



# Chapter 6

## INTRODUCTION TO STRUCTURED QUERY LANGUAGE (SQL)

- What is query
- The function of query
- SQL as DDL
  - Create DB
  - Creating table using SQL
  - Create view
  - Alter table
  - Drop table
  - Add column to a table
  - Delete column from a table
- SQL as DML
  - Select data
  - Delete data
  - Insert data
  - Update data
- Using aggregate function in SQL- AVG, COUNT, MAX, MIN, SUM
- Sorting and Grouping with SQL – ORDER BY..., GROUP BY...



## In this chapter, you will learn:

The basic commands and functions of SQL

How to use SQL for data administration (to create tables, indexes, and views)

How to use SQL for data manipulation (to add, modify, delete, and retrieve data)

How to use SQL to query a database to extract useful information



# Introduction to SQL

SQL functions fit into two broad categories:

- Data definition language

- SQL includes commands to:

- Create database objects, such as tables, indexes, and views

- Define access rights to those database objects

- Data manipulation language

- Includes commands to insert, update, delete, and retrieve data within database tables



# Introduction to SQL (continued)

SQL is relatively easy to learn

Basic command set has vocabulary of less than 100 words

Nonprocedural language

American National Standards Institute (ANSI)

prescribes a standard SQL

Several SQL dialects exist

# Introduction to SQL (continued)

**TABLE 7.1** SQL Data Definition Commands

COMMAND OR OPTION	DESCRIPTION
CREATE SCHEMA AUTHORIZATION	Creates a database schema
CREATE TABLE	Creates a new table in the user's database schema
NOT NULL	Ensures that a column will not have null values
UNIQUE	Ensures that a column will not have duplicate values
PRIMARY KEY	Defines a primary key for a table
FOREIGN KEY	Defines a foreign key for a table
DEFAULT	Defines a default value for a column (when no value is given)
CHECK	Constraint used to validate data in an attribute
CREATE INDEX	Creates an index for a table
CREATE VIEW	Creates a dynamic subset of rows/columns from one or more tables
ALTER TABLE	Modifies a table's definition (adds, modifies, or deletes attributes or constraints)
CREATE TABLE AS	Creates a new table based on a query in the user's database schema
DROP TABLE	Permanently deletes a table (and thus its data)
DROP INDEX	Permanently deletes an index
DROP VIEW	Permanently deletes a view



# Introduction to SQL (continued)

TABLE  
7.2

SQL Data Manipulation Commands

COMMAND OR OPTION	DESCRIPTION
INSERT	Inserts row(s) into a table
SELECT	Selects attributes from rows in one or more tables or views
WHERE	Restricts the selection of rows based on a conditional expression
GROUP BY	Groups the selected rows based on one or more attributes
HAVING	Restricts the selection of grouped rows based on a condition
ORDER BY	Orders the selected rows based on one or more attributes
UPDATE	Modifies an attribute's values in one or more table's rows
DELETE	Deletes one or more rows from a table
COMMIT	Permanently saves data changes
ROLLBACK	Restores data to their original values

# Introduction to SQL (continued)

TABLE  
7.2

SQL Data Manipulation Commands (continued)

COMMAND OR OPTION	DESCRIPTION
<b>COMPARISON OPERATORS</b>	
=, <, >, <=, >=, <>	Used in conditional expressions
<b>LOGICAL OPERATORS</b>	
AND/OR/NOT	Used in conditional expressions
<b>SPECIAL OPERATORS</b>	Used in conditional expressions
BETWEEN	Checks whether an attribute value is within a range
IS NULL	Checks whether an attribute value is null
LIKE	Checks whether an attribute value matches a given string pattern
IN	Checks whether an attribute value matches any value within a value list
EXISTS	Checks whether a subquery returns any rows
DISTINCT	Limits values to unique values
<b>AGGREGATE FUNCTIONS</b>	Used with SELECT to return mathematical summaries on columns
COUNT	Returns the number of rows with non-null values for a given column
MIN	Returns the minimum attribute value found in a given column
MAX	Returns the maximum attribute value found in a given column
SUM	Returns the sum of all values for a given column
AVG	Returns the average of all values for a given column



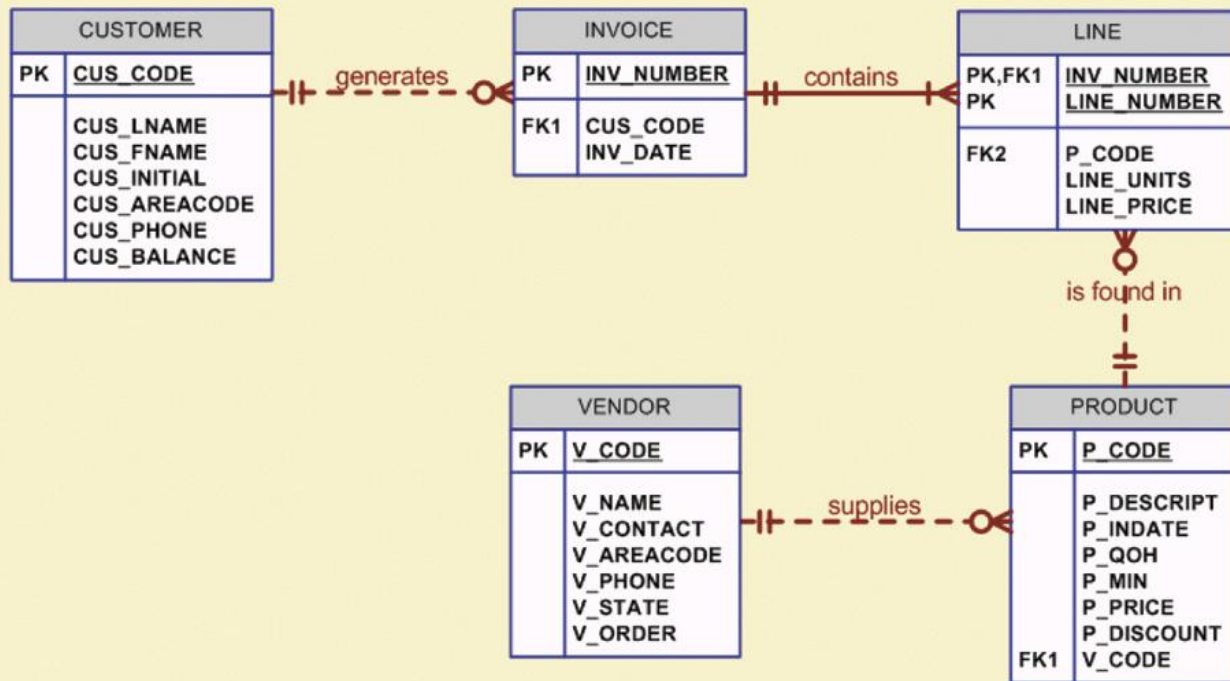
# Data Definition Commands

Examine simple database model and database tables that will form basis for many SQL examples

Understand data environment

# The Database Model

FIGURE 7.1 The database model



# The Database Model (continued)

**FIGURE 7.2** The **VENDOR** and **PRODUCT** tables

Table name: **VENDOR**

Database name: Ch07\_SaleCo

	V_CODE	V_NAME	V_CONTACT	V_AREACODE	V_PHONE	V_STATE	V_ORDER
▶ +	21225	Bryson, Inc.	Smithson	615	223-3234	TN	Y
+	21226	SuperLoo, Inc.	Flushing	904	215-8995	FL	N
+	21231	D&E Supply	Singh	615	228-3245	TN	Y
+	21344	Gomez Bros.	Ortega	615	889-2546	KY	N
+	22567	Dome Supply	Smith	901	678-1419	GA	N
+	23119	Randssets Ltd.	Anderson	901	678-3998	GA	Y
+	24004	Brockman Bros.	Browning	615	228-1410	TN	N
+	24288	ORDVA, Inc.	Hakford	615	898-1234	TN	Y
+	25443	B&K, Inc.	Smith	904	227-0093	FL	N
+	25501	Damal Supplies	Smythe	615	890-3529	TN	N
+	25595	Rubicon Systems	Orton	904	456-0092	FL	Y

