Ch 6

Database Management Systems

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Overview

- Introduction to Structured Query Language (SQL)
  - Environment
  - Data types
  - Data Definition Language
  - Data Manipulation Language
- Example

SQL

- Structured Query Language
- The standard for relational database management systems (RDBMS)
- SQL-92 Standard
- Purpose
  - Specify syntax/semantics for data definition and manipulation
  - Define data structures
  - Enable portability
  - Specify minimal (level 1) and complete (level 2) standards
  - Allow for later growth/enhancement to standard

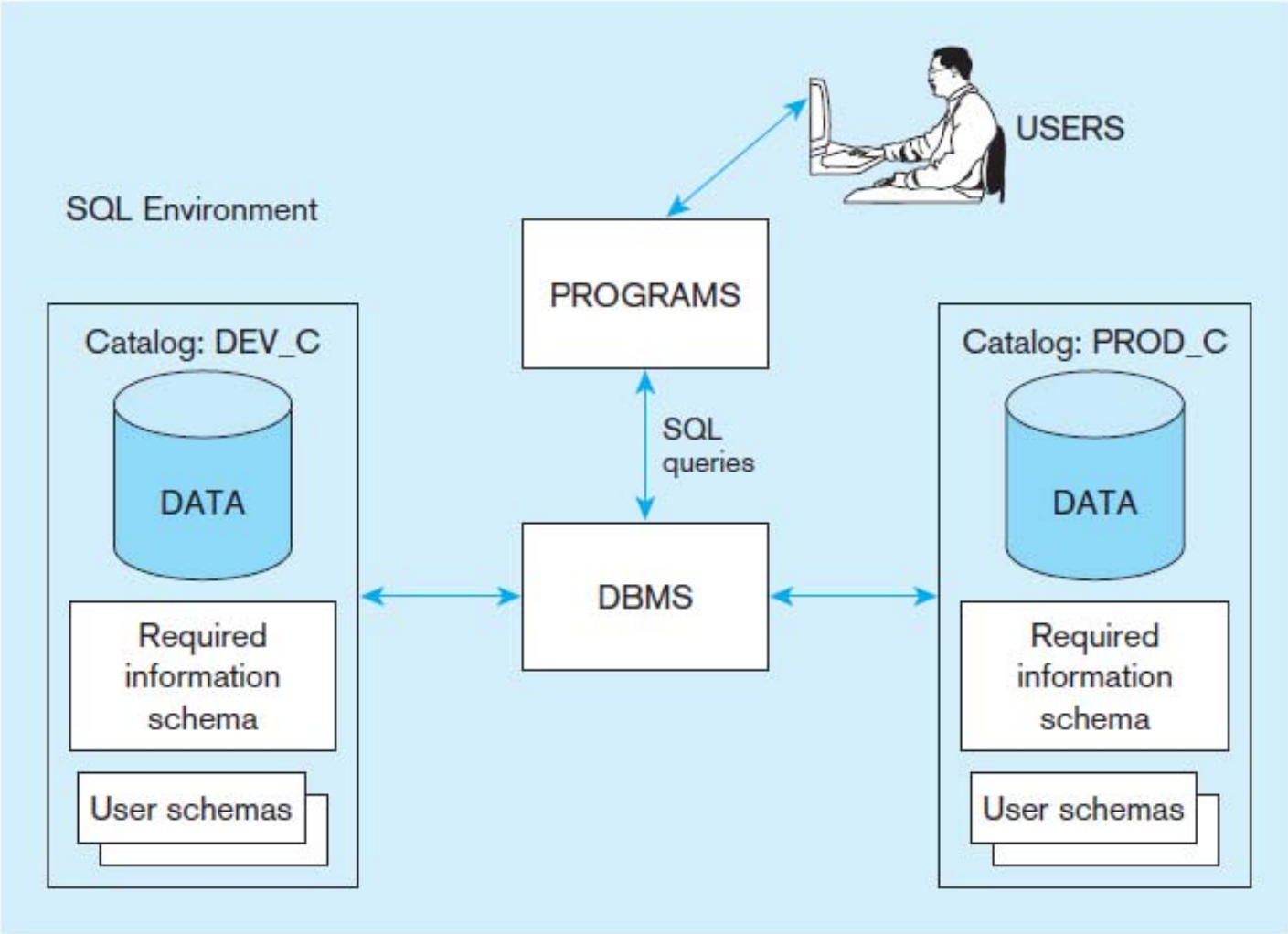
Benefits of Standardized Relational Language

- Reduced training costs
- Productivity
- Application portability
- Application longevity
- Reduced dependence on a single vendor
- Cross-system communication

