mgr
```

7 order by 1

1 select emp_tree

2 from (

3 select ename as emp_tree 4 from emp

5 where mgr is null

6 union

7 select a.ename||' - '||b.ename 8 from emp a

9 join

10 emp b on (a.empno=b.mgr) 11 where a.mgr is null

12 union

13 select rtrim(a.ename||' - '||b.ename 14 ||' - '||c.ename,' - ') 15 from emp a

16 join

17 emp b on (a.empno=b.mgr)

18 left join

19 emp c on (b.empno=c.mgr) 20 where a.ename = 'KING'

21 union

22 select rtrim(a.ename||' - '||b.ename||' - '||

23 c.ename||' - '||d.ename,' - ') 24 from emp a

25 join

26 emp b on (a.empno=b.mgr)

27 join

28 emp c on (b.empno=c.mgr)

29 left join

30 emp d on (c.empno=d.mgr) 31 where a.ename = 'KING'

32) x

33 where tree is not null

34 order by 1

1 select emp_tree

2 from (

3 select ename as emp_tree 4 from emp

5 where mgr is null

6 union

7 select concat(a.ename,' - ',b.ename) 8 from emp a

9 join

10 emp b on (a.empno=b.mgr) 11 where a.mgr is null

12 union

13 select concat(a.ename,' - ', 14 b.ename,' - ',c.ename) 15 from emp a

16 join

17 emp b on (a.empno=b.mgr)

18 left join

19 emp c on (b.empno=c.mgr) 20 where a.ename = 'KING'

21 union

22 select concat(a.ename,' - ',b.ename,' - ', 23 c.ename,' - ',d.ename) 24 from emp a

25 join

26 emp b on (a.empno=b.mgr)

27 join

28 emp c on (b.empno=c.mgr)

29 left join

30 emp d on (c.empno=d.mgr) 31 where a.ename = 'KING'

32) x

33 where tree is not null

34 order by 1

<b>

```
with x (ename,empno) as (

select cast(ename as varchar(100)),empno from emp

where mgr is null union all

select cast(e.ename as varchar(100)),e.empno from emp e, x

where e.mgr = x.empno )

select ename emp_tree from x</b>

EMP_TREE

----------------

KING

JONES

SCOTT

ADAMS

FORD

SMITH

BLAKE

ALLEN

WARD
```

```
    MARTIN

    TURNER

    JAMES

    CLARK

    MILLER

cast(x.ename+','+e.ename as varchar(100))

<b>

    select ename emp_tree from emp

    start with mgr is null connect by prior empno = mgr</b>

    EMP_TREE

    -----------------

    KING

    JONES

    SCOTT

    ADAMS

    FORD

    SMITH

    BLAKE

    ALLEN

    WARD
    MARTIN

    TURNER

    JAMES

    CLARK

    MILLER
```

```
select lpad('.',2*level,'.')||ename emp_tree from emp
    start with mgr is null connect by prior empno = mgr
```

```
    EMP_TREE

    -----------------

    ..KING

    ....JONES

    ......SCOTT

    ........ADAMS

    ......FORD

    ........SMITH

    ....BLAKE

    ......ALLEN

    ......WARD

    ......MARTIN

    ......TURNER
```

```
   ......JAMES
   ....CLARK
   ......MILLER
KING
   KING - JONES
   KING - JONES - SCOTT
   KING - JONES - SCOTT - ADAMS
```

<b>

```
   select rtrim(a.ename||' - '||b.ename||' - '||
   c.ename||' - '||d.ename,' - ') as max_depth_4
   from emp a
   join
   emp b on (a.empno=b.mgr) join
   emp c on (b.empno=c.mgr) left join
   emp d on (c.empno=d.mgr) where a.ename = 'KING'</b>
   MAX_DEPTH_4
   ----------------------------
   KING - JONES - FORD - SMITH
   KING - JONES - SCOTT - ADAMS
   KING - BLAKE - TURNER
   KING - BLAKE - ALLEN
   KING - BLAKE - WARD
   KING - CLARK - MILLER
   KING - BLAKE - MARTIN
   KING - BLAKE - JAMES
<b>
   select rtrim(a.ename||' - '||b.ename ||' - '||c.ename,' - ') as max_depth_3
   from emp a
   join
   emp b on (a.empno=b.mgr) left join
   emp c on (b.empno=c.mgr) where a.ename = 'KING'</b>
   MAX_DEPTH_3
   --------------------------
   KING - BLAKE - ALLEN
   KING - BLAKE - WARD
   KING - BLAKE - MARTIN
   KING - JONES - SCOTT
   KING - BLAKE - TURNER
   KING - BLAKE - JAMES
   KING - JONES - FORD
   KING - CLARK - MILLER

<b>

   select rtrim(a.ename||' - '||b.ename ||' - '||c.ename,' - ') as partial_tree from
emp a

   join

   emp b on (a.empno=b.mgr) left join

   emp c on (b.empno=c.mgr) where a.ename = 'KING'

   union

   select rtrim(a.ename||' - '||b.ename||' - '||

   c.ename||' - '||d.ename,' - ') from emp a

   join

   emp b on (a.empno=b.mgr) join

   emp c on (b.empno=c.mgr) left join

   emp d on (c.empno=d.mgr) where a.ename = 'KING'</b>

   PARTIAL_TREE

   ------------------------------

   KING - BLAKE - ALLEN

   KING - BLAKE - JAMES

   KING - BLAKE - MARTIN

   KING - BLAKE - TURNER

   KING - BLAKE - WARD
   KING - CLARK - MILLER

   KING - JONES - FORD

   KING - JONES - FORD - SMITH

   KING - JONES - SCOTT

   KING - JONES - SCOTT - ADAMS

<b>

   select a.ename||' - '||b.ename as max_depth_2

   from emp a

   join

   emp b on (a.empno=b.mgr) where a.mgr is null</b>

   MAX_DEPTH_2

   --------------

   KING - JONES

   KING - BLAKE

   KING - CLARK

<b>

   select a.ename||' - '||b.ename as partial_tree from emp a

   join

   emp b on (a.empno=b.mgr) where a.mgr is null union

   select rtrim(a.ename||' - '||b.ename ||' - '||c.ename,' - ') from emp a
```

```
join
emp b on (a.empno=b.mgr) left join
emp c on (b.empno=c.mgr) where a.ename = 'KING'
union
select rtrim(a.ename||' - '||b.ename||' - '||
c.ename||' - '||d.ename,' - ') from emp a
join
emp b on (a.empno=b.mgr) join
emp c on (b.empno=c.mgr) left join
emp d on (c.empno=d.mgr) where a.ename = 'KING'</b>
PARTIAL_TREE
---------------------------------
KING - BLAKE
KING - BLAKE - ALLEN
KING - BLAKE - JAMES
KING - BLAKE - MARTIN
KING - BLAKE - TURNER
KING - BLAKE - WARD
KING - CLARK
KING - CLARK - MILLER
KING - JONES

<a name="idx-CHP-13-0812"></a>KING - JONES - FORD

KING - JONES - FORD - SMITH

KING - JONES - SCOTT

KING - JONES - SCOTT - ADAMS
```

The final step is to UNION KING to the top of PARTIAL_TREE to return the desired result set.

```
ENAME
    ----------
    JONES
    SCOTT
    ADAMS
    FORD
    SMITH
1 with x (ename,empno)
    2 as (
    3 select ename,empno
```

4 from emp

5 where ename = 'JONES'

6 union all

7 select e.ename, e.empno 8 from emp e, x 9 where x.empno = e.mgr 10)

11 select ename

12 from x

1 select ename

2 from emp

```
3 start with ename = 'JONES'

4 connect by prior empno = mgr
```

<b>

```
/* find JONES' EMPNO */

select ename,empno,mgr from emp

where ename = 'JONES'</b>

ENAME EMPNO MGR

---------- ----------- ---------

JONES 7566 7839
```

```
<b>

/* are there any employees who work directly under JONES? */

select count(*) from emp

where mgr = 7566</b>

COUNT(*)

---------

2
```

```
<b>

/* there are two employees under JONES, find their EMPNOs */

select ename,empno,mgr from emp

where mgr = 7566</b>

ENAME EMPNO MGR

---------- ----------- -----------

SCOTT 7788 7566

FORD 7902 7566


<b>

/* are there any employees under SCOTT or FORD? */

select count(*) from emp

where mgr in (7788,7902)</b>

COUNT(*)

---------

2


<b>

/* there are two employees under SCOTT or FORD, find their EMPNOs
*/

select ename,empno,mgr from emp
```

```
where mgr in (7788,7902)</b>

ENAME EMPNO MGR

--------- ----------- --------

SMITH 7369 7902

ADAMS 7876 7788


<b>

/* are there any employees under SMITH or ADAMS? */

select count(*) from emp

where mgr in (7369,7876)</b>

COUNT(*)

----------

0
```

1 select distinct

2 case t100.id 3 when 1 then root 4 when 2 then branch 5 else leaf

6 end as JONES_SUBORDINATES

7 from (

8 select a.ename as root, 9 b.ename as branch, 10 c.ename as leaf 11 from emp a, emp b, emp c 12 where a.ename = 'JONES'

13 and a.empno = b.mgr 14 and b.empno = c.mgr 15) x,

16 t100

```
   17 where t100.id <= 6
create view v1
   as
   select ename,mgr,empno from emp
   where ename = 'JONES'
   create view v2
   as
   select ename,mgr,empno from emp
   where mgr = (select empno from v1)
   create view v3
   as
   select ename,mgr,empno from emp
   where mgr <a name="idx-CHP-13-0815"></a>in (select empno from v2)
select ename from v1
   union
   select ename from v2
   union
   select ename from v3
```

Discussion

DB2 and SQL Server

The recursive WITH clause makes this a relatively easy problem to solve. The first part of the WITH clause, the upper part of the UNION ALL, returns the row for employee JONES. You need to return ENAME to see the name and EMPNO so you can use it to join on. The lower part of the UNION ALL recursively joins EMP.MGR to X.EMPNO. The join condition will be applied until the result set is exhausted.

Oracle

The START WTH clause tells the query to make JONES the root node. The condition in the CONNECT BY clause drives the tree walk and will run until the condition is no longer true.

PostgreSQL and MySQL

The technique used here is the same as that of the second recipe in this chapter, "Expressing a Child-Parent-Grandparent Relationship." A major drawback is that you must know in advance the depth of the hierarchy.

```
ENAME IS_LEAF IS_BRANCH IS_ROOT

    ---------- ---------- ---------- ----------

    KING 0 0 1

    JONES 0 1 0

    SCOTT 0 1 0

    FORD 0 1 0

    CLARK 0 1 0

    BLAKE 0 1 0

    ADAMS 1 0 0

    MILLER 1 0 0

    JAMES 1 0 0

    TURNER 1 0 0

    ALLEN 1 0 0

    WARD 1 0 0

    MARTIN 1 0 0

    SMITH 1 0 0
```

```
1 select e.ename,

    2 (select sign(count(*)) from emp d 3 where 0 =

    4 (select count(*) from emp f 5 where f.mgr = e.empno)) as is_leaf, 6
(select sign(count(*)) from emp d 7 where d.mgr = e.empno 8 and e.mgr is
```

not null) as is_branch, 9 (select sign(count(*)) from emp d 10 where d.empno = e.empno 11 and d.mgr is null) as is_root

12 from emp e

13 order by 4 desc,3 desc

1 select ename,

2 connect_by_isleaf is_leaf, 3 (select count(*) from emp e 4 where e.mgr = emp.empno 5 and emp.mgr is not null 6 and rownum = 1) is_branch, 7 decode(ename,connect_by_root(ename),1,0) is_root 8 from emp

9 start with mgr is null

10 connect by prior empno = mgr 11 order by 4 desc, 3 desc

<b>

select e.ename,

(select sign(count(*)) from emp d where 0 =

(select count(*) from emp f where f.mgr = e.empno)) as is_leaf from emp e

order by 2 desc</b>

ENAME IS_LEAF

----------- --------

SMITH 1

ALLEN 1

WARD 1

ADAMS 1

TURNER 1

MARTIN 1

JAMES 1

MILLER 1

JONES 0

BLAKE 0

```
CLARK 0

FORD 0

SCOTT 0

KING 0
```

<b>

```
select e.ename,

(select count(*) from t1 d where not exists (select null from emp f where
f.mgr = e.empno)) as is_leaf from emp e

order by 2 desc</b>
```

```
ENAME IS_LEAF

---------- ----------

SMITH 1

ALLEN 1

WARD 1

ADAMS 1

TURNER 1

MARTIN 1

JAMES 1

MILLER 1

JONES 0

BLAKE 0
```

```
CLARK 0

FORD 0

SCOTT 0

KING 0
```

<b>

```
select e.ename,

(select sign(count(*)) from emp d where d.mgr = e.empno and e.mgr is not null) as is_branch from emp e

order by 2 desc</b>

ENAME IS_BRANCH

----------- ---------

JONES 1

BLAKE 1

SCOTT 1

CLARK 1

FORD 1

SMITH 0

TURNER 0

MILLER 0

JAMES 0

ADAMS 0
```

```
   KING 0

   ALLEN 0

   MARTIN 0

   WARD 0
```

<b>

```
   select e.ename,

   (select count(*) from t1 t where exists (

   select null from emp f where f.mgr = e.empno and e.mgr is not null)) as
is_branch from emp e

   order by 2 desc</b>

   ENAME IS_BRANCH

   --------------- ----------

   JONES 1

   BLAKE 1

   SCOTT 1

   CLARK 1

   FORD 1

   SMITH 0

   TURNER 0

   MILLER 0

   JAMES 0
```

```
ADAMS 0

KING 0

ALLEN 0

MARTIN 0

WARD 0
```

<b>

```
select e.ename,

(select sign(count(*)) from emp d where d.empno = e.empno and d.mgr is null) as is_root from emp e

order by 2 desc</b>
```

```
ENAME IS_ROOT

---------- ---------

KING 1

SMITH 0

ALLEN 0

WARD 0

JONES 0

TURNER 0

JAMES 0

MILLER 0

FORD 0
```

```
ADAMS 0

MARTIN 0

BLAKE 0

CLARK 0

SCOTT 0
```

<b>

```
select ename,

connect_by_isleaf is_leaf from emp

start with mgr is null connect by prior empno = mgr order by 2 desc</b>

ENAME IS_LEAF

---------- ----------

ADAMS 1

SMITH 1

ALLEN 1

TURNER 1

MARTIN 1

WARD 1

JAMES 1

MILLER 1

KING 0
```

```
JONES 0

BLAKE 0

CLARK 0

FORD 0

SCOTT 0
```

<b>

```
select ename,

(select count(*) from emp e where e.mgr = emp.empno and emp.mgr is not null and rownum = 1) is_branch from emp

start with mgr is null connect by prior empno = mgr order by 2 desc</b>

ENAME IS_BRANCH

---------- ----------

JONES 1

SCOTT 1

BLAKE 1

FORD 1

CLARK 1

KING 0

MARTIN 0

MILLER 0

JAMES 0
```

```
TURNER 0

WARD 0

ADAMS 0

ALLEN 0

SMITH 0
```

<b>

```
select ename,

decode(ename,connect_by_root(ename),1,0) is_root from emp

start with mgr is null connect by prior empno = mgr order by 2 desc</b>

ENAME IS_ROOT

---------- ----------

KING 1

JONES 0

SCOTT 0

ADAMS 0

FORD 0

SMITH 0

BLAKE 0

ALLEN 0

WARD 0
```

```
MARTIN 0

TURNER 0

JAMES 0

CLARK 0

MILLER 0
```

<b>

```
select ename,

decode(substr(root,1,instr(root,',')-1),NULL,1,0) root from (

select ename,

ltrim(sys_connect_by_path(ename,','),',') root from emp

start with mgr is null connect by prior empno=mgr )</b>
```

```
ENAME ROOT

---------- ----

KING 1

JONES 0

SCOTT 0

ADAMS 0

FORD 0

SMITH 0
```

```
    BLAKE 0
    ALLEN 0
    WARD 0
    MARTIN 0
    TURNER 0
    JAMES 0
    CLARK 0
    MILLER 0
<b>
    select ename,
    ltrim(sys_connect_by_path(ename,','),',') path from emp
    start with mgr is null connect by prior empno=mgr</b>
    ENAME PATH
    ---------- ----------------------------
    KING KING
    JONES KING,JONES
    SCOTT KING,JONES,SCOTT
    ADAMS KING,JONES,SCOTT,ADAMS
    FORD KING,JONES,FORD
    SMITH KING,JONES,FORD,SMITH
```

```
BLAKE KING,BLAKE

ALLEN KING,BLAKE,ALLEN

WARD KING,BLAKE,WARD

MARTIN KING,BLAKE,MARTIN

TURNER KING,BLAKE,TURNER

JAMES KING,BLAKE,JAMES

CLARK KING,CLARK

MILLER KING,CLARK,MILLER
```

<b>

```
select ename,

substr(root,1,instr(root,',')-1) root from (

select ename,

ltrim(sys_connect_by_path(ename,','),',') root from emp

start with mgr is null connect by prior empno=mgr )</b>
```

```
ENAME ROOT

---------- ----------

KING

JONES KING

SCOTT KING
```

```
ADAMS KING

FORD KING

SMITH KING

BLAKE KING

ALLEN KING

WARD KING

MARTIN KING

TURNER KING

JAMES KING

CLARK KING

MILLER KING
```

The last step is to flag the result from the ROOT column if it is NULL; that is your root row.

Chapter 14. Odds 'n' Ends

This chapter contains queries that didn't fit in any other chapter either because the chapter they would belong to is already long enough, or because the problems they solve are more fun than realistic. This chapter is meant to be a "fun" chapter, in that the recipes here may or may not be recipes that you would actually use; nevertheless, I consider the queries interesting and wanted to include them somewhere in this book.

Recipe 14.1. Creating Cross-Tab Reports Using SQL Server's PIVOT Operator

Problem

You want to create a cross-tab report, to transform your result set's rows into columns. You are aware of traditional methods of pivoting but would like to try something different. In particular, you want to return the following result set without using CASE expressions or joins:

```
DEPT_10     DEPT_20     DEPT_30    DEPT_40
        ------- ----------- ----------- ----------
              3           5           6          0
```

Solution

Use the PIVOT operator to create the required result set without CASE expressions or additional joins:

```
select [10] as dept_10,
       [20] as dept_20,
       [30] as dept_30,
       [40] as dept_40
  from (select deptno, empno from emp) driver
 pivot (
    count(driver.empno)
    for driver.deptno in ( [10],[20],[30],[40] )
 ) as empPivot
```

Discussion

The PIVOT operator may seem strange at first, but the operation it performs in the solution is technically the same as the more familiar transposition query shown below:

```
select sum(case deptno when 10 then 1 else 0 end) as dept_10,
       sum(case deptno when 20 then 1 else 0 end) as dept_20,
       sum(case deptno when 30 then 1 else 0 end) as dept_30,
       sum(case deptno when 40 then 1 else 0 end) as dept_40
  from emp

DEPT_10    DEPT_20    DEPT_30    DEPT_40
------- ---------- ---------- ----------
      3          5          6          0
```

Now that you know what is essentially happening, let's break down what the PIVOT operator is doing. Line 5 of the solution shows an inline view named DRIVER:

```
from (select deptno, empno from emp) driver
```

I've chosen the alias "driver" because the rows from this inline view (or table expression) feed directly into the PIVOT operation. The PIVOT operator rotates the rows to columns by evaluating the items listed on line 8 in the FOR list (shown below):

```
for driver.deptno in ( [10],[20],[30],[40] )
```

The evaluation goes something like this:

1. If there are any DEPTNOs with a value of 10, perform the aggregate operation defined (COUNT(DRIVER.EMPNO)) for those rows.
2. Repeat for DEPTNOs 20, 30, and 40.

The items listed in the brackets on line 8 serve not only to define values for which aggregation is performed; the items also become the column names in the result set (without the square brackets). In the SELECT clause of the solution, the items in the FOR list are referenced and aliased. If you do not alias the items in the FOR list, the column names become the items in the FOR list sans brackets.

Interestingly enough, since inline view DRIVER is just that, an inline view, you may put more complex SQL in there. For example, consider the situation where you want to modify the result set such that the actual department name is the name of the column. Listed below are the rows in table DEPT:

```
        select * from dept

        DEPTNO DNAME          LOC
        ------ -------------- -------------
            10 ACCOUNTING     NEW YORK
            20 RESEARCH       DALLAS
            30 SALES          CHICAGO
            40 OPERATIONS     BOSTON
```

You would like to use PIVOT to return the following result set:

```
ACCOUNTING   RESEARCH      SALES OPERATIONS
        ---------- ---------- ---------- ----------
                 3          5          6          0
```

Because inline view DRIVER can be practically any valid table expression, you can perform the join from table EMP to table DEPT, and then have PIVOT evaluate those rows. The following query will return the desired result set:

```
select [ACCOUNTING] as ACCOUNTING,
               [SALES]      as SALES,
               [RESEARCH]   as RESEARCH,
               [OPERATIONS] as OPERATIONS
          from (
                  select d.dname, e.empno
                    from emp e,dept d
                   where e.deptno=d.deptno
```

```
      ) driver
pivot (
 count(driver.empno)
 for driver.dname in ([ACCOUNTING],[SALES],[RESEARCH],[OPERATIONS])
) as empPivot
```

As you can see, PIVOT provides an interesting spin on pivoting result sets. Regardless of whether or not you prefer using it to the traditional methods of pivoting, it's nice to have another tool in your toolbox.