Table name: **PRODUCT**

	P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
▶ +	10ER31	Power painter, 15 psi., 3-nozzle	03-Nov-05	8	5	109.99	0.00	25595
+	13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-05	32	15	14.99	0.05	21344
+	14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-05	18	12	17.49	0.00	21344
+	1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-06	15	8	39.95	0.00	23119
+	1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-Jan-06	23	5	43.99	0.00	23119
+	2232/QTY	B&D jigsaw, 12-in. blade	30-Dec-05	8	5	109.92	0.05	24288
+	2232/QWE	B&D jigsaw, 8-in. blade	24-Dec-05	6	5	99.87	0.05	24288
+	2238/QPD	B&D cordless drill, 1/2-in.	20-Jan-06	12	5	38.95	0.05	25595
+	23109-HB	Claw hammer	20-Jan-06	23	10	9.95	0.10	21225
+	23114-AA	Sledge hammer, 12 lb.	02-Jan-06	8	5	14.40	0.05	
+	54778-2T	Rat-tail file, 1/8-in. fine	15-Dec-05	43	20	4.99	0.00	21344
+	89-WRE-Q	Hicut chain saw, 16 in.	07-Feb-06	11	5	256.99	0.05	24288
+	PVC23DRT	PVC pipe, 3.5-in., 8-ft.	20-Feb-06	188	75	5.87	0.00	
+	SM-18277	1.25-in. metal screw, 25	01-Mar-06	172	75	6.99	0.00	21225
+	SW-23116	2.5-in. wd. screw, 50	24-Feb-06	237	100	8.45	0.00	21231
+	WR3/TT3	Steel matting, 4'x8'x1/8", .5" mesh	17-Jan-06	18	5	119.95	0.10	25595



# Creating the Database

Following two tasks must be completed:

- Create database structure
- Create tables that will hold end-user data

First task:

- RDBMS creates physical files that will hold database
- Tends to differ substantially from one RDBMS to another



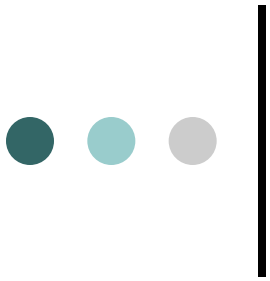
# The Database Schema

## Authentication

- Process through which DBMS verifies that only registered users are able to access database
- Log on to RDBMS using user ID and password created by database administrator

## Schema

- Group of database objects—such as tables and indexes—that are related to each other



# Data Types

Data type selection is usually dictated by nature of data and by intended use

Pay close attention to expected use of attributes for sorting and data retrieval purposes

# Data Types (continued)

TABLE  
7.4

Some Common SQL Data Types

DATA TYPE	FORMAT	COMMENTS
<b>Numeric</b>	NUMBER(L,D)	The declaration NUMBER(7,2) indicates numbers that will be stored with two decimal places and may be up to six digits long, including the sign and the decimal place. Examples: 12.32, -134.99.
	INTEGER	May be abbreviated as INT. Integers are (whole) counting numbers, so they cannot be used if you want to store numbers that require decimal places.
	SMALLINT	Like INTEGER, but limited to integer values up to six digits. If your integer values are relatively small, use SMALLINT instead of INT.
	DECIMAL(L,D)	Like the NUMBER specification, but the storage length is a <i>minimum</i> specification. That is, greater lengths are acceptable, but smaller ones are not. DECIMAL(9,2), DECIMAL(9), and DECIMAL are all acceptable.
<b>Character</b>	CHAR(L)	Fixed-length character data for up to 255 characters. If you store strings that are not as long as the CHAR parameter value, the remaining spaces are left unused. Therefore, if you specify CHAR(25), strings such as "Smith" and "Katzenjammer" are each stored as 25 characters. However, a U.S. area code is always three digits long, so CHAR(3) would be appropriate if you wanted to store such codes.
	VARCHAR(L) or VARCHAR2(L)	Variable-length character data. The designation VARCHAR2(25) will let you store characters up to 25 characters long. However, VARCHAR will not leave unused spaces. Oracle users may use VARCHAR2 as well as VARCHAR.
<b>Date</b>	DATE	Stores dates in the Julian date format.



# Creating Table Structures

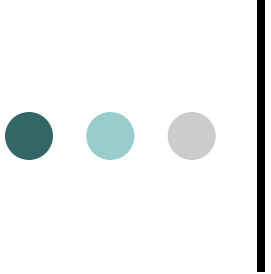
Use one line per column (attribute) definition

Use spaces to line up attribute characteristics and constraints

Table and attribute names are capitalized

NOT NULL specification

UNIQUE specification



# Creating Table Structures (continued)

Primary key attributes contain both a NOT NULL and a UNIQUE specification

RDBMS will automatically enforce referential integrity for foreign keys

Command sequence ends with semicolon



# SQL Constraints

## NOT NULL constraint

- Ensures that column does not accept nulls

## UNIQUE constraint

- Ensures that all values in column are unique

## DEFAULT constraint

- Assigns value to attribute when a new row is added to table

## CHECK constraint

- Validates data when attribute value is entered



# SQL Indexes

When primary key is declared, DBMS automatically creates unique index

Often need additional indexes

Using CREATE INDEX command, SQL indexes can be created on basis of any selected attribute

Composite index

- Index based on two or more attributes
- Often used to prevent data duplication

# SQL Indexes (continued)

TABLE  
7.5

A Duplicated Test Record

EMP_NUM	TEST_NUM	TEST_CODE	TEST_DATE	TEST_SCORE
110	1	WEA	15-May-2005	93
110	2	WEA	12-May-2005	87
111	1	HAZ	14-Dec-2005	91
111	2	WEA	18-Feb-2006	95
111	3	WEA	18-Feb-2006	95
112	1	CHEM	17-Aug-2005	91



# Advanced Data Definition Commands

- All changes in table structure are made by using ALTER command
  - Followed by keyword that produces specific change
  - Following three options are available:
    - ADD
    - MODIFY
    - DROP



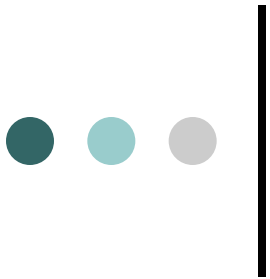
## Changing a Column's Data Type

- ALTER can be used to change data type
- Some RDBMSs (such as Oracle) do not permit changes to data types unless column to be changed is empty



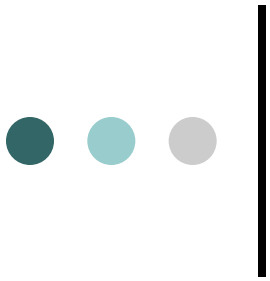
# Changing a Column's Data Characteristics

- Use `ALTER` to change data characteristics
- If column to be changed already contains data, changes in column's characteristics are permitted if those changes do not alter the data type