SQL Environment

- Catalog
  - A set of schemas that constitute the description of a database
- Schema
  - The structure that contains description of objects created by a user (base tables, views, constraints)
- Data Definition Language (DDL)
  - Commands that define a database, including creating, altering, and dropping tables and establishing constraints
- Data Manipulation Language (DML)
  - Commands that maintain and query a database
- Data Control Language (DCL)
  - Commands that control a database, including administering privileges and committing data

Figure 6-1
A simplified schematic of a typical SQL environment, as described by the SQL:2000n standards

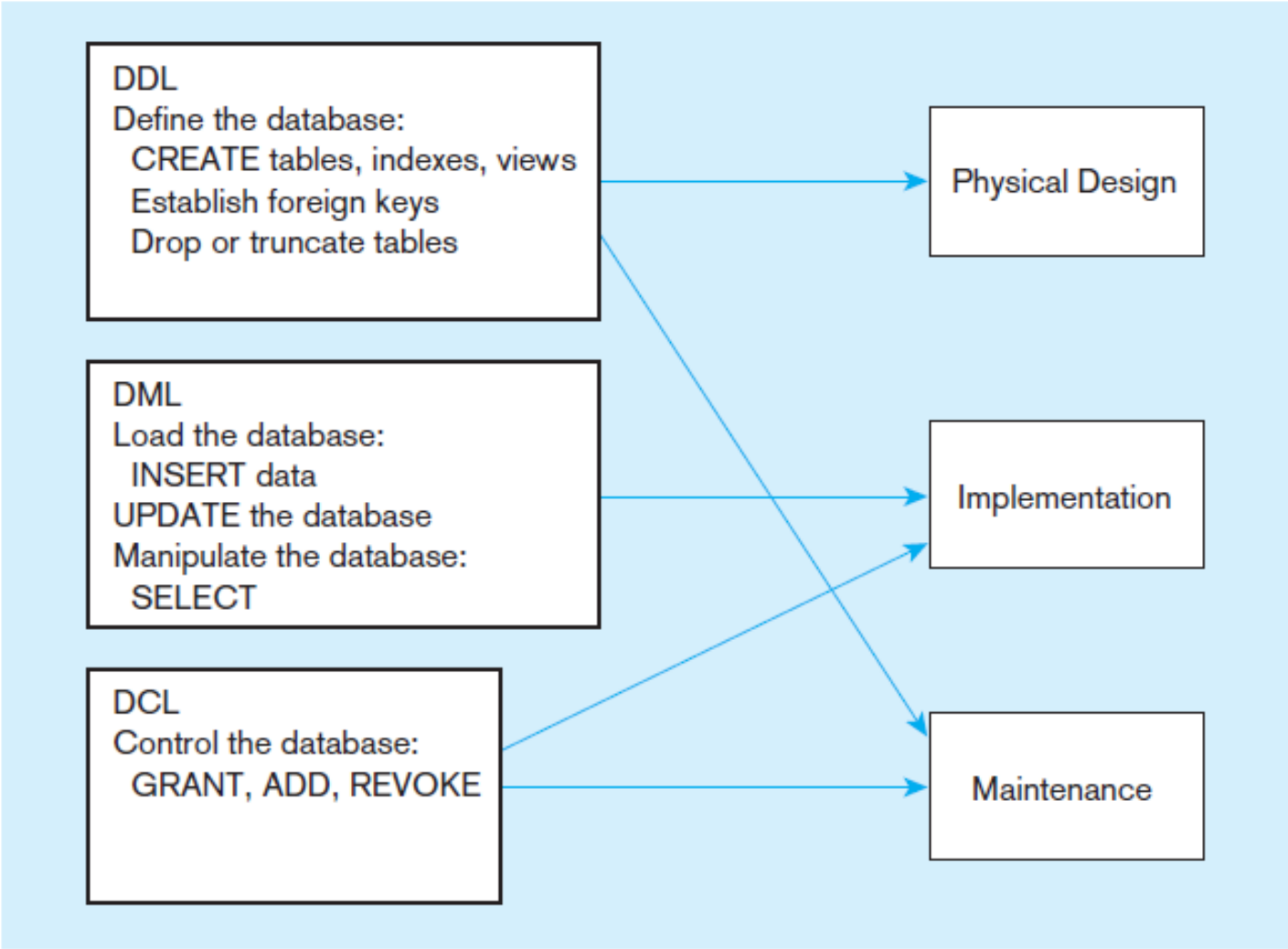


SQL Data types

TABLE 6-2 Sample SQL Data Types

String	CHARACTER (CHAR)	Stores string values containing any characters in a character set. CHAR is defined to be a fixed length.
	CHARACTER VARYING (VARCHAR or VARCHAR2)	Stores string values containing any characters in a character set but of definable variable length.
	BINARY LARGE OBJECT (BLOB)	Stores binary string values in hexadecimal format. BLOB is defined to be a variable length. (Oracle also has CLOB and NCLOB, as well as BFILE for storing unstructured data outside the database.)
Number	NUMERIC	Stores exact numbers with a defined precision and scale.
	INTEGER (INT)	Stores exact numbers with a predefined precision and scale of zero.
Temporal	TIMESTAMPTIMESTAMP WITH LOCAL TIME ZONE	Stores a moment an event occurs, using a definable fraction-of–a-second precision.Value adjusted to the user's session time zone (available in Oracle and MySQL)
Boolean	BOOLEAN	Stores truth values: TRUE, FALSE, or UNKNOWN.