```
ACCOUNTING RESEARCH SALES OPERATIONS
---------- ---------- ---------- ----------
```

3 5 6 0

DNAME CNT

```
-------------- ----------

ACCOUNTING 3

RESEARCH 5

SALES 6

OPERATIONS 0
```

```
1 select DNAME, CNT

   2 from (

   3 select [ACCOUNTING] as ACCOUNTING, 4 [SALES] as SALES, 5
[RESEARCH] as RESEARCH, 6 [OPERATIONS] as OPERATIONS

   7 from (

   8 select d.dname, e.empno 9 from emp e,dept d 10 where
e.deptno=d.deptno 11

   12 ) driver

   13 pivot (

   14 count(driver.empno) 15 for driver.dname in ([ACCOUNTING],
[SALES],[RESEARCH],[OPERATIONS]) 16 ) as empPivot 17 )
new_driver 18 unpivot (cnt for dname in
(ACCOUNTING,SALES,RESEARCH,OPERATIONS) 19 ) as un_pivot
```

<b>

```
select DNAME, CNT
```

```
from (

select [ACCOUNTING] as ACCOUNTING, [SALES] as SALES,
[RESEARCH] as RESEARCH, [OPERATIONS] as OPERATIONS

from (

select d.dname, e.empno from emp e,dept d where e.deptno=d.deptno

) driver

pivot (

count(driver.empno) for driver.dname in ( [ACCOUNTING],[SALES],
[RESEARCH],[OPERATIONS] ) ) as empPivot ) new_driver

<a name="idx-CHP-14-0839"></a>unpivot (cnt for dname in
(ACCOUNTING,SALES,RESEARCH,OPERATIONS) ) as un_pivot</b>

DNAME CNT

-------------- ----------

ACCOUNTING 3

RESEARCH 5

SALES 6

OPERATIONS 0
```

Recipe 14.3. Transposing a Result Set Using Oracle's MODEL Clause

Problem

Like the fist recipe in this chapter, you wish to find an alternative to the traditional pivoting techniques you've seen already. You want to try your hand at Oracle's MODEL clause. Unlike SQL Server's PIVOT operator, Oracle's MODEL clause does not exist to transpose result sets; as a matter of fact, it would be quite accurate to say the application of the MODEL clause for pivoting would be a misuse and clearly not what the MODEL clause was intended for. Nevertheless, the MODEL clause provides for an interesting approach to a common problem. For this particular problem, you want to transform the following result set from this:

```
        select deptno, count(*) cnt
          from emp
         group by deptno

        DEPTNO        CNT
        ------ ----------
            10          3
            20          5
            30          6
```

to this:

```
D10        D20        D30
        ---------- ---------- ----------
                 3          5          6
```

Solution

Use aggregation and CASE expressions in the MODEL clause just as you would use them if pivoting with traditional techniques. The main difference in this case is that you use arrays to store the values of the aggregation and return the arrays in the result set:

```
select max(d10) d10,
               max(d20) d20,
               max(d30) d30
          from (
        select d10,d20,d30
          from ( select deptno, count(*) cnt from emp group by deptno )
         model
          dimension by(deptno d)
           measures(deptno, cnt d10, cnt d20, cnt d30)
           rules(
             d10[any] = case when deptno[cv()]=10 then d10[cv()] else 0 end,
             d20[any] = case when deptno[cv()]=20 then d20[cv()] else 0 end,
             d30[any] = case when deptno[cv()]=30 then d30[cv()] else 0 end
          )
          )
```

Discussion

The MODEL clause is an extremely useful and powerful addition to the Oracle SQL toolbox. Once you begin working with MODEL you'll notice helpful features such as iteration, array access to row values, the ability to "upsert" rows into a result set, and the ability to build reference models. You'll quickly see that this recipe doesn't take advantage of any of the cool features the MODEL clause offers, but it's nice to be able to look at a problem from multiple angles and use different features in unexpected ways (if for no other reason than to learn where certain features are more useful than others).

The first step to understanding the solution is to examine the inline view in the FROM clause. The inline view simply counts the number of employees in each DEPTNO in table EMP. The results are shown below:

```
select deptno, count(*) cnt
  from emp
 group by deptno

DEPTNO        CNT
------ ----------
    10          3
    20          5
    30          6
```

This result set is what is given to MODEL to work with. Examining the MODEL clause, you see three subclauses that stand out: DIMENSION BY, MEASURES, and RULES. Let's start with MEASURES.

The items in the MEASURES list are simply the arrays you are declaring for this query. The query uses four arrays: DEPTNO, D10, D20, and D30. Like columns in a SELECT list, arrays in the MEASURES list can have aliases. As you can see, three of the four arrays are actually CNT from the inline view.

If the MEASURES list contains our arrays, then the items in the DIMENSION BY subclause are the array indices. Consider this: array D10 is simply an alias for CNT. If you look at the result set for the inline view above, you'll see that CNT has three values: 3, 5, and 6. When you create an array of CNT, you are creating an array with three elements, namely, the three integers 3, 5, and 6. Now, how do you access these values from the array individually? You use the array index. The index, defined in the DIMENSION BY subclause, has the values of 10, 20, and 30 (from the result set above). So, for example, the following expression:

```
d10[10]
```

would evaluate to 3, as you are accessing the value for CNT in array D10 for DEPTNO 10 (which is 3).

Because each of the three arrays (D10, D20, D30) contain the values from CNT, all three of them have the same results. How then do we get the proper count into the correct array? Enter the RULES subclause. If you look at the result set for the inline view shown earlier, you'll see that the values for DEPTNO are 10, 20, and 30. The expressions involving CASE in the RULES clause simply evaluate each value in the DEPTNO array:

- If the value is 10, store the CNT for DEPTNO 10 in D10[10] else store 0.
- If the value is 20, store the CNT for DEPTNO 20 in D20[20] else store 0.

- If the value is 30, store the CNT for DEPTNO 30 in D30[30] else store 0.

If you find yourself feeling a bit like Alice tumbling down the rabbit hole, don't worry; just stop and execute what's been discussed thus far. The following result set represents what has been discussed. Sometimes it's easier to read a bit, look at the code that actually performs what you just read, then go back and read it again. The following is quite simple once you see it in action:

```
select deptno, d10,d20,d30
  from ( select deptno, count(*) cnt from emp group by deptno )
 model
  dimension by(deptno d)
   measures(deptno, cnt d10, cnt d20, cnt d30)
   rules(
     d10[any] = case when deptno[cv( )]=10 then d10[cv( )] else 0 end,
     d20[any] = case when deptno[cv( )]=20 then d20[cv( )] else 0 end,
     d30[any] = case when deptno[cv( )]=30 then d30[cv( )] else 0 end
  )

  DEPTNO        D10        D20        D30
  ------ ---------- ---------- ----------
      10          3          0          0
      20          0          5          0
      30          0          0          6
```

As you can see, the RULES subclause is what changed the values in each array. If you are still not catching on, simply execute the same query but comment out the expressions in the RULES subclase:

```
select deptno, d10,d20,d30
  from ( select deptno, count(*) cnt from emp group by deptno )
 model
  dimension by(deptno d)
   measures(deptno, cnt d10, cnt d20, cnt d30)
   rules(
    /*
     d10[any] = case when deptno[cv( )]=10 then d10[cv( )] else 0 end,
     d20[any] = case when deptno[cv( )]=20 then d20[cv( )] else 0 end,
     d30[any] = case when deptno[cv( )]=30 then d30[cv( )] else 0 end
    */
  )

  DEPTNO        D10        D20        D30
  ------ ---------- ---------- ----------
      10          3          3          3
      20          5          5          5
      30          6          6          6
```

It should be clear now that the result set from the MODEL clause is the same as the inline view, except that the COUNT operation is aliased D10, D20, and D30. The query below proves this:

```
select deptno, count(*) d10, count(*) d20, count(*) d30
  from emp
 group by deptno

 DEPTNO        D10        D20        D30
```

```
------ ---------- ---------- ----------
    10          3          3          3
    20          5          5          5
    30          6          6          6
```

So, all the MODEL clause did was to take the values for DEPTNO and CNT, put them into arrays, and then make sure that each array represents a single DEPTNO. At this point, arrays D10, D20, and D30 each have a single non-zero value representing the CNT for a given DEPTNO. The result set is already transposed, and all that is left is to use the aggregate function MAX (you could have used MIN or SUM; it would make no difference in this case) to return only one row:

```
select max(d10) d10,
       max(d20) d20,
       max(d30) d30
  from (
select d10,d20,d30
  from ( select deptno, count(*) cnt from emp group by deptno )
 model
  dimension by(deptno d)
   measures(deptno, cnt d10, cnt d20, cnt d30)
   rules(
     d10[any] = case when deptno[cv()]=10 then d10[cv()] else 0 end,
     d20[any] = case when deptno[cv()]=20 then d20[cv()] else 0 end,
     d30[any] = case when deptno[cv()]=30 then d30[cv()] else 0 end
  )
  )

         D10        D20        D30
  ---------- ---------- ----------
           3          5          6
```

```
xxxxxabc[867]xxx[-]xxxx[5309]xxxxx

    xxxxxtime:[11271978]favnum:[4]id:[Joe]xxxxx call:
[F_GET_ROWS()]b1:[ROSEWOOD…SIR]b2:[44400002]77.90xxxxx
film:[non_marked]qq:[unit]tailpipe:[withabanana?]80sxxxxx

FIRST_VAL SECOND_VAL LAST_VAL

    --------------- ------------------- ---------------

    867 - 5309
```

11271978 4 Joe

```
F_GET_ROWS( ) ROSEWOOD…SIR 44400002

non_marked unit withabanana?

create view V

as

select 'xxxxxabc[867]xxx[-]xxxx[5309]xxxxx' msg from dual

union all

select 'xxxxxtime:[11271978]favnum:[4]id:[Joe]xxxxx' msg from dual

union all

select 'call:[F_GET_ROWS()]b1:[ROSEWOOD…SIR]b2:
[44400002]77.90xxxxx' msg from dual

union all

select 'film:[non_marked]qq:[unit]tailpipe:[withabanana?]80sxxxxx' msg
from dual



1 select substr(msg, 2 <a name="idx-CHP-14-0854">
</a>instr(msg,'[',1,1)+1, 3 instr(msg,']',1,1)-instr(msg,'[',1,1)-1) first_val, 4
substr(msg,

5 instr(msg,'[',1,2)+1, 6 instr(msg,']',1,2)-instr(msg,'[',1,2)-1) second_val,
7 substr(msg,

8 instr(msg,'[',-1,1)+1, 9 instr(msg,']',-1,1)-instr(msg,'[',-1,1)-1) last_val
```

10 from V

<b>

select instr(msg,'[',1,1) "1st_[", instr(msg,']',1,1) "]_1st", instr(msg,'[',1,2) "2nd_[", instr(msg,']',1,2) "]_2nd", instr(msg,'[',-1,1) "3rd_[", instr(msg,']',-1,1) "]_3rd"

from V</b>

```
1st_[ ]_1st 2nd_[ ]_2nd 3rd_[ ]_3rd ------ ----- ---------- ----- ---------- -----

9 13 17 19 24 29

11 20 28 30 34 38

6 19 23 38 42 51
```

6 17 21 26 36 49

```
<b>

   select substr(msg,

   instr(msg,'[',1,1),

   instr(msg,']',1,1)-instr(msg,'[',1,1)) first_val, substr(msg,

   instr(msg,'[',1,2),

   instr(msg,']',1,2)-instr(msg,'[',1,2)) second_val, substr(msg,

   instr(msg,'[',-1,1), instr(msg,']',-1,1)-instr(msg,'[',-1,1)) last_val from
V</b>



   FIRST_VAL SECOND_VAL LAST_VAL

   --------------- -------------------- -------

   [867 [- [5309

   [11271978 [4 [Joe

   [F_GET_ROWS( ) [ROSEWOOD…SIR [44400002

   [non_marked [unit [withabanana?

<b>

   select substr(msg,

   instr(msg,'[',1,1)+1, instr(msg,']',1,1)-instr(msg,'[',1,1)) first_val,
substr(msg,
    instr(msg,'[',1,2)+1, instr(msg,']',1,2)-instr(msg,'[',1,2)) second_val,
substr(msg,

    instr(msg,'[',-1,1)+1, instr(msg,']',-1,1)-instr(msg,'[',-1,1)) last_val from
V</b>
```

```
    FIRST_VAL SECOND_VAL LAST_VAL

    -------------- -------------- -------------

    867] -] 5309]

    11271978] 4] Joe]

    F_GET_ROWS( )] ROSEWOOD…SIR] 44400002]

    non_marked] unit] withabanana?]
```

At this point it should be clear: to ensure you include neither of the square brackets, you must add 1 to the beginning index and subtract one from the ending index.

<b>

```
1 select 'Days in 2005: '||

2 to_char(add_months(trunc(sysdate,'y'),12)-1,'DDD') 3 as report

4 from dual
```

5 union all

```
6 select 'Days in 2004: '||

7 to_char(add_months(trunc(

8 to_date('01-SEP-2004'),'y'),12)-1,'DDD') 9 from dual</b>

REPORT

-----------------

Days in 2005: 365

Days in 2004: 366
```

<b>

```
select trunc(to_date('01-SEP-2004'),'y') from dual</b>

TRUNC(TO_DA

-----------

01-JAN-2004
```

<b>

```
select add_months(

trunc(to_date('01-SEP-2004'),'y'), 12) before_subtraction, add_months(

trunc(to_date('01-SEP-2004'),'y'), 12)-1 after_subtraction from dual</b>

BEFORE_SUBT AFTER_SUBTR

----------- -----------
```

```
01-JAN-2005 31-DEC-2004
```

<b>

```
select to_char(
add_months(
trunc(to_date('01-SEP-2004'),'y'), 12)-1,'DDD') num_days_in_2004
from dual</b>
```

```
NUM
---
366
```

STRINGS

1010 switch

333

3453430278

ClassSummary findRow 55

threes

STRINGS

1010 switch

findRow 55

```
with v as (

   select 'ClassSummary' strings from dual union select '3453430278' from
dual union select 'findRow 55' from dual union select '1010 switch' from
dual union select '333' from dual union select 'threes' from dual )

   select strings from (

   select strings, translate(

   strings,

   'abcdefghijklmnopqrstuvwxyz0123456789',
rpad('#',26,'#')||rpad('*',10,'*')) translated from v

) x

where <a name="idx-CHP-14-0857"></a>instr(translated,'#') > 0

and instr(translated,'*') > 0

<b>

   with v as (

   select 'ClassSummary' strings from dual union select '3453430278' from
dual union select 'findRow 55' from dual union select '1010 switch' from
dual union select '333' from dual union select 'threes' from dual )

   select strings, translate(

   strings,
   'abcdefghijklmnopqrstuvwxyz0123456789',
rpad('#',26,'#')||rpad('*',10,'*')) translated from v</b>

   STRINGS TRANSLATED

   ------------ -----------

   1010 switch **** ######

   333 ***

   3453430278 **********

   ClassSummary C####S######

   findRow 55 ####R## **

   threes ######

<b>

   with v as (

   select 'ClassSummary' strings from dual union select '3453430278' from
dual union select 'findRow 55' from dual union select '1010 switch' from
dual union select '333' from dual union select 'threes' from dual )

   select strings, translated from (

   select strings, translate(

   strings,

   'abcdefghijklmnopqrstuvwxyz0123456789',
rpad('#',26,'#')||rpad('*',10,'*')) translated from v

   )

   where instr(translated,'#') > 0
```

```
and instr(translated,'*') > 0</b>

STRINGS TRANSLATED

------------ ------------

1010 switch **** ######

findRow 55 ####R## **
```

```
ENAME SAL SAL_BINARY
    ---------- ----- --------------------
    SMITH 800 1100100000
    ALLEN 1600 11001000000
    WARD 1250 10011100010
    JONES 2975 101110011111
    MARTIN 1250 10011100010
    BLAKE 2850 101100100010
    CLARK 2450 100110010010
    SCOTT 3000 101110111000
    KING 5000 1001110001000
    TURNER 1500 10111011100
    ADAMS 1100 10001001100
    JAMES 950 1110110110
    FORD 3000 101110111000
    MILLER 1300 10100010100
1 select ename,
    2 sal,
    3 (
    4 select bin
```

5 from dual

6 model

7 dimension by (0 attr) 8 measures (sal num, 9 cast(null as varchar2(30)) bin, 10 '0123456789ABCDEF' hex 11)

12 rules iterate (10000) until (num[0] <= 0) (

13 bin[0] = substr(hex[cv()],mod(num[cv( )],2)+1,1)||bin[cv( )], 14 num[0] = trunc(num[cv( )]/2) 15)

16) sal_binary

17 from emp

```
<b>

   select bin

   from dual

   model

   dimension by ( 0 attr ) measures ( 2 num, cast(null as varchar2(30)) bin,
'0123456789ABCDEF' hex )

   rules iterate (10000) until (num[0] <= 0) (

   bin[0] = substr (hex[cv()],mod(num[cv( )],2)+1,1)||bin[cv( )], num[0] =
trunc(num[cv( )]/2) )</b>



   BIN

   ----------

   10

<b>

   select 2 start_val, '0123456789ABCDEF' hex,
substr('0123456789ABCDEF',mod(2,2)+1,1) ||

   cast(null as varchar2(30)) bin, trunc(2/2) num

   from dual</b>

   START_VAL HEX BIN NUM

   --------- ---------------- ---------- ---
```

2 0123456789ABCDEF 0 1

```
<b>

   select num start_val, substr('0123456789ABCDEF',mod(1,2)+1,1) || bin
bin, trunc(1/2) num

   from (

   select 2 start_val, '0123456789ABCDEF' hex,
substr('0123456789ABCDEF',mod(2,2)+1,1) ||

   cast(null as varchar2(30)) bin, trunc(2/2) num

   from dual

   )</b>



   START_VAL BIN NUM

   --------- ---------- ---
```

1 10 0

<b>

```
   select 2 orig_val, num, bin from dual

   model

   dimension by ( 0 attr ) measures ( 2 num, cast(null as varchar2(30)) bin,
'0123456789ABCDEF' hex )

   rules (

   bin[0] = substr (hex[cv()],mod(num[cv( )],2)+1,1)||bin[cv( )], num[0] =
trunc(num[cv( )]/2), bin[1] = substr (hex[0],mod(num[0],2)+1,1)||bin[0],
num[1] = trunc(num[0]/2) )</b>
```

```
   ORIG_VAL NUM BIN

   -------- --- ---------

   2 1 0
```

2 0 10

```
TOP_3 NEXT_3 REST

    --------------- --------------- --------------

    KING (5000) BLAKE (2850) TURNER (1500) FORD (3000) CLARK
(2450) MILLER (1300) SCOTT (3000) ALLEN (1600) MARTIN (1250)
JONES (2975) WARD (1250) ADAMS (1100)