## Adding a Column

- Use ALTER to add column
  - Do not include the NOT NULL clause for new column

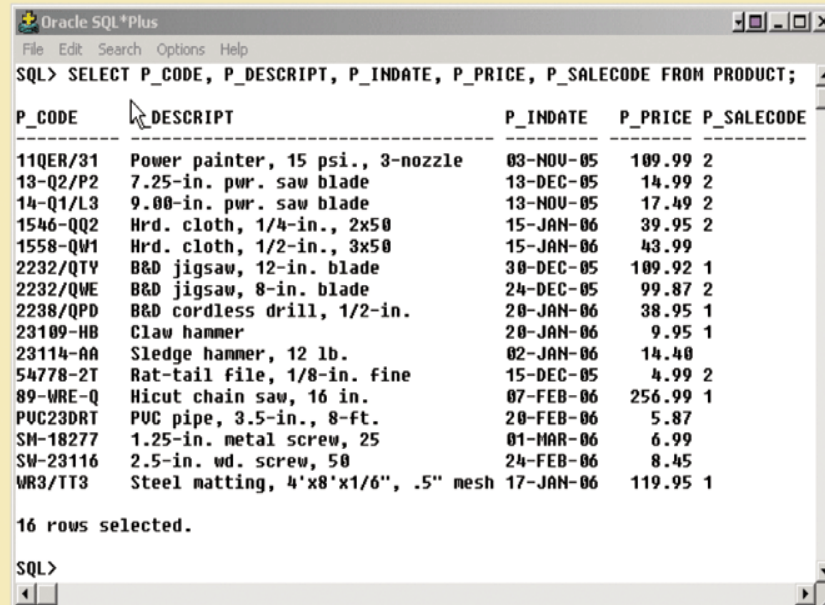


## Dropping a Column

- Use ALTER to drop column
  - Some RDBMSs impose restrictions on the deletion of an attribute

# Advanced Data Updates

FIGURE 7.15 The cumulative effect of the multiple updates in the PRODUCT table (Oracle)



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT P_CODE, P_DESCRIPT, P_INDATE, P_PRICE, P_SALECODE FROM PRODUCT;
```

P_CODE	P_DESCRIPT	P_INDATE	P_PRICE	P_SALECODE
11QER/31	Power painter, 15 psi., 3-nozzle	03-NOV-05	109.99	2
13-Q2/P2	7.25-in. pwr. saw blade	13-DEC-05	14.99	2
14-Q1/L3	9.00-in. pwr. saw blade	13-NOV-05	17.49	2
1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-JAN-06	39.95	2
1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-JAN-06	43.99	
2232/QTY	B&D jigsaw, 12-in. blade	30-DEC-05	109.92	1
2232/QWE	B&D jigsaw, 8-in. blade	24-DEC-05	99.87	2
2238/QPD	B&D cordless drill, 1/2-in.	20-JAN-06	38.95	1
23109-HB	Claw hammer	20-JAN-06	9.95	1
23114-AA	Sledge hammer, 12 lb.	02-JAN-06	14.40	
54778-2T	Rat-tail file, 1/8-in. fine	15-DEC-05	4.99	2
89-WRE-Q	Hicut chain saw, 16 in.	07-FEB-06	256.99	1
PVC23DRT	PVC pipe, 3.5-in., 8-ft.	20-FEB-06	5.87	
SM-18277	1.25-in. metal screw, 25	01-MAR-06	6.99	
SW-23116	2.5-in. wd. screw, 50	24-FEB-06	8.45	
WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	17-JAN-06	119.95	1

16 rows selected.

```
SQL>
```



# Copying Parts of Tables

- SQL permits copying contents of selected table columns so that the data need not be reentered manually into newly created table(s)
- First create the PART table structure
- Next add rows to new PART table using PRODUCT table rows

# Copying Parts of Tables (continued)

**FIGURE 7.16**

**PART table attributes copied from the PRODUCT table**

	PART_CODE	PART_DESCRIPTION	PART_PRICE	V_CODE
▶	11QER/31	Power painter, 15 psi, 3-nozzle	109.99	25595
	13-Q2/P2	7.25-in. pwr. saw blade	14.99	21344
	14-Q1/L3	9.00-in. pwr. saw blade	17.49	21344
	1546-QQ2	Hrd. cloth, 1/4-in., 2x50	39.95	23119
	1558-QW1	Hrd. cloth, 1/2-in., 3x50	43.99	23119
	2232/QTY	B&D jigsaw, 12-in. blade	109.92	24268
	2232/QWE	B&D jigsaw, 8-in. blade	99.87	24268
	2238/QPD	B&D cordless drill, 1/2-in.	38.95	25595
	23109-HB	Claw hammer	9.95	21225
	23114-AA	Sledge hammer, 12 lb.	14.4	
	54778-2T	Rat-tail file, 1/8-in. fine	4.99	21344
	89-WRE-Q	Hicut chain saw, 16 in.	256.99	24268
	PVC23DRT	PVC pipe, 3.5-in., 8-ft.	5.87	
	SM-18277	1.25-in. metal screw, 25	6.99	21225
	SW-23116	2.5-in. wd. screw, 50	8.45	21231
	WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	119.95	25595



# Adding Primary and Foreign Key Designations

- When table is copied, integrity rules do not copy, so primary and foreign keys need to be manually defined on new table
- User ALTER TABLE command
  - Syntax:
    - ALTER TABLE *tablename* ADD  
PRIMARY KEY(*fieldname*);
    - For foreign key, use FOREIGN KEY in place of PRIMARY KEY



# Deleting a Table from the Database

- DROP
  - Deletes table from database
  - Syntax:
    - DROP TABLE *tablename*;





# Data Manipulation Commands

Adding table rows

Saving table changes

Listing table rows

Updating table rows

Restoring table contents

Deleting table rows

Inserting table rows with a select subquery



# Adding Table Rows(Data)

## INSERT

- Used to enter data into table
- Syntax:
  - INSERT INTO *columnname*  
*VALUES (value1, value2, ... , valuen);*



# Adding Table Rows (continued)

When entering values, notice that:

- Row contents are entered between parentheses
- Character and date values are entered between apostrophes
- Numerical entries are not enclosed in apostrophes
- Attribute entries are separated by commas
- A value is required for each column

Use NULL for unknown values



# Saving Table Changes

Changes made to table contents are not physically saved on disk until, one of the following occurs:

- Database is closed
- Program is closed
- COMMIT command is used

Syntax:

- COMMIT [WORK];

Will permanently save any changes made to any table in the database



# Listing Table Rows

## SELECT

- Used to list contents of table
- Syntax:
  - `SELECT columnlist`  
`FROM tablename;`

*Columnlist* represents one or more attributes, separated by commas

Asterisk can be used as wildcard character to list all attributes

# Listing Table Rows (continued)

FIGURE 7.3 The contents of the PRODUCT table

	P_CODE	P_DESCRIPT	P_INDATE	P_QOH	P_MIN	P_PRICE	P_DISCOUNT	V_CODE
▶ +	1QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-05	8	5	109.99	0.00	25595
+	13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-05	32	15	14.99	0.05	21344
+	14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-05	18	12	17.49	0.00	21344
+	1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-06	15	8	39.95	0.00	23119
+	1558-QW1	Hrd. cloth, 1/2-in., 3x50	15-Jan-06	23	5	43.99	0.00	23119
+	2232/QTY	B&D jigsaw, 12-in. blade	30-Dec-05	8	5	109.92	0.05	24288
+	2232/QWE	B&D jigsaw, 8-in. blade	24-Dec-05	6	5	99.87	0.05	24288
+	2238/QPD	B&D cordless drill, 1/2-in.	20-Jan-06	12	5	38.95	0.05	25595
+	23109-HB	Claw hammer	20-Jan-06	23	10	9.95	0.10	21225
+	23114-AA	Sledge hammer, 12 lb.	02-Jan-06	8	5	14.40	0.05	
+	54778-2T	Rat-tail file, 1/8-in. fine	15-Dec-05	43	20	4.99	0.00	21344
+	89-WRE-Q	Hicut chain saw, 16 in.	07-Feb-06	11	5	256.99	0.05	24288
+	PVC23DRT	PVC pipe, 3.5-in., 8-ft.	20-Feb-06	188	75	5.87	0.00	
+	SM-18277	1.25-in. metal screw, 25	01-Mar-06	172	75	6.99	0.00	21225
+	SW-23116	2.5-in. wd. screw, 50	24-Feb-06	237	100	8.45	0.00	21231
+	WR3/TT3	Steel matting, 4'x8'x1/8", .5" mesh	17-Jan-06	18	5	119.95	0.10	25595



# Updating Table Rows

## UPDATE

- Modify data in a table
- Syntax:

- UPDATE *tablename*

SET *columnname* = *expression* [, *columnname* = *expression*]

[WHERE *conditionlist*];

If more than one attribute is to be updated in row,  
separate corrections with commas



# Restoring Table Contents

## ROLLBACK

- Used to restore database to its previous condition
- Only applicable if COMMIT command has not been used to permanently store changes in database

### Syntax:

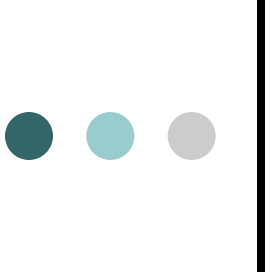
- ROLLBACK;

COMMIT and ROLLBACK only work with data manipulation commands that are used to add, modify, or delete table rows



# Deleting Table Rows

- DELETE
  - Deletes a table row
  - Syntax:
    - DELETE FROM *tablename*  
[WHERE *conditionlist* ];
- WHERE condition is optional
- If WHERE condition is not specified, all rows from specified table will be deleted



# Selecting Rows with Conditional Restrictions

- Select partial table contents by placing restrictions on rows to be included in output
  - Add conditional restrictions to SELECT statement, using WHERE clause
- Syntax:
  - `SELECT columnlist`  
`FROM tablelist`  
`[ WHERE conditionlist ] ;`

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE  
7.4**

**Selected PRODUCT table  
attributes for vendor  
code 21344**

	P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
▶	7.25-in. pwr. saw blade	13-Dec-05	14.99	21344
	9.00-in. pwr. saw blade	13-Nov-05	17.49	21344
	Rat-tail file, 1/8-in. fine	15-Dec-05	4.99	21344

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE 7.5** The Microsoft Access QBE and its SQL

**Microsoft Access-generated SQL**