SQL Languages



SQL Database Definition

- Data Definition Language (DDL)
- Major CREATE statements:
  - CREATE DATABASE: defines a portion of the database owned by a particular user
  - CREATE TABLE : defines a table and its columns
  - CREATE VIEW : defines a logical table from one or more views
- Other CREATE statements : CHARACTER SET, COLLATION, TRANSLATION, ASSERTION, DOMAIN

Table Creation

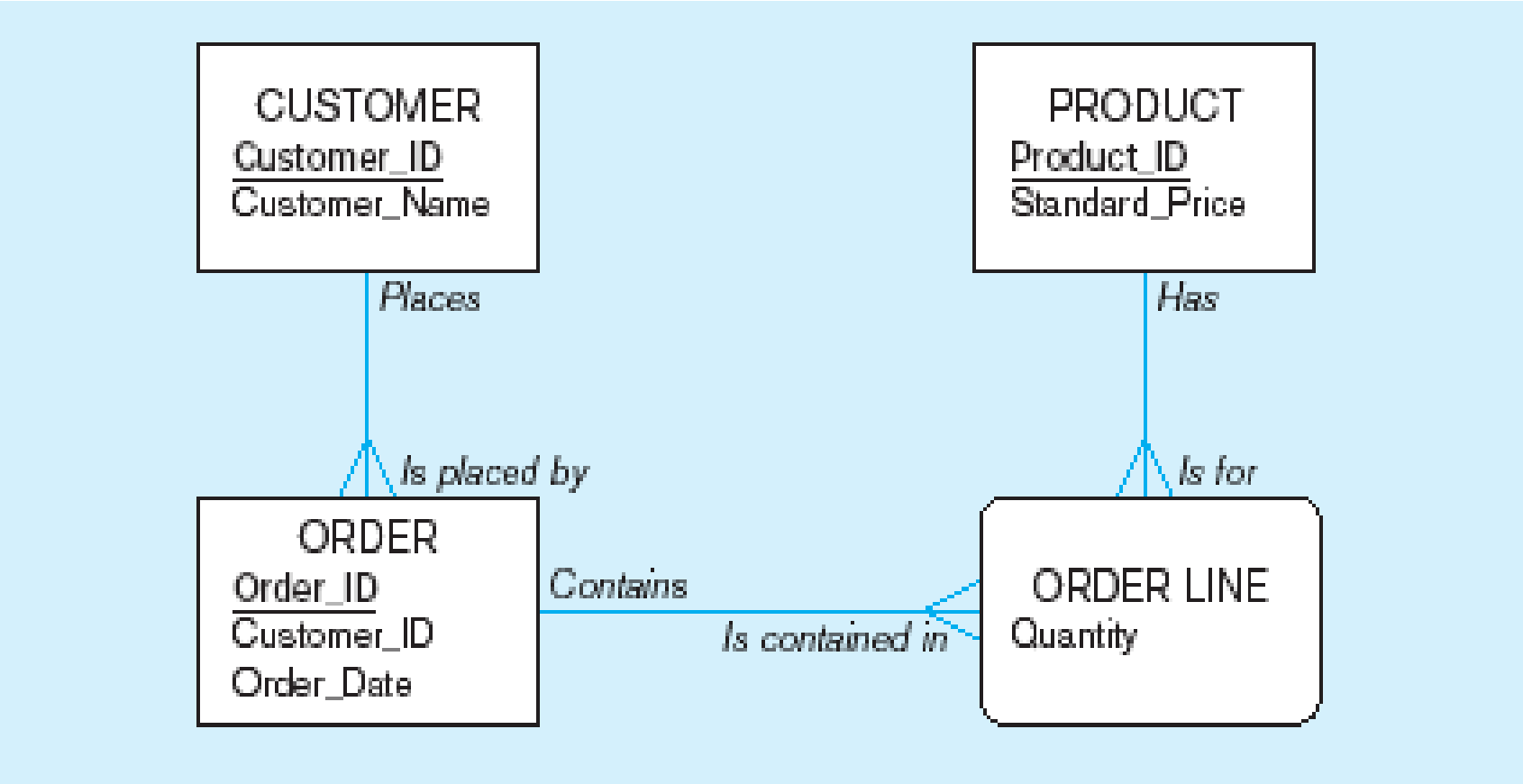
Figure 6-5 General syntax for CREATE TABLE

```
CREATE TABLE tablename
( {column definition      [table constraint] } . , . .
[ON COMMIT {DELETE I P RESERVE} ROWS] );

where column definition ::=
column_name
        {domain namel d atatype [(size)] }
        [column_constraint_clause. . .]
        [default value]
        [collate clause]

and table constraint ::=
        [CONSTRAINT constraint_name]
        Constraint_type [constraint_attributes]
```