    JAMES (950)

    SMITH (800)
```

```
select max(case grp when 1 then rpad(ename,6) ||

    ' ('|| sal ||')' end) top_3, max(case grp when 2 then rpad(ename,6) ||

    ' ('|| sal ||')' end) next_3, max(case grp when 3 then rpad(ename,6) ||

    ' ('|| sal ||')' end) rest from (

    select ename, sal,

    rnk,

    case when rnk <= 3 then 1

    when rnk <= 6 then 2
```

```
else 3
end grp,
row_number( )over (
partition by case when rnk <= 3 then 1
when rnk <= 6 then 2
else 3
```

```
end
order by sal desc, ename
) grp_rnk
from (
select ename,
sal,
dense_rank( )over(order by sal desc) rnk
```

26 from emp

27) x

28) y

29 group by grp_rnk

```
<b>

    select ename,

    sal,

    dense_rank( )over(order by sal desc) rnk from emp</b>

    ENAME SAL RNK

    ---------- ----- ----------

    KING 5000 1

    SCOTT 3000 2

    FORD 3000 2

    JONES 2975 3

    BLAKE 2850 4

    CLARK 2450 5

    ALLEN 1600 6

    TURNER 1500 7

    MILLER 1300 8

    WARD 1250 9

    MARTIN 1250 9

    ADAMS 1100 10
```

```
JAMES 950 11

SMITH 800 12
```

<b>

```
select ename,

sal,

rnk,

case when rnk <= 3 then 1

when rnk <= 6 then 2

else 3

end grp,

row_number( )over (

partition by case when rnk <= 3 then 1

when rnk <= 6 then 2

else 3

end

order by sal desc, ename ) grp_rnk

from (

select ename,

sal,

dense_rank( )over(order by sal desc) rnk from emp
) x</b>

ENAME SAL RNK GRP GRP_RNK
---------- ----- ---- ---- -------
KING 5000 1 1 1
FORD 3000 2 1 2
SCOTT 3000 2 1 3
JONES 2975 3 1 4
BLAKE 2850 4 2 1
CLARK 2450 5 2 2
ALLEN 1600 6 2 3
TURNER 1500 7 3 1
MILLER 1300 8 3 2
MARTIN 1250 9 3 3
WARD 1250 9 3 4
ADAMS 1100 10 3 5
JAMES 950 11 3 6
SMITH 800 12 3 7
```
<b>

```
select max(case grp when 1 then rpad(ename,6) ||
' ('|| sal ||')' end) top_3, max(case grp when 2 then rpad(ename,6) ||
' ('|| sal ||')' end) next_3, max(case grp when 3 then rpad(ename,6) ||
' ('|| sal ||')' end) rest from (
select ename,
sal,
rnk,
case when rnk <= 3 then 1
when rnk <= 6 then 2
else 3
end grp,
row_number( )over (
partition by case when rnk <= 3 then 1
when rnk <= 6 then 2
else 3
end
Order by sal desc, ename ) grp_rnk
from (
select ename,
sal,
dense_rank( )over(order by sal desc) rnk from emp
```

```
   ) x

   ) y

   group by grp_rnk</b>

   TOP_3 NEXT_3 REST

   --------------- --------------- -------------

   KING (5000) BLAKE (2850) TURNER (1500) FORD (3000) CLARK
(2450) MILLER (1300) SCOTT (3000) ALLEN (1600) MARTIN (1250)
JONES (2975) WARD (1250) ADAMS (1100)

   JAMES (950)

   SMITH (800)
```

If you examine the queries in all of the steps you'll notice that table EMP is accessed exactly once. One of the remarkable things about window functions is how much work you can do in just one pass through your data. No need for self joins or temp tables; just get the rows you need, then let the window functions do the rest. Only in inline view X do you need to access EMP. From there, it's simply a matter of massaging the result set to look the way you want. Consider what all this means for performance if you can create this type of report with a single table access. Pretty cool.

<b>

```
select * from it_research</b>

DEPTNO ENAME

------ --------------------

100 HOPKINS

100 JONES

100 TONEY
```

200 MORALES

200 P.WHITAKER

200 MARCIANO

200 ROBINSON

300 LACY

300 WRIGHT

```
300 J.TAYLOR

<b>

select * from it_apps</b>

DEPTNO ENAME

------ -----------------

400 CORRALES

400 MAYWEATHER

400 CASTILLO

400 MARQUEZ

400 MOSLEY

500 GATTI

500 CALZAGHE

600 LAMOTTA

600 HAGLER

600 HEARNS

600 FRAZIER

700 GUINN
```

700 MARGARITO

RESEARCH APPS

-------------------- ---------------

100 400

JONES MAYWEATHER

TONEY CASTILLO

HOPKINS MARQUEZ

200 MOSLEY

P.WHITAKER CORRALES

MARCIANO 500

ROBINSON CALZAGHE

MORALES GATTI

300 600

WRIGHT HAGLER

J.TAYLOR HEARNS

LACY FRAZIER

LAMOTTA

700

JUDAH

MARGARITO

GUINN

create table IT_research (deptno number, ename varchar2(20))

insert into IT_research values (100,'HOPKINS') insert into IT_research values (100,'JONES') insert into IT_research values (100,'TONEY') insert into IT_research values (200,'MORALES') insert into IT_research values (200,'P.WHITAKER') insert into IT_research values (200,'MARCIANO') insert into IT_research values (200,'ROBINSON') insert into IT_research values (300,'LACY') insert into IT_research values (300,'WRIGHT') insert into IT_research values (300,'J.TAYLOR')

create table IT_apps (deptno number, ename varchar2(20))

insert into IT_apps values (400,'CORRALES') insert into IT_apps values (400,'MAYWEATHER') insert into IT_apps values (400,'CASTILLO') insert into IT_apps values (400,'MARQUEZ') insert into IT_apps values (400,'MOSLEY') insert into IT_apps values (500,'GATTI') insert into IT_apps values (500,'CALZAGHE') insert into IT_apps values (600,'LAMOTTA') insert into IT_apps values (600,'HAGLER') insert into IT_apps values (600,'HEARNS') insert into IT_apps values

(600,'FRAZIER') insert into IT_apps values (700,'GUINN') insert into IT_apps values (700,'JUDAH') insert into IT_apps values (700,'MARGARITO')

1 select max(decode(flag2,0,it_dept)) research, 2 max(decode(flag2,1,it_dept)) apps 3 from (

4 select sum(flag1)over(partition by flag2

5 order by flag1,rownum) flag, 6 it_dept, flag2

7 from (

8 select 1 flag1, 0 flag2, 9 decode(rn,1,to_char(deptno),' '||ename) it_dept 10 from (

11 select x.*, y.id, 12 row_number( )over(partition by x.deptno order by y.id) rn 13 from (

14 select deptno,

15 ename,

16 count(*)over(partition by deptno) cnt

17 from it_research

18) x,

19 (select level id from dual connect by level <= 2) y 20)

21 where rn <= cnt+1

22 union all

23 select 1 flag1, 1 flag2, 24 decode(rn,1,to_char(deptno),' '||ename) it_dept 25 from (

26 select x.*, y.id, 27 row_number( )over(partition by x.deptno order by y.id) rn 28 from (

29 select deptno,

30 ename,

31 count(*)over(partition by deptno) cnt

```
32 from it_apps
33 ) x,
34 (select level id from dual connect by level <= 2) y 35 )
36 where rn <= cnt+1
37 ) tmp1
38 ) tmp2
```

39 group by flag

```
<b>

   select 1 flag1, 1 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number( )over(partition by x.deptno order by y.id) rn from (

   select deptno,

   ename,

   count(*)over(partition by deptno) cnt from it_apps

   ) x,

   (select level id from dual connect by level <= 2) y ) z

   where rn <= cnt+1</b>

   FLAG1 FLAG2 IT_DEPT

   ----- ---------- -------------------------

   1 1 400

   1 1 MAYWEATHER

   1 1 CASTILLO

   1 1 MARQUEZ

   1 1 MOSLEY

   1 1 CORRALES
```

1 1 500

1 1 CALZAGHE

1 1 GATTI

1 1 600

1 1 HAGLER

1 1 HEARNS

1 1 FRAZIER

1 1 LAMOTTA

1 1 700

1 1 JUDAH

1 1 MARGARITO

1 1 GUINN

<b>

```
select deptno deptno, ename,
count(*)over(partition by deptno) cnt from it_apps</b>
DEPTNO ENAME CNT
------ -------------------- ----------
400 CORRALES 5
400 MAYWEATHER 5
400 CASTILLO 5
400 MARQUEZ 5
400 MOSLEY 5
500 GATTI 2
500 CALZAGHE 2
600 LAMOTTA 4
600 HAGLER 4
600 HEARNS 4
600 FRAZIER 4
700 GUINN 3
700 JUDAH 3
```

700 MARGARITO 3

<b>

```
select *
from (
select deptno deptno, ename,
count(*)over(partition by deptno) cnt from it_apps
) x,
(select level id from dual connect by level <= 2) y order by 2</b>
DEPTNO ENAME CNT ID
------ ---------- --- ---
500 CALZAGHE 2 1
500 CALZAGHE 2 2
400 CASTILLO 5 1
400 CASTILLO 5 2
400 CORRALES 5 1
400 CORRALES 5 2
600 FRAZIER 4 1
600 FRAZIER 4 2
500 GATTI 2 1
```

500 GATTI 2 2

700 GUINN 3 1

700 GUINN 3 2

600 HAGLER 4 1

600 HAGLER 4 2

600 HEARNS 4 1

600 HEARNS 4 2

700 JUDAH 3 1

700 JUDAH 3 2

600 LAMOTTA 4 1

600 LAMOTTA 4 2

700 MARGARITO 3 1

700 MARGARITO 3 2

400 MARQUEZ 5 1

400 MARQUEZ 5 2

400 MAYWEATHER 5 1

400 MAYWEATHER 5 2

400 MOSLEY 5 1

400 MOSLEY 5 2

<b>

```
select x.*, y.id,
row_number( )over(partition by x.deptno order by y.id) rn from (
select deptno deptno, ename,
count(*)over(partition by deptno) cnt from it_apps
) x,
(select level id from dual connect by level <= 2) y</b>
```

```
DEPTNO ENAME CNT ID RN
------ ---------- --- --- ----------
400 CORRALES 5 1 1
400 MAYWEATHER 5 1 2
400 CASTILLO 5 1 3
400 MARQUEZ 5 1 4
400 MOSLEY 5 1 5
400 CORRALES 5 2 6
400 MOSLEY 5 2 7
400 MAYWEATHER 5 2 8
400 CASTILLO 5 2 9
```

400 MARQUEZ 5 2 10

500 GATTI 2 1 1

500 CALZAGHE 2 1 2

500 GATTI 2 2 3

500 CALZAGHE 2 2 4

600 LAMOTTA 4 1 1

600 HAGLER 4 1 2

600 HEARNS 4 1 3

600 FRAZIER 4 1 4

600 LAMOTTA 4 2 5

600 HAGLER 4 2 6

600 FRAZIER 4 2 7

600 HEARNS 4 2 8

700 GUINN 3 1 1

700 JUDAH 3 1 2

700 MARGARITO 3 1 3

700 GUINN 3 2 4

700 JUDAH 3 2 5

700 MARGARITO 3 2 6

<b>

```
select 1 flag1, 1 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

select x.*, y.id,

row_number( )over(partition by x.deptno order by y.id) rn from (

select deptno deptno, ename,

count(*)over(partition by deptno) cnt from it_apps

) x,

(select level id from dual connect by level <= 2) y ) z

where rn <= cnt+1</b>

FLAG1 FLAG2 IT_DEPT

----- ---------- ------------------------

1 1 400

1 1 MAYWEATHER

1 1 CASTILLO

1 1 MARQUEZ

1 1 MOSLEY

1 1 CORRALES

1 1 500
```

1 1 CALZAGHE

1 1 GATTI

1 1 600

1 1 HAGLER

1 1 HEARNS

1 1 FRAZIER

1 1 LAMOTTA

1 1 700

1 1 JUDAH

1 1 MARGARITO

1 1 GUINN

<b>

```
   select 1 flag1, 0 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number( )over(partition by x.deptno order by y.id) rn from (

   select deptno,

   ename,

   count(*)over(partition by deptno) cnt from it_research

   ) x,

   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1

   union all

   select 1 flag1, 1 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number( )over(partition by x.deptno order by y.id) rn from (

   select deptno deptno, ename,

   count(*)over(partition by deptno) cnt from it_apps

   ) x,
   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1</b>

   FLAG1 FLAG2 IT_DEPT

   ----- ---------- ----------------------

   1 0 100

   1 0 JONES

   1 0 TONEY

   1 0 HOPKINS
```

1 0 200

1 0 P.WHITAKER

1 0 MARCIANO

1 0 ROBINSON

1 0 MORALES

1 0 300

1 0 WRIGHT

1 0 J.TAYLOR

1 0 LACY

1 1 400

1 1 MAYWEATHER

1 1 CASTILLO

1 1 MARQUEZ

1 1 MOSLEY

1 1 CORRALES

1 1 500

1 1 CALZAGHE

1 1 GATTI

1 1 600

1 1 HAGLER

1 1 HEARNS

1 1 FRAZIER

1 1 LAMOTTA

1 1 700

1 1 JUDAH

1 1 MARGARITO

1 1 GUINN

<b>

```
   select sum(flag1)over(partition by flag2

   order by flag1,rownum) flag, it_dept, flag2

   from (

   select 1 flag1, 0 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number()over(partition by x.deptno order by y.id) rn from (

   select deptno,

   ename,

   count(*)over(partition by deptno) cnt from it_research

   ) x,

   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1

   union all

   select 1 flag1, 1 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number( )over(partition by x.deptno order by y.id) rn from (
   select deptno deptno, ename,

   count(*)over(partition by deptno) cnt from it_apps

   ) x,

   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1

   ) tmp1</b>


   FLAG IT_DEPT FLAG2

   ---- --------------- ----------

   1 100 0

   2 JONES 0

   3 TONEY 0

   4 HOPKINS 0
```

5 200 0

6 P.WHITAKER 0

7 MARCIANO 0

8 ROBINSON 0

9 MORALES 0

10 300 0

11 WRIGHT 0

12 J.TAYLOR 0

13 LACY 0

1 400 1

2 MAYWEATHER 1

3 CASTILLO 1

4 MARQUEZ 1

5 MOSLEY 1

6 CORRALES 1

7 500 1

8 CALZAGHEe 1

9 GATTI 1

10 600 1

11 HAGLER 1

12 HEARNS 1

13 FRAZIER 1

14 LAMOTTA 1

15 700 1

16 JUDAH 1

18 GUINN 1

<b>

```
   select max(decode(flag2,0,it_dept)) research,
max(decode(flag2,1,it_dept)) apps from (

   select sum(flag1)over(partition by flag2

   order by flag1,rownum) flag, it_dept, flag2

   from (

   select 1 flag1, 0 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,

   row_number( )over(partition by x.deptno order by y.id) rn from (

   select deptno,

   ename,

   count(*)over(partition by deptno) cnt from it_research

   ) x,

   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1

   union all

   select 1 flag1, 1 flag2, decode(rn,1,to_char(deptno),' '||ename) it_dept
from (

   select x.*, y.id,
   row_number( )over(partition by x.deptno order by y.id) rn from (

   select deptno deptno, ename,

   count(*)over(partition by deptno) cnt from it_apps

   ) x,

   (select level id from dual connect by level <= 2) y )

   where rn <= cnt+1

   ) tmp1

   ) tmp2

   group by flag</b>

   RESEARCH APPS

   ------------------- ---------------
```

100 400

JONES MAYWEATHER

TONEY CASTILLO

HOPKINS MARQUEZ

200 MOSLEY

P.WHITAKER CORRALES

MARCIANO 500

ROBINSON CALZAGHE

MORALES GATTI

300 600

WRIGHT HAGLER

J.TAYLOR HEARNS

LACY FRAZIER

LAMOTTA

700

JUDAH

MARGARITO

GUINN

```
select e.deptno,

   e.ename,

   e.sal,

   (select d.dname,d.loc,sysdate today from dept d

   where e.deptno=d.deptno) from emp e

create type generic_obj

   as object (

   val1 varchar2(10),

   val2 varchar2(10),

   val3 date

   );

<b>

   1 select x.deptno,

   2 x.ename,

   3 x.multival.val1 dname, 4 x.multival.val2 loc, 5 x.multival.val3 <a
name="idx-CHP-14-0877"></a>today 6 from (

   7select e.deptno,

   8 e.ename,

   9 e.sal,

   10 (select generic_obj(d.dname,d.loc,sysdate+1)
```

11 from dept d

12 where e.deptno=d.deptno) multival

13 from emp e

```
14 ) x</b>

DEPTNO ENAME DNAME LOC TODAY
------ ---------- ---------- ---------- -----------
20 SMITH RESEARCH DALLAS 12-SEP-2005
30 ALLEN SALES CHICAGO 12-SEP-2005
30 WARD SALES CHICAGO 12-SEP-2005
20 JONES RESEARCH DALLAS 12-SEP-2005
30 MARTIN SALES CHICAGO 12-SEP-2005
30 BLAKE SALES CHICAGO 12-SEP-2005
10 CLARK ACCOUNTING NEW YORK 12-SEP-2005
20 SCOTT RESEARCH DALLAS 12-SEP-2005
10 KING ACCOUNTING NEW YORK 12-SEP-2005
30 TURNER SALES CHICAGO 12-SEP-2005
20 ADAMS RESEARCH DALLAS 12-SEP-2005
30 JAMES SALES CHICAGO 12-SEP-2005
20 FORD RESEARCH DALLAS 12-SEP-2005
```

10 MILLER ACCOUNTING NEW YORK 12-SEP-2005

<b>

```
select e.deptno,

e.ename,

e.sal,

(select generic_obj(d.dname,d.loc,sysdate-1) from dept d

where e.deptno=d.deptno) multival from emp e</b>
```

DEPTNO ENAME SAL MULTIVAL(VAL1, VAL2, VAL3) ------ ------ ----- ---

20 SMITH 800 GENERIC_OBJ('RESEARCH', 'DALLAS', '12-SEP-2005') 30 ALLEN 1600 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 30 WARD 1250 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 20 JONES 2975 GENERIC_OBJ('RESEARCH', 'DALLAS', '12-SEP-2005') 30 MARTIN 1250 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 30 BLAKE 2850 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 10 CLARK 2450 GENERIC_OBJ('ACCOUNTING', 'NEW YORK', '12-SEP-2005') 20 SCOTT 3000 GENERIC_OBJ('RESEARCH', 'DALLAS', '12-SEP-2005') 10 KING 5000 GENERIC_OBJ('ACCOUNTING', 'NEW YORK', '12-SEP-2005') 30 TURNER 1500 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 20 ADAMS 1100 GENERIC_OBJ('RESEARCH', 'DALLAS', '12-SEP-2005') 30 JAMES 950 GENERIC_OBJ('SALES', 'CHICAGO', '12-SEP-2005') 20 FORD 3000 GENERIC_OBJ('RESEARCH', 'DALLAS', '12-SEP-2005') 10 MILLER 1300 GENERIC_OBJ('ACCOUNTING', 'NEW YORK', '12-SEP-2005')

The next step is to simply wrap the query in an inline view and extract the attributes.

> One important note: In Oracle, unlike the case with other vendors, you do not generally need to name your inline views. In this particular case, however, you do need to name your inline view. Otherwise you will not be able to reference the object's attributes.