```
SELECT PRODUCT.P_DESCRIPT, PRODUCT.P_INDATE, PRODUCT.P_PRICE, PRODUCT.V_CODE
FROM PRODUCT
WHERE (((PRODUCT.V_CODE)=21344));
```

**User-entered SQL**

```
SELECT P_DESCRIPT, P_INDATE, P_PRICE, V_CODE
FROM PRODUCT
WHERE V_CODE=21344;
```

# Selecting Rows with Conditional Restrictions (continued)

<b>SYMBOL</b>	<b>MEANING</b>
=	Equal to
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
<> or !=	Not equal to

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE  
7.6**

**Selected PRODUCT table  
attributes for vendor codes  
other than 21344**

	P_DESCRIPT	P_INDATE	P_PRICE	V_CODE
▶	Power painter, 15 psi., 3-nozzle	03-Nov-05	109.99	25595
	Hrd. cloth, 1/4-in., 2x50	15-Jan-06	39.95	23119
	Hrd. cloth, 1/2-in., 3x50	15-Jan-06	43.99	23119
	B&D jigsaw, 12-in. blade	30-Dec-05	109.92	24288
	B&D jigsaw, 8-in. blade	24-Dec-05	99.87	24288
	B&D cordless drill, 1/2-in.	20-Jan-06	38.95	25595
	Claw hammer	20-Jan-06	9.95	21225
	Hicut chain saw, 16 in.	07-Feb-06	256.99	24288
	1.25-in. metal screw, 25	01-Mar-06	6.99	21225
	2.5-in. wd. screw, 50	24-Feb-06	8.45	21231
	Steel matting, 4'x8'x1/8", .5" mesh	17-Jan-06	119.95	25595

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE  
7.7**

**Selected PRODUCT table  
attributes with a P\_PRICE  
restriction**

	P_DESCRIPT	P_QOH	P_MIN	P_PRICE
▶	Claw hammer	23	10	9.95
	Rat-tail file, 1/8-in. fine	43	20	4.99
	PVC pipe, 3.5-in., 8-ft	188	75	5.87
	1.25-in. metal screw, 25	172	75	6.99
	2.5-in. wvd. screw, 50	237	100	8.45

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE  
7.8**

**Selected PRODUCT table  
attributes: the ASCII code  
effect**

	P_CODE	P_DESCRIPT	P_QOH	P_MIN	P_PRICE
▶	<b>11QER/31</b>	Power painter, 15 psi., 3-nozzle	8	5	109.99
	13-Q2/P2	7.25-in. pwr. saw blade	32	15	14.99
	14-Q1/L3	9.00-in. pwr. saw blade	18	12	17.49
	1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15	8	39.95

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE  
7.9**

**Selected PRODUCT table  
attributes: date restriction**

	P_DESCRIPTION	P_QOH	P_MIN	P_PRICE	P_INDATE
▶	B&D cordless drill, 1/2-in.	12	5	38.95	20-Jan-06
	Claw hammer	23	10	9.95	20-Jan-06
	Hicut chain saw, 16 in.	11	5	256.99	07-Feb-06
	PVC pipe, 3.5-in., 8-ft.	188	75	5.87	20-Feb-06
	1.25-in. metal screw, 25	172	75	6.99	01-Mar-06
	2.5-in. wd. screw, 50	237	100	8.45	24-Feb-06

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE 7.10**

**SELECT statement with a computed column**

	P_DESCRIPTION	P_QOH	P_PRICE	Expr1
▶	Power painter, 15 psi., 3-nozzle	8	109.99	879.92
	7.25-in. pwr. saw blade	32	14.99	479.68
	9.00-in. pwr. saw blade	18	17.49	314.82
	Hrd. cloth, 1/4-in., 2x50	15	39.95	599.25
	Hrd. cloth, 1/2-in., 3x50	23	43.99	1011.77
	B&D jigsaw, 12-in. blade	8	109.92	879.36
	B&D jigsaw, 8-in. blade	6	99.87	599.22
	B&D cordless drill, 1/2-in.	12	38.95	467.40
	Claw hammer	23	9.95	228.85
	Sledge hammer, 12 lb.	8	14.40	115.20
	Rat-tail file, 1/8-in. fine	43	4.99	214.57
	Hicut chain saw, 16 in.	11	256.99	2826.89
	PVC pipe, 3.5-in., 8-ft.	188	5.87	1103.56
	1.25-in. metal screw, 25	172	6.99	1202.28
	2.5-in. wd. screw, 50	237	8.45	2002.65
	Steel matting, 4'x8'x1/8", .5" mesh	18	119.95	2159.10

# Selecting Rows with Conditional Restrictions (continued)

**FIGURE 7.11**

**SELECT statement with a computed column and an alias**

	P_DESCRIPT	P_QOH	P_PRICE	TOTVALUE
▶	Power painter, 15 psi., 3-nozzle	8	109.99	879.92
	7.25-in. pwr. saw blade	32	14.99	479.68
	9.00-in. pwr. saw blade	18	17.49	314.82
	Hrd. cloth, 1/4-in., 2x50	15	39.95	599.25
	Hrd. cloth, 1/2-in., 3x50	23	43.99	1011.77
	B&D jigsaw, 12-in. blade	8	109.92	879.36
	B&D jigsaw, 8-in. blade	6	99.87	599.22
	B&D cordless drill, 1/2-in.	12	38.95	467.40
	Claw hammer	23	9.95	228.85
	Sledge hammer, 12 lb.	8	14.40	115.20
	Rat-tail file, 1/8-in. fine	43	4.99	214.57
	Hicut chain saw, 16 in.	11	256.99	2826.89
	PVC pipe, 3.5-in., 8-ft.	188	5.87	1103.56
	1.25-in. metal screw, 25	172	6.99	1202.28
	2.5-in. wd. screw, 50	237	8.45	2002.65
	Steel matting, 4'x8'x1/8", .5" mesh	18	119.95	2159.10



# Arithmetic Operators: The Rule of Precedence

- Perform operations within parentheses
- Perform power operations
- Perform multiplications and divisions
- Perform additions and subtractions

# Arithmetic Operators: The Rule of Precedence (continued)

TABLE  
7.7

The Arithmetic Operators

ARITHMETIC OPERATOR	DESCRIPTION
+	Add
-	Subtract
*	Multiply
/	Divide
^	Raise to the power of (Some applications use ** instead of ^.)

# Logical Operators: AND, OR, and NOT

**FIGURE  
7.12**

**Selected PRODUCT table  
attributes: the logical OR**

	P_DESCRIPTION	P_INDATE	P_PRICE	V_CODE
▶	7.25-in. pwr. saw blade	13-Dec-05	14.99	21344
	9.00-in. pwr. saw blade	13-Nov-05	17.49	21344
	B&D jigsaw, 12-in. blade	30-Dec-05	109.92	24288
	B&D jigsaw, 8-in. blade	24-Dec-05	99.87	24288
	Rat-tail file, 1/8-in. fine	15-Dec-05	4.99	21344
