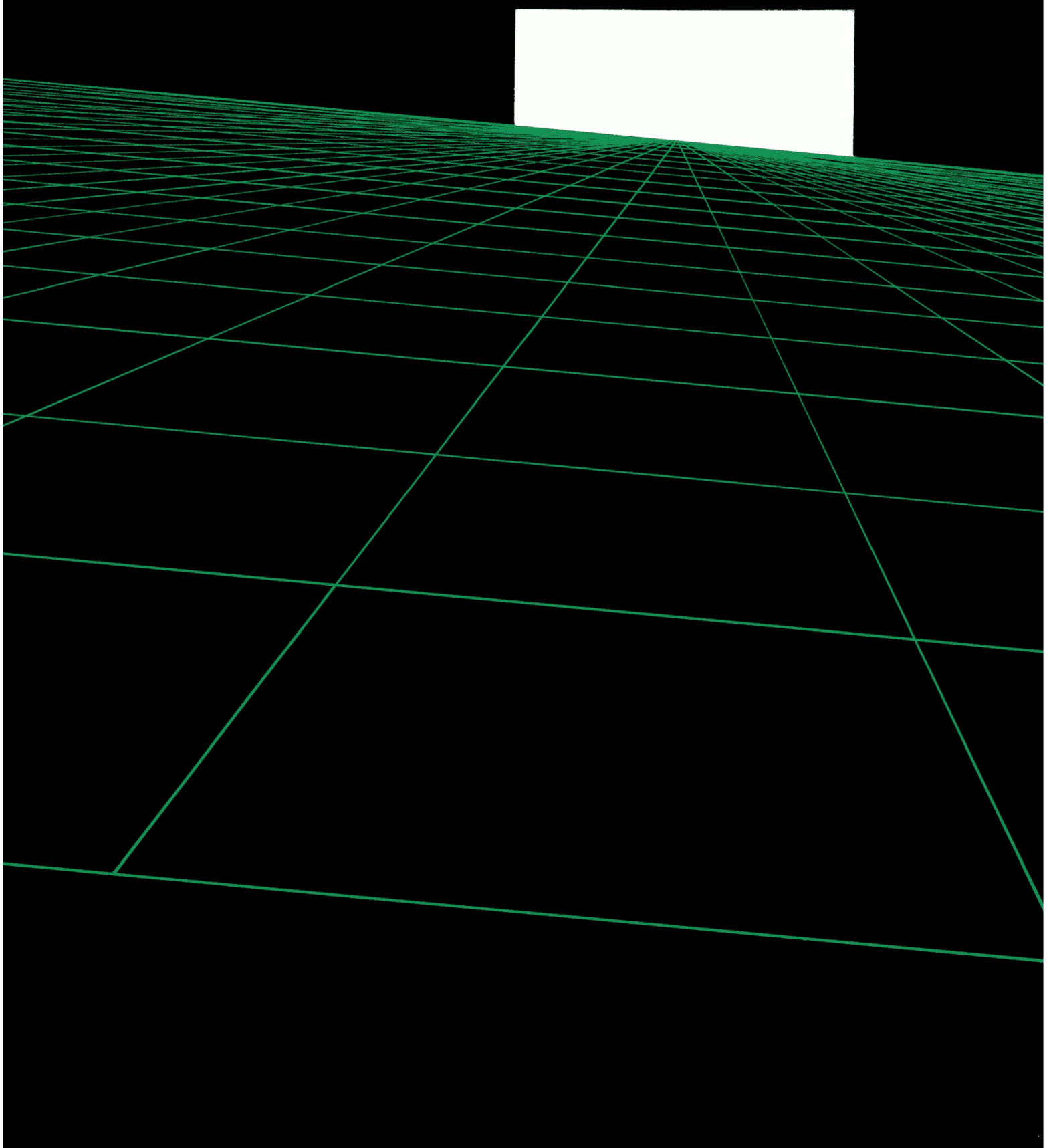
RSI

Relational Software Incorporated

ORACLE



ORACLE

Users' Guide

Relational Software Incorporated

RSI-100

R S I

O R A C L E

U S E R S - G U I D E

Oracle Users Guide - Version 2.3

R S I

ORACLE

SQL LANGUAGE

USER'S GUIDE

Oracle User's Guide - Version 2.3

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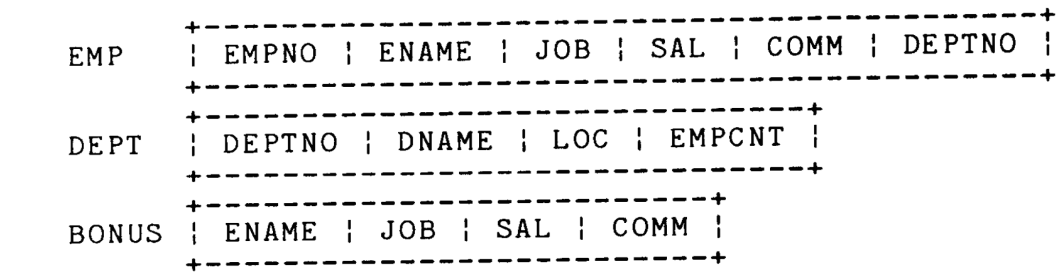
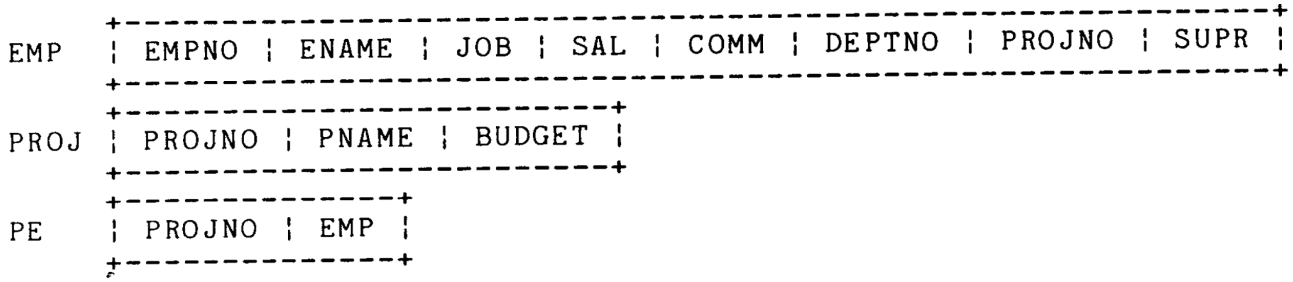
INTRODUCTION

This section of the "User's Guide" introduces the SQL facilities for query, data manipulation, data definition and data control through a series of examples. The examples are based on the following database:



The EMP table contains information on employees, giving the employee's number, name, job title, salary, commission, and department number. The department table gives the department's number, name, location, and a count of the employees in the department. The BONUS table contains an extract of the information in the EMP table. Through the course of the examples, the EMP table is expanded to contain a project number column and a supervisor column, and two new tables are added. The PROJ table contains columns for the project number, name, and budget. The PE table relates projects to employees where one project can have many employees, and one employee can be working on many projects. The expanded EMP table and the two added tables are as follows:



The examples in this section of the documentation were produced by executing the ORACLE User Friendly Interface (UFI) and capturing the output in hard-copy form. The actual output has been post-processed to add page numbers and to remove the SQL prompts at the beginning of each line. The command file which produces this output is provided with each ORACLE installation. It contains the comments interspersed with the SQL statements. This section of the documentation serves as a self-tutorial in the facilities of SQL as implemented in ORACLE.

ORACLE accepts SQL statements in free format. The arrangement of each SQL clause on a separate line and indentation in the following examples is used for clarity only.

1. DATA BASE CONTENTS

This section of the manual describes the structure and content of the example PERSONNEL data base.

1.1 Dictionary Contents

ORACLE's integrated data dictionary can be queried using standard SQL query facilities.

Example 1-1: List the names of the user tables in the data base.

```
SQL>SELECT  TABLE
SQL>FROM    TAB;
SQL>/

TABLE
----------
EMP
DEPT
BONUS
```

Example 1-2: List the names of the columns of the department and employee tables.

```
SQL>SELECT  *
SQL>FROM    COL
SQL>WHERE   TABLE = 'DEPT';
SQL>/

TABLE       COLUMN
----------- -------
DEPT        DEPTNO
DEPT        DNAME
DEPT        LOC
DEPT        EMPCNT

SQL>SELECT  *
SQL>FROM    COL
SQL>WHERE   TABLE = 'EMP';
SQL>/

TABLE       COLUMN
----------- -------
EMP         EMPNO
EMP         ENAME
EMP         JOB
EMP         SAL
EMP         COMM
EMP         DEPTNO

6 records selected.
```

1.2 **Data Base Contents**

Example 1-3: List all the columns and rows of the DEPT table.

```
SQL>SELECT * FROM DEPT;
SQL>/

DEPTNO DNAME          LOC           EMPCNT
------ -------------- ------------- ------
    10 ADMINISTRATION NEW YORK
    20 RESEARCH       SAN FRANCISCO
    30 SALES          CHICAGO
    40 OPERATIONS     BOSTON
```

Example 1-4: List all the columns and rows of the EMP table.

```
SQL>SELECT * FROM EMP;
SQL>/

EMPNO ENAME  JOB              SAL        COMM DEPTNO
----- ------ ---------- ---------- ---------- ------
 7369 SMITH  CLERK         $800.00                20
 7499 ALLEN  SALESMAN    $1,600.00    $300.00     30
 7521 WARD   SALESMAN    $1,250.00    $500.00     30
 7566 JONES  MANAGER     $2,975.00                20
 7654 MARTIN SALESMAN    $1,250.00  $1,400.00     30
 7698 BLAKE  MANAGER     $2,850.00                30
 7782 CLARK  MANAGER     $2,450.00                10
 7788 SCOTT  ANALYST     $3,000.00                20
 7839 OATES  PRESIDENT   $5,000.00                10
 7844 TURNER SALESMAN    $1,500.00      $0.00     30
 7876 ADAMS  CLERK       $1,100.00                20
 7900 JAMES  CLERK         $950.00                30
 7902 FORD   ANALYST     $3,000.00                20
 7934 MILLER CLERK       $1,300.00                10

14 records selected.
```

2. QUERY FACILITIES

This section of the manual contains a description of the query facilities of ORACLE.

2.1 Query Block

The SELECT clause lists the columns to be returned. The FROM clause lists the tables involved in the query. The WHERE clause specifies the selection criteria.

Example 2-1: Find the name of department 10.

```
SQL>SELECT  DNAME
SQL>FROM    DEPT
SQL>WHERE   DEPTNO=10;
SQL>/

DNAME
--------------
ADMINISTRATION
```

The SELECT clause can contain several columns. Character string constants are enclosed by single quotation marks.

Example 2-2: List the names, numbers, and departments of all clerks.

```
SQL>SELECT  ENAME,EMPNO,DEPTNO
SQL>FROM    EMP
SQL>WHERE   JOB = 'CLERK';
SQL>/

ENAME  EMPNO DEPTNO
------ ----- ------
SMITH   7369     20
ADAMS   7876     20
MILLER  7934     10
JAMES   7900     30
```

If all columns of the row are to be returned, SELECT * is specified.

Example 2-3: List all the columns in the employee table for employees in department 30.

```
SQL>SELECT  *
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30
7521	WARD	SALESMAN	$1,250.00	$500.00	30
7698	BLAKE	MANAGER	$2,850.00		30
7654	MARTIN	SALESMAN	$1,250.00	$1,400.00	30
7844	TURNER	SALESMAN	$1,500.00	$0.00	30
7900	JAMES	CLERK	$950.00		30

6 records selected.

The WHERE clause can compare two fields of a row with each other.

Example 2-4: List the name, salary, and commission of each employee whose commission is greater than his salary.

```
SQL>SELECT  ENAME,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   COMM > SAL;
SQL>/
```

ENAME	SAL	COMM
MARTIN	$1,250.00	$1,400.00

The absence of a WHERE clause causes all rows to be returned.

Example 2-5: List all columns and all rows in the DEPT table.

```
SQL>SELECT  *
SQL>FROM    DEPT;
SQL>/

DEPTNO DNAME          LOC           EMPCNT
------ -------------- ------------- ------
    10 ADMINISTRATION NEW YORK
    20 RESEARCH       SAN FRANCISCO
    30 SALES          CHICAGO
    40 OPERATIONS     BOSTON
```

2.2 **Logical Expressions**

Predicates within the WHERE clause may be connected by the boolean operators, AND and OR.

Example 2-6: List the name, job title, and salary of all employees in department 20 that make more than $2,000.

```
SQL>SELECT  ENAME,JOB,SAL
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 20
SQL>  AND   SAL > 2000;
SQL>/

ENAME  JOB                 SAL
------ ---------- ----------
JONES  MANAGER     $2,975.00
SCOTT  ANALYST     $3,000.00
FORD   ANALYST     $3,000.00
```

The BETWEEN operator simplifies the syntax for specifying a range. The predicates SAL >= 1200 AND SAL <= 1400 are simplified to SAL BETWEEN 1200 AND 1400.

Example 2-7: List the name, job title, and salary of all employees who earn between $1,200 AND $1,400.

```
SQL>SELECT  ENAME,JOB,SAL
SQL>FROM    EMP
SQL>WHERE   SAL BETWEEN 1200 AND 1400;
SQL>/

ENAME  JOB                 SAL
------ ---------- ----------
WARD   SALESMAN     $1,250.00
MARTIN SALESMAN     $1,250.00
MILLER CLERK        $1,300.00
```

Example 2-8: List the name, job, salary, and commission of each employee whose job title begins with MAN or whose salary is greater than 3000 a month.

```
SQL>SELECT  ENAME,JOB,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   JOB = 'MAN...'
SQL>  OR    SAL > 3000;
SQL>/

ENAME  JOB                 SAL       COMM
------ ---------- ---------- ----------
JONES  MANAGER      $2,975.00
BLAKE  MANAGER      $2,850.00
CLARK  MANAGER      $2,450.00
OATES  PRESIDENT    $5,000.00
```

Example 2-9: List the department number, name, job title, salary and commission of each employee in department 30 whose salary is greater than his commission.

```
SQL>SELECT  DEPTNO,ENAME,JOB,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   SAL > COMM
SQL>  AND   DEPTNO = 30;
SQL>/
```

DEPTNO	ENAME	JOB	SAL	COMM
30	ALLEN	SALESMAN	$1,600.00	$300.00
30	WARD	SALESMAN	$1,250.00	$500.00
30	TURNER	SALESMAN	$1,500.00	$0.00

Predicates within a WHERE clause form logical expressions with square brackets [ ] used to establish precedence.

Example 2-10: List the department number, name, job title, salary, and commission of all analysts, or all people in department 10 who earn more than $2,500.