Steps in table creation:

1. Identify data types for attributes
2. Identify columns that can and cannot be null
3. Identify columns that must be unique (candidate keys)
4. Identify primary key–foreign key mates
5. Determine default values
6. Identify constraints on columns (domain specifications)
7. Create the table and associated indexes

Sample Pine Valley Furniture Data Model



Sample Pine Valley Furniture Data

customers

Customer_ID	Customer_Name	Customer_Address	City	State	Postal_Code
1	Contemporary Casuals	1355 S Hines Blvd	Gainesville	FL	32601-
2	Value Furniture	15145 S.W. 17th St.	Plano	TX	75094-
3	Home Furnishings	1900 Allard Ave.	Albany	NY	12209-
4	Eastern Furniture	1925 Beltline Rd.	Carteret	NJ	07008-
5	Impressions	5585 Westcott Ct.	Sacramento	CA	94206-
6	Furniture Gallery	325 Flatiron Dr.	Boulder	CO	80514-
7	Period Furniture	394 Rainbow Dr.	Seattle	WA	97954-
8	Calfornia Classics	816 Peach Rd.	Santa Clara	CA	96915-
9	M & H Casual Furniture	3			4620-
10	Seminole Interiors	2			4646-
11	American Euro Lifestyles	2			7508-
12	Battle Creek Furniture	3			9015-
13	Heritage Furnishings	6			7013-
14	Kaneohe Homes	112 Kiowai St.	Kaneohe	HI	96744-
15	Mountain Scenes	4132 Main Street	Ogden	UT	84403-
(AutoNumber)					

Record: 1 of 15

Unique number to identify customer

orders

Order_Id	Order_Date	Customer_ID
1001	10/21/2000	1
1002	10/21/2000	8
1003	10/22/2000	15
1004	10/22/2000	5
1005	10/24/2000	3
1006	10/24/2000	2
1007	10/27/2000	11
1008	10/30/2000	12
1009	11/5/2000	4
1010	11/5/2000	1
0		0

Record: 1 of 10

Datasheet View

order lines

Order_Id	Product_Id	Ordered_Quan
1001	1	2
1001	2	2
1001	4	1
1002	3	5
1003	3	3
1004	6	2
1004	8	2
1005	4	
1006	4	
1006	5	
1006	7	
1007	1	3
1007	2	2
1008	3	3
1008	8	3
1009	4	2
1009	7	3
1010	8	10
0	0	0

Record: 1 of 18

Datasheet View

products

Product_ID	Product_Description	Product_Finish	Standard_Price	Product_Line_Id
1	End Table	Cherry	$175.00	10001
2	Coffee Table	Natural Ash	$200.00	20001
3	Computer Desk	Natural Ash	$375.00	20001
4	Entertainment Center	Natural Maple	$650.00	30001
5	Writer's Desk	Cherry	$325.00	10001
6	8-Drawer Dresser	White Ash	$750.00	20001
7	Dining Table	Natural Ash	$800.00	20001
8	Computer Desk	Walnut	$250.00	
(AutoNumber)			$0.00	

Record: 1 of 8

Datasheet View

SQL Database Definition Commands

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25)  NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                    CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                              'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0)  NOT NULL,
         PRODUCT_ID             NUMBER(11,0)  NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

SQL Database Definition Commands (cont)

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25) NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0)
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                    CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                              'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0) NOT NULL,
         PRODUCT_ID             NUMBER(11,0) NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

Defining attributes and their data types

SQL Database Definition Commands (cont)

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID          NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME        VARCHAR2(25) NOT NULL,
         CUSTOMER_ADDRESS     VARCHAR2(30),
         CITY                 VARCHAR2(20),
         STATE                VARCHAR2(2),
         POSTAL_CODE          VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID             NUMBER(11, 0) NOT NULL,
         ORDER_DATE           DATE DEFAULT SYSDATE,
         CUSTOMER_ID          NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID           INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION  VARCHAR2(50),
         PRODUCT_FINISH       VARCHAR2(20)
                    CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                              'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE       DECIMAL(6,2),
         PRODUCT_LINE_ID      INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID             NUMBER(11,0) NOT NULL,
         PRODUCT_ID           NUMBER(11,0) NOT NULL,
         ORDERED_QUANTITY     NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

Non-nullable Specifications

Note: primary keys should not be null

SQL Database Definition Commands (cont)