	Hicut chain saw, 16 in.	07-Feb-06	256.99	24288

# Logical Operators: AND, OR, and NOT (continued)

**FIGURE  
7.13**

**Selected PRODUCT table  
attributes: the logical AND**

	P_DESCRIPTION	P_INDATE	P_PRICE	V_CODE
▶	<b>B&amp;D cordless drill, 1/2-in.</b>	20-Jan-06	38.95	25595
	Claw hammer	20-Jan-06	9.95	21225
	PVC pipe, 3.5-in., 8-ft.	20-Feb-06	5.87	
	1.25-in. metal screw, 25	01-Mar-06	6.99	21225
	2.5-in. wd. screw, 50	24-Feb-06	8.45	21231

# Logical Operators: AND, OR, and NOT (continued)

**FIGURE  
7.14**

**Selected PRODUCT table  
attributes: the logical AND  
and OR**

	P_DESCRIPTION	P_INDATE	P_PRICE	V_CODE
▶	B&D jigsaw, 12-in. blade	30-Dec-05	109.92	24288
	B&D jigsaw, 8-in. blade	24-Dec-05	99.87	24288
	B&D cordless drill, 1/2-in.	20-Jan-06	38.95	25595
	Claw hammer	20-Jan-06	9.95	21225
	Hicut chain saw, 16 in.	07-Feb-06	256.99	24288
	PVC pipe, 3.5-in., 8-ft.	20-Feb-06	5.87	
	1.25-in. metal screw, 25	01-Mar-06	6.99	21225
	2.5-in. wd. screw, 50	24-Feb-06	8.45	21231



# Special Operators

- BETWEEN
  - Used to check whether attribute value is within a range
- IS NULL
  - Used to check whether attribute value is null
- LIKE
  - Used to check whether attribute value matches given string pattern



## Special Operators (continued)

- IN
  - Used to check whether attribute value matches any value within a value list
- EXISTS
  - Used to check if subquery returns any rows



# Advanced Select Queries

- SQL provides useful functions that can:
  - Count
  - Find minimum and maximum values
  - Calculate averages
- SQL allows user to limit queries to only those entries having no duplicates or entries whose duplicates may be grouped

# Ordering a Listing

**FIGURE 7.17**

**Selected PRODUCT table attributes: ordered by (ascending) P\_PRICE**

	P_CODE	P_DESCRIPT	P_INDATE	P_PRICE
▶	54778-2T	Rat-tail file, 1/8-in. fine	15-Dec-05	4.99
	PVC23DRT	PVC pipe, 3.5-in., 8-ft.	20-Feb-06	5.87
	SM-18277	1.25-in. metal screw, 25	01-Mar-06	6.99
	SW-23116	2.5-in. wd. screw, 50	24-Feb-06	8.45
	23109-HB	Claw hammer	20-Jan-06	9.95
	23114-AA	Sledge hammer, 12 lb.	02-Jan-06	14.40
	13-Q2/P2	7.25-in. pwr. saw blade	13-Dec-05	14.99
	14-Q1/L3	9.00-in. pwr. saw blade	13-Nov-05	17.49
	2238/QPD	B&D cordless drill, 1/2-in.	20-Jan-06	38.95
	1546-QQ2	Hrd. cloth, 1/4-in., 2x50	15-Jan-06	39.95
	1558-QV1	Hrd. cloth, 1/2-in., 3x50	15-Jan-06	43.99
	2232/QV6	B&D jigsaw, 8-in. blade	24-Dec-05	99.87
	2232/QTY	B&D jigsaw, 12-in. blade	30-Dec-05	109.92
	11QER/31	Power painter, 15 psi., 3-nozzle	03-Nov-05	109.99
	WR3/TT3	Steel matting, 4'x8'x1/6", .5" mesh	17-Jan-06	119.95
	89-WRE-Q	Hicut chain saw, 16 in.	07-Feb-06	256.99

# Ordering a Listing (continued)

FIGURE 7.18 Telephone list query results

	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_AREACODE	EMP_PHONE
▶	Brandon	Marie	G	901	882-0845
	Diante	Jorge	D	615	890-4567
	Genkazi	Leighla	W	901	569-0093
	Johnson	Edward	E	615	898-4387
	Jones	Anne	M	615	898-3456
	Kolmycz	George	D	615	324-5456
	Lange	John	P	901	504-4430
	Lewis	Rhonda	G	615	324-4472
	Saranda	Hermine	R	615	324-5505
	Smith	George	A	615	890-2984
	Smith	George	K	901	504-3339
	Smith	Jeanine	K	615	324-7883
	Smythe	Melanie	P	615	324-9006
	Vandam	Rhett		901	675-8993
	Washington	Rupert	E	615	890-4925
	Wiesenbach	Paul	R	615	897-4358
	Williams	Robert	D	615	890-3220

# Ordering a Listing (continued)

**FIGURE 7.19**

A query based on multiple restrictions

	P_DESCRIPT	V_CODE	P_INDATE	P_PRICE
▶	Sledge hammer, 12 lb.		02-Jan-06	14.40
	Claw hammer	21225	20-Jan-06	9.95
	9.00-in. pwr. saw blade	21344	13-Nov-05	17.49
	7.25-in. pwr. saw blade	21344	13-Dec-05	14.99
	Rat-tail file, 1/8-in. fine	21344	15-Dec-05	4.99
	Hrd. cloth, 1/2-in., 3x50	23119	15-Jan-06	43.99
	Hrd. cloth, 1/4-in., 2x50	23119	15-Jan-06	39.95
	B&D cordless drill, 1/2-in.	25595	20-Jan-06	38.95

# Listing Unique Values

**FIGURE  
7.20**

A listing of distinct (different) V\_CODE values in the PRODUCT table

	V_CODE
▶	
	21225
	21231
	21344
	23119
	24288
	25595



# Aggregate Functions

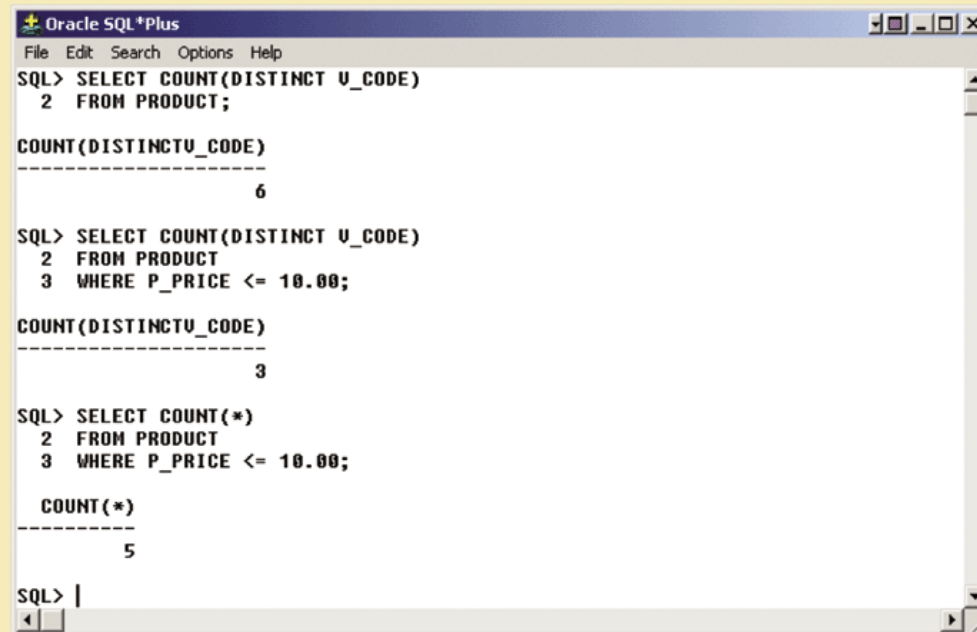
**TABLE  
7.8**

**Some Basic SQL Aggregate  
Functions**

<b>FUNCTION</b>	<b>OUTPUT</b>
COUNT	The number of rows containing non-null values
MIN	The minimum attribute value encountered in a given column
MAX	The maximum attribute value encountered in a given column
SUM	The sum of all values for a given column
AVG	The arithmetic mean (average) for a specified column

# Aggregate Functions (continued)

FIGURE 7.21 COUNT function output examples



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT COUNT(DISTINCT U_CODE)
2 FROM PRODUCT;

COUNT(DISTINCT U_CODE)
-----
6

SQL> SELECT COUNT(DISTINCT U_CODE)
2 FROM PRODUCT
3 WHERE P_PRICE <= 10.00;

COUNT(DISTINCT U_CODE)
-----
3

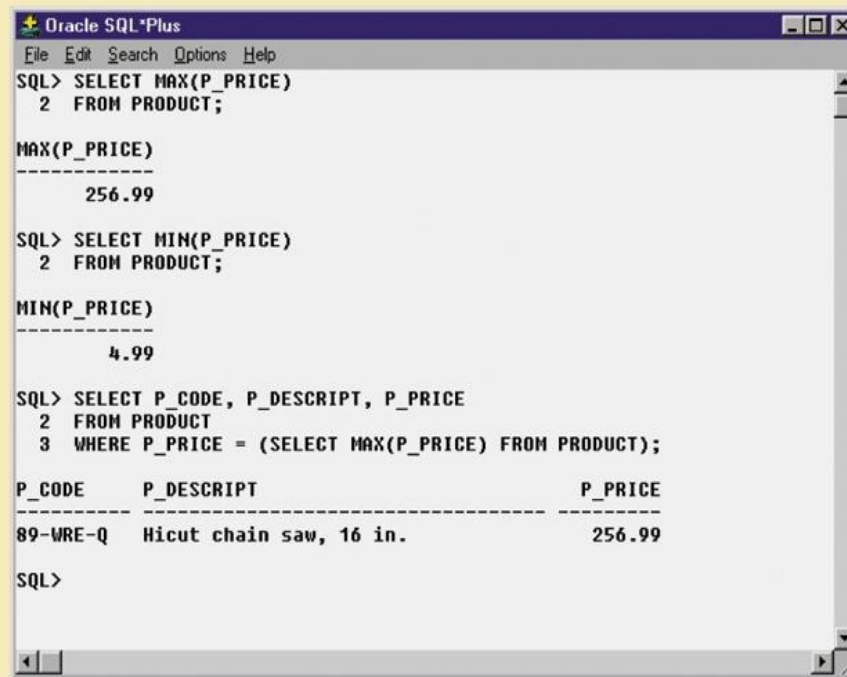
SQL> SELECT COUNT(*)
2 FROM PRODUCT
3 WHERE P_PRICE <= 10.00;

COUNT(*)
-----
5

SQL> |
```