```
SQL>SELECT  DEPTNO,ENAME,JOB,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   JOB = 'ANALYST'
SQL>   OR   [SAL > 2500 AND DEPTNO = 10];
SQL>/
```

DEPTNO	ENAME	JOB	SAL	COMM
20	SCOTT	ANALYST	$3,000.00	
20	FORD	ANALYST	$3,000.00	
10	OATES	PRESIDENT	$5,000.00	

Example 2-11: List the department number, name, job title, salary, and commission of employees in department 10 who are either analysts or earn more than $2,500.

```
SQL>SELECT  DEPTNO,ENAME,JOB,SAL,COMM
SQL>FROM    EMP
SQL>WHERE  [JOB = 'ANALYST'
SQL>   OR   SAL > 2500]  AND  DEPTNO = 10;
SQL>/
```

DEPTNO	ENAME	JOB	SAL	COMM
10	OATES	PRESIDENT	$5,000.00	

2.3 **Not Conditions**

Predicates within a WHERE clause may be negated.

Example 2-12: List the name, salary, commission, job title, and department number of employees in department 30 who are not a salesman.

```
SQL>SELECT  ENAME,SAL,COMM,JOB,DEPTNO
SQL>FROM    EMP
SQL>WHERE   JOB ^=  'SALESMAN'
SQL>  AND   DEPTNO = 30;
SQL>/
```

ENAME	SAL	COMM	JOB	DEPTNO
BLAKE	$2,850.00		MANAGER	30
JAMES	$950.00		CLERK	30

Entire logical expressions may be negated.

Example 2-13: List the name, salary, commission, job title, and department number of employees in department 30 who are not a salesman or do not earn more than $1,500.

```
SQL>SELECT  ENAME,SAL,COMM,JOB,DEPTNO
SQL>FROM    EMP
SQL>WHERE   NOT [JOB = 'SALESMAN' OR SAL > 1500]
SQL>  AND   DEPTNO = 30;
SQL>/
```

ENAME	SAL	COMM	JOB	DEPTNO
JAMES	$950.00		CLERK	30

2.4 Set Inclusion Operator

A predicate in a WHERE clause may test a field for inclusion in a set of constant literal values. A set of constant literal values is enclosed within angle brackets < >.

Example 2-14: List the name and department number of employees in departments 10 and 30.

```
SQL>SELECT  ENAME,DEPTNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO IN <10,30>;
SQL>/

ENAME  DEPTNO
------ ------
CLARK      10
MILLER     10
OATES      10
ALLEN      30
WARD       30
BLAKE      30
MARTIN     30
TURNER     30
JAMES      30

9 records selected.
```

Example 2-15: List all fields from the department table for departments that are located in either Chicago or New York.

```
SQL>SELECT  *
SQL>FROM    DEPT
SQL>WHERE   LOC IN <'CHICAGO','NEW YORK'>;
SQL>/

DEPTNO DNAME          LOC           EMPCNT
------ -------------- ------------- ------
    30 SALES          CHICAGO
    10 ADMINISTRATION NEW YORK
```

2.5 **Nested Query**

The result of one query may be used in the WHERE clause of another query. The inner query returns one or a set of values. The outer query uses this result as if it were given a set of constant literal values. Query blocks may be nested to any number of levels.

Example 2-16: List the name and job of employees who have the same job as Jones.

```
SQL>SELECT  ENAME,JOB
SQL>FROM    EMP
SQL>WHERE   JOB IN
SQL>        SELECT  JOB
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'JONES';
SQL>/

ENAME  JOB
------ ----------
JONES  MANAGER
BLAKE  MANAGER
CLARK  MANAGER
```

Example 2-17: List the name, job title, and salary of employees who have the same job and salary as Ford.

```
SQL>SELECT  ENAME,JOB,SAL
SQL>FROM    EMP
SQL>WHERE   <JOB,SAL> =
SQL>        SELECT  JOB,SAL
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'FORD';
SQL>/

ENAME  JOB                SAL
------ ---------- ----------
SCOTT  ANALYST     $3,000.00
FORD   ANALYST     $3,000.00
```

Inner query blocks may be connected by the boolean operators AND and OR to form compound nested queries.

Example 2-18: List the name, job, and department of employees who have the same job as Jones, or a salary greater than or equal to Ford.

```
SQL>SELECT  ENAME,JOB,DEPTNO,SAL
SQL>FROM    EMP
SQL>WHERE   JOB IN
SQL>        SELECT  JOB
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'JONES';
SQL>OR SAL >=
SQL>        SELECT  SAL
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'FORD';
SQL>/
```

ENAME	JOB	DEPTNO	SAL
JONES	MANAGER	20	$2,975.00
BLAKE	MANAGER	30	$2,850.00
CLARK	MANAGER	10	$2,450.00
SCOTT	ANALYST	20	$3,000.00
OATES	PRESIDENT	10	$5,000.00
FORD	ANALYST	20	$3,000.00

6 records selected.

2.6 **ORDER BY**

The ORDER BY clause specifies major and minor sort fields in ascending or descending order. Ascending order is default.

Example 2-19: List the name, job, department, and employee number of employees in a department whose number is greater than or equal to 20, in order of employee name.

```
SQL>SELECT  ENAME,JOB,DEPTNO,EMPNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO >= 20
SQL>ORDER BY ENAME;
SQL>/

ENAME  JOB         DEPTNO EMPNO
------ ---------- ------ -----
ADAMS  CLERK           20  7876
ALLEN  SALESMAN        30  7499
BLAKE  MANAGER         30  7698
FORD   ANALYST         20  7902
JAMES  CLERK           30  7900
JONES  MANAGER         20  7566
MARTIN SALESMAN        30  7654
SCOTT  ANALYST         20  7788
SMITH  CLERK           20  7369
TURNER SALESMAN        30  7844
WARD   SALESMAN        30  7521

11 records selected.
```

Example 2-20: List the department, salary, name, and job of all employees, in descending order by salary, ascending order by job within salary, and ascending order by name within job.

```
SQL>SELECT  DEPTNO,SAL,JOB,ENAME
SQL>FROM    EMP
SQL>ORDER BY SAL DESC,JOB,ENAME;
SQL>/
```

DEPTNO	SAL	JOB	ENAME
10	$5,000.00	PRESIDENT	OATES
20	$3,000.00	ANALYST	FORD
20	$3,000.00	ANALYST	SCOTT
20	$2,975.00	MANAGER	JONES
30	$2,850.00	MANAGER	BLAKE
10	$2,450.00	MANAGER	CLARK
30	$1,600.00	SALESMAN	ALLEN
30	$1,500.00	SALESMAN	TURNER
10	$1,300.00	CLERK	MILLER
30	$1,250.00	SALESMAN	MARTIN
30	$1,250.00	SALESMAN	WARD
20	$1,100.00	CLERK	ADAMS
30	$950.00	CLERK	JAMES
20	$800.00	CLERK	SMITH

14 records selected.

Expressions can be specified within the ORDER BY clause.

Example 2-21: List all salesman in ascending order of the ratio of their salary divided by their commission.

```
SQL>SELECT  ENAME,SAL/COMM,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   JOB = 'SALESMAN'
SQL>ORDER BY SAL/COMM
SQL>/
```

ENAME	SAL/COMM	SAL	COMM
MARTIN	.893	$1,250.00	$1,400.00
WARD	2.500	$1,250.00	$500.00
ALLEN	5.333	$1,600.00	$300.00
TURNER	~.000	$1,500.00	$0.00

2.7 **UNIQUE**

A query returns a set of rows that satisfy the WHERE clause. Duplicate rows are not eliminated unless SELECT UNIQUE is specified.

Example 2-22: List all the different jobs in the job table.

```
SQL>SELECT  UNIQUE JOB
SQL>FROM    EMP;
SQL>/

JOB
----------
CLERK
SALESMAN
MANAGER
ANALYST
PRESIDENT
```

If a WHERE clause has multiple predicates connected by an OR, there exists the possibility that a single row may satisfy both predicates and be returned twice in the query result. UNIQUE specified within the SELECT clause eliminates this duplication.

Example 2-23: List the name and job of employees who are in department 30, or employees who are managers. Sort by employee name.

```
SQL>SELECT  ENAME,JOB,DEPTNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>   OR   JOB = 'MANAGER'
SQL>ORDER BY ENAME;
SQL>/

ENAME  JOB         DEPTNO
------ ---------- ------
ALLEN  SALESMAN        30
BLAKE  MANAGER         30
BLAKE  MANAGER         30
CLARK  MANAGER         10
JAMES  CLERK           30
JONES  MANAGER         20
MARTIN SALESMAN        30
TURNER SALESMAN        30
WARD   SALESMAN        30

9 records selected.
```

Example 2-24: List the name and job of employees who are in department 30 or, employees who are managers. Eliminate duplicate rows and sort the result by employee name.

```
SQL>SELECT  UNIQUE ENAME,JOB,DEPTNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>  OR    JOB = 'MANAGER'
SQL>ORDER BY ENAME;
SQL>/

ENAME  JOB         DEPTNO
------ ---------- ------
ALLEN  SALESMAN        30
BLAKE  MANAGER         30
CLARK  MANAGER         10
JAMES  CLERK           30
JONES  MANAGER         20
MARTIN SALESMAN        30
TURNER SALESMAN        30
WARD   SALESMAN        30

8 records selected.
```

Example 2-25: List the salary, job title, name, and department number for all employees in departments that have salesmen. Sort the results by salary in descending order.

```
SQL>SELECT  SAL,JOB,ENAME,DEPTNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO IN
SQL>        SELECT  UNIQUE DEPTNO
SQL>        FROM    EMP
SQL>        WHERE   JOB = 'SALESMAN';
SQL>ORDER BY SAL DESC;
SQL>/

       SAL JOB         ENAME  DEPTNO
---------- ---------- ------ ------
 $2,850.00 MANAGER    BLAKE      30
 $1,600.00 SALESMAN   ALLEN      30
 $1,500.00 SALESMAN   TURNER     30
 $1,250.00 SALESMAN   WARD       30
 $1,250.00 SALESMAN   MARTIN     30
   $950.00 CLERK      JAMES      30

6 records selected.
```

2.8 **Arithmetic Expressions**

The SELECT, WHERE, and HAVING clauses may all contain arithmetic expressions containing fields and constants.

Example 2-26: List the name, salary, commission, and sum of salary plus commission of employees in department 30.

```
SQL>SELECT  ENAME,SAL,COMM,SAL + COMM
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30;
SQL>/
```

ENAME	SAL	COMM	SAL+COMM
ALLEN	$1,600.00	$300.00	$1,900.00
WARD	$1,250.00	$500.00	$1,750.00
BLAKE	$2,850.00		
MARTIN	$1,250.00	$1,400.00	$2,650.00
TURNER	$1,500.00	$0.00	$1,500.00
JAMES	$950.00		

6 records selected.

Example 2-27: List the name, salary, and commission of employees whose commission is greater than or equal to 25% of their salary.

```
SQL>SELECT  ENAME,SAL,COMM
SQL>FROM    EMP
SQL>WHERE   COMM >= 0.25 * SAL;
SQL>/
```

ENAME	SAL	COMM
WARD	$1,250.00	$500.00
MARTIN	$1,250.00	$1,400.00

Parentheses are used to establish precedence within arithmetic expressions.

Example 2-28: List the name, salary, commission, and 1.25 times salary plus two-thirds of the commission of all salesmen.

```
SQL>SELECT  ENAME,SAL,COMM,((SAL * 1.25) + (COMM * ( 2/3 )))
SQL>FROM    EMP
SQL>WHERE   JOB = 'SALES...';
SQL>/
```

ENAME	SAL	COMM	((SAL*1.25)+(COMM*(2/3)))
ALLEN	$1,600.00	$300.00	$2,200.00
WARD	$1,250.00	$500.00	$1,895.83
MARTIN	$1,250.00	$1,400.00	$2,495.83
TURNER	$1,500.00	$0.00	$1,875.00

2.9 **Built-In Functions**

ORACLE provides several built-in functions that may be used in either SELECT or HAVING clauses.

Example 2-29: Find the average salary of all employees who are clerks.

```
SQL>SELECT  AVG(SAL)
SQL>FROM    EMP
SQL>WHERE   JOB = 'CLERK';
SQL>/

  AVG(SAL)
----------
 $1,037.50
```

Example 2-30: Find the maximum, average, and minimum salary of employees in department 10.

```
SQL>SELECT  MAX(SAL),AVG(SAL),MIN(SAL)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 10;
SQL>/

  MAX(SAL)   AVG(SAL)   MIN(SAL)
---------- ---------- ----------
 $5,000.00  $2,916.67  $1,300.00
```

Example 2-31: Find the sum of all salesmen's commissions.

```
SQL>SELECT  SUM(COMM)
SQL>FROM    EMP
SQL>WHERE   JOB = 'SALESMAN';
SQL>/

 SUM(COMM)
----------
 $2,200.00
```

Example 2-32: Find the number of employees in department 30.

```
SQL>SELECT  COUNT(*)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30;
SQL>/

COUNT(*)
--------
       6
```

Built-in functions can be used in arithmetic expressions.

Example 2-33: Compute the average annual salary plus commission for all salesmen.

```
SQL>SELECT  AVG(SAL + COMM) * 12
SQL>FROM    EMP
SQL>WHERE   JOB = 'SALESMAN'
SQL>/

AVG(SAL+COMM)*12
----------------
      $23,400.00
```

ORACLE allows functions to be applied to the results of other built-in functions.

Example 2-34: List the name, job, and salary of the employee who has the largest salary.

```
SQL>SELECT  ENAME,JOB,SAL
SQL>FROM    EMP
SQL>WHERE   SAL =
SQL>        SELECT  MAX(SAL)
SQL>        FROM    EMP;
SQL>/

ENAME  JOB                  SAL
------ ---------- ----------
OATES  PRESIDENT   $5,000.00
```

2.10 **GROUP-BY**

A table may be partitioned into groups according to the values in a column or set of columns. A built-in function may then be applied to each group. When a built-in function is used, each item in the SELECT clause must be a unique property of the group.

Example 2-35: List the department number and average salary of each department.

```
SQL>SELECT  DEPTNO,AVG(SAL)
SQL>FROM    EMP
SQL>GROUP BY DEPTNO;
SQL>/

DEPTNO   AVG(SAL)
------ ----------
    10  $2,916.67
    20  $2,175.00
    30  $1,566.67
```

Example 2-36: List the department number and average annual salary of each departments employees, excluding managers salaries.