```
STRINGS

    ----------------------------------

    entry:stewiegriffin:lois:brian: entry:moe::sizlack:
entry:petergriffin:meg:chris: entry:willie:

    entry:quagmire:mayorwest:cleveland: entry:::flanders:

    entry:robo:tchi:ken:

VAL1 VAL2 VAL3

    --------------- --------------- ---------------

    moe sizlack

    petergriffin meg chris quagmire mayorwest cleveland robo tchi ken

    stewiegriffin lois brian willie

    flanders

entry:::flanders:

create view V

    as

    select 'entry:stewiegriffin:lois:brian:' strings from dual

    union all

    select 'entry:moe::sizlack:'

    from dual

    union all
```

```
   select 'entry:petergriffin:meg:chris:'
   from dual
   union all
   select 'entry:willie:'
   from dual
   union all
   select 'entry:quagmire:mayorwest:cleveland:'
   from dual
   union all
   select 'entry:::flanders:'
   from dual
   union all
   select 'entry:robo:tchi:ken:'
   from dual
1 with cartesian as (
   2 select level id
from dual
connect by level <= 100
)
select max(decode(id,1,substr(strings,p1+1,p2-1))) val1,
max(decode(id,2,substr(strings,p1+1,p2-1))) val2,
max(decode(id,3,substr(strings,p1+1,p2-1))) val3
from (
select v.strings,
c.id,
instr(v.strings,':',1,c.id) p1,
instr(v.strings,':',1,c.id+1)-instr(v.strings,':',1,c.id) p2
from v, cartesian c
where c.id <= (length(v.strings)-length(replace(v.strings,':')))-1
)
group by strings
```

18 order by 1

<b>

```
   with cartesian as (

   select level id

   from dual

   connect by level <= 100

   )

   select v.strings,

   c.id

   from v,cartesian c where c.id <= (length(v.strings)-
length(replace(v.strings,':')))-1</b>

   STRINGS ID

   ---------------------------------- ---

   entry:::flanders: 1

   entry:::flanders: 2

   entry:::flanders: 3

   entry:moe::sizlack: 1

   entry:moe::sizlack: 2

   entry:moe::sizlack: 3

   entry:petergriffin:meg:chris: 1
```

```
    entry:petergriffin:meg:chris: 3
    entry:petergriffin:meg:chris: 2
    entry:quagmire:mayorwest:cleveland: 1
    entry:quagmire:mayorwest:cleveland: 3
    entry:quagmire:mayorwest:cleveland: 2
    entry:robo:tchi:ken: 1
    entry:robo:tchi:ken: 2
    entry:robo:tchi:ken: 3
    entry:stewiegriffin:lois:brian: 1
    entry:stewiegriffin:lois:brian: 3
    entry:stewiegriffin:lois:brian: 2
    entry:willie: 1
```

<b>

```
    with cartesian as (
    select level id
    from dual
    connect by level <= 100
    )
    select v.strings,
    c.id,
    instr(v.strings,':',1,c.id) p1, instr(v.strings,':',1,c.id+1)-
instr(v.strings,':',1,c.id) p2

    from v,cartesian c where c.id <= (length(v.strings)-
length(replace(v.strings,':')))-1

    order by 1</b>

    STRINGS ID P1 P2

    --------------------------------- --- ---------- ----------

    entry:::flanders: 1 6 1

    entry:::flanders: 2 7 1

    entry:::flanders: 3 8 9

    entry:moe::sizlack: 1 6 4

    entry:moe::sizlack: 2 10 1

    entry:moe::sizlack: 3 11 8

    entry:petergriffin:meg:chris: 1 6 13

    entry:petergriffin:meg:chris: 3 23 6

    entry:petergriffin:meg:chris: 2 19 4

    entry:quagmire:mayorwest:cleveland: 1 6 9

    entry:quagmire:mayorwest:cleveland: 3 25 10

    entry:quagmire:mayorwest:cleveland: 2 15 10

    entry:robo:tchi:ken: 1 6 5

    entry:robo:tchi:ken: 2 11 5
    entry:robo:tchi:ken: 3 16 4

    entry:stewiegriffin:lois:brian: 1 6 14

    entry:stewiegriffin:lois:brian: 3 25 6

    entry:stewiegriffin:lois:brian: 2 20 5

    entry:willie: 1 6 7

<b>with cartesian as (

    select level id

    from dual

    connect by level <= 100

    )

    select decode(id,1,substr(strings,p1+1,p2-1)) val1,
decode(id,2,substr(strings,p1+1,p2-1)) val2,
decode(id,3,substr(strings,p1+1,p2-1)) val3

    from (

    select v.strings,

    c.id,

    instr(v.strings,':',1,c.id) p1, instr(v.strings,':',1,c.id+1)-
instr(v.strings,':',1,c.id) p2

    from v,cartesian c where c.id <= (length(v.strings)-
length(replace(v.strings,':')))-1

    )

    order by 1</b>
```

```
VAL1 VAL2 VAL3

--------------- --------------- --------------

moe

petergriffin

quagmire

robo

stewiegriffin

willie

lois


meg

mayorwest


tchi

brian

sizlack

chris

cleveland

flanders

ken
```

```
<b>

   with cartesian as (

   select level id

   from dual

   connect by level <= 100

   )

   select max(decode(id,1,substr(strings,p1+1,p2-1))) val1,
max(decode(id,2,substr(strings,p1+1,p2-1))) val2,
max(decode(id,3,substr(strings,p1+1,p2-1))) val3

   from (

   select v.strings,

   c.id,

   instr(v.strings,':',1,c.id) p1, instr(v.strings,':',1,c.id+1)-
instr(v.strings,':',1,c.id) p2

   from v,cartesian c where c.id <= (length(v.strings)-
length(replace(v.strings,':')))-1

   )

   group by strings

   order by 1</b>

   VAL1 VAL2 VAL3

   -------------- -------------- ----------

   moe sizlack
```

petergriffin meg chris quagmire mayorwest cleveland robo tchi ken

stewiegriffin lois brian willie

flanders

```
JOB NUM_EMPS PCT_OF_ALL_SALARIES

    --------- ---------- -------------------

    CLERK 4 14

    ANALYST 2 20

    MANAGER 3 28

    SALESMAN 4 19

    PRESIDENT 1 17
```

```
1 select job,num_emps,sum(round(pct)) pct_of_all_salaries 2 from (

    3 select job, 4 count(*)over(partition by job) num_emps, 5
ratio_to_report(sal)over()*100 pct
```

6 from emp

7)

8 group by job,num_emps

<b>

select job,

count(*)over(partition by job) num_emps, ratio_to_report(sal)over()*100 pct from emp</b>

JOB NUM_EMPS PCT

--------- ---------- ----------

ANALYST 2 10.3359173

ANALYST 2 10.3359173

CLERK 4 2.75624462

CLERK 4 3.78983635

CLERK 4 4.4788975

CLERK 4 3.27304048

MANAGER 3 10.2497847

MANAGER 3 8.44099914

MANAGER 3 9.81912145

PRESIDENT 1 17.2265289

SALESMAN 4 5.51248923

```
   SALESMAN 4 4.30663221

   SALESMAN 4 5.16795866

   SALESMAN 4 4.30663221

<b>

   select job,num_emps,sum(round(pct)) pct_of_all_salaries from (

   select job,

   count(*)over(partition by job) num_emps, ratio_to_report(sal)over( )*100
pct from emp

   )

   group by job,num_emps</b>

   JOB NUM_EMPS PCT_OF_ALL_SALARIES

   --------- ---------- -------------------

   CLERK 4 14

   ANALYST 2 20

   MANAGER 3 28

   SALESMAN 4 19

   PRESIDENT 1 17
```

```
DEPTNO LIST
    ------ --------------------------------------
    10 MILLER,KING,CLARK
    20 FORD,ADAMS,SCOTT,JONES,SMITH
    30 JAMES,TURNER,BLAKE,MARTIN,WARD,ALLEN
1 select deptno,
```

2 list

3 from (

4 select *

5 from (

6 select deptno,empno,ename, 7 lag(deptno)over(partition by deptno 8 order by empno) prior_deptno

9 from emp

10)

11 model

12 dimension by

13 (

14 deptno,

15 row_number()over(partition by deptno order by empno) rn 16)

17 measures

18 (

19 ename,

20 prior_deptno,cast(null as varchar2(60)) list, 21 count(*)over(partition by deptno) cnt, 22 row_number()over(partition by deptno order by empno) rnk 23)

24 rules

25 (

26 list[any,any]

27 order by deptno,rn = case when prior_deptno[cv(),cv( )] is null 28 then ename[cv( ),cv( )]

29 else ename[cv( ),cv( )]||','||

30 list[cv(),rnk[cv( ),cv( )]-1]

31 end

```
32 )

33 )

34 where cnt = rn
```

<b>

select deptno,empno,ename, lag(deptno)over(partition by deptno order by empno) prior_deptno from emp</b>

```
DEPTNO EMPNO ENAME PRIOR_DEPTNO

------ ---------- ------ ------------

10 7782 CLARK

10 7839 KING 10

10 7934 MILLER 10

20 7369 SMITH

20 7566 JONES 20

20 7788 SCOTT 20

20 7876 ADAMS 20

20 7902 FORD 20

30 7499 ALLEN

30 7521 WARD 30

30 7654 MARTIN 30
```

30 7698 BLAKE 30

30 7844 TURNER 30

30 7900 JAMES 30

<b>

```
   select *

   from (

   select deptno,empno,ename, lag(deptno)over(partition by deptno order by empno) prior_deptno from emp

   )

   model

   dimension by

   (

   deptno,

   row_number()over(partition by deptno order by empno) rn )

   measures

   (

   ename,

   prior_deptno,cast(null as varchar2(60)) list, count(*)over(partition by deptno) cnt, row_number()over(partition by deptno order by empno) rnk )

   rules

   (

   /*
```

```
list[any,any]

order by deptno,rn = case when prior_deptno[cv(),cv()] is null then
ename[cv(),cv()]

else ename[cv(),cv()]||','||

list[cv(),rnk[cv(),cv( )]-1]

end

*/

)

order by 1</b>

DEPTNO RN ENAME PRIOR_DEPTNO LIST CNT RNK

------ --- ------ ------------ ---------- --- ----

10 1 CLARK 3 1

10 2 KING 10 3 2

10 3 MILLER 10 3 3

20 1 SMITH 5 1

20 2 JONES 20 5 2

20 4 ADAMS 20 5 4

20 5 FORD 20 5 5

20 3 SCOTT 20 5 3

30 1 ALLEN 6 1

30 6 JAMES 30 6 6
```

```
30 4 BLAKE 30 6 4

30 3 MARTIN 30 6 3

30 5 TURNER 30 6 5
```

30 2 WARD 30 6 2

<b>

```
   select deptno,

   list

   from (

   select *

   from (

   select deptno,empno,ename, lag(deptno)over(partition by deptno order by
empno) prior_deptno from emp

   )

   model

   dimension by

   (

   deptno,

   row_number()over(partition by deptno order by empno) rn )

   measures

   (

   ename,

   prior_deptno,cast(null as varchar2(60)) list, count(*)over(partition by
deptno) cnt, row_number()over(partition by deptno order by empno) rnk )
```

```
    rules

    (

    list[any,any]

    order by deptno,rn = case when prior_deptno[cv(),cv()] is null then
ename[cv(),cv()]

    else ename[cv(),cv()]||','||

    list[cv(),rnk[cv(),cv( )]-1]

    end

    )

    )</b>


    DEPTNO LIST

    ------ -------------------------------------
```

10 CLARK

10 KING,CLARK

10 MILLER,KING,CLARK

20 SMITH

```
20 JONES,SMITH

20 SCOTT,JONES,SMITH

20 ADAMS,SCOTT,JONES,SMITH

20 FORD,ADAMS,SCOTT,JONES,SMITH
```

30 ALLEN

```
   30 WARD,ALLEN

   30 MARTIN,WARD,ALLEN

   30 BLAKE,MARTIN,WARD,ALLEN

   30 TURNER,BLAKE,MARTIN,WARD,ALLEN

   30 JAMES,TURNER,BLAKE,MARTIN,WARD,ALLEN
```

<b>

```
   select deptno,

   list

   from (

   select *

   from (

   select deptno,empno,ename, lag(deptno)over(partition by deptno order by
empno) prior_deptno from emp

   )

   model

   dimension by

   (

   deptno,

   row_number()over(partition by deptno order by empno) rn )
   measures

   (

   ename,

   prior_deptno,cast(null as varchar2(60)) list, count(*)over(partition by
deptno) cnt, row_number()over(partition by deptno order by empno) rnk )

   rules

   (

   list[any,any]

   order by deptno,rn = case when prior_deptno[cv(),cv()] is null then
ename[cv(),cv()]

   else ename[cv(),cv()]||','||

   list[cv(),rnk[cv(),cv( )]-1]

   end

   )

   )

   where cnt = rn</b>

   DEPTNO LIST

   ------ ----------------------------------------

   10 MILLER,KING,CLARK

   20 <a name="idx-CHP-14-0893">
</a>FORD,ADAMS,SCOTT,JONES,SMITH
```

```
30 JAMES,TURNER,BLAKE,MARTIN,WARD,ALLEN
```

Recipe 14.14. Finding Text Not Matching a Pattern (Oracle)

Problem

You have a text field that contains some structured text values (e.g., phone numbers), and you wish to find occurrences where those values are structured incorrectly. For example, you have data like the following:

```
select emp_id, text
  from employee_comment

EMP_ID     TEXT
---------- ------------------------------------------------------------
7369       126 Varnum, Edmore MI 48829, 989 313-5351
7499       1105 McConnell Court
           Cedar Lake MI 48812
           Home: 989-387-4321
           Cell: (237) 438-3333
```

and you wish to list rows having invalidly formatted phone numbers. For example, you wish to list the following row because its phone number uses two different separator characters:

```
7369            126 Varnum, Edmore MI 48829, 989 313-5351
```

You wish to consider valid only those phone numbers that use the same character for both delimiters.

Solution

This problem has a multi-part solution:

1. Find a way to describe the universe of apparent phone numbers that you wish to consider.
2. Remove any validly formatted phone numbers from consideration.
3. See whether you still have any apparent phone numbers left. If you do, you know those are invalidly formatted.

The following solution makes good use of the regular expression functionality introduced in Oracle Database 10*g*

```
select emp_id, text
from employee_comment
where regexp_like(text, '[0-9]{3}[-. ][0-9]{3}[-. ][0-9]{4}')
  and regexp_like(
         regexp_replace(text,
            '[0-9]{3}([-. ])[0-9]{3}\1[0-9]{4}','***'),
         '[0-9]{3}[-. ][0-9]{3}[-. ][0-9]{4}')

    EMP_ID TEXT
```

```
        ---------- ------------------------------------------------------------
          7369     126 Varnum, Edmore MI 48829, 989 313-5351
          7844     989-387.5359
          9999     906-387-1698, 313-535.8886
```

Each of these rows contains at least one apparent phone number that is not correctly formatted.

Discussion

The key to this solution lies in the detection of an "apparent phone number." Given that the phone numbers are stored in a comment field, any text at all in the field could be construed to be an invalid phone number. You need a way to narrow the field to a more reasonable set of values to consider. You don't, for example, want to see the following row in your output:

```
EMP_ID TEXT
        ---------- ---------------------------------------------------------
              7900 Cares for 100-year-old aunt during the day. Schedule only
                   for evening and night shifts.
```

Clearly there's no phone number at all in this row, much less one that is invalid. You and I can see that. The question is, how do you get the RDBMS to "see" it. I think you'll enjoy the answer. Please read on.

This recipe comes (with permission) from an article by Jonathan Gennick called "Regular Expression Anti-Patterns," which you can read at: http://gennick.com/antiregex.htm.

The solution uses Pattern A to define the set of "apparent" phone numbers to consider:

```
Pattern A: [0-9]{3}[-. ][0-9]{3}[-. ][0-9]{4}
```

Pattern A checks for two groups of three digits followed by one group of four digits. Any one of a dash (-), a period (.), or a space are accepted as delimiters between groups. You could come up with a more complex pattern. For example, you could decide that you also wish to consider seven-digit phone numbers. But don't get side-tracked. The point now is that somehow you do need to define the universe of possible phone number strings to consider, and for this problem that universe is defined by Pattern A. You can define a different Pattern A, and the general solution still applies.

The solution uses Pattern A in the WHERE clause to ensure that only rows having potential phone numbers (as defined by the pattern!) are considered:

```
select emp_id, text
          from employee_comment
         where regexp_like(text, '[0-9]{3}[-. ][0-9]{3}[-. ][0-9]{4}')
```

Next, you need to define what a "good" phone number looks like. The solution does this using Pattern B:

```
Pattern B: [0-9]{3}([-. ])[0-9]{3}\1[0-9]{4}
```

This time, the pattern uses \1 to reference the first subexpression. Whichever character is matched by ([-.]) must also be matched by \1. Pattern B describes good phone numbers, which must be eliminated from consideration (as they are not bad). The solution eliminates the well-formatted phone numbers through a call to REGEXP_ REPLACE:

```
regexp_replace(text,
           '[0-9]{3}([-. ])[0-9]{3}\1[0-9]{4}','***'),
```

This call to REGEXP_REPLACE occurs in the WHERE clause. Any well-formatted phone numbers are replaced by a string of three asterisks. Again, Pattern B can be any pattern that you desire. The point is that Pattern B describes the acceptable pattern that you are after.

Having replaced well-formatted phone numbers with strings of three asterisks (***), any "apparent" phone numbers that remain must, by definition, be poorly formatted. The solution applies REGEXP_LIKE to the output from REGEXP_LIKE to see whether any poorly formatted phone numbers remain:

```
and regexp_like(
               regexp_replace(text,
                  '[0-9]{3}([-. ])[0-9]{3}\1[0-9]{4}','***'),
               '[0-9]{3}[-. ][0-9]{3}[-. ][0-9]{4}')
```

This recipe would be difficult to implement without the pattern matching capabilities inherent in Oracle's relatively new regular expression features. In particular, this recipe depends on REGEXP_REPLACE. Other databases (notably PostgreSQL) implement support for regular expressions. But to my knowledge, only Oracle supports the regular expression search and replace functionality on which this recipe depends.

Recipe 14.15. Transforming Data with an Inline View

Problem

You have a table in a column that sometimes contains numeric data and sometimes character data. Another column in the same table indicates which is the case. You wish to use a subquery to isolate only the numeric data:

```
select *
          from ( select flag, to_number(num) num
               from subtest
               where flag in ('A', 'C') )
               where num > 0
```

Unfortunately, this query against an inline view often (but perhaps not always!) results in the following error message;

```
ERROR:
        ORA-01722: invalid number
```

Solution

One solution is to force the inline view to completely execute prior to the outer SELECT statement. You can do that, in Oracle at least, by including the row number pseudo-column in your inner SELECT list:

```
select *
          from ( select rownum, flag, to_number(num) num
               from subtest
               where flag in ('A', 'C') )
               where num > 0
```

See "Discussion" for an explanation of why this solution works.

Discussion

The reason for the invalid number error in the problem query is that some optimizers will merge the inner and outer queries. While it looks like you are executing an inner query first to remove all non-numeric NUM values, you might really be executing: select flag, to_number(num) num from subtest where to_number(num) > 0 and flag in ('A', 'C');

And now you can probably clearly see the reason for the error: rows with non-numeric NUM values are *not* filtered out before the TO_NUMBER function is applied.

Should a database merge sub and main queries? The answer depends on whether you are thinking in terms of relational theory, in terms of the SQL standard, or in terms of how your particular database vendor chooses to implement his brand of SQL. You can learn more by visiting http://gennick.com/madness.html.

The solution solves the problem, in Oracle at least, because it adds ROWNUM to the inner query's SELECT list. ROWNUM is a function that returns a sequentially increasing number for each row *returned by a query*. Those last words are important. The sequentially increasing number, termed a *row number*, cannot be computed outside the context of returning a row from a query. Thus, Oracle is forced to materialize the result of the subquery, which means that Oracle is forced to execute the subquery first in order to return rows from that subquery in order to properly assign row numbers. Thus, querying for ROWNUM is one mechanism that you can use to force Oracle to fully execute a subquery prior to the main query (i.e., no merging of queries allowed). If you are not using Oracle, and you need to force the order of execution of a subquery, check to see whether your database supports something analogous to Oracle's ROWNUM function.