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25)  NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                  CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                          'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0)  NOT NULL,
         PRODUCT_ID             NUMBER(11,0)  NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

Identifying Primary keys

This is composite primary key

SQL Database Definition Commands (cont)

Identifying Foreign keys & establishing Relationships

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25)  NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                    CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                              'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0)  NOT NULL,
         PRODUCT_ID             NUMBER(11,0)  NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

SQL Database Definition Commands (cont)

Default Values and Domain Constraints

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25)  NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));

CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));

CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                 CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                        'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));

CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0)  NOT NULL,
         PRODUCT_ID             NUMBER(11,0)  NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

SQL Database Definition Commands (cont)

Overall Table Definitions

```
CREATE TABLE CUSTOMER_T
        (CUSTOMER_ID            NUMBER(11, 0) NOT NULL,
         CUSTOMER_NAME          VARCHAR2(25)  NOT NULL,
         CUSTOMER_ADDRESS       VARCHAR2(30),
         CITY                   VARCHAR2(20),
         STATE                  VARCHAR2(2),
         POSTAL_CODE            VARCHAR2(9),
CONSTRAINT CUSTOMER_PK PRIMARY KEY (CUSTOMER_ID));
```

```
CREATE TABLE ORDER_T
        (ORDER_ID               NUMBER(11, 0) NOT NULL,
         ORDER_DATE             DATE DEFAULT SYSDATE,
         CUSTOMER_ID            NUMBER(11, 0),
CONSTRAINT ORDER_PK PRIMARY KEY (ORDER_ID),
CONSTRAINT ORDER_FK FOREIGN KEY (CUSTOMER_ID) REFERENCES CUSTOMER_T(CUSTOMER_ID));
```

```
CREATE TABLE PRODUCT_T
        (PRODUCT_ID             INTEGER       NOT NULL,
         PRODUCT_DESCRIPTION    VARCHAR2(50),
         PRODUCT_FINISH         VARCHAR2(20)
                    CHECK (PRODUCT_FINISH IN ('Cherry', 'Natural Ash', 'White Ash',
                              'Red Oak', 'Natural Oak', 'Walnut')),
         STANDARD_PRICE         DECIMAL(6,2),
         PRODUCT_LINE_ID        INTEGER,
CONSTRAINT PRODUCT_PK PRIMARY KEY (PRODUCT_ID));
```

```
CREATE TABLE ORDER_LINE_T
        (ORDER_ID               NUMBER(11,0)  NOT NULL,
         PRODUCT_ID             NUMBER(11,0)  NOT NULL,
         ORDERED_QUANTITY       NUMBER(11,0),
CONSTRAINT ORDER_LINE_PK PRIMARY KEY (ORDER_ID, PRODUCT_ID),
CONSTRAINT ORDER_LINE_FK1 FOREIGN KEY(ORDER_ID) REFERENCES ORDER_T(ORDER_ID),
CONSTRAINT ORDER_LINE_FK2 FOREIGN KEY (PRODUCT_ID) REFERENCES PRODUCT_T(PRODUCT_ID));
```

Using and Defining Views

- Views provide users controlled access to tables
- Advantages of views:
  - Simplify query commands
  - Provide data security
  - Enhance programming productivity
- CREATE VIEW command

View Terminology

- Base Table
  - A table containing the raw data
- Dynamic View
  - A "virtual table" created dynamically upon request by a user
  - No data actually stored; instead data from base table made
  - Based on SQL SELECT statement on base tables or other views
- Materialized View
  - Copy or replication of data
  - Data actually stored
  - Must be refreshed periodically to match the corresponding base tables

Sample CREATE VIEW

```
CREATE VIEW EXPENSIVE_STUFF_V AS
SELECT PRODUCT_ID, PRODUCT_NAME, UNIT_PRICE
FROM PRODUCT_T
WHERE UNIT_PRICE > 300
WITH CHECK_OPTION;
```

- View has a name
- View is based on a SELECT statement
- CHECK_OPTION works only for updateable views and prevents updates that would create rows not included in the view

About Dynamic Views

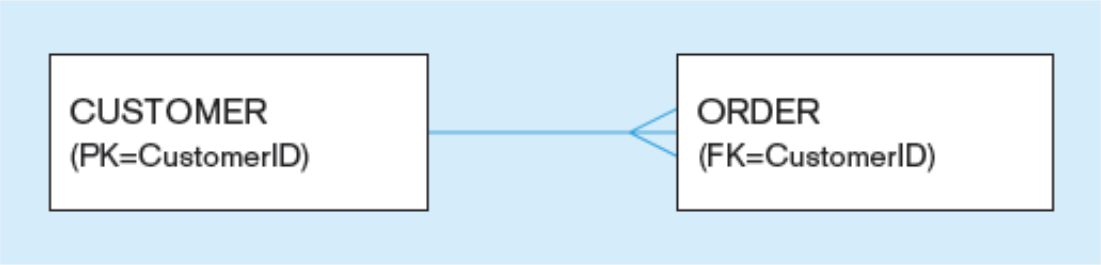
TABLE 6-4 Pros and Cons of Using Dynamic Views