```
SQL>SELECT  DEPTNO,AVG(SAL) * 12
SQL>FROM    EMP
SQL>WHERE   NOT JOB = 'MAN...'
SQL>GROUP BY DEPTNO;
SQL>/

DEPTNO AVG(SAL)*12
------ -----------
    10  $37,800.00
    20  $23,700.00
    30  $15,720.00
```

A table can be partitioned into groups based on the values in more than one column.

Example 2-37: Divide all employees into groups by department, and by job within department. Count the employees in each group and compute each group's average salary.

```
SQL>SELECT  DEPTNO,JOB,COUNT(*),AVG(SAL) * 12
SQL>FROM    EMP
SQL>GROUP BY DEPTNO,JOB;
SQL>/
```

DEPTNO	JOB	COUNT(*)	AVG(SAL)*12
10	CLERK	1	$15,600.00
10	MANAGER	1	$29,400.00
10	PRESIDENT	1	$60,000.00
20	ANALYST	2	$36,000.00
20	CLERK	2	$11,400.00
20	MANAGER	1	$35,700.00
30	CLERK	1	$11,400.00
30	MANAGER	1	$34,200.00
30	SALESMAN	4	$16,800.00

9 records selected.

Built-in functions can be applied to the results of other group functions to form functions of functions.

Example 2-38: Total the salaries of all the departments and list the department with the maximum total.

```
SQL>SELECT  DEPTNO,MAX(SUM(SAL))
SQL>FROM    EMP
SQL>GROUP BY DEPTNO;
SQL>/
```

DEPTNO	MAX(SUM(SAL))
30	$10,875.00

2.11 **HAVING**

After a table has been partitioned into groups, a predicate or set of predicates in a HAVING clause can be applied to the groups.

Example 2-39: List the average annual salary for all job groups having more than 2 employees in the group.

```
SQL>SELECT  JOB,AVG(SAL) * 12
SQL>FROM    EMP
SQL>GROUP BY JOB
SQL>HAVING  COUNT(*) > 2;
SQL>/

JOB         AVG(SAL)*12
----------  -----------
CLERK        $12,450.00
MANAGER      $33,100.00
SALESMAN     $16,800.00
```

A query block may contain both a WHERE and HAVING clause. First, the WHERE clause is applied to qualify rows; second, the groups are formed and the built-in functions are computed; third, the HAVING clause is applied to qualify groups.

Example 2-40: List all the departments that have more than two clerks.

```
SQL>SELECT  DEPTNO
SQL>FROM    EMP
SQL>WHERE   JOB = 'CLERK'
SQL>GROUP BY DEPTNO
SQL>HAVING COUNT(*) >= 2;
SQL>/

DEPTNO
------
    20
```

HAVING clauses may contain query blocks.

Example 2-41: List the departments and their average salary that have a greater average salary than department 20.

```
SQL>SELECT  DEPTNO,AVG(SAL)
SQL>FROM    EMP
SQL>GROUP BY DEPTNO
SQL>HAVING  AVG(SAL) >
SQL>        SELECT  AVG(SAL)
SQL>        FROM    EMP
SQL>        WHERE   DEPTNO = 20;
SQL>/

DEPTNO   AVG(SAL)
------ ----------
    10  $2,916.67
```

2.12 **NULL Conditions**

Predicates within a WHERE clause can explicitly test for null conditions within a column.

Example 2-42: List the name, salary, commission and job title of all employees who do not receive commissions.

```
SQL>SELECT  ENAME,SAL,COMM,JOB
SQL>FROM    EMP
SQL>WHERE   COMM = NULL;
SQL>/

ENAME          SAL       COMM JOB
------ ---------- ---------- ---------
SMITH     $800.00            CLERK
JONES   $2,975.00            MANAGER
BLAKE   $2,850.00            MANAGER
CLARK   $2,450.00            MANAGER
SCOTT   $3,000.00            ANALYST
OATES   $5,000.00            PRESIDENT
ADAMS   $1,100.00            CLERK
JAMES     $950.00            CLERK
FORD    $3,000.00            ANALYST
MILLER  $1,300.00            CLERK

10 records selected.
```

Example 2-43: List the name, salary, commission, and job title of those employees who receive a commission.

```
SQL>SELECT  ENAME,SAL,COMM,JOB
SQL>FROM    EMP
SQL>WHERE   NOT COMM = NULL;
SQL>/

ENAME          SAL        COMM JOB
------ ---------- ---------- ----------
ALLEN   $1,600.00    $300.00 SALESMAN
WARD    $1,250.00    $500.00 SALESMAN
MARTIN  $1,250.00  $1,400.00 SALESMAN
TURNER  $1,500.00      $0.00 SALESMAN
```

Example 2-44: If a predicate within a WHERE or HAVING clause can be expressed without using NOT or NULL, it is usually more efficient.

```
SQL>SELECT  ENAME,SAL,COMM,JOB
SQL>FROM    EMP
SQL>WHERE   COMM >= 0;
SQL>/

ENAME          SAL        COMM JOB
------ ---------- ---------- ----------
ALLEN   $1,600.00    $300.00 SALESMAN
WARD    $1,250.00    $500.00 SALESMAN
MARTIN  $1,250.00  $1,400.00 SALESMAN
TURNER  $1,500.00      $0.00 SALESMAN
```

Null values in the data base are treated as unknowns in the evaluation of logical expressions. Only those rows that are known to satisfy the WHERE clause are returned as the result of a query.

Example 2-45: List all columns of the employee table for employees in department 30 or employees whose commission is less than or equal to $1,000.

```
SQL>SELECT  *
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>  AND   COMM <= 1000;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30
7521	WARD	SALESMAN	$1,250.00	$500.00	30
7844	TURNER	SALESMAN	$1,500.00	$0.00	30

Example 2-46: List all the columns of the employee table for employees in department 30 or employees whose commission is less than or equal to $1,000.

```
SQL>SELECT  *
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>  OR    COMM <= 1000;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30
7521	WARD	SALESMAN	$1,250.00	$500.00	30
7698	BLAKE	MANAGER	$2,850.00		30
7654	MARTIN	SALESMAN	$1,250.00	$1,400.00	30
7844	TURNER	SALESMAN	$1,500.00	$0.00	30
7900	JAMES	CLERK	$950.00		30
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30
7521	WARD	SALESMAN	$1,250.00	$500.00	30
7844	TURNER	SALESMAN	$1,500.00	$0.00	30

9 records selected.

2.13 **NULL-Function**

When an expression or built-in function references a column of a table that contains one or more null values, the result of the expression or built-in function is null.

Example 2-47: In the following example the expression SAL + COMM returns a null value for all employees that have a null commmission.

```
SQL>SELECT  ENAME,JOB,SAL,COMM,SAL + COMM
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/
```

ENAME	JOB	SAL	COMM	SAL+COMM
ALLEN	SALESMAN	$1,600.00	$300.00	$1,900.00
WARD	SALESMAN	$1,250.00	$500.00	$1,750.00
BLAKE	MANAGER	$2,850.00		
MARTIN	SALESMAN	$1,250.00	$1,400.00	$2,650.00
TURNER	SALESMAN	$1,500.00	$0.00	$1,500.00
JAMES	CLERK	$950.00		

6 records selected.

The ORACLE Null-Value Function NVL can be used to assign a temporary value to nulls encountered within an expression.

Example 2-48: Assign null commissions a temporary value of zero within the expression SAL + COMM.

```
SQL>SELECT  ENAME,JOB,SAL,COMM,SAL + NVL(COMM,0)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/
```

ENAME	JOB	SAL	COMM	SAL+NVL(COMM,0)
ALLEN	SALESMAN	$1,600.00	$300.00	$1,900.00
WARD	SALESMAN	$1,250.00	$500.00	$1,750.00
BLAKE	MANAGER	$2,850.00		$2,850.00
MARTIN	SALESMAN	$1,250.00	$1,400.00	$2,650.00
TURNER	SALESMAN	$1,500.00	$0.00	$1,500.00
JAMES	CLERK	$950.00		$950.00

6 records selected.

The expression SAL + NVL(COMM,0) will return a value equal to SAL when COMM is null.

Example 2-49: Null values do not participate in the computation of built-in functions.

```
SQL>SELECT  SUM(SAL),COUNT(SAL),SUM(COMM),COUNT(COMM)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/

  SUM(SAL) COUNT(SAL)  SUM(COMM) COUNT(COMM)
---------- ---------- ---------- -----------
 $9,400.00          6  $2,200.00           4
```

In the above example the count of people who receive a salary, (4), is greater than the number of people that receive a commission, (6), because null commissions were not counted.

Example 2-50: List the average commission of employees who receive a commission, and the average commission of all employees (treating employees who do not receive a commission as receiving a zero commission).

```
SQL>SELECT  AVG(COMM),AVG(NVL(COMM,0))
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/

 AVG(COMM) AVG(NVL(COMM,0))
---------- ----------------
   $550.00          $366.67
```

Example 2-51: List the average commission of employees who receive a commission, and the average commission of all employees (treating employees who do not receive a commission as receiving a $1000 commission).

```
SQL>SELECT  AVG(COMM),AVG(NVL(COMM,1000))
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/

 AVG(COMM) AVG(NVL(COMM,1000))
---------- --------------------
   $550.00              $700.00
```

Example 2-52: For department 30, list the average salary of employees that receive a salary, the average commission of employees that receive a commission, the average salary plus commission of only those employees that receive a commission, and average salary plus commission of all employees including those who do not receive a commission.

```
SQL>SELECT  AVG(SAL),AVG(COMM),AVG(SAL+COMM),AVG(SAL+NVL(COMM,0))
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 30
SQL>/

  AVG(SAL)  AVG(COMM) AVG(SAL+COMM) AVG(SAL+NVL(COMM,0))
---------- ---------- ------------- --------------------
 $1,566.67    $550.00     $1,950.00             $1,933.33
```

2.14 **Join Query**

A query may return values from more than one table. The FROM clause may list several tables. The WHERE clause specifies the relationship on which the tables are to be joined.

Example 2-53: List the names of all employees and the locations of their departments.

```
SQL>SELECT  ENAME,LOC
SQL>FROM    EMP,DEPT
SQL>WHERE   EMP.DEPTNO = DEPT.DEPTNO;
SQL>/

ENAME  LOC
------ -------------
CLARK  NEW YORK
MILLER NEW YORK
OATES  NEW YORK
SMITH  SAN FRANCISCO
JONES  SAN FRANCISCO
ADAMS  SAN FRANCISCO
SCOTT  SAN FRANCISCO
FORD   SAN FRANCISCO
ALLEN  CHICAGO
WARD   CHICAGO
BLAKE  CHICAGO
MARTIN CHICAGO
TURNER CHICAGO
JAMES  CHICAGO

14 records selected.
```

Example 2-54: List names of employees and all the fields of the department table for employees in departments located in Chicago.

```
SQL>SELECT  ENAME,DEPT.*
SQL>FROM    EMP,DEPT
SQL>WHERE   EMP.DEPTNO = DEPT.DEPTNO
SQL>  AND   LOC = 'CHICAGO';
SQL>/

ENAME  DEPTNO DNAME          LOC            EMPCNT
------ ------ -------------- ------------- ------
ALLEN      30 SALES          CHICAGO
WARD       30 SALES          CHICAGO
BLAKE      30 SALES          CHICAGO
MARTIN     30 SALES          CHICAGO
TURNER     30 SALES          CHICAGO
JAMES      30 SALES          CHICAGO

6 records selected.
```

Predicates in a WHERE clause may compare data values in columns from any number of tables in a join query.

Example 2-55: List the names and jobs of employees who are not salesmen and work for departments that are located in Chicago.

```
SQL>SELECT  ENAME,JOB,LOC
SQL>FROM    DEPT,EMP
SQL>WHERE   EMP.DEPTNO=DEPT.DEPTNO
SQL>  AND   LOC = 'CHICAGO'
SQL>  AND   JOB ^= 'SALESMAN';
SQL>/

ENAME  JOB        LOC
------ ---------- -------------
BLAKE  MANAGER    CHICAGO
JAMES  CLERK      CHICAGO
```

Example 2-56: List the name, location, salary, job of employees located in Chicago who have the same job as Allen. Sort the results by employee name.

```
SQL>SELECT  ENAME,LOC,SAL,JOB
SQL>FROM    EMP,DEPT
SQL>WHERE   LOC = 'CHICAGO'
SQL>  AND   EMP.DEPTNO = DEPT.DEPTNO
SQL>  AND   JOB =
SQL>        SELECT  JOB
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'ALLEN';
SQL>ORDER BY ENAME;
SQL>/

ENAME  LOC                  SAL JOB
------ ------------- ---------- ----------
ALLEN  CHICAGO        $1,600.00 SALESMAN
MARTIN CHICAGO        $1,250.00 SALESMAN
TURNER CHICAGO        $1,500.00 SALESMAN
WARD   CHICAGO        $1,250.00 SALESMAN
```

2.15 **Self-Join**

A table may be joined with itself by listing the same table more than once in the FROM clause and associating a temporary label with each table. This label is used in place of the table name in qualifying references to columns within the SELECT and FROM clauses in the query block.

Example 2-57: For each employee whose salary exceeds his department's managers's salary, list the employee's name and salary and the manager's name and salary. Within the context of this query, the EMP table is treated logically as if it were two separate tables named WORKER and MGR. However, the EMP table is "not" physically duplicated.

```
SQL>SELECT  WORKER.ENAME,WORKER.SAL,MGR.ENAME,MGR.SAL
SQL>FROM    EMP WORKER,EMP MGR
SQL>WHERE   WORKER.DEPTNO = MGR.DEPTNO
SQL>  AND  [MGR.JOB = 'MANAGER'  AND  WORKER.SAL > MGR.SAL];
SQL>/
```

ENAME	SAL	ENAME	SAL
SCOTT	$3,000.00	JONES	$2,975.00
FORD	$3,000.00	JONES	$2,975.00
OATES	$5,000.00	CLARK	$2,450.00

2.16 **Outer-Join**

When the DEPT table is joined to the EMP table using the join predicate DEPT.DEPTNO = EMP.DEPTNO, a department without any employees would not satisfy the join and would not be returned as a result of the query.

Example 2-58: List all the departments in the DEPT table.