# Aggregate Functions (continued)

FIGURE 7.22 MAX and MIN function output examples



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT MAX(P_PRICE)
2 FROM PRODUCT;

MAX(P_PRICE)
-----
256.99

SQL> SELECT MIN(P_PRICE)
2 FROM PRODUCT;

MIN(P_PRICE)
-----
4.99

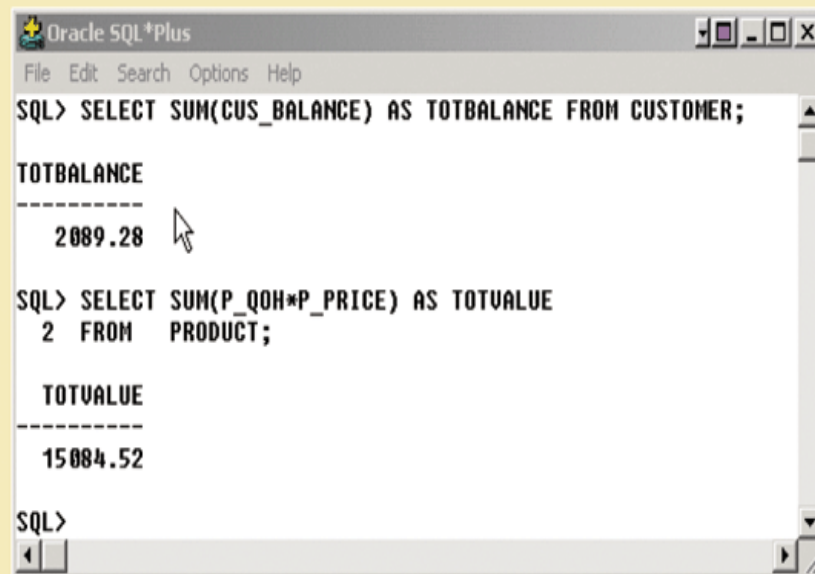
SQL> SELECT P_CODE, P_DESCRIPT, P_PRICE
2 FROM PRODUCT
3 WHERE P_PRICE = (SELECT MAX(P_PRICE) FROM PRODUCT);

P_CODE      P_DESCRIPT      P_PRICE
-----
89-WRE-Q    Hicut chain saw, 16 in.      256.99

SQL>
```

# Aggregate Functions (continued)

FIGURE 7.23 The total value of all items in the PRODUCT table



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT SUM(CUS_BALANCE) AS TOTBALANCE FROM CUSTOMER;

TOTBALANCE
-----
  2089.28

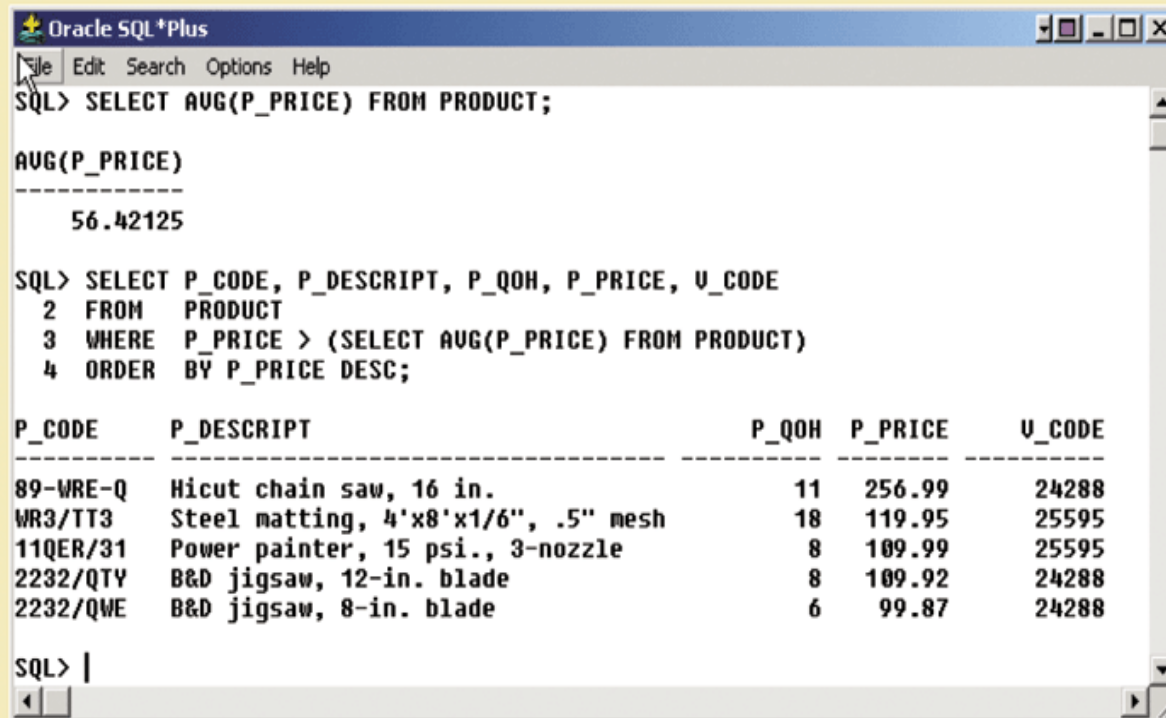
SQL> SELECT SUM(P_QOH*P_PRICE) AS TOTVALUE
2 FROM PRODUCT;

TOTVALUE
-----
15084.52

SQL>
```