Positive Aspects	Negative Aspects
Simplify query commands	Use processing time re-creating the view each time it is referenced
Help provide data security and confidentiality	May or may not be directly updateable
Improve programmer productivity	
Contain most current base table data	
Use little storage space	
Provide a customized view for a user	
Establish physical data independence	

Data Integrity Controls

- Referential Integrity
  - Constraint that ensures that foreign key values of a table must match primary key values of a related table in 1:M relationships
- Restricting
  - Deletes of primary records
  - Updates of primary records
  - Inserts of dependent records

Ensuring Data Integrity through Updates



Relational integrity is enforced via the primary-key to foreign-key match

Restricted Update: A customer ID can only be deleted if it is not found in ORDER table.

```
CREATE TABLE CustomerT
        (CustomerID          INTEGER DEFAULT '999'     NOT NULL,
         CustomerName        VARCHAR(40)               NOT NULL,
         . . .
CONSTRAINT Customer_PK PRIMARY KEY (CustomerID),
ON UPDATE RESTRICT);
```

Cascaded Update: Changing a customer ID in the CUSTOMER table will result in that value changing in the ORDER table to match.

```
. . . ON UPDATE CASCADE);
```

Set Null Update: When a customer ID is changed, any customer ID in the ORDER table that matches the old customer ID is set to NULL.

```
. . . ON UPDATE SET NULL);
```

Set Default Update: When a customer ID is changed, any customer ID in the ORDER tables that matches the old customer ID is set to a predefined default value.

```
. . . ON UPDATE SET DEFAULT);
```

Changing and Removing Tables

- ALTER TABLE statement allows you to change column specifications:
  - **ALTER TABLE** CUSTOMER_T **ADD** (TYPE VARCHAR(2))
- DROP TABLE statement allows you to remove tables from your schema:
  - **DROP TABLE** CUSTOMER_T

Alter Table

Syntax:

```
ALTER TABLE table_name alter_table_action;
```

```
ADD [COLUMN] column_definition
ALTER [COLUMN] column_name SET DEFAULT default-value
ALTER [COLUMN] column_name DROP DEFAULT
DROP [COLUMN] column_name [RESTRICT] [CASCADE]
ADD table_constraint
```

```
ALTER TABLE CUSTOMER_T
ADD COLUMN CustomerType VARCHAR2 (2) DEFAULT "Commercial";
```

Alter Table (Add Column)

```
mysql> describe employee;
+----------+--------------+------+-----+---------+-------+
| Field    | Type         | Null | Key | Default | Extra |
+----------+--------------+------+-----+---------+-------+
| emp_id   | int(11)      | NO   | PRI | NULL    |       |
| emp_name | varchar(30)  | NO   |     | NULL    |       |
| emp_job  | varchar(30)  | NO   |     | NULL    |       |
| dep_ID   | int(5)       | YES  | MUL | NULL    |       |
+----------+--------------+------+-----+---------+-------+
4 rows in set (0.03 sec)

mysql> alter table employee add column (city varchar(30) not null default 'Peshawar');
Query OK, 0 rows affected (0.68 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+--------------+------+-----+----------+-------+
| Field    | Type         | Null | Key | Default  | Extra |
+----------+--------------+------+-----+----------+-------+
| emp_id   | int(11)      | NO   | PRI | NULL     |       |
| emp_name | varchar(30)  | NO   |     | NULL     |       |
| emp_job  | varchar(30)  | NO   |     | NULL     |       |
| dep_ID   | int(5)       | YES  | MUL | NULL     |       |
| city     | varchar(30)  | NO   |     | Peshawar |       |
+----------+--------------+------+-----+----------+-------+
5 rows in set (0.08 sec)
```

Alter Table (Drop Column)

```
mysql> alter table employee drop column city;
Query OK, 0 rows affected (1.03 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+--------------+------+-----+---------+-------+
| Field    | Type         | Null | Key | Default | Extra |
+----------+--------------+------+-----+---------+-------+
| emp_id   | int(11)      | NO   | PRI | NULL    |       |
| emp_name | varchar(30)  | NO   |     | NULL    |       |
| emp_job  | varchar(30)  | NO   |     | NULL    |       |
| dep_ID   | int(5)       | YES  | MUL | NULL    |       |
+----------+--------------+------+-----+---------+-------+
4 rows in set (0.01 sec)
```