```
SQL>SELECT  *
SQL>FROM    DEPT
SQL>/

DEPTNO DNAME          LOC           EMPCNT
------ -------------- ------------- ------
    10 ADMINISTRATION NEW YORK
    20 RESEARCH       SAN FRANCISCO
    30 SALES          CHICAGO
    40 OPERATIONS     BOSTON
```

Example 2-59: List all the employees in the EMP table.

```
SQL>SELECT  DEPTNO,ENAME,JOB
SQL>FROM    EMP
SQL>ORDER BY DEPTNO
SQL>/

DEPTNO ENAME  JOB
------ ------ ----------
    10 CLARK  MANAGER
    10 OATES  PRESIDENT
    10 MILLER CLERK
    20 SMITH  CLERK
    20 JONES  MANAGER
    20 SCOTT  ANALYST
    20 ADAMS  CLERK
    20 FORD   ANALYST
    30 ALLEN  SALESMAN
    30 WARD   SALESMAN
    30 MARTIN SALESMAN
    30 BLAKE  MANAGER
    30 TURNER SALESMAN
    30 JAMES  CLERK

14 records selected.
```

Example 2-60: Join the DEPT table to the EMP table.

```
SQL>SELECT  DEPT.DEPTNO,DNAME,LOC,ENAME,JOB
SQL>FROM    DEPT,EMP
SQL>WHERE   DEPT.DEPTNO = EMP.DEPTNO
SQL>/

DEPTNO DNAME          LOC           ENAME  JOB
------ -------------- ------------- ------ ----------
    10 ADMINISTRATION NEW YORK      CLARK  MANAGER
    10 ADMINISTRATION NEW YORK      MILLER CLERK
    10 ADMINISTRATION NEW YORK      OATES  PRESIDENT
    20 RESEARCH       SAN FRANCISCO SMITH  CLERK
    20 RESEARCH       SAN FRANCISCO JONES  MANAGER
    20 RESEARCH       SAN FRANCISCO ADAMS  CLERK
    20 RESEARCH       SAN FRANCISCO SCOTT  ANALYST
    20 RESEARCH       SAN FRANCISCO FORD   ANALYST
    30 SALES          CHICAGO       ALLEN  SALESMAN
    30 SALES          CHICAGO       WARD   SALESMAN
    30 SALES          CHICAGO       BLAKE  MANAGER
    30 SALES          CHICAGO       MARTIN SALESMAN
    30 SALES          CHICAGO       TURNER SALESMAN
    30 SALES          CHICAGO       JAMES  CLERK

14 records selected.
```

The result of this join does not include department 40 because department 40 does not have any employees. An "outer-join", will return those department rows that have no matching employees.

Example 2-61: List all departments that have employees, plus those departments that do not have employees.

```
SQL>SELECT  DEPT.DEPTNO,DNAME,LOC,ENAME,JOB
SQL>FROM    DEPT,EMP*
SQL>WHERE   DEPT.DEPTNO = EMP.DEPTNO
SQL>/

DEPTNO DNAME          LOC           ENAME  JOB
------ -------------- ------------- ------ ----------
    10 ADMINISTRATION NEW YORK      CLARK  MANAGER
    10 ADMINISTRATION NEW YORK      MILLER CLERK
    10 ADMINISTRATION NEW YORK      OATES  PRESIDENT
    20 RESEARCH       SAN FRANCISCO SMITH  CLERK
    20 RESEARCH       SAN FRANCISCO JONES  MANAGER
    20 RESEARCH       SAN FRANCISCO ADAMS  CLERK
    20 RESEARCH       SAN FRANCISCO SCOTT  ANALYST
    20 RESEARCH       SAN FRANCISCO FORD   ANALYST
    30 SALES          CHICAGO       ALLEN  SALESMAN
    30 SALES          CHICAGO       WARD   SALESMAN
    30 SALES          CHICAGO       BLAKE  MANAGER
    30 SALES          CHICAGO       MARTIN SALESMAN
    30 SALES          CHICAGO       TURNER SALESMAN
    30 SALES          CHICAGO       JAMES  CLERK
    40 OPERATIONS     BOSTON

15 records selected.
```

The asterisk (*) after the EMP table in the FROM clause indicates that an extra row containing a null value in every column is to be appended to the EMP table when processing this query block. This null row of the EMP table is joined to those DEPT rows that do not have any matching rows in the EMP table.

Example 2-62: List all departments that do not have any employees.

```
SQL>SELECT  UNIQUE DEPT.DEPTNO,DNAME,LOC
SQL>FROM    DEPT,EMP*
SQL>WHERE   DEPT.DEPTNO = EMP.DEPTNO
SQL> AND    EMPNO = NULL
SQL>/

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

The outer-join can be used to join more than two tables, however, at least one table in the join must not be outer-joined. The table that is not outer-joined must be listed first in the FROM clause.

3. DATA MANIPULATION FACILITIES

3.1 INSERT

The INSERT statement specifies the adding of a new row or set of rows into a table.

Example 3-1: Insert a new employee named Carter with an employee number of 7989, a job title of salesman, salary of 1500, and commission of 0, into department 30.

```
SQL>INSERT  INTO EMP(EMPNO,ENAME,JOB,SAL,COMM,DEPTNO):
SQL>        <7989,'CARTER','SALESMAN',1500,0,30>;
SQL>/
1 record created.
```

All fields do not have to be included in the INSERT statement.

Example 3-2: Insert a new employee named Wilson, employee number 7955, in department 20, having all other fields null.

```
SQL>INSERT  INTO EMP(EMPNO,ENAME,DEPTNO):
SQL>        <7955,'WILSON',20>;
SQL>/
1 record created.
```

If all fields are present in the right order, the list of column names may be omitted.

Example 3-3: Insert a new employee into named Jakes into the EMP table.

```
SQL>INSERT  INTO EMP:
SQL>        <7956,'JAKES','CLERK',1000,NULL,20>;
SQL>/
1 record created.

SQL>SELECT  *
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 20;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO
7369	SMITH	CLERK	$800.00		20
7566	JONES	MANAGER	$2,975.00		20
7876	ADAMS	CLERK	$1,100.00		20
7788	SCOTT	ANALYST	$3,000.00		20
7902	FORD	ANALYST	$3,000.00		20
7955	WILSON				20
7956	JAKES	CLERK	$1,000.00		20

```
7 records selected.
```

An INSERT statement may store the result of a query into an existing table.

Example 3-4: Add to the BONUS table all those employees whose commission is greater than 25% of their salary, or those employees who have the job title of president or manager.

```
SQL>INSERT INTO BONUS:
SQL>         SELECT  ENAME,JOB,SAL,COMM
SQL>         FROM    EMP
SQL>         WHERE   COMM > 0.25 * SAL
SQL>           OR    JOB IN <'PRESIDENT','MANAGER'>;
SQL>/
6 records created.
```

Example 3-5: List the BONUS table.

```
SQL>SELECT  *
SQL>FROM    BONUS;
SQL>/
```

ENAME	JOB	SAL	COMM
BLAKE	MANAGER	$2,850.00	
CLARK	MANAGER	$2,450.00	
JONES	MANAGER	$2,975.00	
MARTIN	SALESMAN	$1,250.00	$1,400.00
OATES	PRESIDENT	$5,000.00	
WARD	SALESMAN	$1,250.00	$500.00

6 records selected.

3.2 **UPDATE**

Update is a process of changing the values of fields within the data base. The rows to be updated are specified by means of a WHERE clause. The updates to be made are specified in a SET clause.

Example 3-6: Set employee number 7782's salary to $2,750.

```
SQL>UPDATE  EMP
SQL>SET     SAL = 2750
SQL>WHERE   EMPNO = 7782;
SQL>/
1 record updated.

SQL>SELECT  * FROM  EMP WHERE EMPNO=7782;
SQL>/

EMPNO ENAME  JOB              SAL       COMM DEPTNO
----- ------ ---------- ---------- ---------- ------
 7782 CLARK  MANAGER     $2,750.00               10
```

A SET clause may update multiple fields within a table.

Example 3-7: Update department 30's location to Paris and increase its employee count by two.

```
SQL>UPDATE  DEPT
SQL>SET     LOC = 'PARIS',EMPCNT=NVL(EMPCNT,0) + 2
SQL>WHERE   DEPTNO = 30;
SQL>/
1 record updated.

SQL>SELECT  *
SQL>FROM    DEPT;
SQL>/

DEPTNO DNAME          LOC           EMPCNT
------ -------------- ------------- ------
    10 ADMINISTRATION NEW YORK
    20 RESEARCH       SAN FRANCISCO
    30 SALES          PARIS              2
    40 OPERATIONS     BOSTON
```

Example 3-8: Update the employee table by giving a 15% raise to all employees whose names appear in the BONUS table.

```
SQL>UPDATE  EMP
SQL>SET     SAL = SAL * 1.15
SQL>WHERE   ENAME IN
SQL>        SELECT  ENAME
SQL>        FROM    BONUS;
SQL>/
6 records updated.

SQL>SELECT * FROM EMP;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO
7369	SMITH	CLERK	$800.00		20
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30
7521	WARD	SALESMAN	$1,437.50	$500.00	30
7566	JONES	MANAGER	$3,421.25		20
7654	MARTIN	SALESMAN	$1,437.50	$1,400.00	30
7698	BLAKE	MANAGER	$3,277.50		30
7782	CLARK	MANAGER	$3,162.50		10
7788	SCOTT	ANALYST	$3,000.00		20
7839	OATES	PRESIDENT	$5,750.00		10
7844	TURNER	SALESMAN	$1,500.00	$0.00	30
7876	ADAMS	CLERK	$1,100.00		20
7900	JAMES	CLERK	$950.00		30
7902	FORD	ANALYST	$3,000.00		20
7934	MILLER	CLERK	$1,300.00		10
7955	WILSON				20
7956	JAKES	CLERK	$1,000.00		20
7989	CARTER	SALESMAN	$1,500.00	$0.00	30

17 records selected.

3.3 **DELETE**

DELETE removes rows from tables in the data base.

Example 3-9: Delete the employee named Oates from the BONUS table.

```
SQL>DELETE  BONUS
SQL>WHERE   ENAME = 'OATES';
SQL>/
1 record deleted.

SQL>SELECT  *  FROM BONUS;
SQL>/

ENAME  JOB              SAL        COMM
------ ---------- ---------- ----------
BLAKE  MANAGER     $2,850.00
CLARK  MANAGER     $2,450.00
JONES  MANAGER     $2,975.00
MARTIN SALESMAN    $1,250.00  $1,400.00
WARD   SALESMAN    $1,250.00    $500.00
```

The WHERE clause in a DELETE statement may contain a query block.

Example 3-10: Delete from the BONUS table all the employees with the same job as Jones.

```
SQL>DELETE  BONUS
SQL>WHERE   JOB IN
SQL>        SELECT  JOB
SQL>        FROM    EMP
SQL>        WHERE   ENAME = 'JONES';
SQL>/
3 records deleted.

SQL>SELECT  * FROM BONUS;
SQL>/

ENAME  JOB              SAL        COMM
------ ---------- ---------- ----------
MARTIN SALESMAN    $1,250.00  $1,400.00
WARD   SALESMAN    $1,250.00    $500.00
```

A DELETE statement without a WHERE clause specifies the removal of all rows in the table.

Example 3-11: Delete all rows from the BONUS table.

```
SQL>DELETE  BONUS;
SQL>/
2 records deleted.

SQL>SELECT  * FROM BONUS;
SQL>/

ENAME  JOB                 SAL        COMM
------ ---------- ---------- ----------

no records selected
```

4. DATA DEFINITION FACILITIES

This section of the manual describes the CREATE TABLE, EXPAND TABLE DEFINE VIEW, and DROP facilities of the system.

4.1 CREATE TABLE

Example 4-1: Display projects table.

```
SQL>SELECT  *
SQL>FROM    PROJ;
SQL>/
FROM    PROJ;
        ^
invalid table name                                    [*** ERROR ***]
```

Example 4-2: Create a new table to contain project number, name, and budget information.

```
SQL>CREATE  TABLE PROJ
SQL>        PROJNO(NUMBER NONULL IMAGE UNIQUE),
SQL>        PNAME(CHAR(10) IMAGE),
SQL>        BUDGET(NUMBER),
SQL>        EMPCNT(NUMBER);
SQL>/
Table created.

SQL>SELECT  *
SQL>FROM    PROJ;
SQL>/

PROJNO PNAME          BUDGET EMPCNT
------ ------- ------------ ------

no records selected
```

Example 4-3: Insert three projects into the project table.

```
SQL>INSERT INTO PROJ(PROJNO,PNAME,BUDGET):
SQL>        <101,'ALPHA',250000>;
SQL>/
1 record created.

SQL>INSERT INTO PROJ(PROJNO,PNAME,BUDGET):
SQL>        <102,'BETA',175000>;
SQL>/
1 record created.

SQL>INSERT INTO PROJ(PROJNO,PNAME,BUDGET):
SQL>        <103,'GAMMA',95000>;
SQL>/
1 record created.

SQL>SELECT  *
SQL>FROM    PROJ;
SQL>/

PROJNO PNAME          BUDGET EMPCNT
------ ------- ------------ ------
   101 ALPHA    $250,000.00
   102 BETA     $175,000.00
   103 GAMMA     $95,000.00
```

4.2 **DROP TABLE**

Tables and views may be dropped dynamically.

Example 4-4: Drop the BONUS table from the data base.

```
SQL>DROP TABLE BONUS;
SQL>/
Table dropped.
```

4.3 **EXPAND TABLE**

Example 4-5: An existing table may be expanded by adding a new column to it.

```
SQL>SELECT  EMPNO,DEPTNO,PROJNO,ENAME
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 10;
SQL>/
SELECT  EMPNO,DEPTNO,PROJNO,ENAME
                     ^
invalid column name                                    [*** ERROR ***]
```

Example 4-6: Add a new project number column to the employee table.

```
SQL>EXPAND  TABLE EMP
SQL>        ADD COLUMN PROJNO(NUMBER IMAGE);
SQL>/
Table expanded.

SQL>SELECT  EMPNO,ENAME,PROJNO,DEPTNO
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 10;
SQL>/

EMPNO ENAME  PROJNO DEPTNO
----- ------ ------ ------
 7782 CLARK             10
 7934 MILLER            10
 7839 OATES             10
```

Example 4-7: Update the employee table by assigning employees to projects.

```
SQL>UPDATE  EMP
SQL>SET     PROJNO = 101
SQL>WHERE   DEPTNO = 20
SQL>    OR  JOB = 'MANAGER';
SQL>/
10 records updated.

SQL>SELECT  *
SQL>FROM    EMP
SQL>WHERE   PROJNO = 101;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO	PROJNO
7369	SMITH	CLERK	$800.00		20	101
7566	JONES	MANAGER	$3,421.25		20	101
7698	BLAKE	MANAGER	$3,277.50		30	101
7782	CLARK	MANAGER	$3,162.50		10	101
7876	ADAMS	CLERK	$1,100.00		20	101
7788	SCOTT	ANALYST	$3,000.00		20	101
7902	FORD	ANALYST	$3,000.00		20	101
7955	WILSON				20	101
7956	JAKES	CLERK	$1,000.00		20	101

```
9 records selected.