```
create view V
    as
    select 1 student_id, 1 test_id,
    2 grade_id,
    1 period_id,
    to_date('02/01/2005','MM/DD/YYYY') test_date,
```

0 pass_fail

from dual union all

select 1, 2, 2, 1, to_date('03/01/2005','MM/DD/YYYY'), 1 from dual union all select 1, 3, 2, 1, to_date('04/01/2005','MM/DD/YYYY'), 0 from dual union all select 1, 4, 2, 2, to_date('05/01/2005','MM/DD/YYYY'), 0 from dual union all select 1, 5, 2, 2, to_date('06/01/2005','MM/DD/YYYY'), 0 from dual union all select 1, 6, 2, 2, to_date('07/01/2005','MM/DD/YYYY'), 0 from dual

select *

from V

STUDENT_ID TEST_ID GRADE_ID PERIOD_ID TEST_DATE PASS_FAIL

---------- ------- -------- --------- ----------- ---------

1 1 2 1 01-FEB-2005 0

1 2 2 1 01-MAR-2005 1

1 3 2 1 01-APR-2005 0

1 4 2 2 01-MAY-2005 0

1 5 2 2 01-JUN-2005 0

1 6 2 2 01-JUL-2005 0

STUDENT_ID TEST_ID GRADE_ID PERIOD_ID TEST_DATE METREQ IN_PROGRESS

---------- ------- -------- --------- ----------- ------ -----------

1 1 2 1 01-FEB-2005 + 0

1 2 2 1 01-MAR-2005 + 0

1 3 2 1 01-APR-2005 + 0

1 4 2 2 01-MAY-2005 - 0

1 5 2 2 01-JUN-2005 - 0

1 6 2 2 01-JUL-2005 - 1

1 select student_id,

2 test_id,

3 grade_id,

4 period_id,

5 test_date,

6 decode(grp_p_f,1,lpad('+',6),lpad('-',6)) metreq, 7 decode(grp_p_f,1,0, 8 decode(test_date,last_test,1,0)) in_progress 9 from (

10 select V.*,

11 max(pass_fail)over(partition by 12 student_id,grade_id,period_id) grp_p_f, 13 max(test_date)over(partition by 14 student_id,grade_id,period_id) last_test

15 from V

16) x

select V.*,

max(pass_fail)over(partition by student_id,grade_id,period_id) grp_pass_fail from V

STUDENT_ID TEST_ID GRADE_ID PERIOD_ID TEST_DATE PASS_FAIL GRP_PASS_FAIL

---------- ------- -------- --------- ----------- --------- -------------

1 1 2 1 01-FEB-2005 0 1

1 2 2 1 01-MAR-2005 1 1

1 3 2 1 01-APR-2005 0 1

1 4 2 2 01-MAY-2005 0 0

1 5 2 2 01-JUN-2005 0 0

1 6 2 2 01-JUL-2005 0 0

select V.*,

max(pass_fail)over(partition by student_id,grade_id,period_id) grp_p_f, max(test_date)over(partition by student_id,grade_id,period_id) last_test from V

STUDENT_ID TEST_ID GRADE_ID PERIOD_ID TEST_DATE PASS_FAIL GRP_P_F LAST_TEST

```
   ---------- ------- -------- --------- ----------- --------- ------- -----------

   1 1 2 1 01-FEB-2005 0 1 01-APR-2005

   1 2 2 1 01-MAR-2005 1 1 01-APR-2005

   1 3 2 1 01-APR-2005 0 1 01-APR-2005

   1 4 2 2 01-MAY-2005 0 0 01-JUL-2005

   1 5 2 2 01-JUN-2005 0 0 01-JUL-2005

   1 6 2 2 01-JUL-2005 0 0 01-JUL-2005

select student_id,

   test_id,

   grade_id,

   period_id,

   test_date,

   decode( grp_p_f,1,lpad('+',6),lpad('-',6) ) metreq, decode( grp_p_f,1,0,
decode( test_date,last_test,1,0 ) ) in_progress from (

   select V.*,

   max(pass_fail)over(partition by student_id,grade_id,period_id) grp_p_f,
max(test_date)over(partition by student_id,grade_id,period_id) last_test
from V

   ) x



   STUDENT_ID TEST_ID GRADE_ID PERIOD_ID TEST_DATE
METREQ IN_PROGRESS
```

```
---------- ------- -------- --------- ----------- ------ -----------
1 1 2 1 01-FEB-2005 + 0
1 2 2 1 01-MAR-2005 + 0
1 3 2 1 01-APR-2005 + 0
1 4 2 2 01-MAY-2005 - 0
1 5 2 2 01-JUN-2005 - 0
1 6 2 2 01-JUL-2005 - 1
```

Appendix A. Window Function Refresher

The recipes in this book take full advantage of the window functions added to the ISO SQL standard in 2003, as well as vendor-specific window functions. This appendix is meant to serve as a brief overview of how window functions work. Window functions make many typically difficult tasks (difficult to solve using standard SQL, that is) quite easy. For a complete list of window functions available, full syntax, and in-depth coverage of how they work, please consult your vendor's documentation.

Recipe A.1. Grouping

Before moving on to window functions, it is crucial that you understand how grouping works in SQL. In my experience, the concept of grouping results in SQL has been a stumbling block for many. The problems stem from not fully understanding how the GROUP BY clause works and why certain queries return certain results when using GROUP BY.

Simply stated, grouping is a way to organize like rows together. When you use GROUP BY in a query, each row in the result set is a group and represents one or more rows with the same values in one or more columns that you specify. That's the gist of it.

If a group is simply a unique instance of a row that represents one or more rows with the same value for a particular column (or columns), then practical examples of groups from table EMP include *all employees in department 10* (the common value for these employees that enable them to be in the same group is DEPTNO=10) or *all clerks* (the common value for these employees that enable them to be in the same group is JOB='CLERK'). Consider the following queries. The first shows all employees in department 10; the second query groups the employees in department 10 and returns the following information about the group: the number of rows (members) in the group, the highest salary, and the lowest salary:

```
select deptno,ename
                from emp
                where deptno=10

          DEPTNO ENAME
          ------ ----------
                  10 CLARK
                  10 KING
                  10 MILLER

         select deptno,
                                  count(*) as cnt,
                                  max(sal) as hi_sal,
                                  min(sal) as lo_sal
                        from emp
                  where deptno=10
                  group by deptno


                DEPTNO           CNT     HI_SAL         LO_SAL
                ------ ---------- ---------- ----------
                        10                     3               5000             1300
```

If you were not able to group the employees in department 10 together, to get the information in the second query above you would have to manually inspect the rows for that department (trivial if there are only three rows, but what if there were three million rows?). So, why would anyone want to group? Reasons for doing so vary; perhaps you want to see how many different groups exist or how many members (rows) are in each group. As you can see from the simple example above, grouping allows you to get information about many rows in a table without having to inspect them one by one.

Definition of an SQL Group

In mathematics, a group is defined, for the most part, as (*G*, •, *e*), where *G* is a set, • is a binary operation in *G*, and *e* is a member of *G*. We will use this definition as the foundation for what a SQL group is. A SQL group will be defined as (*G*, *e*), where *G* is a result set of a single or self-contained query that uses GROUP BY, *e* is a member of *G*, and the following axioms are satisfied:

- For each *e* in *G*, *e* is distinct and represents one or more instances of *e*.
- For each *e* in G, the aggregate function COUNT returns a value > 0.

> The result set is included in the definition of a SQL group to reinforce the fact that we are defining what groups are when working with queries only. Thus, it would be accurate to replace "e" in each axiom with the word "row" because the rows in the result set are technically the groups.

Because these properties are fundamental to what we consider a group, it is important that we prove they are true (and we will proceed to do so through the use of some example SQL queries).

Groups are non-empty

By its very definition, a group must have at least one member (or row). If we accept this as a truth, then it can be said that a group cannot be created from an empty table. To prove that proposition true, simply try to prove it is false. The following example creates an empty table, and then attempts to create groups via three different queries against that empty table:

```
create table fruits (name varchar(10))

        select name
                from fruits
          group by name

          (no rows selected)

         select count(*) as cnt
                  from fruits
                group by name

                (no rows selected)

        select name, count(*) as cnt
                from fruits
           group by name

           (no rows selected)
```

As you can see from these queries, it is impossible to create what SQL considers a group from an empty table.

Groups are distinct

Now let's prove that the groups created via queries with a GROUP BY clause are distinct. The following example inserts five rows into table FRUITS, and then creates groups from those rows:

```
insert into fruits values ('Oranges')
        insert into fruits values ('Oranges')
        insert into fruits values ('Oranges')
        insert into fruits values ('Apple')
        insert into fruits values ('Peach')

        select *
                from fruits

        NAME
        --------
        Oranges
        Oranges
        Oranges
        Apple
        Peach

        select name
                from fruits
          group by name

         NAME
         -------
         Apple
         Oranges
         Peach

         select name, count(*) as cnt
                from fruits
           group by name

           NAME                 CNT
           ------- --------
           Apple                1
           Oranges              3
           Peach                1
```

The first query shows that "Oranges" occurs three times in table FRUITS. However, the second and third queries (using GROUP BY) return only one instance of "Oranges." Taken together, these queries prove that the rows in the result set (e in G, from our definition) are distinct, and each value of NAME represents one or more instances of itself in table FRUITS.

Knowing that groups are distinct is important because it means, typically, you would not use the DISTINCT keyword in your SELECT list when using a GROUP BY in your queries.

I am in no way suggesting GROUP BY and DISTINCT are the same. They represent two completely different concepts. I am merely stating that the items listed in the GROUP BY clause will be distinct in the result set and that using DISTINCT as well as GROUP BY is redundant.

Frege's Axiom and Russell's Paradox

For those of you who are interested, Frege's *axiom of abstraction*, based on Cantor's solution for defining set membership for infinite or uncountable sets, states that, given a specific identifying property, there exists a set whose members are only those items having that property. The source of trouble, as put by Robert Stoll, "is the unrestrictd use of the principal of abstraction." Bertrand Russell asked Gottlob Frege to consider a set whose members are sets and have the defining property of not being members of themselves.

As Russell pointed out, the axiom of abstraction gives too much freedom because you are simply specifiying a condition or property to define set membership, thus a contradiction can be found. To better explain how a contradiction can be found, he devised the "Barber Puzzle." The Barber Puzzle states:

> In a certain town there is a male barber who shaves all those men, and only those men, who do not shave themselves. If this is true, who, then, shaves the barber?

For a more concrete example, consider the set that can be described as:

> *For all members x in y that satisfy a specific condition (P)*

The mathematical notation for this description is:

```
{x e y | P(x)}
```

Because the above set considers *only those x in y that satisfy a condition (P)* you may find it more intuitive to describe the set as *x is a member of y if and only if x satisfies a condition (P)*.

At this point let us define this condition *P(x)* as *x is not a member of x*:

```
( x e x )
```

The set is now defined as *x is a member of y if and only if x is not a member of x*:

```
{x e y | ( x e x )}
```

Russell's paradox may not be clear to you yet, but ask yourself this: can the set above be a member of itself? Let's assume that *x* = *y* and look at the above set again. The following set can be defined as *y is a member of y if and only if y is not a member of y*:

```
{y e y | ( y e y )}
```

Simply put, Russell's paradox leaves us in a position to have a set that is concurrently a member of itself and not a member of itself, which is a contradiction. Intuitive thinking would lead one to believe this isn't a problem at all; indeed, how can a set be a member of itself? The set of all books, after all, is not a book. So why does this paradox exist and how can it be an issue? It becomes an issue when you consider more abstract applications of set theory. For example, a "practical" application of Russell's paradox can be demonstrated by considering the set of all sets. If we allow such a concept to exist, then by its very definition, it must be a member of itself (it is, after all, the set of all sets). What then happens when you apply *P(x)* above to the set of all sets? Simply stated, Russell's paradox would state that the set of all sets is a member of itself if and only if it is not a member of itselfclearly a contradiction.

For those of you who are interested, Ernst Zermelo developed the axiom schema of separation (also referred to as the axiom schema of subsets or the axiom of specification) to elegantly sidestep Russell's paradox in axiomatic set theory.

COUNT is never zero

The queries and results in the preceding section also prove the final axiom that the aggregate function COUNT will never return zero when used in a query with GROUP BY on a nonempty table. It should not be surprising that you cannot return a count of zero for a group. We have already proved that a group cannot be created from an empty table, thus a group must have at least one row. If at least one row exists, then the count will always be at least 1.

> Remember, we are talking about using COUNT with GROUP BY, not COUNT by itself. A query using COUNT without a GROUP BY on an empty table will of course return zero.

Paradoxes

> "Hardly anything more unfortunate can befall a scientific writer than to have one of the foundations of his edifice shaken after the work is finished…. This was the position I was placed in by a letter of Mr. Bertrand Russell, just when the printing of this volume was nearing its completion."

The preceding quote is from Gottlob Frege in response to Bertrand Russell's discovery of a contradiction to Frege's axiom of abstraction in set theory.

Paradoxes many times provide scenarios that would seem to contradict established theories or ideas. In many cases these contradictions are localized and can be "worked around," or they are applicable to such small test cases that they can be safely ignored.

You may have guessed by now that the point to all this discussion of paradoxes is that there exists a paradox concerning our definition of an SQL group, and that paradox must be addressed. Although our focus right now is on groups, ultimately we are discussing SQL queries. In its GROUP BY clause, a query may have a wide range of values such as constants, expressions, or, most commonly, columns from a table. We pay a price for this flexibility, because NULL is a valid "value" in SQL. NULLs present problems because they are effectively ignored by aggregate functions. With that said, if a table consists of a single row and its value is NULL, what would the aggregate function COUNT return when used in a GROUP BY query? By our very definition, when using GROUP BY and the aggregate function COUNT, a value >= 1 must be returned. What happens, then, in the case of values ignored by functions such as COUNT, and what does this mean to our definition of a GROUP? Consider the following example, which reveals the NULL group paradox (using the function COALESCE when necessary for readability):

```
select *
                from fruits

         NAME
         -------
         Oranges
         Oranges
         Oranges
         Apple
         Peach

         insert into fruits values (null)
         insert into fruits values (null)
         insert into fruits values (null)
         insert into fruits values (null)
         insert into fruits values (null)

         select coalesce(name,'NULL') as name
                from fruits

         NAME
         --------
         Oranges
         Oranges
         Oranges
         Apple
         Peach
         NULL
         NULL
         NULL
         NULL
         NULL

         select coalesce(name,'NULL') as name,
                        count(name) as cnt
                from fruits
          group by name

          NAME                    CNT
          -------- ----------
          Apple                         1
          NULL                          0
          Oranges                       3
          Peach                         1
```

It would seem that the presence of NULL values in our table introduces a contradiction, or paradox, to our definition of a SQL group. Fortunately, this contradiction is not a real cause for concern, because the paradox has more to do with the implementation of aggregate functions than our definition. Consider the final query in the preceding set; a general problem statement for that query would be:

> *Count the number of times each name occurs in table FRUITS or count the number of members in each group*.

Examining the INSERT statements above, it's clear that there are five rows with NULL values, which means there exists a NULL group with five members.

> While NULL certainly has properties that differentiate it from other values, it is nevertheless a value, and can in fact be a group.

How, then, can we write the query to return a count of 5 instead of 0, thus returning the information we are looking for while conforming to our definition of a group? The example below shows a workaround to deal with the NULL group paradox:

```
select coalesce(name,'NULL') as name,
                   count(*) as cnt
           from fruits
         group by name
```

```
NAME                   CNT
--------- --------
Apple                   1
Oranges                 3
Peach                   1
NULL                    5
```

The workaround is to use COUNT(*) rather than COUNT(NAME) to avoid the NULL group paradox. Aggregate functions will ignore NULL values if any exist in the column passed to them. Thus, to avoid a zero when using COUNT do not pass the column name; instead, pass in an asterisk (*). The * causes the COUNT function to count rows rather than the actual column values, so whether or not the actual values are NULL or not NULL is irrelevant.

One more paradox has to do with the axiom that each group in a result set (for each *e* in *G*) is distinct. Because of the nature of SQL result sets and tables, which are more accurately defined as multisets or "bags," not sets (because duplicate rows are allowed), it is possible to return a result set with duplicate groups. Consider the following queries:

```
select coalesce(name,'NULL') as name,
                   count(*) as cnt
           from fruits
         group by name
         union all
        select coalesce(name,'NULL') as name,
                        count(*) as cnt
           from fruits
         group by name

         NAME                     CNT
         ---------- ---------
         Apple                          1
         Oranges                        3
         Peach                          1
         NULL                           5
         Apple                          1
         Oranges                        3
         Peach                          1
         NULL                           5


         select x.*
                from (
         select coalesce(name,'NULL') as name,
                        count(*) as cnt
                from fruits
          group by name
                        ) x,
                        (select deptno from dept) y

         NAME                       CNT
         ---------- ----------
         Apple                           1
         Apple                           1
         Apple                           1
         Apple                           1
         Oranges                         3
         Oranges                         3
         Oranges                         3
         Oranges                         3
         Peach                           1
         Peach                           1
         Peach                           1
         Peach                             1
         NULL                              5
         NULL                              5
         NULL                              5
         NULL                              5
```

As you can see in these queries, the groups are in fact repeated in the final results. Fortunately, this is not much to worry about because it represents only a partial paradox. The first property of a group states that for (*G*, *e*), *G* is a result set from a single or self-contained query that uses GROUP BY. Simply put, the result set from any GROUP BY query itself conforms to our definition of a group. It is only when you combine the result sets from two GROUP BY queries to create a multiset that groups may repeat. The first query in the preceding example uses UNION ALL, which is not a set operation but a multiset operation, and invokes GROUP BY twice, effectively executing two queries.

> If you use UNION, which is a set operation, you will not see repeating groups.

The second query in the preceding set uses a Cartesian product, which only works if you materialize the group first and then perform the Cartesian. Thus the GROUP BY query when self-contained conforms to our definition. Neither of the two examples takes anything away from the definition of a SQL group. They are shown for completeness, and so that you can be aware that almost anything is possible in SQL.

Relationship Between SELECT and GROUP BY

With the concept of a group defined and proved, it is now time to move on to more practical matters concerning queries using GROUP BY. It is important to understand the relationship between the SELECT clause and the GROUP BY clause when grouping in SQL. It is important to keep in mind when using aggregate functions such as COUNT that any item in your SELECT list that is not used as an argument to an aggregate function must be part of your group. For example, if you write a SELECT clause such as:

```
select deptno, count(*) as cnt
                from emp
```

then you must list DEPTNO in your GROUP BY clause:

```
select deptno, count(*) as cnt
                from emp
           group by deptno

           DEPTNO       CNT
           ------- ----
                        10         3
                        20         5
                        30    6
```

Constants, scalar values returned by user-defined functions, window functions, and non-correlated scalar subqueries are exceptions to this rule. Since the SELECT clause is evaluated after the GROUP BY clause, these constructs are allowed in the SELECT list and do not have to (and in some cases cannot) be specified in the GROUP BY clause. For example:

```
select 'hello' as msg,
                        1 as num,
                        deptno,
                        (select count(*) from emp) as total,
                        count(*) as cnt
           from emp
         group by deptno

         MSG    NUM DEPTNO TOTAL CNT
         -----  --- ------ ----- ---
         hello  1               10      14              3
         hello  1               20      14              5
         hello  1               30      14              6
```

Don't let this query confuse you. The items in the SELECT list not listed in the GROUP BY clause do not change the value of CNT for each DEPTNO, nor do the values for DEPTNO change. Based on the results of the preceding query, we can define the rule about matching items in the SELECT list and the GROUP BY clause when using aggregates a bit more precisely:

> Items in a SELECT list that can potentially change the group or change the value returned by an aggregate function must be included in the GROUP BY clause.

The additional items in the preceding SELECT list did not change the value of CNT for any group (each DEPTNO), nor did they change the groups themselves.

Now it's fair to ask: exactly what items in a SELECT list can change a grouping or the value returned by an aggregate function? The answer is simple: other columns from the table(s) you are selecting from. Consider the prospect of adding the JOB column to the query we've been looking at:

```
select deptno, job, count(*) as cnt
                from emp
          group by deptno, job