Alter Table (Add/Drop Primary Key)

```
mysql> alter table employee drop primary key;
Query OK, 13 rows affected (1.31 sec)
Records: 13  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| emp_id   | int(11)     | NO   |     | NULL    |       |
| emp_name | varchar(30) | NO   |     | NULL    |       |
| emp_job  | varchar(30) | NO   |     | NULL    |       |
| dep_ID   | int(5)      | YES  | MUL | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.14 sec)

mysql> alter table employee add primary key (emp_id);
Query OK, 0 rows affected (0.53 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| emp_id   | int(11)     | NO   | PRI | NULL    |       |
| emp_name | varchar(30) | NO   |     | NULL    |       |
| emp_job  | varchar(30) | NO   |     | NULL    |       |
| dep_ID   | int(5)      | YES  | MUL | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.01 sec)
```

Insert Statement

- Adds data to a table
- Inserting into a table
  - **INSERT INTO** CUSTOMER_T **VALUES** (001, 'CONTEMPORARY Casuals', '1335 S. Himes Blvd.', 'Gainesville', 'FL', 32601);
- Inserting a record that has some null attributes requires identifying the fields that actually get data
  - **INSERT INTO** PRODUNT_T (PRODUCT_ID, PRODUCT_DESCRIPTION, PRODUCT_FINISH, STANDARD_PRICE, PRODUCT_ON_HAND) **VALUES** (1, 'End Table', 'Cherry', 175, 8);
- Inserting from another table
  - **INSERT INTO** CA_CUSTOMER_T **SELECT** * **FROM** CUSTOMER_T **WHERE** STATE = 'CA';

Insert Statement (Cont.)

```
mysql> insert into department (dep_Name, dep_ID) values
    -> ('Industrial Engineering', 20);
Query OK, 1 row affected (0.15 sec)

mysql> select * from department;
+--------+-------------------------------+
| dep_ID | dep_Name                      |
+--------+-------------------------------+
|     10 | Computer Systems Engineering  |
|     20 | Industrial Engineering        |
|     40 | Chemical Engineering          |
|     50 | Mechanical Engineering        |
|     70 | Software Engineering          |
|     75 | Mechatronics Engineering      |
|     76 | Software Engineering          |
|     78 | Computer Science & Information |
|    100 | Agriculture Engineering       |
|    105 | Electrical Engineering        |
+--------+-------------------------------+
10 rows in set (0.00 sec)
```

Insert Statement (Cont.)

```
mysql> select * from employee_mrdn;
Empty set (0.00 sec)

mysql> insert into employee_mrdn
    -> select * from employee
    -> where emp_domicile = 'mardan';
Query OK, 4 rows affected (0.14 sec)
Records: 4  Duplicates: 0  Warnings: 0

mysql> select * from employee_mrdn;
+--------+----------+----------------------+--------+---------------+
| emp_id | emp_name | emp_job              | dep_ID | emp_domicile  |
+--------+----------+----------------------+--------+---------------+
|      4 | CVA      | Lecturer             |     50 | Mardan        |
|      6 | ACB      | Assistant Professor  |    105 | Mardan        |
|      8 | XZY      | Assistant Professor  |     70 | Mardan        |
|      9 | ABS      | Assistant Professor  |     70 | Mardan        |
+--------+----------+----------------------+--------+---------------+
4 rows in set (0.00 sec)
```

Delete Statement

- Removes rows from a table
- Delete certain rows
  - **DELETE FROM** CUSTOMER_T **WHERE** STATE = 'HI';
- Delete all rows
  - **DELETE FROM** CUSTOMER_T;