SQL>UPDATE  EMP
SQL>SET     PROJNO  = 102
SQL>WHERE   EMPNO > 7700
SQL>  AND   NOT PROJNO = 101;
SQL>/
5 records updated.
```

Example 4-8: The PROJ table may now be joined to the EMP table.

```
SQL>SELECT  ENAME,PNAME
SQL>FROM    EMP,PROJ
SQL>WHERE   EMP.PROJNO = PROJ.PROJNO;
SQL>/

ENAME  PNAME
------ -------
SMITH  ALPHA
JONES  ALPHA
BLAKE  ALPHA
CLARK  ALPHA
ADAMS  ALPHA
SCOTT  ALPHA
FORD   ALPHA
WILSON ALPHA
JAKES  ALPHA
TURNER BETA
MILLER BETA
OATES  BETA
JAMES  BETA
CARTER BETA
ALLEN  GAMMA
WARD   GAMMA
MARTIN GAMMA

17 records selected.
```

4.4 DEFINE VIEW

Alternative views of stored data may be defined. Any vaild query may be used in the definition of a view.

Example 4-9: Define a view called EMP10 containing employee number, name, job and project number information for employees in department 10.

```
SQL>DEFINE  VIEW EMP10 AS
SQL>        SELECT  EMPNO,ENAME,JOB,PROJNO
SQL>        FROM    EMP
SQL>        WHERE   DEPTNO = 10;
SQL>/
View defined.

SQL>SELECT  *
SQL>FROM    EMP10;
SQL>/

EMPNO ENAME  JOB         PROJNO
----- ------ ---------- ------
 7782 CLARK  MANAGER        101
 7934 MILLER CLERK          102
 7839 OATES  PRESIDENT      102
```

Example 4-10: A view can contain more than one table.

```
SQL>DEFINE  VIEW PROJSTAFF(EMPLOYEE,PROJECT) AS
SQL>        SELECT  ENAME,PNAME
SQL>        FROM    EMP,PROJ
SQL>        WHERE   EMP.PROJNO = PROJ.PROJNO;
SQL>/
View defined.

SQL>SELECT  *
SQL>FROM    PROJSTAFF;
SQL>/

EMPLOYEE PROJECT
-------- -------
SMITH    ALPHA
JONES    ALPHA
BLAKE    ALPHA
CLARK    ALPHA
ADAMS    ALPHA
SCOTT    ALPHA
FORD     ALPHA
WILSON   ALPHA
JAKES    ALPHA
TURNER   BETA
MILLER   BETA
OATES    BETA
JAMES    BETA
CARTER   BETA
ALLEN    GAMMA
WARD     GAMMA
MARTIN   GAMMA

17 records selected.
```

When defining a view, ORACLE may draw the column names from the underlying tables or the user may rename the columns as in the example below.

Example 4-11: Define a view containing information from the project, employee, and department table.

```
SQL>DEFINE  VIEW PROJECTS (PROJECT,EMPLOYEE,EMP#,LOCATION) AS
SQL>        SELECT  PNAME,ENAME,EMPNO,LOC
SQL>        FROM    PROJ,EMP,DEPT
SQL>        WHERE   EMP.DEPTNO = DEPT.DEPTNO
SQL>          AND   EMP.PROJNO = PROJ.PROJNO;
SQL>/
View defined.
```

Example 4-12: Views may be selectively queried in the same way as a table.

```
SQL>SELECT  PROJECT,EMPLOYEE,LOCATION
SQL>FROM    PROJECTS
SQL>WHERE   LOCATION = 'NEW YORK';
SQL>/

PROJECT EMPLOYEE LOC
------- -------- -------------
ALPHA   CLARK    NEW YORK
BETA    MILLER   NEW YORK
BETA    OATES    NEW YORK
```

Example 4-13: Views may be joined to tables or other views.

```
SQL>SELECT  ENAME,JOB,PNAME
SQL>FROM    PROJ,EMP10
SQL>WHERE   PROJ.PROJNO=EMP10.PROJNO
SQL>  AND   JOB ^= 'CLERK'
SQL>/

ENAME  JOB        PNAME
------ ---------- -------
CLARK  MANAGER    ALPHA
OATES  PRESIDENT  BETA
```

Views may be defined in terms of other views.

Example 4-14: Define a view containing the name of projects and employees located in Paris.

```
SQL>DEFINE  VIEW PARIS (NAME,PROJ) AS
SQL>        SELECT  EMPLOYEE,PROJECT
SQL>        FROM    PROJECTS
SQL>        WHERE   LOCATION = 'PARIS';
SQL>/
View defined.

SQL>SELECT  *
SQL>FROM    PARIS;
SQL>/

NAME   PROJ
------ ----------
ALLEN  GAMMA
WARD   GAMMA
BLAKE  ALPHA
MARTIN GAMMA
TURNER BETA
JAMES  BETA
CARTER BETA

7 records selected.
```

4.5 **Virtual-Fields**

A view may contain arithmetic expressions or built in functions. These expressions or functions appear to the user of the view as "virtual fields." When expressions or functions are used within a view, column names must be specified for the view.

Example 4-15: Define a view containing employee name, salary, annual salary, and department number.

```
SQL>DEFINE  VIEW PAY (NAME,SAL,COMM,ASAL,DEPTNO) AS
SQL>        SELECT  ENAME,SAL,COMM,SAL * 12,DEPTNO
SQL>        FROM    EMP;
SQL>/
View defined.
```

Example 4-16: List salary information for employees in department 30.

```
SQL>SELECT  *
SQL>FROM    PAY
SQL>WHERE   DEPTNO = 30
SQL>/
```

NAME	SAL	COMM	ASAL	DEPTNO
ALLEN	$1,600.00	$300.00	$19,200.00	30
WARD	$1,437.50	$500.00	$17,250.00	30
BLAKE	$3,277.50		$39,330.00	30
MARTIN	$1,437.50	$1,400.00	$17,250.00	30
TURNER	$1,500.00	$0.00	$18,000.00	30
JAMES	$950.00		$11,400.00	30
CARTER	$1,500.00	$0.00	$18,000.00	30

7 records selected.

Example 4-17: Define a view containing a departments minimum, average, maximum, and total compensation.

```
SQL>DEFINE  VIEW DEPT_SAL (DEPTNO,LOSAL,MEDSAL,HISAL,TOTSAL) AS
SQL>        SELECT  DEPTNO,MIN(SAL),AVG(SAL),MAX(SAL),SUM(SAL)
SQL>        FROM    EMP
SQL>        GROUP BY DEPTNO;
SQL>/
View defined.
```

Example 4-18: List minimum, average, and total salary for each department.

```
SQL>SELECT  DEPTNO,LOSAL,HISAL,TOTSAL
SQL>FROM    DEPT_SAL
SQL>/
```

DEPTNO	LOSAL	HISAL	TOTSAL
10	$1,300.00	$5,750.00	$10,212.50
20	$800.00	$3,421.25	$12,321.25
30	$950.00	$3,277.50	$11,702.50

5. DATA STRUCTURES

Create a data structure that allows one employee to work on many projects, and one project to have many employees.

Example 5-1: Create a two column table relating employees to projects.

```
SQL>CREATE  TABLE PE
SQL>        EMPNO(NUMBER NONULL IMAGE),
SQL>        PROJNO(NUMBER NONULL IMAGE);
SQL>/
Table created.
```

Example 5-2: Move the relationship between employees and projects from the EMP table to the PE table.

```
SQL>INSERT  INTO PE(EMPNO,PROJNO):
SQL>        SELECT EMPNO,PROJNO
SQL>        FROM    EMP;
SQL>/
17 records created.

SQL>SELECT  *
SQL>FROM    PE;
SQL>/

EMPNO PROJNO
----- ------
 7369    101
 7499    103
 7521    103
 7566    101
 7654    103
 7698    101
 7782    101
 7788    101
 7839    102
 7844    102
 7876    101
 7900    102
 7902    101
 7934    102
 7955    101
 7956    101
 7989    102

17 records selected.
```

Example 5-3: Delete the data from the PROJNO column of the EMP table.

```
SQL>UPDATE  EMP
SQL>SET     PROJNO = NULL;
SQL>/
17 records updated.

SQL>SELECT  *
SQL>FROM    EMP;
SQL>/
```

EMPNO	ENAME	JOB	SAL	COMM	DEPTNO	PROJNO
7369	SMITH	CLERK	$800.00		20	
7499	ALLEN	SALESMAN	$1,600.00	$300.00	30	
7521	WARD	SALESMAN	$1,437.50	$500.00	30	
7566	JONES	MANAGER	$3,421.25		20	
7654	MARTIN	SALESMAN	$1,437.50	$1,400.00	30	
7698	BLAKE	MANAGER	$3,277.50		30	
7782	CLARK	MANAGER	$3,162.50		10	
7788	SCOTT	ANALYST	$3,000.00		20	
7839	OATES	PRESIDENT	$5,750.00		10	
7844	TURNER	SALESMAN	$1,500.00	$0.00	30	
7876	ADAMS	CLERK	$1,100.00		20	
7900	JAMES	CLERK	$950.00		30	
7902	FORD	ANALYST	$3,000.00		20	
7934	MILLER	CLERK	$1,300.00		10	
7955	WILSON				20	
7956	JAKES	CLERK	$1,000.00		20	
7989	CARTER	SALESMAN	$1,500.00	$0.00	30	

17 records selected.

Example 5-4: The new structure requires that the EMP table be joined to the PROJ table via the PE table.

```
SQL>SELECT  ENAME,PNAME
SQL>FROM    EMP,PROJ,PE
SQL>WHERE   EMP.EMPNO = PE.EMPNO
SQL>  AND   PROJ.PROJNO = PE.PROJNO;
SQL>/

ENAME  PNAME
------ -------
SMITH  ALPHA
ALLEN  GAMMA
WARD   GAMMA
JONES  ALPHA
MARTIN GAMMA
BLAKE  ALPHA
CLARK  ALPHA
SCOTT  ALPHA
OATES  BETA
TURNER BETA
ADAMS  ALPHA
JAMES  BETA
FORD   ALPHA
MILLER BETA
WILSON ALPHA
JAKES  ALPHA
CARTER BETA

17 records selected.
```

The new data structure with the PE table allows employees to be assigned to more than one project.

Example 5-5: Assign employee 7989 to projects 101 and 103, and employee 7956 to project 102.

```
SQL>INSERT  INTO PE:
SQL>        <7989,101>;
SQL>/
1 record created.

SQL>INSERT  INTO PE:
SQL>        <7989,103>;
SQL>/
1 record created.

SQL>INSERT  INTO PE:
SQL>        <7956,103>;
SQL>/
1 record created.
```

Example 5-6: List the projects for employees 7956 and 7989.

```
SQL>SELECT  ENAME,EMP.EMPNO,PNAME,PROJ.PROJNO
SQL>FROM    EMP,PROJ,PE
SQL>WHERE  [EMP.EMPNO = PE.EMPNO  AND  PROJ.PROJNO = PE.PROJNO]
SQL>  AND   EMP.EMPNO = <7956,7989>;
SQL>/

ENAME   EMPNO PNAME    PROJNO
------ ----- ------- ------
JAKES    7956 ALPHA      101
JAKES    7956 GAMMA      103
CARTER   7989 BETA       102
CARTER   7989 ALPHA      101
CARTER   7989 GAMMA      103
```

6. DATA INDEPENDENCE

The view facility within ORACLE in combination with the non-procedural nature of the SQL data language allows the user's programs to be independent to changes in data structure.

A new PROJSTAFF view can be defined on the new data structure. The new view will contain the same information as the old PROJSTAFF view only the definition of the view will be different. Users of the old PROJSTAFF view will be insulated from the change.

Example 6-1: Drop the old PROJSTAFF view.

```
SQL>DROP    VIEW PROJSTAFF;
SQL>/
View dropped.
```

Example 6-2: Define a new PROJSTAFF view that joins the EMP table to the PROJ table via the PE table.

```
SQL>DEFINE VIEW PROJSTAFF(EMPLOYEE,PROJECT) AS
SQL>SELECT  ENAME,PNAME
SQL>FROM    EMP,PROJ,PE
SQL>WHERE   EMP.EMPNO = PE.EMPNO
SQL>  AND   PROJ.PROJNO = PE.PROJNO;
SQL>/
View defined.
```

Example 6-3: Queries that used the old PROJSTAFF view continue to run without modification once the new PROJSTAFF view has been defined even though the structure of the data base has been altered.

```
SQL>SELECT  *
SQL>FROM    PROJSTAFF
SQL>WHERE   PROJECT = 'GAMMA';
SQL>/

EMPLOYEE PNAME
-------- -------
ALLEN    GAMMA
WARD     GAMMA
MARTIN   GAMMA
CARTER   GAMMA
JAKES    GAMMA
```

7. OPERATIONS ON TREE-STRUCTURED TABLES

The EMP table does not contain all the information necessary to define the "reporting structure" between the employees in the EMP table. This is because the EMP table does not identify each employee's direct supervisor. In order to store this reporting structure information, the EMP table has to be expanded.

Example 7-1: Add a new column called SUPR to the EMP table.

```
SQL>EXPAND  TABLE EMP
SQL>        ADD COLUMN SUPR(NUMBER IMAGE);
SQL>/
Table expanded.
```

Example 7-2: Assign a supervisor to each employee except OATES.

```
SQL>UPDATE  EMP
SQL>SET     SUPR=7839
SQL>WHERE   EMPNO=7782
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7839
SQL>WHERE   EMPNO=7566
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7839
SQL>WHERE   EMPNO=7698
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7782
SQL>WHERE   EMPNO=7934
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7566
SQL>WHERE   EMPNO=7788
SQL>/
1 record updated.
```

Continue assigning supervisors to employees.

```
SQL>UPDATE  EMP
SQL>SET     SUPR=7566
SQL>WHERE   EMPNO=7902
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7566
SQL>WHERE   EMPNO=7955
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7788
SQL>WHERE   EMPNO=7876
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7902
SQL>WHERE   EMPNO=7369
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7955
SQL>WHERE   EMPNO=7956
SQL>/
1 record updated.
```

Continue assigning supervisors to employees.