          DEPTNO JOB            CNT
          ------ ---------- ----
          10    CLERK                    1
          10    MANAGER                  1
          10    PRESIDENT                1
          20    CLERK                    2
          20    ANALYST                  2
          20    MANAGER                  1
          30    CLERK                    1
          30    MANAGER                  1
          30    SALESMAN                 4
```

By listing another column, JOB, from table EMP, we are changing the group and changing the result set; thus we must now include JOB in the GROUP BY clause along with DEPTNO, otherwise the query will fail. The inclusion of JOB in the SELECT/GROUP BY clauses changes the query from "How many employees are in each department?" to "How many different types of employees are in each department?" Notice again that the groups are distinct; the values for DEPTNO and JOB *individually* are not distinct, but the combination of the two (which is what is in the GROUP BY and SELECT list, and thus is the group) are distinct (e.g., 10 and CLERK appear only once).

If you choose not to put items other than aggregate functions in the SELECT list, then you may list any valid column you wish, in the GROUP BY clause. Consider the following two queries, which highlight this fact:

```
select count(*)
        from emp
    group by deptno

        COUNT(*)
    ---------
                3
                5
                6

        select count(*)
        from emp
    group by deptno,job

    COUNT(*)
    ----------
            1
            1
            1
            2
            2
            1
            1
            1
            4
```

Including items other than aggregate functions in the SELECT list is not mandatory, but often improves readability and usability of the results.

As a rule, when using GROUP BY and aggregate functions, any items in the SELECT list [from the table(s) in the FROM clause] not used as an argument to an aggregate function must be included in the GROUP BY clause. However, MySQL has a "feature" that allows you to deviate from this rule, allowing you to place items in your SELECT list [that are columns in the table(s) you are selecting from] that are not used as arguments to an aggregate function and that are not present in your GROUP BY clause. I use the term "feature" very loosely here as its use is a bug waiting to happen and I urge you to avoid it. As a matter of fact, if you use MySQL and care at all about the accuracy of your queries I suggest you urge them to remove this, ahem, "feature."

Recipe A.2. Windowing

Once you understand the concept of grouping and using aggregates in SQL, understanding *window functions* is easy. Window functions, like aggregate functions, perform an aggregation on a defined set (a group) of rows, but rather than returning one value per group, window functions can return multiple values for each group. The group of rows to perform the aggregation on is the *window* (hence the name "window functions"). DB2 actually calls such functions *online analytic processing (OLAP) functions*, and Oracle calls them *analytic functions*, but the ISO SQL standard calls them window functions, so that's the term I use in this book.

A Simple Example

Let's say that you wish to count the total number of employees across all departments. The traditional method for doing that is to issue a COUNT(*) query against the entire EMP table:

```
select count(*) as cnt
                from emp

                  CNT
                -----
                   14
```

This is easy enough, but often you will find yourself wanting to access such aggregate data from rows that do not represent an aggregation, or that represent a different aggregation. Window functions make light work of such problems. For example, the following query shows how you can use a window function to access aggregate data (the total count of employees) from detail rows (one per employee):

```
select ename,
                           deptno,
                           count(*) over( ) as cnt
                 from emp
           order by 2

           ENAME            DEPTNO      CNT
           ----------   ------ ------
           CLARK                        10         14
           KING                         10         14
           MILLER                       10         14
           SMITH                        20         14
           ADAMS                        20         14
           FORD                         20         14
           SCOTT                        20         14
           JONES                        20         14
           ALLEN                        30         14
           BLAKE                        30         14
           MARTIN                       30         14
           JAMES                        30         14
           TURNER                       30         14
           WARD                         30         14
```

The window function invocation in this example is COUNT(*) OVER( ). The presence of the OVER keyword indicates that the invocation of COUNT will be treated as a window function, not as an aggregate function. In general, the SQL standard allows for all aggregate functions to also be window functions, and the keyword OVER is how the language distinguishes between the two uses.

So, what did the window function COUNT(*) OVER ( ) do exactly? For every row being returned in the query, it returned the count of *all the rows* in the table. As the empty parentheses suggest, the OVER keyword accepts additional clauses to affect the range of rows that a given window function considers. Absent any such clauses, the window function looks at all rows in the result set, which is why you see the value 14 repeated in each row of output.

Hopefully you begin to see the great utility of window functions, which is that they allow you to work with multiple levels of aggregation in one row. As you continue through this appendix, you'll begin to see even more just how incredibly useful that ability can be.

Order of Evaluation

Before digging deeper into the OVER clause, it is important to note that window functions are performed as the last step in SQL processing prior to the ORDER BY clause. As an example of how window functions are processed last, let's take the query from the preceding section and use a WHERE clause to filter out employees from DEPTNO 20 and 30:

```
select ename,
                   deptno,
                   count(*) over( ) as cnt
           from emp
         where deptno = 10
         order by 2

         ENAME          DEPTNO    CNT
         ---------- ------  ------
         CLARK                  10              3
         KING                   10              3
         MILLER                 10              3
```

The value for CNT for each row is no longer 14, it is now 3. In this example, it is the WHERE clause that restricts the result set to three rows, hence the window function will count only three rows (there are only three rows available to the window function by the time processing reaches the SELECT portion of the query). From this example you can see that window functions perform their computations after clauses such as WHERE and GROUP BY are evaluated.

Partitions

Use the PARTITION BY clause to define a *partition* or group of rows to perform an aggregation over. As we've seen already, if you use empty parentheses then the entire result set is the partition that a window function aggregation will be computed over. You can think of the PARTITION BY clause as a "moving GROUP BY" because unlike a traditional GROUP BY, a group created by PARTITION BY is not distinct in a result set. You can use PARTITION BY to compute an aggregation over a defined group of rows (resetting when a new group is encountered) and rather than having one group represent all instances of that value in the table, each value (each member in each group) is returned. Consider the following query:

```
select ename,
                                  deptno,
                                  count(*) over(partition by deptno) as cnt
                                from emp
                        order by 2

                        ENAME           DEPTNO          CNT
                        ----------      ------   ------
                        CLARK                   10              3
                        KING                    10              3
                        MILLER                  10              3
                        SMITH                   20              5
                        ADAMS                   20              5
                        FORD                    20              5
                        SCOTT                   20              5
                        JONES                   20              5
                        ALLEN                   30              6
                        BLAKE                   30              6
                        MARTIN                  30              6
                        JAMES                   30              6
                        TURNER                  30              6
                        WARD                    30      6
```

This query still returns 14 rows, but now the COUNT is performed for each department as a result of the PARTITION BY DEPTNO clause. Each employee in the same department (in the same partition) will have the same value for CNT, because the aggregation will not reset (recompute) until a new department is encountered. Also note that you are returning information about each group, along with the members of each group. You can think of the preceding query as a more efficient version of the following:

```
select e.ename,
                   e.deptno,
                   (select count(*) from emp d
                          where e.deptno=d.deptno) as cnt
                from emp e
          order by 2


          ENAME          DEPTNO    CNT
          ---------- ------ ------
          CLARK                 10              3
          KING                  10              3
          MILLER                10              3
          SMITH                 20              5
          ADAMS                 20              5
          FORD                  20              5
          SCOTT                 20              5
          JONES                 20              5
          ALLEN                 30              6
          BLAKE                 30              6
          MARTIN                30              6
          JAMES                 30              6
          TURNER                30              6
          WARD                  30              6
```

Additionally, what's nice about the PARTITION BY clause is that it performs its computations independently of other window functions, partitioning by different columns in the same SELECT statement. Consider the following query, which returns each employee, her department, the number of employees in her respective department, her job, and the number of employees with the same job:

```
select ename,
                        deptno,
                        count(*) over(partition by deptno) as dept_cnt,
                        job,
                        count(*) over(partition by job) as job_cnt
                from emp
           order by 2
           ENAME            DEPTNO   DEPT_CNT JOB               JOB_CNT
           ----------   ------   -------- --------- -------
           MILLER                        10                       3 CLERK
4
           CLARK                         10                       3 MANAGER
3
           KING                          10                       3 PRESIDENT
1
           SCOTT                         20                       5 ANALYST
2
           FORD                          20                       5 ANALYST
2
           SMITH                         20                       5 CLERK
4
           JONES                         20                       5 MANAGER
3
           ADAMS                         20                       5 CLERK
4
           JAMES                         30                       6 CLERK
4
           MARTIN                        30                       6 SALESMAN
4
           TURNER                        30                       6 SALESMAN
4
           WARD                          30                       6 SALESMAN
4
           ALLEN                         30                       6 SALESMAN
4
           BLAKE                         30                       6 MANAGER
3
```

In this result set, you can see that employees in the same department have the same value for DEPT_CNT, and that employees who have the same job position have the same value for JOB_CNT.

By now it should be clear that the PARTITION BY clause works like a GROUP BY clause, but it does so without being affected by the other items in the SELECT clause and without requiring you to write a GROUP BY clause.

Effect of NULLs

Like the GROUP BY clause, the PARTITION BY clause lumps all the NULLs into one group or partition. Thus, the effect from NULLs when using PARTITION BY is similar to that from using GROUP BY. The following query uses a window function to count the number of employees with each distinct commission (returning1 in place of NULL for readability):

```
select coalesce(comm,-1) as comm,
                count(*)over(partition by comm) as cnt
          from emp

          COMM            CNT
        ------ ----------
                0                       1
          300                  1
          500                  1
         1400                  1
            -1            10
            -1            10
            -1            10
```

```
           -1              10
           -1              10
           -1              10
           -1          10
           -1          10
           -1              10
           -1              10
```

Because COUNT(*) is used, the function counts rows. You can see that there are 10 employees having NULL commissions. Use COMM instead of *, however, and you get quite different results:

```
select coalesce(comm,-1) as comm,
           count(comm)over(partition by comm) as cnt
      from emp

    COMM                CNT
        ---- ----------
           0          1
         300                1
     500          1
    1400          1
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
      -1          0
```

This query uses COUNT(COMM), which means that only the non-NULL values in the COMM column are counted. There is one employee with a commission of 0, one employee with a commission of 300, and so forth. But notice the counts for those with NULL commissions! Those counts are 0. Why? Because aggregate functions ignore NULL values, or more accurately, aggregate functions count only non-NULL values.

When using COUNT, consider whether you wish to include NULLs. Use COUNT(column) to avoid counting NULLs. Use COUNT(*) if you do wish to include NULLs (since you are no longer counting actual column values, you are counting rows).

When Order Matters

Sometimes the order in which rows are treated by a window function is material to the results that you wish to obtain from a query. For this reason, window function syntax includes an ORDER BY subclause that you can place within an OVER clause. Use the ORDER BY clause to specify how the rows are ordered with a partition (remember, "partition" in the absence of a PARTITION BY clause means the entire result set).

Some window functions *require* you to impose order on the partitions of rows being affected. Thus, for some window functions an ORDER BY clause is mandatory.

When you use an ORDER BY clause in the OVER clause of a window function you are specifying two things:

1. How the rows in the partition are ordered
2. What rows are included in the computation

Consider the following query, which sums and computes a running total of salaries for employees in DEPTNO 10:

```
select deptno,
                        ename,
                        hiredate,
                        sal,
                        sum(sal)over(partition by deptno) as total1,
                        sum(sal)over( ) as total2,
                        sum(sal)over(order by hiredate) as running_total
                from emp
           where deptno=10

           DEPTNO  ENAME   HIREDATE        SAL  TOTAL1 TOTAL2 RUNNING_TOTAL
           ------  ------  ----------- -----  ------ ------ -------------
                   10  CLARK   09-JUN-1981  2450   8750   8750          2450
                   10  KING        17-NOV-1981  5000   8750       8750          7450
                   10  MILLER  23-JAN-1982  1300   8750   8750          8750
```

Just to keep you on your toes, I've included a sum with empty parentheses. Notice how TOTAL1 and TOTAL2 have the same values. Why? Once again, the order in which window functions are evaluated answers the question. The WHERE clause filters the result set such that only salaries from DEPTNO 10 are considered for summation. In this case there is only one partitionthe entire result set, which consists of only salaries from DEPTNO 10. Thus TOTAL1 and TOTAL2 are the same.

Looking at the values retuned by column SAL, you can easily see where the values for RUNNING_TOTAL come from. You can eyeball the values and add them yourself to compute the running total. But more importantly, why did including an ORDER BY in the OVER clause create a running total in the first place? The reason is, when you use ORDER BY in the OVER clause you are specify a default "moving" or "sliding" window within the partition even though you don't see it. The ORDER BY HIREDATE clause terminates summation at the HIREDATE in the current row.

The following query is the same as the previous one, but uses the RANGE BETWEEN clause (which you'll learn more about later) to explicitly specify the default behavior that results from ORDER BY HIREDATE:

```
select deptno,
                   ename,
                   hiredate,
                   sal,
                   sum(sal)over(partition by deptno) as total1,
                   sum(sal)over( ) as total2,
                   sum(sal)over(order by hiredate
                                                range between unbounded preceding
                                                        and current row) as
running_total
           from emp
         where deptno=10

         DEPTNO ENAME  HIREDATE          SAL TOTAL1 TOTAL2 RUNNING_TOTAL
         ------ ------ ----------- ----- ------ ------ -------------
                10 CLARK  09-JUN-1981  2450 8750         8750                  2450
                10 KING   17-NOV-1981  5000 8750         8750                  7450
                10 MILLER 23-JAN-1982  1300 8750     8750          8750
```

The RANGE BETWEEN clause that you see in this query is termed the *framing clause* by ANSI and I'll use that term here. Now, it should be easy to see why specifying an ORDER BY in the OVER clause created a running total; we've (by default) told the query to sum all rows starting from the current row and include all prior rows ("prior" as defined in the ORDER BY, in this case ordering the rows by HIREDATE).

The Framing Clause

Let's apply the framing clause from the preceding query to the result set, starting with the first employee hired, who is named CLARK.

1. Starting with CLARK's salary, 2450, and including all employees hired before CLARK, compute a sum. Since CLARK was the first employee hired in DEPTNO 10, the sum is simply CLARK's salary, 2450, which is the first value returned by RUNNING_TOTAL.
2. Let's move to the next employee based on HIREDATE, named KING, and apply the framing clause once again. Compute a sum on SAL starting with the current row, 5000 (KING's salary), and include all prior rows (all employees hired before KING). CLARK is the only one hired before KING so the sum is 5000 + 2450, which is 7450, the second value returned by RUNNING_TOTAL.
3. Moving on to MILLER, the last employee in the partition based on HIREDATE, let's one more time apply the framing clause. Compute a sum on SAL starting with the current row, 1300 (MILLER's salary), and include all prior rows (all employees hired before MILLER). CLARK and KING were both hired before MILLER, and thus their salaries are included in MILLER's RUNNING_TOTAL: 2450 + 5000 + 1300 is 8750, which is the value for RUNNING_TOTAL for MILLER.

As you can see, it is really the framing clause that produces the running total. The ORDER BY defines the order of evaluation and happens to also imply a default framing.

In general, the framing clause allows you to define different "sub-windows" of data to include in your computations. There are many ways to specify such sub-windows. Consider the following query:

```
select deptno,
                        ename,
                        sal,
                        sum(sal)over(order by hiredate
                                                 range between unbounded preceding
                                                   and current row) as run_total1,
                        sum(sal)over(order by hiredate
                                                  rows between 1 preceding
                                                   and current row) as run_total2,
                        sum(sal)over(order by hiredate
                                                 range between current row
                                                   and unbounded following) as
run_total3,
                        sum(sal)over(order by hiredate
                                                  rows between current row
                                                   and 1 following) as run_total4
```

```
                from emp
          where deptno=10

        DEPTNO ENAME    SAL RUN_TOTAL1 RUN_TOTAL2 RUN_TOTAL3 RUN_TOTAL4
        ------ ------ ----- ---------- ---------- ---------- ----------
                10 CLARK        2450      2450           2450       8750
7450
                10 KING         5000      7450       7450       6300        6300
                10 MILLER   1300      8750       6300       1300        1300
```

Don't be intimidated here; this query is not as bad as it looks. You've already seen RUN_TOTAL1 and the effects of the framing clause "UNBOUNDED PRECEDING AND CURRENT ROW". Here's a quick description of what's happening in the other examples:

RUN_TOTAL2

Rather than the keyword RANGE, this framing clause specifies ROWS, which means the *frame*, or window, is going to be constructed by counting some number of rows. The 1 PRECEDING means that the frame will begin with the row immediately preceding the current row. The range continues through the CUR-RENT ROW. So what you get in RUN_TOTAL2 is the sum of the current employee's salary and that of the preceding employee, based on HIREDATE.

> It so happens that RUN_TOTAL1 and RUN_TOTAL2 are the same for both CLARK and KING. Why? Think about which values are being summed for each of those employees, for each of the two window functions. Think carefully, and you'll get the answer.

RUN_TOTAL3

The window function for RUN_TOTAL3 works just the opposite of that for RUN_TOTAL1; rather than starting with the current row and including all prior rows in the summation, summation begins with the current row and includes all subsequent rows in the summation.

RUN_TOTAL4

Is inverse of RUN_TOTAL2; rather than starting from the current row and including one prior row in the summation, start with the current row and include one subsequent row in the summation.

> If you can understand what's been explained thus far, you will have no problem with any of the recipes in this book. If you're not catching on, though, try practicing with your own examples and your own data. I personally find learning easier by actually coding new features rather than just reading about them.

A Framing Finale

As a final example of the effect of the framing clause on query output, consider the following query:

```
select ename,
                        sal,
                        min(sal)over(order by sal) min1,
                        max(sal)over(order by sal) max1,
                        min(sal)over(order by sal
                                                 range between unbounded preceding
                                                   and unbounded following) min2,
                        max(sal)over(order by sal
                                                 range between unbounded preceding
                                                   and unbounded following) max2,
                        min(sal)over(order by sal
                                                 range between current row
                                                   and current row) min3,
                        max(sal)over(order by sal
                                                 range between current row
                                                   and current row) max3,
                        max(sal)over(order by sal
                                                  rows between 3 preceding
                                                   and 3 following) max4
          from emp

          ENAME         SAL             MIN1    MAX1    MIN2    MAX2    MIN3    MAX3
MAX4
          ------  -----   ------  ------  ------  ------  ------  ------  ------
          SMITH         800             800             800             800
5000    800             800             1250
          JAMES         950             800             950             800
5000    950             950             1250
          ADAMS         1100    800             1100    800             5000    1100
1100    1300
          WARD          1250    800             1250    800             5000    1250
1250    1500
          MARTIN        1250    800             1250    800             5000    1250
1250    1600
          MILLER        1300    800             1300    800             5000    1300
1300    2450
          TURNER        1500    800             1500    800             5000    1500
1500    2850
          ALLEN         1600    800             1600    800             5000    1600
1600    2975
          CLARK         2450    800             2450    800             5000    2450
2450    3000
          BLAKE         2850    800             2850    800             5000    2850
2850    3000
          JONES         2975    800             2975    800             5000    2975
2975    5000
          SCOTT         3000    800             3000    800             5000    3000
3000    5000
          FORD          3000    800             3000    800             5000    3000
3000    5000
          KING          5000    800             5000    800             5000    5000
5000    5000
```

OK, let's break this query down:

MIN1

The window function generating this column does not specify a framing clause, so the default framing clause of UNBOUNDED PRECEDING AND CURRENT ROW kicks in. Why is MIN1 800 for all rows? It's because the lowest salary comes first (ORDER BY SAL), and it remains the lowest, or minimum, salary forever after.

MAX1

The values for MAX1 are much different from those for MIN1. Why? The answer (again) is the default framing clause UNBOUNDED PRECEDING AND CURRENT ROW. In conjunction with ORDER BY SAL, this framing clause ensures that the maximum salary will also correspond to that of the current row.

Consider the first row, for SMITH. When evaluating SMITH's salary and all prior salaries, MAX1 for SMITH is SMITH's salary, because there are no prior salaries. Moving on to the next row, JAMES, when comparing JAMES' salary to all prior salaries, in this case comparing to the salary of SMITH, JAMES' salary is the higher of the two, and thus it is the maximum. If you apply this logic to all rows, you will see that the value of MAX1 for each row is the current employee's salary.

MIN2 and MAX2

The framing clause given for these is UNBOUNDED PRECEDING AND UNBOUNDED FOLLOWING, which is the same as specifying empty parentheses. Thus, all rows in the result set are considered when computing MIN and MAX. As you might expect, the MIN and MAX values for the entire result set are constant, and thus the value of these columns is constant as well.

MIN3 and MAX3

The framing clause for these is CURRENT ROW AND CURRENT ROW, which simply means use only the current employee's salary when looking for the MIN and MAX salary. Thus both MIN3 and MAX3 are the same as SAL for each row. That was easy, wasn't it?

MAX4

The framing clause defined for MAX4 is 3 PRECEDING AND 3 FOLLOWING, which means, for every row, consider the three rows prior and the three rows after the current row, as well as the current row itself. This particular invocation of MAX(SAL) will return from those rows the highest salary value.

If you look at the value of MAX4 for employee MARTIN you can see how the framing clause is applied. MARTIN's salary is 1250 and the three employee salaries prior to MARTIN's are WARD's (1250), ADAMS' (1100) and JAMES' (950). The three employee salaries after MARTIN's are MILLER's (1300), TURNER's (1500), and ALLEN's (1600). Out of all those salaries, including MARTIN's, the highest is ALLEN's, and thus the value of MAX4 for MARTIN is 1600.

Readability + Performance = Power

As you can see, window functions are extremely powerful as they allow you to write queries that contain both detailed and aggregate information. Using window functions allows you to write smaller, more efficient queries as compared to using multiple self join and/or scalar subqueries. Consider the following query, which easily answers all of the following questions: "What is the number of employees in each department? How many different types of employees are in each department (e.g., how many clerks are in department 10)? How many total employees are in table EMP?"