# Aggregate Functions (continued)

FIGURE 7.24  
AVG function output examples



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT AVG(P_PRICE) FROM PRODUCT;

AVG(P_PRICE)
-----
56.42125

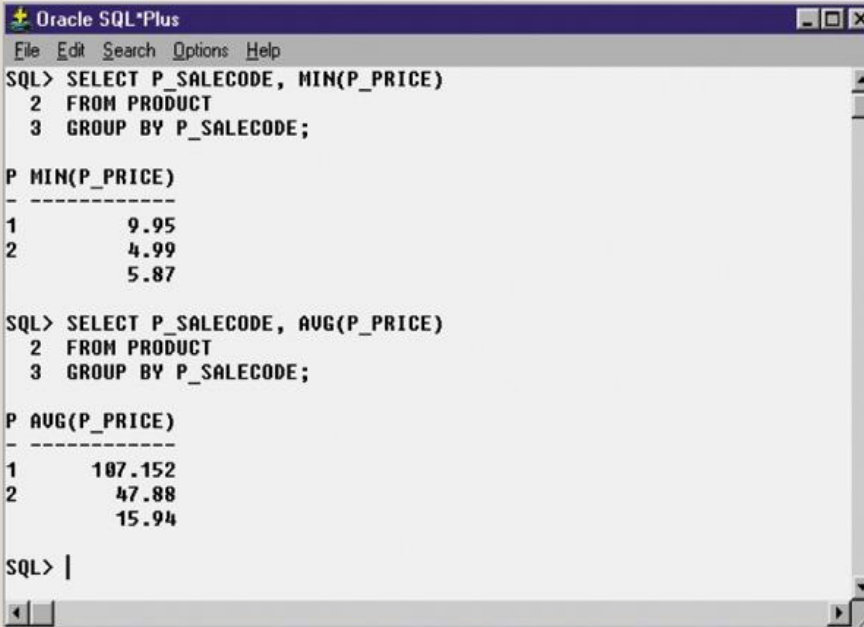
SQL> SELECT P_CODE, P_DESCRIPT, P_QOH, P_PRICE, V_CODE
2 FROM PRODUCT
3 WHERE P_PRICE > (SELECT AVG(P_PRICE) FROM PRODUCT)
4 ORDER BY P_PRICE DESC;

P_CODE      P_DESCRIPT                                P_QOH  P_PRICE  V_CODE
-----
89-WRE-Q    Hicut chain saw, 16 in.                   11    256.99   24288
WR3/TT3     Steel matting, 4'x8'x1/6", .5" mesh       18    119.95   25595
11QER/31    Power painter, 15 psi., 3-nozzle          8    109.99   25595
2232/QTY    B&D jigsaw, 12-in. blade                   8    109.92   24288
2232/QWE    B&D jigsaw, 8-in. blade                    6     99.87   24288

SQL> |
```

# Grouping Data

FIGURE 7.25 GROUP BY clause output examples



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT P_SALECODE, MIN(P_PRICE)
2 FROM PRODUCT
3 GROUP BY P_SALECODE;

P MIN(P_PRICE)
-----
1          9.95
2          4.99
           5.87

SQL> SELECT P_SALECODE, AVG(P_PRICE)
2 FROM PRODUCT
3 GROUP BY P_SALECODE;

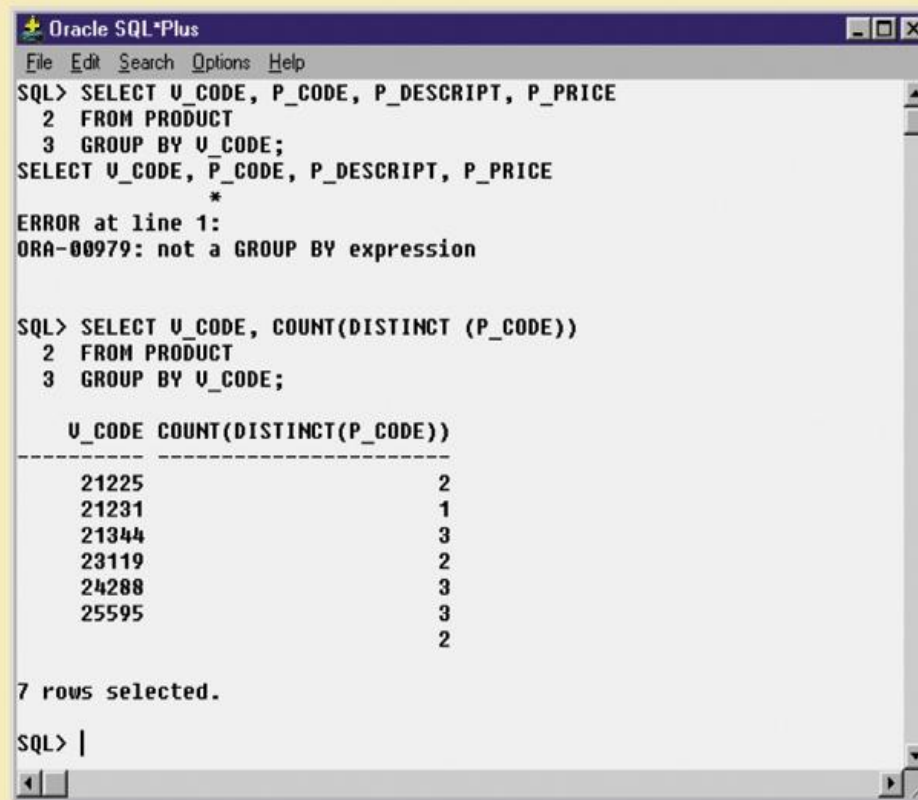
P AVG(P_PRICE)
-----
1        107.152
2         47.88
           15.94

SQL> |
```

# Grouping Data (continued)

FIGURE  
7.26

Incorrect and correct use of the GROUP BY clause



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT U_CODE, P_CODE, P_DESCRIPT, P_PRICE
  2 FROM PRODUCT
  3 GROUP BY U_CODE;
SELECT U_CODE, P_CODE, P_DESCRIPT, P_PRICE
      *
ERROR at line 1:
ORA-00979: not a GROUP BY expression

SQL> SELECT U_CODE, COUNT(DISTINCT (P_CODE))
  2 FROM PRODUCT
  3 GROUP BY U_CODE;