```
SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7499
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7521
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7654
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7844
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7900
SQL>/
1 record updated.

SQL>UPDATE  EMP
SQL>SET     SUPR=7698
SQL>WHERE   EMPNO=7989
SQL>/
1 record updated.
```

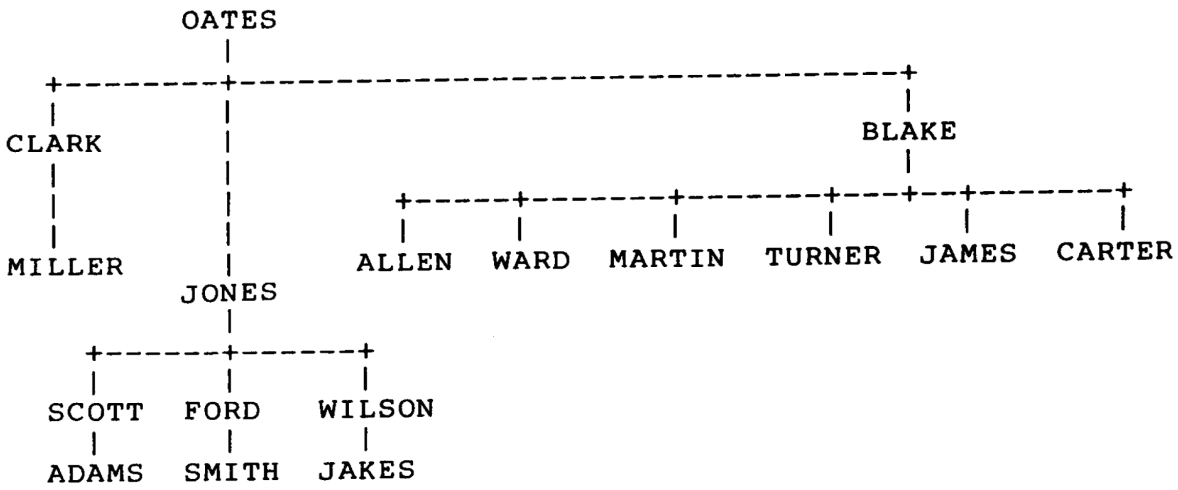
Example 7-3: List the reporting structure information from the EMP table including each employees name, number, department, and his supervisor's number.

```
SQL>SELECT  ENAME,EMPNO,SUPR,DEPTNO
SQL>FROM    EMP
SQL>/
```

ENAME	EMPNO	SUPR	DEPTNO
SMITH	7369	7902	20
ALLEN	7499	7698	30
WARD	7521	7698	30
JONES	7566	7839	20
MARTIN	7654	7698	30
BLAKE	7698	7839	30
CLARK	7782	7839	10
SCOTT	7788	7566	20
OATES	7839		10
TURNER	7844	7698	30
ADAMS	7876	7788	20
JAMES	7900	7698	30
FORD	7902	7566	20
MILLER	7934	7782	10
WILSON	7955	7566	20
JAKES	7956	7955	20
CARTER	7989	7698	30

17 records selected.

When considering the reporting structure information contained in the EMP table, it may be useful to think of the EMP table as tree-structured or hierarchical as in the diagram below.



7.1 **CONNECT BY**

ORACLE provides a unique set of operators that allows the user to query these "Tree-Structured" tables. Operations on tree-structured tables include three clauses: START WITH, CONNECT BY, and INCLUDING. CONNECT BY and START WITH are required clauses; INCLUDING is an optional clause.

The CONNECT BY clause indicates the two columns within the table that contain the information necessary to logically specify the structure of the tree. The START WITH clause indicates the leaf within the tree (row within the table) that the query is to start.

Example 7-4: Find all the people who work directly or indirectly for JONES.

```
SQL>SELECT UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM   EMP
SQL>START  WITH ENAME = 'JONES'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>/

ENAME  EMPNO JOB         DEPTNO  SUPR
------ ----- ---------- ------ -----
JONES   7566 MANAGER         20  7839
SCOTT   7788 ANALYST         20  7566
FORD    7902 ANALYST         20  7566
WILSON  7955                 20  7566
ADAMS   7876 CLERK           20  7788
SMITH   7369 CLERK           20  7902
JAKES   7956 CLERK           20  7955

7 records selected.
```

A query may "walk" the tree in either the UP or DOWN direction. The user specifies the direction the tree is to be walked by means of the PRIOR keyword within the CONNECT BY clause. In this example, if the PRIOR is placed before EMPNO, the tree is walked in the down direction. If the PRIOR is placed before SUPR, the tree is walked in the UP direction.

Example 7-5: List all the people in the reporting structure above SMITH.

```
SQL>SELECT UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM   EMP
SQL>START WITH ENAME = 'SMITH'
SQL>CONNECT BY   EMPNO = PRIOR  SUPR
SQL>/

ENAME  EMPNO JOB         DEPTNO  SUPR
------ ----- ---------- ------ -----
SMITH   7369 CLERK          20  7902
FORD    7902 ANALYST        20  7566
JONES   7566 MANAGER        20  7839
OATES   7839 PRESIDENT      10
```

Example 7-6: SELECT UNIQUE must be specified when walking the tree in the UP direction.

7.2 **START WITH**

The START WITH clause can reference more than one starting point within the tree.

Example 7-7: List all the people who work for CLARK or BLAKE.

```
SQL>SELECT  UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM    EMP
SQL>START   WITH ENAME = 'CLARK'
SQL>  OR    ENAME = 'BLAKE'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>ORDER   BY DEPTNO
SQL>/
```

ENAME	EMPNO	JOB	DEPTNO	SUPR
CLARK	7782	MANAGER	10	7839
MILLER	7934	CLERK	10	7782
BLAKE	7698	MANAGER	30	7839
ALLEN	7499	SALESMAN	30	7698
WARD	7521	SALESMAN	30	7698
MARTIN	7654	SALESMAN	30	7698
TURNER	7844	SALESMAN	30	7698
JAMES	7900	CLERK	30	7698
CARTER	7989	SALESMAN	30	7698

9 records selected.

Example 7-8: List all the people who work for people who have the same job as SCOTT.

```
SQL>SELECT  UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM    EMP
SQL>START   WITH JOB IN
SQL>        SELECT   JOB
SQL>        FROM     EMP
SQL>        WHERE    ENAME = 'SCOTT';
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>/
```

ENAME	EMPNO	JOB	DEPTNO	SUPR
SCOTT	7788	ANALYST	20	7566
FORD	7902	ANALYST	20	7566
ADAMS	7876	CLERK	20	7788
SMITH	7369	CLERK	20	7902

7.3 **INCLUDING**

As a tree is being walked, a predicate or set of predicates can be applied to individual leafs of the tree or entire branches of the tree. The INCLUDING clause is used to qualify or disqualify leafs of the tree. The WHERE clause is used to "prune" entire branches of the tree.

Example 7-9: List all the people who work for JONES except SCOTT.

```
SQL>SELECT      UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM        EMP
SQL>START       WITH ENAME = 'JONES'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>INCLUDING  ENAME ^= 'SCOTT'
SQL>/
```

ENAME	EMPNO	JOB	DEPTNO	SUPR
JONES	7566	MANAGER	20	7839
FORD	7902	ANALYST	20	7566
WILSON	7955		20	7566
ADAMS	7876	CLERK	20	7788
SMITH	7369	CLERK	20	7902
JAKES	7956	CLERK	20	7955

6 records selected.

Example 7-10: List all the employees that work for JONES except SCOTT and the people who work for SCOTT.

```
SQL>SELECT UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM   EMP
SQL>WHERE  ENAME ^= 'SCOTT'
SQL>START  WITH ENAME = 'JONES'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>/
```

ENAME	EMPNO	JOB	DEPTNO	SUPR
JONES	7566	MANAGER	20	7839
FORD	7902	ANALYST	20	7566
WILSON	7955		20	7566
SMITH	7369	CLERK	20	7902
JAKES	7956	CLERK	20	7955

Note that ADAMS, who works for SCOTT was eliminated when SCOTT was pruned using the WHERE clause. ADAMS was not eliminated when SCOTT was excluded using the INCLUDING clause.

A query on a tree-structured table can contain both a WHERE clause and an INCLUDING clause. First, the tree is logically formed using the CONNECT BY clause; Second, the tree is walked in the direction specified by the PRIOR keyword in the CONNECT BY clause starting with the leaf specified in the START WITH clause; Third, the WHERE clause is applied to each leaf of the tree (row of the table) to prune branches from the tree; Fourth, the INCLUDING clause is applied to each leaf of the tree to qualify or disqualify individual rows.

Example 7-11: List all the employees that work for JONES except SCOTT and the people who work for SCOTT, and FORD.

```
SQL>SELECT UNIQUE ENAME,EMPNO,JOB,DEPTNO,SUPR
SQL>FROM   EMP
SQL>WHERE  ENAME ^= 'SCOTT'
SQL>START  WITH ENAME = 'JONES'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>INCLUDING ENAME ^= 'FORD'
SQL>/

ENAME  EMPNO JOB         DEPTNO  SUPR
------ ----- ---------- ------ -----
JONES   7566 MANAGER        20  7839
WILSON  7955                20  7566
SMITH   7369 CLERK          20  7902
JAKES   7956 CLERK          20  7955
```

Queries on tree-structured tables can include joins.

Example 7-12: List all the employees and the location of their departments that work for JONES except SCOTT and the people who work for SCOTT, and FORD.

```
SQL>SELECT UNIQUE ENAME,LOC,EMPNO,JOB,DEPT.DEPTNO,SUPR
SQL>FROM   EMP,DEPT
SQL>WHERE  EMP.DEPTNO = DEPT.DEPTNO
SQL>AND  ENAME ^= 'SCOTT'
SQL>START  WITH ENAME = 'JONES'
SQL>CONNECT BY PRIOR EMPNO = SUPR
SQL>INCLUDING ENAME ^= 'FORD'
SQL>/

ENAME  LOC           EMPNO JOB         DEPTNO  SUPR
------ ------------- ----- ---------- ------ -----
JONES  SAN FRANCISCO  7566 MANAGER        20  7839
WILSON SAN FRANCISCO  7955                20  7566
SMITH  SAN FRANCISCO  7369 CLERK          20  7902
JAKES  SAN FRANCISCO  7956 CLERK          20  7955
```

8. SECURITY FACILITIES

ORACLE supports both secure and nonsecure data bases. If a data base is defined as secure, that data base's dictionary contains information about the users of the data base in addition to a description of data stored within the data base. This allows ORACLE to control access to the data base on a user by access privilege basis.

An ORACLE data base is created by means of the DBF utility program. At the time a data base is created, the creating user specifies whether the data base is to be secure or nonsecure. If the data base is to be secure, the creating user specifies a USER-NAME and PASSWORD to DBF. The data base used in this manual is a secure data base created with the following DBF command:

```
DBF C PERSONNEL PERSONNEL.DBS 2048 SCOTT/TIGER
```

Initially, only the creating user, SCOTT with a PASSWORD of TIGER is authorized to operate on the PERSONNEL data base. All the SQL example operations prior to this section of the manual have been issued by the fully authorized creating user, SCOTT.

8.1 DEFINE USER

The creator of a secure data base can authorize additional users of the data base by means of the DEFINE USER command. A defined user of the data base is authorized to log on to the data base, create his own tables, define views on his tables, and define new users of the data base.

ORACLE security facilities prevent unauthorized users from logging on the secure PERSONNEL data base.

Have user SCOTT log off of the PERSONNEL data base and attempt to log on as user ADAMS with a password of WOOD.

Example 8-1: Log on to the PERSONNEL data base as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

The creator of the PERSONNEL data base, in this case SCOTT, can authorize additional users to log on to the data base by means of the DEFINE USER command.

Example 8-2: Define a new user of the PERSONNEL data base with a USER-NAME of ADAMS and a PASSWORD of WOOD.

```
SQL>DEFINE  USER ADAMS/WOOD
SQL>/
User defined.
```

After a user has been defined, that user may log on to the data base.

Example 8-3: Log on as user ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

A new user can create his own tables, define views on his tables, and define new users of the data base.

Example 8-4: Have user ADAMS create a new table and insert a record into it.

```
SQL>CREATE  TABLE PARTS
SQL>        PARTNO(NUMBER IMAGE UNIQUE),
SQL>        PART_NAME(CHAR(10));
SQL>/
Table created.

SQL>INSERT INTO PARTS:
SQL>        <1,'WIDGET'>;
SQL>/
1 record created.
```

8.2 **GRANT PRIVILEGE**

The ORACLE security facilities enable users to control access to their data by other users. It is the responsibility of the user who creates a table or view to control access to that table or view. A user may extend access to his table or view by means of the GRANT command.

Even though user ADAMS can create his own tables he can not access data via tables and views created by other users unless specifically authorized.

Example 8-5: Have user ADAMS attempt to list the DEPT table.

```
SQL>SELECT  *
SQL>FROM    DEPT
SQL>/
FROM    DEPT
        ^
invalid table name                                    [*** ERROR ***]
```

At this point ADAMS is not authorized to access the DEPT table and is told that the table does not exist.

Example 8-6: Log back on as user SCOTT, the creator of the EMP and DEPT tables.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 8-7: Authorize user ADAMS to READ the DEPT table.

```
SQL>GRANT   READ
SQL>ON      DEPT
SQL>TO      ADAMS
SQL>/
Privileges granted.
```

Example 8-8: Log on as user ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 8-9: Have ADAMS list the DEPT table.

```
SQL>SELECT  *
SQL>FROM    DEPT
SQL>/

DEPTNO DNAME          LOC            EMPCNT
------ -------------- -------------- ------
    10 ADMINISTRATION NEW YORK
    20 RESEARCH       SAN FRANCISCO
    30 SALES          PARIS               2
    40 OPERATIONS     BOSTON
```

Example 8-10: Have ADAMS list the PARTS table he created.

```
SQL>SELECT  *
SQL>FROM    PARTS
SQL>/

PARTNO PART_N
------ ------
     1 WIDGET
```

Example 8-11: Log on as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 8-12: Have user SCOTT attempt to list the PARTS table.