```
select deptno,
                        job,
                        count(*) over (partition by deptno) as emp_cnt,
                        count(job) over (partition by deptno,job) as job_cnt,
                        count(*) over ( ) as total
                from emp
                DEPTNO JOB                     EMP_CNT         JOB_CNT         TOTAL
                ------ --------- ---------- ---------- ----------
                        10 CLERK                        3                        1
14
                        10 MANAGER                      3                        1
14
                        10 PRESIDENT            3                        1
14
                        20 ANALYST                      5                        2
14
                        20 ANALYST                      5                        2
14
                        20 CLERK                        5                        2
14
                        20 CLERK                        5                        2
14
                        20 MANAGER                      5                        1
14
                        30 CLERK                        6                        1
14
                        30 MANAGER                      6                        1
14
                        30 SALESMAN                     6                        4
14
                        30 SALESMAN                     6                        4
14
                        30 SALESMAN                     6                        4
14
                        30 SALESMAN                     6                        4
14
```

To return the same result set without using window functions would require a bit more work:

```
select a.deptno, a.job,
                (select count(*) from emp b
                        where b.deptno = a.deptno) as emp_cnt,
                (select count(*) from emp b
                        where b.deptno = a.deptno and b.job = a.job) as job_cnt,
                (select count(*) from emp) as total
         from emp a
        order by 1,2
```

```
        DEPTNO JOB                     EMP_CNT         JOB_CNT         TOTAL
        ------ --------- ----------  ---------- ----------
                10 CLERK                        3                        1
14
                10 MANAGER                      3                        1
14
                10 PRESIDENT            3                        1
14
                20 ANALYST                      5                        2
14
                20 ANALYST                      5                        2
14
                20 CLERK                        5                        2
14
                20 CLERK                        5                        2
14
```

```
                20 MANAGER                     5                        1
14
                30 CLERK                       6                        1
14
                30 MANAGER                     6                        1
14
                30 SALESMAN                    6                        4
14
                30 SALESMAN                    6                        4
14
                30 SALESMAN                    6                        4
14
                30 SALESMAN                    6                        4
14
```

The non-window solution is obviously not difficult to write, yet it certainly is not as clean or efficient (you won't see performance differences with a 14-row table, but try these queries with, say, a 1,000- or 10,000-row table and then you'll see the benefit of using window functions over multiple self joins and scalar subqueries).

Providing a Base

Besides readability and performance, window functions are useful for providing a "base" for more complex "report style" queries. For example, consider the following "report style" query that uses window functions in an inline view and then aggregates the results in an outer query. Using window functions allows you to return detailed as well as aggregate data, which is useful for reports. The query below uses window functions to find counts using different partitions. Because the aggregation is applied to multiple rows, the inline view returns all rows from EMP, which the outer CASE expressions can use to transpose and create a formatted report:

```
select deptno,
                   emp_cnt as dept_total,
                   total,
                   max(case when job = 'CLERK'
                                    then job_cnt else 0 end) as clerks,
                   max(case when job = 'MANAGER'
                                    then job_cnt else 0 end) as mgrs,
                   max(case when job = 'PRESIDENT'
                                    then job_cnt else 0 end) as prez,
                   max(case when job = 'ANALYST'
                                    then job_cnt else 0 end) as anals,
                   max(case when job = 'SALESMAN'
                                    then job_cnt else 0 end) as smen
                from (
          select deptno,
                        job,
                        count(*) over (partition by deptno) as emp_cnt,
                        count(job) over (partition by deptno,job) as job_cnt,
                        count(*) over () as total
                from emp
                        ) x
          group by deptno, emp_cnt, total

          DEPTNO DEPT_TOTAL TOTAL CLERKS MGRS PREZ ANALS SMEN
          ------ ---------- ----- ------ ---- ---- ----- ----
                10                    3              14               1       1
1         0             0
                20                    5              14               2       1
0         2             0
```

```
                30                      6               14               1       1
0         0             4
```

The query above returns each department, the total number of employees in each department, the total number of employees in table EMP, and a breakdown of the number of different job types in each department. All this is done in one query, without additional joins or temp tables!

As a final example of how easily multiple questions can be answered using window functions, consider the following query:

```
select ename as name,
                        sal,
                        max(sal)over(partition by deptno) as hiDpt,
                        min(sal)over(partition by deptno) as loDpt,
                        max(sal)over(partition by job) as hiJob,
                        min(sal)over(partition by job) as loJob,
                        max(sal)over( ) as hi,
                        min(sal)over( ) as lo,
                        sum(sal)over(partition by deptno
                                                         order by sal,empno) as dptRT,
                        sum(sal)over(partition by deptno) as dptSum,
                        sum(sal)over( ) as ttl
                 from emp
           order by deptno,dptRT
```

```
           NAME         SAL HIDPT LODPT HIJOB LOJOB             HI       LO DPTRT
DPTSUM          TTL
           ------ ----- ----- ----- ----- ----- ----- ---- ------ ------ ------
           MILLER 1300  5000  1300  1300   800  5000  800   1300   8750  29025
           CLARK  2450  5000  1300  2975  2450  5000  800   3750   8750  29025
           KING   5000  5000  1300  5000  5000  5000  800   8750   8750  29025
           SMITH   800  3000   800  1300   800  5000  800    800  10875  29025
           ADAMS  1100  3000   800  1300   800  5000  800   1900  10875  29025
           JONES  2975  3000   800  2975  2450  5000  800   4875  10875  29025
           SCOTT  3000  3000   800  3000  3000  5000  800   7875  10875  29025
           FORD   3000  3000   800  3000  3000  5000  800  10875  10875  29025
           JAMES   950  2850   950  1300   800  5000  800    950   9400  29025
           WARD   1250  2850   950  1600  1250  5000  800   2200   9400  29025
           MARTIN 1250  2850   950  1600  1250  5000  800   3450   9400  29025
           TURNER 1500  2850   950      1600  1250  5000  800   4950   9400  29025
           ALLEN  1600  2850   950  1600  1250  5000  800   6550   9400  29025
           BLAKE  2850  2850   950  2975  2450  5000  800   9400   9400  29025
```

This query answers the following questions easily, efficiently, and readably (and without additional joins to EMP!). Simply match the employee and her salary with the different rows in the result set to determine:

1. who makes the highest salary of all employees (HI)

2. who makes the lowest salary of all employees (LO)

3. who makes the highest salary in her department (HIDPT)

4. who makes the lowest salary in her department (LODPT)

5. who makes the highest salary in her job (HIJOB)

6. who makes the lowest salary in her job (LOJOB)

7. what is the sum of all salaries (TTL)

8. what is the sum of salaries per department (DPTSUM)

9. what is the running total of all salaries per department (DPTRT)

Appendix B. Rozenshtein Revisited

This appendix is a tribute to David Rozenshtein. As I mentioned in the introduction, I feel his book *The Essence of SQL* is (even today) the best book ever written on SQL. Although only 119 pages long, the book covers what I consider to be crucial topics for any SQL programmer. In particular, David shows how to think through a problem and arrive at an answer. The solutions provided by Rozenshtein are very set oriented. Even if the size of your tables do not permit you to use his solutions in a practical environment, his approach is excellent as it forces you to stop searching for a procedural solution to a problem and start thinking in sets.

The Essence of SQL was published long before window functions and MODEL clauses. In this appendix I provide alternative solutions to some of the questions in Rozenshtein's book using some of the newer functions available in standard SQL. (Whether these new solutions are "better" than Rozenshtein's depends on the circumstances.) At the end of each discussion, I present a solution based on the original solution from Rozenshtein's book. For the examples in which I present a variation of a problem found in Rozenshtein's text, I will also present a variation of a solution (a solution that may not necessarily exist in Rozenshtein's book, but that uses a similar technique).

```
/* table of students */

   create table student ( sno integer,

   sname varchar(10), age integer

   )



   /* table of courses */

   create table courses ( cno varchar(5),

   title varchar(10), credits integer

   )



   /* table of professors */

   create table professor ( lname varchar(10), dept varchar(10), salary
integer,

   age integer

   )



   /* table of students and the courses they take */

   create table take

   ( sno integer,

   cno varchar(5)
```

)

/* table of professors and the courses they teach */

create table teach (lname varchar(10), cno varchar(5)

)

insert into student values (1,'AARON',20) insert into student values (2,'CHUCK',21) insert into student values (3,'DOUG',20) insert into student values (4,'MAGGIE',19) insert into student values (5,'STEVE',22) insert into student values (6,'JING',18) insert into student values (7,'BRIAN',21) insert into student values (8,'KAY',20) insert into student values (9,'GILLIAN',20) insert into student values (10,'CHAD',21)

insert into courses values ('CS112','PHYSICS',4) insert into courses values ('CS113','CALCULUS',4) insert into courses values ('CS114','HISTORY',4)

insert into professor values ('CHOI','SCIENCE',400,45) insert into professor values ('GUNN','HISTORY',300,60) insert into professor values ('MAYER','MATH',400,55) insert into professor values ('POMEL','SCIENCE',500,65) insert into professor values ('FEUER','MATH',400,40)

insert into take values (1,'CS112') insert into take values (1,'CS113') insert into take values (1,'CS114') insert into take values (2,'CS112') insert into take values (3,'CS112') insert into take values (3,'CS114') insert into take values (4,'CS112') insert into take values (4,'CS113') insert into take values (5,'CS113') insert into take values (6,'CS113') insert into take values (6,'CS114')

insert into teach values ('CHOI','CS112') insert into teach values ('CHOI','CS113') insert into teach values ('CHOI','CS114') insert into teach values ('POMEL','CS113') insert into teach values ('MAYER','CS112') insert into teach values ('MAYER','CS114')

```
select *
   from student where sno in ( select sno from take
   where cno != 'CS112' )
SNO SNAME AGE
   --------- ---------- ----------
   5 STEVE 22
   6 JING 18
   7 BRIAN 21
   8 KAY 20
   9 GILLIAN 20
   10 CHAD 21
1 select s.sno,s.sname,s.age
   2 from student s left join take t 3 on (s.sno = t.sno) 4 group by
s.sno,s.sname,s.age 5 having max(case when t.cno = 'CS112'
   6 then 1 else 0 end) = 0
1 select distinct sno,sname,age
   2 from (
   3 select s.sno,s.sname,s.age, 4 max(case when t.cno = 'CS112'
   5 then 1 else 0 end) 7 over(partition by s.sno,s.sname,s.age) as
takes_CS112
   9 from student s left join take t 10 on (s.sno = t.sno) 11 ) x
```

12 where takes_CS112 = 0

/* group by solution */

1 select s.sno,s.sname,s.age 2 from student s, take t 3 where s.sno = t.sno (+) 4 group by s.sno,s.sname,s.age 5 having max(case when t.cno = 'CS112'

6 then 1 else 0 end) = 0

/* window solution */

1 select distinct sno,sname,age 2 from (

3 select s.sno,s.sname,s.age, 4 max(case when t.cno = 'CS112'

5 then 1 else 0 end) 7 over(partition by s.sno,s.sname,s.age) as takes_CS112

9 from student s, take t 10 where s.sno = t.sno (+) 11) x

12 where takes_CS112 = 0

<b>select s.sno,s.sname,s.age, case when t.cno = 'CS112'

then 1

else 0

end as takes_CS112

from student s left join take t on (s.sno=t.sno)</b>

SNO SNAME AGE TAKES_CS112

```
   --- ---------- ---------- -----------

   1 AARON 20 1

   1 AARON 20 0

   1 AARON 20 0

   2 CHUCK 21 1

   3 DOUG 20 1

   3 DOUG 20 0

   4 MAGGIE 19 1

   4 MAGGIE 19 0

   5 STEVE 22 0

   6 JING 18 0

   6 JING 18 0

   8 KAY 20 0

   10 CHAD 21 0

   7 BRIAN 21 0

   9 GILLIAN 20 0
```

```
select *

   from student where sno <a name="idx-APP-B-0994"></a>not in (select
sno from <a name="idx-APP-B-0995"></a>take where cno = 'CS112')

select *

   from student where sno in ( select sno from take
   where cno != 'CS112'

   and cno != 'CS114' )

SNO SNAME AGE

   --- ---------- ----------

   2 CHUCK 21

   4 MAGGIE 19

   6 JING 18

1 select s.sno,s.sname,s.age

   2 from student s, take t 3 where s.sno = t.sno 4 group by
s.sno,s.sname,s.age 5 having sum(case when t.cno in ('CS112','CS114') 6
then 1 else 0 end) = 1

1 select distinct sno,sname,age

   2 from (

   3 select s.sno,s.sname,s.age, 4 sum(case when t.cno in ('CS112','CS114')
then 1 else 0 end) 5 over (partition by s.sno,s.sname,s.age) as
takes_either_or 6 from student s, take t 7 where s.sno = t.sno 8 ) x

   9 where takes_either_or = 1

<b>select s.sno,s.sname,s.age, case when t.cno in ('CS112','CS114') then 1
else 0 end as takes_either_or from student s, take t where s.sno = t.sno</b>

   SNO SNAME AGE TAKES_EITHER_OR

   --- ---------- --- ---------------

   1 AARON 20 1
   1 AARON 20 0

   1 AARON 20 1

   2 CHUCK 21 1

   3 DOUG 20 1

   3 DOUG 20 1

   4 MAGGIE 19 1

   4 MAGGIE 19 0

   5 STEVE 22 0

   6 JING 18 0

   6 JING 18 1
```

<b>select s.sno,s.sname,s.age, sum(case when t.cno in ('CS112','CS114') then 1 else 0 end) as takes_either_or from student s, take t where s.sno = t.sno group by s.sno,s.sname,s.age</b>

```
   SNO SNAME AGE TAKES_EITHER_OR

   --- ---------- --- ---------------

   1 <a name="idx-APP-B-0998"></a><a name="idx-APP-B-0999">
</a>AARON 20 2

   2 CHUCK 21 1

   3 DOUG 20 2

   4 MAGGIE 19 1

   5 STEVE 22 0
```

6 JING 18 1

select *

from student s, take t where s.sno = t.sno and t.cno in ('CS112', 'CS114') and s.sno not in (select a.sno from take a, take b where a.sno = b.sno and a.cno = 'CS112'

and b.cno = 'CS114')

select s.*

from student s, take t where s.sno = t.sno and t.cno = 'CS112'

1 select s.*

2 from student s, 3 take t1,

4 (

5 select sno

6 from take

7 group by sno

```
8 having count(*) = 1

9 ) t2

10 where s.sno = t1.sno 11 and t1.sno = t2.sno 12 and t1.cno = 'CS112'

1 select sno,sname,age

2 from (

3 select s.sno,s.sname,s.age,t.cno, 4 count(t.cno) over (

5 partition by s.sno,s.sname,s.age 6 ) as cnt

7 from student s, take t 8 where s.sno = t.sno 9 ) x

10 where cnt = 1

11 and cno = 'CS112'

<b>select t1.*

from take t1, (

select sno

from <a name="idx-APP-B-1001"></a>take group by sno having count(*) = 1

) t2

where t1.sno = t2.sno and t1.cno = 'CS112'</b>

SNO CNO

--- -----
```

2 CS112

```
<b>select s.sno,s.sname,s.age,t.cno, count(t.cno) over (
    partition by s.sno,s.sname,s.age ) as cnt
    from student s, take t where s.sno = t.sno</b>
    SNO SNAME AGE CNO CNT
    --- ---------- ---------- ----- ----------
    1 AARON 20 CS112 3
    1 AARON 20 CS113 3
    1 AARON 20 CS114 3
    2 CHUCK 21 CS112 1
    3 DOUG 20 CS112 2
    3 DOUG 20 CS114 2
    4 MAGGIE 19 CS112 2
    4 MAGGIE 19 CS113 2
    5 STEVE 22 CS113 1
    6 JING 18 CS113 2
    6 JING 18 CS114 2
select s.*
    from student s, take t where s.sno = t.sno and s.sno not in ( select sno
from take
```

```
   where cno != 'CS112' )
<b>select sno
   from take
   where cno != 'CS112'</b>
   SNO
   ----
   1
   1
   3
   4
   5
   6
   6
<b>select s.*
   from student s, take t where s.sno = t.sno</b>
   SNO SNAME AGE
   --- ---------- ----------
   1 AARON 20
   1 AARON 20
   1 AARON 20
   2 CHUCK 21

   3 DOUG 20

   3 DOUG 20

   4 MAGGIE 19

   4 MAGGIE 19

   5 STEVE 22

   6 JING 18

   6 JING 18
```

If you compare the two results sets, you see that the addition of NOT IN to the outer query effectively performs a set difference between SNO from the outer query and SNO from the subquery, returning only the student whose SNO is 2. In summary, the subquery finds all students who take a course that is not CS112. The outer query returns all students who are not amongst those that take a course other than CS112 (at this point the only available students are those who actually take CS112 or take nothing at all). The join between table STUDENT and table TAKE filters out the students who do not take any classes at all, leaving you only with the student who takes CS112 and only CS112. Set-based problem solving at its best!