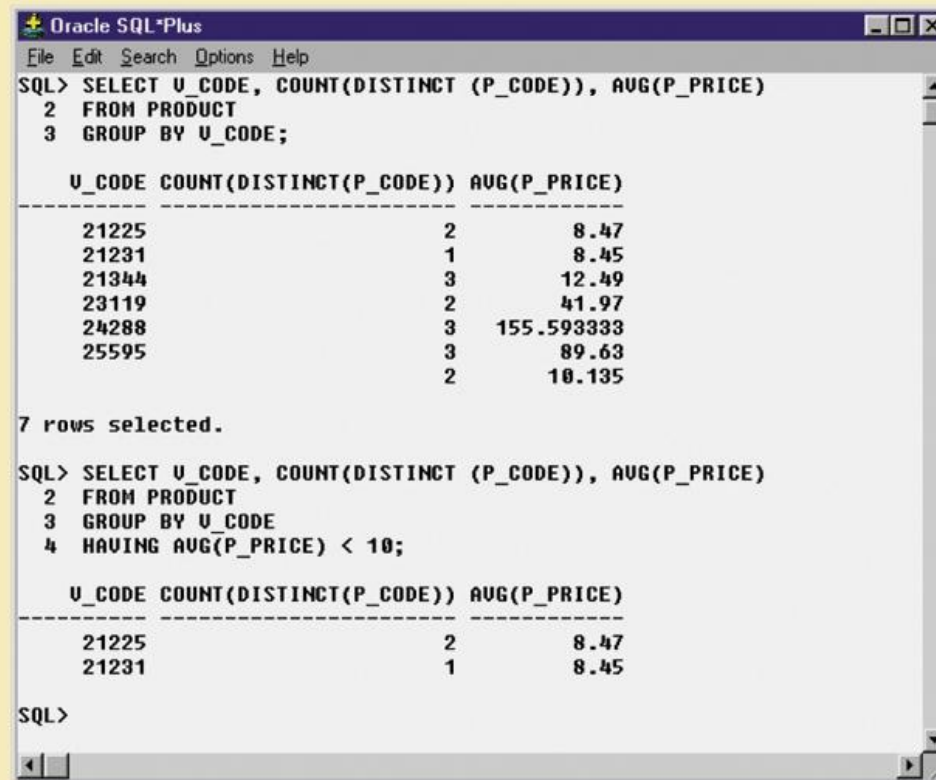
  U_CODE COUNT(DISTINCT(P_CODE))
-----
21225          2
21231          1
21344          3
23119          2
24288          3
25595          3
                2

7 rows selected.

SQL> |
```

# Grouping Data (continued)

FIGURE 7.27 An application of the HAVING clause



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> SELECT U_CODE, COUNT(DISTINCT (P_CODE)), AVG(P_PRICE)
2 FROM PRODUCT
3 GROUP BY U_CODE;

U_CODE COUNT(DISTINCT(P_CODE)) AVG(P_PRICE)
-----
21225          2          8.47
21231          1          8.45
21344          3         12.49
23119          2         41.97
24288          3       155.593333
25595          3          89.63
          2         10.135

7 rows selected.

SQL> SELECT U_CODE, COUNT(DISTINCT (P_CODE)), AVG(P_PRICE)
2 FROM PRODUCT
3 GROUP BY U_CODE
4 HAVING AVG(P_PRICE) < 10;

U_CODE COUNT(DISTINCT(P_CODE)) AVG(P_PRICE)
-----
21225          2          8.47
21231          1          8.45

SQL>
```

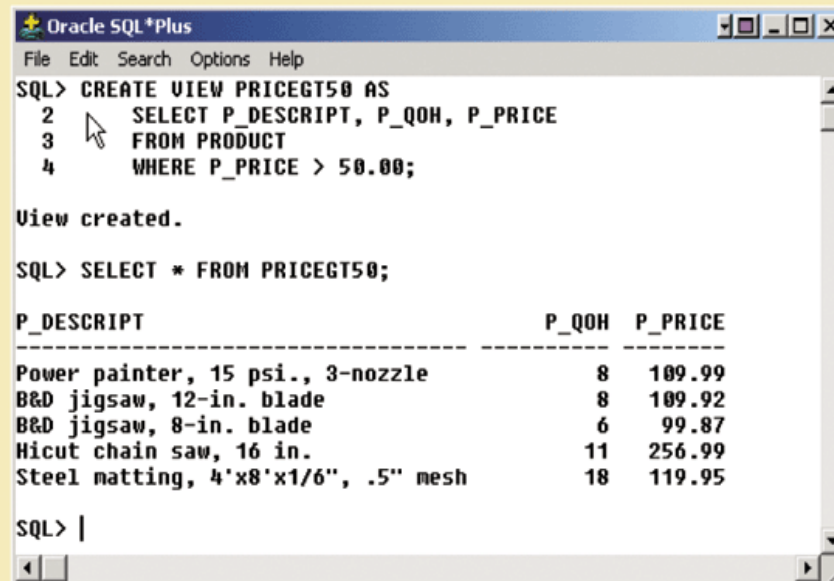


# Virtual Tables: Creating a View

- View is virtual table based on `SELECT` query
  - Can contain columns, computed columns, aliases, and aggregate functions from one or more tables
- Base tables are tables on which view is based
- Create view by using `CREATE VIEW` command

# Virtual Tables: Creating a View (continued)

FIGURE 7.28 Creating a virtual table with the CREATE VIEW command



```
Oracle SQL*Plus
File Edit Search Options Help
SQL> CREATE VIEW PRICEGT50 AS
2  SELECT P_DESCRIPT, P_QOH, P_PRICE
3  FROM PRODUCT
4  WHERE P_PRICE > 50.00;

View created.

SQL> SELECT * FROM PRICEGT50;

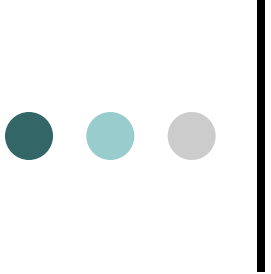
P_DESCRIPT                                P_QOH  P_PRICE
-----
Power painter, 15 psi., 3-nozzle           8    109.99
B&D jigsaw, 12-in. blade                   8    109.92
B&D jigsaw, 8-in. blade                    6     99.87
Hicut chain saw, 16 in.                   11   256.99
Steel matting, 4'x8'x1/6", .5" mesh       18   119.95

SQL> |
```



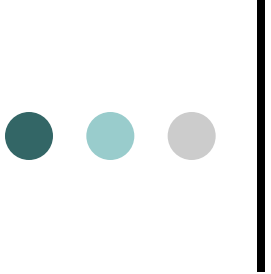
# Summary

- SQL commands can be divided into two overall categories:
  - Data definition language commands
  - Data manipulation language commands
- The ANSI standard data types are supported by all RDBMS vendors in different ways
- Basic data definition commands allow you to create tables, indexes, and views



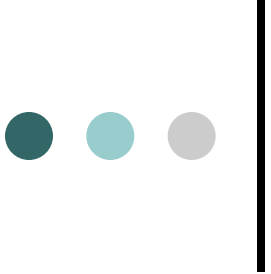
## Summary (continued)

- DML commands allow you to add, modify, and delete rows from tables
- The basic DML commands are SELECT, INSERT, UPDATE, DELETE, COMMIT, and ROLLBACK
- INSERT command is used to add new rows to tables
- SELECT statement is main data retrieval command in SQL



## Summary (continued)

- Many SQL constraints can be used with columns
- The column list represents one or more column names separated by commas
- WHERE clause can be used with SELECT, UPDATE, and DELETE statements to restrict rows affected by the DDL command



## Summary (continued)

- Aggregate functions
  - Special functions that perform arithmetic computations over a set of rows
- ORDER BY clause
  - Used to sort output of SELECT statement
  - Can sort by one or more columns and use either an ascending or descending order