```
SQL>SELECT  *
SQL>FROM    PARTS
SQL>/
FROM    PARTS
        ^
invalid table name                                  [*** ERROR ***]
```

Even though user SCOTT defined user ADAMS to the PERSONNEL data base, SCOTT is not allowed to see data stored in tables created by ADAMS unless specifically authorized to do so by means of a GRANT privilege command.

8.3 **PRIVILEGES**

The following privileges may be granted: READ, INSERT, DELETE, UPDATE (by column), and EXPAND. In addition, the grantor may allow the grantee to GRANT the listed privileges to other users.

Example 8-13: Log back on as user SCOTT. #COMMENT #DBS PERSONNEL SCOTT/TIGER #COMMENT *** Give the following privileges on the EMP table to user ADAMS: the right to READ, INSERT, and UPDATE only the JOB, and DEPTNO columns.

```
SQL>GRANT   READ,INSERT,UPDATE(JOB,DEPTNO)
SQL>ON      EMP
SQL>TO      ADAMS
SQL>/
Privileges granted.
```

Example 8-14: Log on as ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 8-15: Have ADAMS update the EMP table.

```
SQL>UPDATE  EMP
SQL>SET     JOB='ANALYST'
SQL>WHERE   ENAME='WILSON'
SQL>/
1 record updated.
```

Example 8-16: Have ADAMS attempt to UPDATE both the JOB and SAL column of the EMP table.

```
SQL>UPDATE EMP
SQL>SET JOB='ANALYST',SAL=100000
SQL>WHERE ENAME='WILSON'
SQL>/
SET JOB='ANALYST',SAL=100000
                  ^
security violation                                  [*** ERROR ***]
```

ORACLE security facilities detect a security violation and indicate the column of the EMP table that ADAMS was not authorized to UPDATE.

The phrase ALL RIGHTS may be substituted for the privilege list in the GRANT statement.

Example 8-17: Have ADAMS grant SCOTT all privileges on the PARTS table.

```
SQL>GRANT   ALL RIGHTS
SQL>ON      PARTS
SQL>TO      SCOTT
SQL>/
Privileges granted.
```

The phrase ALL BUT can be specified preceding a privilege list.

Example 8-18: Log on as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 8-19: Give ADAMS all the privileges on the DEPT table except EXPAND, along with the right to GRANT these privileges to other users.

```
SQL>GRANT   ALL BUT EXPAND
SQL>ON      DEPT
SQL>TO      ADAMS
SQL>WITH GRANT OPTION
SQL>/
Privileges granted.
```

Privileges can be granted to all users by specifying PUBLIC in place of the user list.

Example 8-20: Give all users READ privileges on the PROJSTAFF view.

```
SQL>GRANT   READ
SQL>ON      PROJSTAFF
SQL>TO      PUBLIC
SQL>/
Privileges granted.
```

Note that the only privilege that may be granted on a view is the READ privilege.

8.4 **USER Keyword**

ORACLE requires users to enter their name and password in order to log on to a secure data base. ORACLE maintains the name of the current user as a keyword constant called USER. The keyword USER may be specified in a SQL statement anywhere a constant is allowed. USER will always return the name of the currently logged on user.

The USER keyword can be specified in the WHERE clause of a SQL statement to control access to the data base. This is especially useful when defining views on the data base.
#WORKSIZE 8

Example 8-21: Define a view of the EMP table allowing any employee to see his own department number, name, salary, commission, and job but not any information about any other employee.

```
SQL>DEFINE  VIEW MYSELF AS
SQL>        SELECT  *
SQL>        FROM    EMP
SQL>        WHERE   ENAME = USER;
SQL>/
View defined.
```

Example 8-22: Give all users access to the MYSELF view.

```
SQL>GRANT   READ
SQL>ON      MYSELF
SQL>TO      PUBLIC
SQL>/
Privileges granted.
```

The USER keyword will always return the USER-NAME of the user currently logged on to the data base.

Example 8-23: Have user SCOTT query the MYSELF view.

```
SQL>SELECT  *
SQL>FROM    MYSELF
SQL>/

EMPNO ENAME  JOB              SAL        COMM DEPTNO PROJNO  SUPR
----- ------ --------- ---------- ---------- ------ ------ -----
 7788 SCOTT  ANALYST    $3,000.00                20         7566
```

Example 8-24: Log on as user ADAMS and query the MYSELF view.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
SQL>SELECT  *
SQL>FROM    MYSELF
SQL>/

EMPNO ENAME  JOB              SAL        COMM DEPTNO PROJNO  SUPR
----- ------ --------- ---------- ---------- ------ ------ -----
 7876 ADAMS  CLERK      $1,100.00                20         7788
```

Example 8-25: Define a view giving managers access to employees in their department only if the manager earns the same amount or more that the employee.

```
SQL>DEFINE  VIEW MY_EMPS (NAME,JOB,SAL,COMM,DEPTNO) AS
SQL>SELECT  WORKER.ENAME,WORKER.JOB,WORKER.SAL,WORKER.COMM,
SQL>SELECT  WORKER.DEPTNO
SQL>FROM    EMP WORKER,EMP MGR
SQL>WHERE   WORKER.DEPTNO = MGR.DEPTNO
SQL>  AND   [MGR.JOB = 'MANAGER'  AND MGR.SAL >= WORKER.SAL]
SQL>  AND   MGR.ENAME=USER;
SQL>/
SELECT  WORKER.DEPTNO
        ^
missing 'from' keyword                                  [*** ERROR ***]
```

Example 8-26: Define JONES and CLARK as users of the PERSONNEL data base.

```
SQL>DEFINE  USER JONES/WOOD
SQL>/
User defined.

SQL>DEFINE  USER CLARK/CLOTH
SQL>/
User defined.
```

Example 8-27: Grant all users access to the MY_EMPS view. Note that the view will only return data if the user's JOB = MANAGER.

```
SQL>GRANT   READ
SQL>ON      MY_EMPS
SQL>TO      PUBLIC
SQL>/
TO      PUBLIC
        ^
security violation                                      [*** ERROR ***]
```

Example 8-28: Have user ADAMS,who is not a manager attempt to query the MY_EMPS view.

```
SQL>SELECT  *
SQL>FROM    MY_EMPS
SQL>/
FROM    MY_EMPS
        ^
invalid table name                                    [*** ERROR ***]
```

Example 8-29: Have users JONES and CLARK, who are managers, query the MY_EMPS view.

```
SQL>#DBS PERSONNEL JONES/WOOD
Database 'PERSONNEL' opened.
SQL>SELECT  *
SQL>FROM    MY_EMPS
SQL>/
FROM    MY_EMPS
        ^
invalid table name                                    [*** ERROR ***]
```

Example 8-30: The view only allows the manager to see people in their own department.

```
SQL>#DBS PERSONNEL CLARK/CLOTH
Database 'PERSONNEL' opened.
SQL>SELECT  *
SQL>FROM    MY_EMPS
SQL>/
FROM    MY_EMPS
        ^
invalid table name                                    [*** ERROR ***]
```

Note that CLARK was not able to see employee OATES because the view prevents managers from seeing anyone in their department who earns more than they do.

8.5 **REVOKE Privilege**

Once a privilege has been granted it may be withdrawn by means of the REVOKE command. Privileges are revoked from the named grantee and from all users to whom he has granted them.

Example 8-31: Log on the PERSONNEL data base as user ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 8-32: Have ADAMS INSERT a new department into the DEPT table.

```
SQL>INSERT  INTO DEPT:
SQL>        <50,'SERVICE','DETROIT',NULL>
SQL>/
1 record created.
```

Example 8-33: Log on the PERSONNEL data base as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 8-34: Revoke from ADAMS the right to INSERT into the DEPT table.

```
SQL>REVOKE  INSERT
SQL>ON      DEPT
SQL>FROM    ADAMS
SQL>/
Privileges revoked.
```

Example 8-35: Log on the PERSONNEL data base as user ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 8-36: Have ADAMS attempt to INSERT a new department into the DEPT table.

```
SQL>INSERT  INTO DEPT:
SQL>        <60,'DEVELOPMENT','PORTLAND',NULL>
SQL>/
INSERT  INTO DEPT:
             ^
invalid table name                                  [*** ERROR ***]
```

9. DATA DICTIONARY STRUCTURE

This section of the manual contains a description of ORACLE's integrated data dictionary.

The ORACLE data dictionary is made up of several system defined tables and views. These dictionary tables are dynamically updated by ORACLE to contain a current description of all user tables, views, and access privileges. In addition, the ORACLE dictionary is self describing. Therefore, a user may query the dictionary to determine the names of the tables that make up the dictionary.

DTAB contains the names and a description of the dictionary tables. DCOL contains the names of the columns of the dictionary tables.

Example 9-1: List the names and a description of the tables in the dictionary.

```
SQL>SELECT  *
SQL>FROM    DTAB
SQL>/

TABLE      COMMENT
---------- ----------------------------------------
COL        COLUMN NAMES OF USERS TABLES AND VIEWS
COLDEF     DEFINITION OF COLUMNS IN USERS TABLES
DCOL       COLUMN NAMES OF DICTIONARY TABLES
DTAB       COMMENTS ON DICTIONARY TABLES
DTABLES    DESCRIPTION OF DICTIONARY TABLES
EXPDEF     COLUMN DEFINITIONS USED BY EXPORT
GRANTS     ACCESS PRIVILEGES GRANTED BY USER
PRIVS      ACCESS PRIVILEGES HELD BY USER
TAB        NAMES OF USERS TABLES AND VIEWS
USERS      NAME OF USERS YOU DEFINED
VIEWS      DEFINITIONS OF VIEWS
VXREF      CROSS-REFERENCE OF VIEWS OF TABLES

12 records selected.
```

Example 9-2: List the names of the columns of the dictionary tables.

```
SQL>SELECT  *
SQL>FROM    DCOL
SQL>/

TABLE       COLUMN
----------- ---------
TAB         TABLE
TAB         TYPE
TAB         CREATOR
TAB         GRANTEE
COL         TABLE
COL         COLUMN
COLDEF      TABLE
COLDEF      COLUMN
COLDEF      DATATYPE
COLDEF      LENGTH
COLDEF      IMAGE
COLDEF      NONULL
EXPDEF      TABLE
EXPDEF      COLID
EXPDEF      COLUMN
EXPDEF      DATATYPE
EXPDEF      LENGTH
EXPDEF      IMAGE
EXPDEF      NONULL
VIEWS       VIEW
VIEWS       TEXT
VXREF       VIEW
VXREF       TABLE
USERS       USER
USERS       OWNER
DTAB        TABLE
DTAB        COMMENT
DTABLES     TABLE
DTABLES     TYPE
DTABLES     CREATOR
DTABLES     GRANTEE
DCOL        TABLE
DCOL        COLUMN
GRANTS      TABLE
GRANTS      COLUMN
GRANTS      GRANTEE
GRANTS      ACCESS
PRIVS       TABLE
PRIVS       COLUMN
PRIVS       GRANTOR
PRIVS       ACCESS

41 records selected.
```

The dictionary table TAB allows a user to list the names of all the tables and views that that user has access privileges on. TAB also indicates if the table is a view, the name of the user who created the table (or view), and the grantee of the privileges.

Example 9-3: List user ADAM's tables.

```
SQL>SELECT  *
SQL>FROM    TAB
SQL>/

TABLE       TYPE  CREATOR GRANTEE
----------- ----- ------- -------
PARTS       TABLE ADAMS   ADAMS
DEPT        TABLE SCOTT   ADAMS
EMP         TABLE SCOTT   ADAMS
PROJSTAFF   VIEW  SCOTT   PUBLIC
MYSELF      VIEW  SCOTT   PUBLIC
```

Example 9-4: Log on as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 9-5: List user SCOTT's table.

```
SQL>SELECT  *
SQL>FROM    TAB
SQL>/

TABLE       TYPE  CREATOR GRANTEE
----------- ----- ------- -------
EMP         TABLE SCOTT   SCOTT
DEPT        TABLE SCOTT   SCOTT
PROJ        TABLE SCOTT   SCOTT
EMP10       VIEW  SCOTT   SCOTT
PROJECTS    VIEW  SCOTT   SCOTT
PARIS       VIEW  SCOTT   SCOTT
PAY         VIEW  SCOTT   SCOTT
DEPT_SAL    VIEW  SCOTT   SCOTT
PE          TABLE SCOTT   SCOTT
PROJSTAFF   VIEW  SCOTT   SCOTT
PARTS       TABLE ADAMS   SCOTT
MYSELF      VIEW  SCOTT   SCOTT
PROJSTAFF   VIEW  SCOTT   PUBLIC
MYSELF      VIEW  SCOTT   PUBLIC

14 records selected.
```

Example 9-6: The dictionary table COL contains the names of the columns of user defined tables.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 9-7: List the names of the columns of user ADAMS' tables.

```
SQL>SELECT  *
SQL>FROM    COL
SQL>/

TABLE       COLUMN
----------- ---------
PARTS       PARTNO
PARTS       PART_NAME
DEPT        DEPTNO
DEPT        DNAME
DEPT        LOC
DEPT        EMPCNT
EMP         EMPNO
EMP         ENAME
EMP         JOB
EMP         SAL
EMP         COMM
EMP         DEPTNO
EMP         PROJNO
EMP         SUPR
PROJSTAFF   EMPLOYEE
PROJSTAFF   PROJECT
MYSELF      EMPNO
MYSELF      ENAME
MYSELF      JOB
MYSELF      SAL
MYSELF      COMM
MYSELF      DEPTNO
MYSELF      PROJNO
MYSELF      SUPR

24 records selected.
```

Example 9-8: Log on as user SCOTT.

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

The dictionary table COLDEF contains the definition of columns in user tables.

Example 9-9: List the definition of the columns in the EMP table.

```
SQL>SELECT  COLUMN,DATATYPE,LENGTH,IMAGE,NONULL
SQL>FROM    COLDEF
SQL>WHERE   TABLE = 'EMP'
SQL>/

COLUMN     DATATYPE LENGTH IMAGE      NON
---------- -------- ------ ---------- ---
EMPNO      NUMBER       22 UNIQUE     YES
ENAME      CHAR         10 NON-UNIQUE NO
JOB        CHAR          9 NON-UNIQUE NO
SAL        NUMBER       22            NO
COMM       NUMBER       22            NO
DEPTNO     NUMBER       22 NON-UNIQUE NO
PROJNO     NUMBER       22 NON-UNIQUE NO
SUPR       NUMBER       22 NON-UNIQUE NO

8 records selected.
```

VIEWS is the dictionary table that contains the SQL text of the DEFINE VIEW statement. Comments that were entered as a part of the SQL view definition are also stored in VIEWS.