```
SNO SNAME AGE

    --- ---------- ----------

    2 CHUCK 21

    3 DOUG 20

    4 MAGGIE 19

    5 STEVE 22

    6 JING 18
```

```
1 select s.sno,s.sname,s.age

    2 from student s, take t 3 where s.sno = t.sno 4 group by
s.sno,s.sname,s.age 5 having count(*) <= 2
```

```
1 select distinct sno,sname,age

    2 from (

    3 select s.sno,s.sname,s.age, 4 count(*) over (

    5 partition by s.sno,s.sname,s.age 6 ) as cnt 7 from student s, take t 8
where s.sno = t.sno 9 ) x

    10 where cnt <= 2
```

```
select distinct s.*

    from student s, take t where s.sno = t.sno and s.sno not in ( select t1.sno
from take t1, take t2, take t3

    where t1.sno = t2.sno and t2.sno = t3.sno and t1.cno < t2.cno and t2.cno <
t3.cno )
```

```
SNO SNAME AGE
    ---- ---------- ---
    6 JING 18
    4 MAGGIE 19
    1 AARON 20
    9 GILLIAN 20
    8 KAY 20
    3 DOUG 20
1 select s1.*
```

2 from student s1

3 where 2 >= (select count(*)

4 from student s2

```
   5 where s2.age < s1.age )

1 select sno,sname,age

   2 from (

   3 select sno,sname,age, 4 dense_rank( )over(order by age) as dr
```

5 from student

```
   6 ) x
   7 where dr <= 3
<b>select s1.*,
   (select count(*) from student s2
   where s2.age < s1.age) as cnt from student s1
   order by 4</b>
   SNO SNAME AGE CNT
   --- ---------- ---------- ----------
   6 JING 18 0
   4 MAGGIE 19 1
   1 AARON 20 2
   3 DOUG 20 2
   8 KAY 20 2
   9 GILLIAN 20 2
   2 CHUCK 21 6
   7 BRIAN 21 6
   10 CHAD 21 6
   5 STEVE 22 9
```

```
<b>select sno,sname,age,
   dense_rank( )over(order by age) as dr from student</b>
   SNO SNAME AGE DR
   --- ---------- ---------- ----------
   6 JING 18 1
   4 MAGGIE 19 2
   1 AARON 20 3
   3 DOUG 20 3
   8 KAY 20 3
   9 GILLIAN 20 3
   2 CHUCK 21 4
   7 BRIAN 21 4
   10 CHAD 21 4
   5 STEVE 22 5
<b>select *
   from student where sno not in (
   select s1.sno from student s1, student s2, student s3, student s4
   where s1.age > s2.age and s2.age > s3.age and s3.age > s4.age )</b>
   SNO SNAME AGE
   --- ---------- ---
   6 JING 18

   4 MAGGIE 19

   1 AARON 20

   9 GILLIAN 20

   8 KAY 20

   3 DOUG 20

<b>select distinct s1.*

   from student s1, student s2, student s3, student s4

   where s1.age > s2.age and s2.age > s3.age and s3.age > s4.age</b>

   SNO SNAME AGE

   --- ---------- ---

   2 CHUCK 21

   5 STEVE 22

   7 BRIAN 21

   10 CHAD 21

<b>select distinct s1.*

   from student s1, student s2

   where s1.age > s2.age</b>

   SNO SNAME AGE

   --- ---------- ---
```

```
  5 STEVE 22

  7 BRIAN 21

  10 CHAD 21

  2 CHUCK 21

  1 AARON 20

  3 DOUG 20

  9 GILLIAN 20

  8 KAY 20

  4 MAGGIE 19

<b>select distinct s1.*

  from student s1, student s2, student s3

  where s1.age > s2.age and s2.age > s3.age</b>

  SNO SNAME AGE

  --- ---------- ---

  1 AARON 20

  2 CHUCK 21

  3 DOUG 20

  5 STEVE 22

  7 BRIAN 21

  8 KAY 20
```

```
   9 GILLIAN 20

   10 CHAD 21

<b>select distinct s1.*

   from student s1, student s2, student s3, student s4

   where s1.age > s2.age and s2.age > s3.age and s3.age > s4.age</b>

   SNO SNAME AGE

   --- ---------- ---

   2 CHUCK 21

   5 STEVE 22

   7 BRIAN 21

   10 CHAD 21
```

Now that you know which students are older than three or more other students, simply return only those students who are not amongst the four students above by using NOT IN with a subquery.

```
SNO SNAME AGE

    --- ---------- ----------

    1 AARON 20

    3 DOUG 20

    4 MAGGIE 19

    6 JING 18
```

```
1 select s.sno,s.sname,s.age

    2 from student s, take t 3 where s.sno = t.sno 4 group by
s.sno,s.sname,s.age 5 having count(*) >= 2
```

```
1 select distinct sno,sname,age

    2 from (

    3 select s.sno,s.sname,s.age, 4 count(*) over (

    5 partition by s.sno,s.sname,s.age 6 ) as cnt

    7 from student s, take t 8 where s.sno = t.sno 9 ) x

    10 where cnt >= 2
```

```
<b>select *

    from student where sno in (

    select t1.sno from take t1, take t2

    where t1.sno = t2.sno and t1.cno > t2.cno )</b>
```

```
SNO SNAME AGE

--- ---------- ----------

1 AARON 20

3 DOUG 20

4 MAGGIE 19

6 JING 18
```

```
SNO SNAME AGE

--- ---------- ----

1 AARON 20

3 DOUG 20
```

```
1 select s.sno, s.sname, s.age

2 from student s, take t 3 where s.sno = t.sno 4 and t.cno in ('CS114','CS112') 5 group by s.sno, s.sname, s.age 6 having min(t.cno) != max(t.cno)
```

```
1 select distinct sno, sname, age

2 from (

3 select s.sno, s.sname, s.age, 4 min(cno) over (partition by s.sno) as min_cno, 5 max(cno) over (partition by s.sno) as max_cno 6 from student s, take t 7 where s.sno = t.sno 8 and t.cno in ('CS114','CS112') 9 ) x

10 where min_cno != max_cno
```

```
<b>select s.sno, s.sname, s.age, t.cno, min(cno) over (partition by s.sno) as min_cno, max(cno) over (partition by s.sno) as max_cno from student s, take t where s.sno = t.sno and t.cno in ('CS114','CS112')</b>
```

```
    SNO SNAME AGE CNO MIN_C MAX_C

    --- ---------- ---- ----- ----- -----

    1 AARON 20 CS114 CS112 CS114

    1 AARON 20 CS112 CS112 CS114

    2 CHUCK 21 CS112 CS112 CS112

    3 DOUG 20 CS114 CS112 CS114

    3 DOUG 20 CS112 CS112 CS114

    4 MAGGIE 19 CS112 CS112 CS112

    6 JING 18 CS114 CS114 CS114

<b>select s.*

    from student s, take t1,

    take t2

    where s.sno = t1.sno and t1.sno = t2.sno and t1.cno = 'CS112'

    and t2.cno = 'CS114'</b>

    SNO SNAME AGE

    --- ----- ---

    1 AARON 20
```

3 DOUG 20

```
<b>select s.*
    from take t1, student s
    where s.sno = t1.sno and t1.cno = 'CS114'
    and 'CS112' = any (select t2.cno from take t2
    where t1.sno = t2.sno and t2.cno != 'CS114')</b> SNO SNAME AGE
    --- ----- ---
    1 AARON 20
```

3 DOUG 20

SNO SNAME AGE

--- ---------- ----------

```
1 AARON 20

    2 CHUCK 21

    3 DOUG 20

    5 STEVE 22

    7 BRIAN 21

    8 KAY 20

    9 GILLIAN 20

    10 CHAD 21

1 select s1.*
```

2 from student s1

3 where 2 <= (select count(*)

4 from student s2

5 where s2.age < s1.age)

1 select sno,sname,age

2 from (

3 select sno,sname,age, 4 dense_rank()over(order by age) as dr

5 from student

```
6 ) x
7 where dr >= 3
```

<b>select distinct s1.*

```
from student s1, student s2,
student s3
where s1.age > s2.age and s2.age > s3.age</b>
SNO SNAME AGE
--- ---------- ----------
1 AARON 20
2 CHUCK 21
3 DOUG 20
5 STEVE 22
7 BRIAN 21
8 KAY 20
9 GILLIAN 20
```

10 CHAD 21

```
LNAME DEPT SALARY AGE

   ---------- ---------- ---------- ----

   POMEL SCIENCE 500 65
```

```
1 select p.lname,p.dept,p.salary,p.age

   2 from professor p, teach t 3 where p.lname = t.lname 4 group by p.lname,p.dept,p.salary,p.age 5 having count(*) = 1
```

```
1 select lname, dept, salary, age

   2 from (

   3 select p.lname,p.dept,p.salary,p.age, 4 count(*) over (partition by p.lname) as cnt 5 from professor p, teach t 6 where p.lname = t.lname 7 ) x

   8 where cnt = 1
```

```
<b>select p.*

   from professor p, teach t

   where p.lname = t.lname and p.lname not in (

   select t1.lname

   from teach t1,

   teach t2

   where t1.lname = t2.lname and t1.cno > t2.cno )</b>
```

```
   LNAME DEPT SALARY AGE

   ---------- ---------- ---------- ----------
```

POMEL SCIENCE 500 65

select s.*

from student s, take t where s.sno = t.sno and t.cno = 'CS112'

and t.cno = 'CS114'

1 select s.sno, s.sname, s.age

2 from student s, take t 3 where s.sno = t.sno 4 group by s.sno, s.sname, s.age 5 having count(*) = 2

6 and max(case when cno = 'CS112' then 1 else 0 end) +

7 max(case when cno = 'CS114' then 1 else 0 end) = 2

1 select sno,sname,age

2 from (

3 select s.sno, 4 s.sname,

5 s.age,

6 count(*) over (partition by s.sno) as cnt, 7 sum(case when t.cno in ('CS112', 'CS114')

8 then 1 else 0

9 end)

10 over (partition by s.sno) as both, 11 row_number() 12 over (partition by s.sno order by s.sno) as rn 13 from student s, take t 14 where s.sno = t.sno 15) x

16 where cnt = 2

17 and both = 2

18 and rn = 1

<b>select s.sno,

s.sname,

s.age,

count(*) over (partition by s.sno) as cnt, sum(case when t.cno in ('CS112', 'CS114') then 1 else 0

end)

over (partition by s.sno) as both, row_number( )

over (partition by s.sno order by s.sno) as rn from student s, take t where s.sno = t.sno</b>

```
SNO SNAME AGE CNT BOTH RN

--- ------ ---- ---- ---- ----

1 AARON 20 3 2 1

1 AARON 20 3 2 2
```

```
    1 AARON 20 3 2 3

    2 CHUCK 21 1 1 1

    3 DOUG 20 2 2 1

    3 DOUG 20 2 2 2

    4 MAGGIE 19 2 1 1

    4 MAGGIE 19 2 1 2

5 STEVE 22 1 0 1

    6 JING 18 2 1 1
```

6 JING 18 2 1 2

```
<b>select s1.*
    from student s1, take t1,
    take t2
    where s1.sno = t1.sno and s1.sno = t2.sno and t1.cno = 'CS112'
    and t2.cno = 'CS114'
    and s1.sno not in (
    select s2.sno
    from student s2, take t3,
    take t4,
    take t5
    where s2.sno = t3.sno and s2.sno = t4.sno and s2.sno = t5.sno and t3.cno
> t4.cno and t4.cno > t5.cno )</b>


    SNO SNAME AGE
    --- ---------- ---
```

3 DOUG 20

```
SNO SNAME AGE
    --- ---------- ----------
1 AARON 20
    3 DOUG 20
    8 KAY 20
```

9 GILLIAN 20

1 select s1.*

2 from student s1

3 where 2 = (select count(*)

4 from student s2

5 where s2.age < s1.age)

1 select sno,sname,age

2 from (

3 select sno,sname,age, 4 dense_rank( )over(order by age) as dr

5 from student

```
 6 ) x
 7 where dr = 3
<b>select s1.*,
 (select count(*) from student s2
 where s2.age < s1.age) as cnt from student s1
 order by 4</b>
 SNO SNAME AGE CNT
 --- ---------- ---------- ----------
```

6 JING 18 0

4 MAGGIE 19 1

1 AARON 20 2

3 DOUG 20 2

8 KAY 20 2

9 GILLIAN 20 2

2 CHUCK 21 6

7 BRIAN 21 6

10 CHAD 21 6

5 STEVE 22 9

```
<b>select sno,sname,age,
    dense_rank()over(order by age) as dr from student</b>
    SNO SNAME AGE DR
    --- ---------- ---------- ----------
    6 JING 18 1
    4 MAGGIE 19 2
    1 AARON 20 3
    3 DOUG 20 3
    8 KAY 20 3
    9 GILLIAN 20 3
    2 CHUCK 21 4
    7 BRIAN 21 4
    10 CHAD 21 4
```

5 STEVE 22 5

```
<b>select s5.*
   from student s5, student s6,
   student s7
   where s5.age > s6.age and s6.age > s7.age and s5.sno not in (
   select s1.sno
   from student s1, student s2,
   student s3,
   student s4
   where s1.age > s2.age and s2.age > s3.age and s3.age > s4.age )</b>

   SNO SNAME AGE
   --- ------ ----
   1 AARON 20
   3 DOUG 20
```

```
9 GILLIAN 20

8 KAY 20
```

The solution above uses the technique shown in Question 5. Refer to Question 5 for a complete discussion of how extremes are found using self joins.

```
SNO SNAME AGE
    --- ------ ---
```

1 AARON 20

1 select s.sno,s.sname,s.age

2 from student s, take t 3 where s.sno = t.sno 4 group by s.sno,s.sname,s.age 5 having count(t.cno) = (select count(*) from courses)

1 select sno,sname,age

2 from (

3 select s.sno,s.sname,s.age, 4 count(t.cno) 5 over (partition by s.sno) as cnt, 6 count(distinct c.title) over() as total, 7 row_number() over 8 (partition by s.sno order by c.cno) as rn

9 from courses c

10 left join take t on (c.cno = t.cno) 11 left join student s on (t.sno = s.sno) 12) x

13 where cnt = total 14 and rn = 1

1 select sno,sname,age

2 from (

3 select s.sno,s.sname,s.age, 4 count(t.cno) 5 over (partition by s.sno) as cnt, 6 count(distinct c.title) over( ) as total, 7 row_number( ) over 8 (partition by s.sno <a name="idx-APP-B-1027"></a>order by c.cno) as rn 9 from courses c, take t, student s 10 where c.cno = t.cno (+) 11 and t.sno = s.sno (+) 12)

13 where cnt = total 14 and rn = 1

<b>select s.sno,s.sname,s.age,

count(distinct t.cno) over (partition by s.sno) as cnt, count(distinct c.title) over( ) as total, row_number( )

over(partition by s.sno order by c.cno) as rn from courses c

left join take t on (c.cno = t.cno) left join student s on (t.sno = s.sno) order by 1</b>

SNO SNAME AGE CNT TOTAL RN

--- ------ ---- ---- ---------- ----

1 AARON 20 3 3 1

1 AARON 20 3 3 2

```
1 AARON 20 3 3 3

2 CHUCK 21 1 3 1

3 DOUG 20 2 3 1

3 DOUG 20 2 3 2

4 MAGGIE 19 2 3 1

4 MAGGIE 19 2 3 2

5 STEVE 22 1 3 1

6 JING 18 2 3 1

6 JING 18 2 3 2
```

<b>insert into courses values ('CS115','BIOLOGY',4)

select s.sno,s.sname,s.age,c.title, count(distinct t.cno) over (partition by s.sno) as cnt, count(distinct c.title) over( ) as total, row_number( )

over(partition by s.sno order by c.cno) as rn from courses c

left join take t on (c.cno = t.cno) left join student s on (t.sno = s.sno) order by 1</b>

```
SNO SNAME AGE TITLE CNT TOTAL RN

--- ------ --- ---------- --- ----- ---

1 AARON 20 PHYSICS 3 4 1

1 AARON 20 CALCULUS 3 4 2

1 AARON 20 HISTORY 3 4 3

2 CHUCK 21 PHYSICS 1 4 1
```

```
   3 DOUG 20 PHYSICS 2 4 1

   3 DOUG 20 HISTORY 2 4 2

   4 MAGGIE 19 PHYSICS 2 4 1

   4 MAGGIE 19 CALCULUS 2 4 2

   5 STEVE 22 CALCULUS 1 4 1

   6 JING 18 CALCULUS 2 4 1

   6 JING 18 HISTORY 2 4 2

   BIOLOGY 0 4 1

select *

   from student

   where sno not in ( select s.sno

   from student s, courses c where (s.sno,c.cno) not in (select sno,cno from
take) )

<b>select *

   from student

   where sno in ( 1,2 )</b>

   SNO SNAME AGE

   --- ---------- ----

   1 AARON 20

   2 CHUCK 21
```

```
<b>select *
from take
where sno in ( 1,2 )</b>
SNO CNO
--- -----
1 CS112
1 CS113
1 CS114
```

2 CS112

<b>select s.sno, c.cno from student s, courses c where s.sno in (1,2) order by 1</b>

```
SNO CNO

--- -----

1 CS112

1 CS113

1 CS114

2 CS112

2 CS113
```

2 CS114

<b>select s.sno, c.cno

from student s, courses c where s.sno in (1,2) and (s.sno,c.cno) not in (select sno,cno from take)</b>

```
SNO CNO
--- ----
2 CS113
```

2 CS114

```
<b>select *

   from student

   where sno in ( 1,2 ) and sno not in

   (select s.sno from student s, courses c where s.sno in ( 1,2 ) and
(s.sno,c.cno) not in (select sno,cno from take))</b>

   SNO SNAME AGE

   --- ---------- -----

   1 AARON 20

SNO SNAME AGE

   --- -------- ------

   5 STEVE 22

1 select *
```

```
2 from student
   3 where age = (select max(age) from student)
1 select sno,sname,age
   2 from (
   3 select s.*,
   4 max(s.age)over() as oldest
```

5 from student s

```
   6 ) x
   7 where age = oldest
<b>select s.*,
   max(s.age) over() as oldest from student s</b>
   SNO SNAME AGE OLDEST
   --- ---------- ---- ----------
   1 AARON 20 22
   2 CHUCK 21 22
   3 DOUG 20 22
   4 MAGGIE 19 22
   5 STEVE 22 22
   6 JING 18 22
   7 BRIAN 21 22
   8 KAY 20 22
   9 GILLIAN 20 22
   10 CHAD 21 22
select *
   from student
```

```
    where age not in (select a.age from student a, student b where a.age <
b.age)

select *

    from student

    where age >= all (select age from student)
```

About the Author

Anthony Molinaro is a database developer at Wireless Generation, Inc. with many years of experience in helping developers improve their SQL queries. SQL is a particular passion of Anthony's, and he's become known as the go-to guy among his clients when it comes to solving difficult SQL query problems. He's well-read, understands relational theory well, and has nine years of hands-on experience solving tough SQL problems. Anthony is particularly well-acquainted with new and powerful SQL features such as the windowing function syntax that was added to the most recent SQL standard.

Colophon

Our look is the result of reader comments, our own experimentation, and feedback from distribution channels. Distinctive covers complement our distinctive approach to technical topics, breathing personality and life into potentially dry subjects.

The animal on the cover of *SQL Cookbook* is an Agamid lizard. These lizards belong to the Agamidae family and have more than 300 species among them. Agamids can be found in Africa, Asia, Australia, and Southern Europe, and are characterized by strong legs andin some varietiesthe ability to change color. Unlike other species of lizards, agamids cannot regenerate their tails if they lose them. They can be found in varied environments from hot deserts to warm, wet tropical rainforests.

Several species of agamids are popular as pets. Among these are the Bearded Dragon (genus *Pogona*). Calm, yet curious, these creatures grow to be only about 20 inches. Even with their small stature, they are still considered "giant" lizards, and therefore require ample space. Males are generally territorial and, although they are social animals, overcrowding can lead to stress, especially when the animals have no place to hide. Overcrowding can lead to injuries from fighting such as lost toes and tails, as well as a loss of appetite.

The head of the bearded lizard is triangular in shape and features many spikes protruding from its chin. These spikes resemble whiskers (thus the name). The spikes are also found along its side. Bearded dragons open their mouths and display their spiky beards to scare predators and other beardeds. They also can flatten their bodies to appear larger. As pets, they may stop displaying their beards once they become comfortable with their owners and habitats.

Although they originated in Australia, the bearded dragons sold by U.S. dealers are descendants of animals that were imported from Europe. This is due to Australia's strict export laws regarding wildlife.

The Flying Lizard (*draco volans*) is another varied example of an agamid lizard. Measuring slightly less than 12 inches, this animal has a long, thin body with flaps of skin along its ribs. The male flying lizard will claim two to three trees for its territory with one to three females living in each tree. In order to transport itself from one place to another, it glides from trees or other high places by extending its skin flaps like wings. However, it usually does not fly in rain or wind. When threatened, the flying lizard may also extend its skin flaps to appear larger.

Another interesting variety of the agamidae family is the Red Headed Rock Agama (*Agama agama*) found in sub-Saharan Africa. These creatures often live in groups of 10 to 20 with an older male acting as the group's "leader." At night, their coloring is dark brown, but at dawn, their bodies change to light blue with a bright orange head and tail. Their skin coloring changes with their mood, acting like a virtual mood ring. For example, when males fight, their heads will become brown, while white spots appear along the body.

Darren Kelly was the production editor for *SQL Cookbook*. Kenneth Kimball was the copyeditor and Karmyn Guthrie was the proofreader. nSight, Inc. provided production services. Jamie Peppard and Genevieve d'Entremont provided quality control. Jansen Fernald provided production support Beth Palmer wrote the index.

Karen Montgomery designed the cover of this book, based on a series design by Edie Freedman. The cover image is a 19th-century engraving from the Dover Pictorial Archive. Karen Montgomery produced the cover layout with Adobe InDesign CS using Adobe's ITC Garamond font.

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