Example 9-10: List the definition of the PROJECTS view.

```
SQL>SELECT  *
SQL>FROM    VIEWS
SQL>WHERE   VIEW = 'PROJECTS';
SQL>/

VIEW       TEXT
---------- ------------------------------------------------
PROJECTS   DEFINE  VIEW PROJECTS (PROJECT,EMPLOYEE,EMP#,LOC
PROJECTS   ATION) AS
PROJECTS            SELECT  PNAME,ENAME,EMPNO,LOC
PROJECTS            FROM    PROJ,EMP,DEPT
PROJECTS            WHERE   EMP.DEPTNO = DEPT.DEPTNO
PROJECTS              AND   EMP.PROJNO = PROJ.PROJNO;

6 records selected.
```

The VXREF dictionary table defines the relationship of user views to underlying tables and views. The first column contains the name of the view. The second column contains the name of the underlying table or view.

Example 9-11: List a cross reference of views and their base tables.

```
SQL>SELECT  *
SQL>FROM    VXREF
SQL>/

VIEW       TABLE
---------- ----------
EMP10      EMP
PROJECTS   EMP
PAY        EMP
DEPT_SAL   EMP
PROJSTAFF  EMP
MYSELF     EMP
PROJECTS   DEPT
PROJECTS   PROJ
PROJSTAFF  PROJ
PARIS      PROJECTS
PROJSTAFF  PE

11 records selected.
```

The ORACLE dictionary allows users to obtain information about only those tables that the user has access privilges on. The user may also determine: the names of users he has directly or indirectly defined, the access privileges he holds, and the access privileges he has directly or indirectly granted.

The USERS table contains the names of all those users that were defined by the user who is currently logged on to the system. The first column in the USERS table contains the name of the defined user. The second column of the USERS table contains the name of the creating user.

Example 9-12: List the names of the users that originated with SCOTT.

```
SQL>SELECT  *
SQL>FROM    USERS
SQL>/

USER  OWNER
----- ------
ADAMS SCOTT
JONES ADAMS
CLARK ADAMS
```

User ADAMS was defined directly by user SCOTT, but users JONES and CLARK were defined by ADAMS and thereby indirectly by SCOTT.

Example 9-13: Log on as user ADAMS.

```
SQL>#DBS PERSONNEL ADAMS/WOOD
Database 'PERSONNEL' opened.
```

Example 9-14: List the users that originated with ADAMS.

```
SQL>SELECT  *
SQL>FROM    USERS
SQL>/

USER  OWNER
----- ------
JONES ADAMS
CLARK ADAMS
```

The PRIVS table contains access privileges held by users of the data base. Each user can only see the privileges he holds. The PRIVS table contains: the name of the table the privileges are on, the name of the column the privileges apply to, the name user who granted the privileges, and the privilege mask described below. A PRIVS table entry will only contain a column name if update privileges have been granted on a column column rather than a table basis.

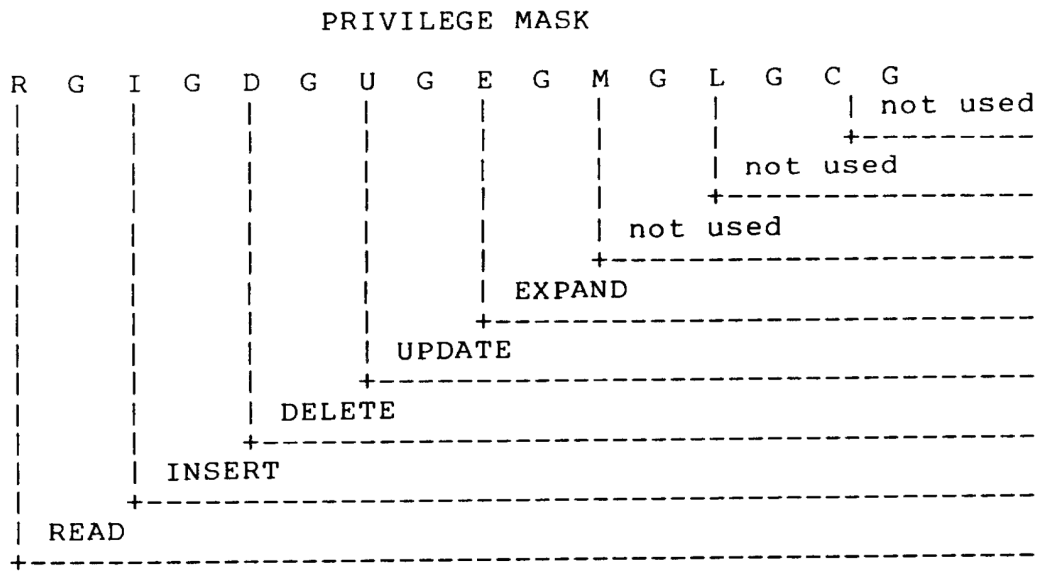
Example 9-15: List all the privileges held by ADAMS.

```
SQL>SELECT  *
SQL>FROM    PRIVS
SQL>/

TABLE       COLUMN     GRANTOR ACCESS
----------- ---------- ------- ----------------
PARTS                  ADAMS   RGIGDGUGEGMGLGCG
DEPT                   SCOTT   RGXXDGUGXXMGLGCG
EMP                    SCOTT   RXIXXXXXXXXXXXX
EMP         JOB        SCOTT   XXXXXXUXXXXXXXX
EMP         DEPTNO     SCOTT   XXXXXXUXXXXXXXX
TAB                    ORACLE  RXXXXXXXXXXXXXX
COL                    ORACLE  RXXXXXXXXXXXXXX
COLDEF                 ORACLE  RXXXXXXXXXXXXXX
EXPDEF                 ORACLE  RXXXXXXXXXXXXXX
VIEWS                  ORACLE  RXXXXXXXXXXXXXX
VXREF                  ORACLE  RXXXXXXXXXXXXXX
USERS                  ORACLE  RXXXXXXXXXXXXXX
DTAB                   ORACLE  RXXXXXXXXXXXXXX
DTABLES                ORACLE  RXXXXXXXXXXXXXX
DCOL                   ORACLE  RXXXXXXXXXXXXXX
GRANTS                 ORACLE  RXXXXXXXXXXXXXX
PRIVS                  ORACLE  RXXXXXXXXXXXXXX
PROJSTAFF              SCOTT   RXXXXXXXXXXXXXX
MYSELF                 SCOTT   RXXXXXXXXXXXXXX

19 records selected.
```

Note that ADAMS has all privileges on MY_EMPS and PARTS, the table and view he created. He has all but INSERT and EXPAND on the DEPT table. He has READ and INSERT without the GRANT option, and UPDATE on the JOB and DEPTNO columns of the EMP table. The diagram below describes the entries in the ACCESS column of both the PRIVS and GRANTS dictionary tables.



The G following each privilege flag indicates that the GRANT OPTION is present for that privilege. If an X is present for any privilege or grant flag, that privilege was not granted.

The GRANTS table indicates the privileges granted either directly or indirectly by the current user. The GRANTS table contains: the name of the table the privileges are on, the name of the column the privileges apply to, the name of the user who is the grantee of the privileges, and the privilege mask. A GRANTS table entry will only contain a column name if update privileges have been granted on a column rather than a table basis.

Example 9-16: List all the privileges granted by ADAMS.

```
SQL>SELECT  *
SQL>FROM    GRANTS
SQL>/

TABLE      COLUMN    GRANTEE ACCESS
---------- --------- ------- ----------------
PARTS                ADAMS   RGIGDGUGEGMGLGCG
PARTS                SCOTT   RXIXDXUXEXMXLXCX
```

9.1 **Dictionary Extensions**

The user is free to expand the ORACLE data dictionary by creating additional tables, and defining views of the user tables joined to the system defined dictionary tables and views.

Example 9-17: Create a dictionary extension to contain comments on user defined tables.

```
SQL>CREATE  TABLE TAB_COM
SQL>        TABLE(CHAR(20) IMAGE UNIQUE),
SQL>        COMMENT(CHAR(35))
SQL>/
Table created.
```

Example 9-18: Enter a comment on the EMP table into the TAB_COM table.

```
SQL>INSERT  INTO TAB_COM:
SQL>        <'EMP','Information about company employees'>
SQL>/
1 record created.
```

Example 9-19: Define a view joining TAB from the dictionary to the TAB_COM table.

```
SQL>DEFINE  VIEW TABC AS
SQL>        SELECT  TAB.TABLE,TYPE,CREATOR,COMMENT
SQL>        FROM    TAB,TAB_COM
SQL>        WHERE   TAB.TABLE=TAB_COM.TABLE;
SQL>/
View defined.

SQL>#WORKSIZE 12
```

Example 9-20: List the characteristics of the EMP table.

```
SQL>SELECT  *
SQL>FROM    TABC
SQL>WHERE   TABLE = 'EMP'
SQL>/

----------------------------------------------------------------
TYPE  CREATOR COMMENT
----- ------- ---------------------------------------

EMP
TABLE SCOTT   Information about company employees
```

10. Concurrency Control Facilities

ORACLE allows multiple user to concurrently UPDATE the same table in a data base. Yet, ORACLE does not require a user to issue locking statements or statements of intent to update. The setting and clearing of locks are the responsibility of ORACLE.

No explicit lock requests are required to insure that concurrent UPDATE operations do not read the same row of a table and attempt to write back that row. ORACLE automatically places locks on individual records to synchronize UPDATE operations preventing the updates from overwriting each other.

A user may not wish to operate on data that has been modified by an operation that is still in progress. To accomplish this serialization the user can place his SQL request between BEGIN TRANSACTION and END TRANSACTION statements.

In addition, placing several SQL statements inside a transaction causes ORACLE to execute these SQL statements as an "atomic act" without permitting interference (UPDATES to the same tables) by other users during the transaction.

ORACLE's automatic update synchronization locks a record (row of a table) at a time. USER requested transactions lock a table at a time.

Example 10-1: Log on as user SCOTT

```
SQL>#DBS PERSONNEL SCOTT/TIGER
Database 'PERSONNEL' opened.
```

Example 10-2: Begin a transaction to calculate the average salaries of each job group within the EMP table.

```
SQL>BEGIN TRANSACTION
SQL>ON TABLE EMP READ
SQL>/
Transaction begun.

SQL>SELECT  JOB,AVG(SAL)
SQL>FROM    EMP
SQL>GROUP BY JOB
SQL>/

JOB           AVG(SAL)
---------- ----------
ANALYST     $3,000.00
CLERK       $1,030.00
MANAGER     $3,287.08
PRESIDENT   $5,750.00
SALESMAN    $1,495.00

SQL>END TRANSACTION
SQL>/
Transaction ended.
```

In the above READ TRANSACTION, all UPDATE activity on the EMP table was suspended for the life of the transaction. All READ activity on the EMP table was allowed to continue concurrently.

Example 10-3: Execute an UPDATE TRANSACTION that gives all employees with the job of ANALYST a 10% raise.

```
SQL>BEGIN TRANSACTION
SQL>ON TABLE EMP UPDATE
SQL>/
Transaction begun.

SQL>UPDATE  EMP
SQL>SET     SAL = SAL * 1.10
SQL>WHERE   JOB = 'ANALYST'
SQL>/
3 records updated.

SQL>END TRANSACTION
SQL>/
Transaction ended.
```

In the above UPDATE TRANSACTION, all UPDATE activity on the EMP table was suspended for the life of the transaction. In addition, all READ transactions on the EMP table also waited for the UPDATE transaction to complete. READ activity on the EMP table that was not a part of a TRANSACTION was allowed to continue concurrently.

Placing several SQL statements inside a transaction causes ORACLE to execute these SQL statements as a "atomic act" without permitting interference (UPDATES to the same tables) by other users during the transaction.

Example 10-4: SELECT the count of employees in department 20 from the EMP table, and UPDATE the DEPT table with the result.

```
SQL>BEGIN TRANSACTION
SQL>ON TABLE EMP READ, DEPT UPDATE
SQL>/
Transaction begun.

SQL>SELECT  COUNT(*)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 20
SQL>/

COUNT(*)
--------
       7

SQL>UPDATE  DEPT
SQL>SET     EMPCNT = 7
SQL>WHERE   DEPTNO = 20
SQL>/
1 record updated.

SQL>END TRANSACTION
SQL>/
Transaction ended.
```

If the above transaction had been done from within a program it could have used from one to three cursors: one for the BEGIN TRANSACTION, one for the query on the EMP table, and one for the UPDATE of the DEPT table.

TRANSACTIONS may be nested. If they are nested, they must be numbered.

Example 10-5: SELECT the count of employees in department 20 from the EMP table and UPDATE the DEPT table with the result as a nested transaction rather than a single transaction.

```
SQL>BEGIN TRANSACTION 1
SQL>ON TABLE EMP READ
SQL>/
Transaction begun.

SQL>SELECT  COUNT(*)
SQL>FROM    EMP
SQL>WHERE   DEPTNO = 20
SQL>/

COUNT(*)
--------
       7

SQL>BEGIN TRANSACTION 2
SQL>ON TABLE DEPT UPDATE
SQL>/
Transaction begun.

SQL>UPDATE  DEPT
SQL>SET     EMPCNT = 7
SQL>WHERE   DEPTNO = 20
SQL>/
1 record updated.

SQL>END TRANSACTION 2
SQL>/
Transaction ended.

SQL>END TRANSACTION 1
SQL>/
Transaction ended.
```

In doing the above operation as a nested transaction rather than a single transaction, the DEPT table was not locked during the query on the EMP table. This allowed update activity to continue on the DEPT table while the EMP table was being queried. This could be significant depending on the length of time it takes the query to execute. However, the nesting of transactions creates the possibility that TRANSACTION 2 will have to wait for access to the DEPT table which may be locked by another ongoing transaction. The nesting of transactions creates the possibility of deadlock. Doing the entire operation as one transaction has no potential for deadlock because once a transaction has begun, it has acquired all the data resources required for completion.

It is important to remember that the above query/update operation could have been done three different ways: 1) without placing them within a transaction; 2) as a single transaction; 3) as a nested transaction. It is up to the user to decide what level of serialization of operations he requires for a particular application.

The following chart indicates what operations on a table wait, and what operations continue when a READ, READ TRANSACTION, UPDATE OR UPDATE TRANSACTION is active on that table.

CONCURRENCY CONTROL TABLE

	READ	READ TRANS	UPDATE	UPDATE TRANS
READ	ALLOWED	ALLOWED	ALLOWED	ALLOWED
READ TRANS	ALLOWED	ALLOWED	SUSPENDED	SUSPENDED
UPDATE	ALLOWED	SUSPENDED	ALLOWED	SUSPENDED
UPDATE TRANS	ALLOWED	SUSPENDED	SUSPENDED	SUSPENDED