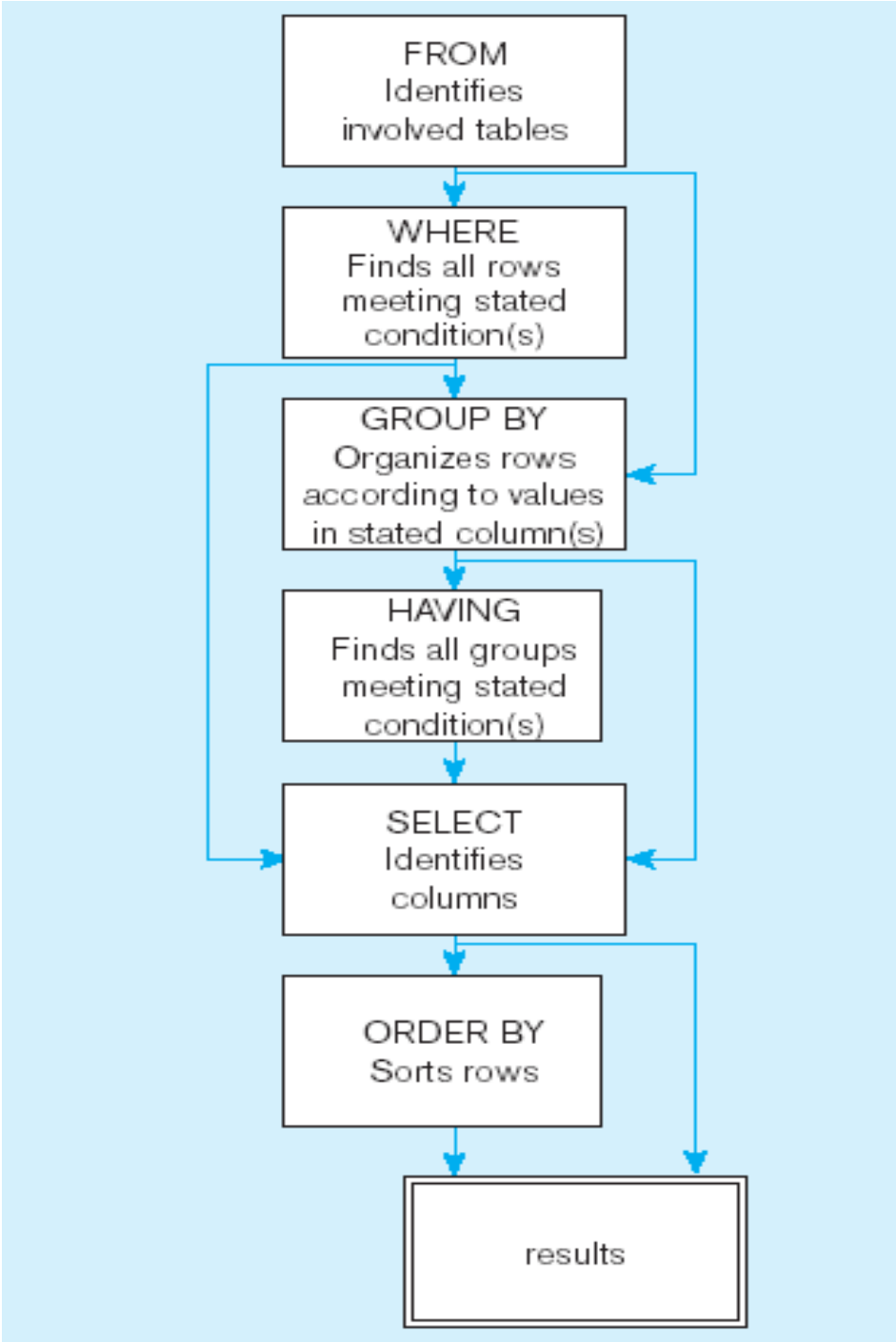
Update Statement

- Modifies data in existing rows
  - **UPDATE** PRODUCT_T **SET** UNIT_PRICE = 775 **WHERE** PRODUCT_ID = 7;

The SELECT Statement

- Used for queries on single or multiple tables
- Clauses of the SELECT statement:
  - SELECT
    - List the column (and expressions) that should be returned from the query
  - FROM
    - Indicate the table(s) or view(s) from which data will be obtained
  - WHERE
    - Indicate the conditions under which a row will be included in the result
  - GROUP BY
    - Indicate categorization of results
  - HAVING
    - Indicate the conditions under which a category (group) will be included
  - ORDER BY
    - Sorts the result according to specified criteria

SQL Statement Processing Order (Adapted from Van der Lans, p.100)



SELECT Example with Comparison Operator (<)

- Find products with standard price less than $275

  – SELECT PRODUCT_NAME, STANDARD_PRICE
    FROM PRODUCT_V
    WHERE STANDARD_PRICE <275;

Result:

PRODUCTDESCRIPTION	PRODUCTSTANDARDPRICE
End Table	175
Computer Desk	250
Coffee Table	200

Comparison Operators in SQL

TABLE 6-3 Comparison Operators in SQL

Operator	Meaning
=	Equal to
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
<>	Not equal to
!=	Not equal to

SELECT Example with Comparison Operator (>)

Query: Which orders have been placed since 10/24/2010?

```
SELECT OrderID, OrderDate
  FROM Order_T
    WHERE OrderDate > '24-OCT-2010';
```

Result:

ORDERID	ORDERDATE
1007	27-OCT-10
1008	30-OCT-10
1009	05-NOV-10
1010	05-NOV-10

SELECT Example with Comparison Operator (!=)

Query: What furniture does Pine Valley carry that isn't made of cherry?

```
SELECT ProductDescription, ProductFinish
  FROM Product_T
    WHERE ProductFinish != 'Cherry';
```

Result:

PRODUCTDESCRIPTION	PRODUCTFINISH
Coffee Table	Natural Ash
Computer Desk	Natural Ash
Entertainment Center	Natural Maple
8-Drawer Desk	White Ash
Dining Table	Natural Ash
Computer Desk	Walnut

SELECT Example with ALIAS

- Alias is an alternative column or table name

  - **SELECT** CUSTOMER_Name **AS NAME**, CUSTOMER_ADDRESS
    FROM CUSTOMER_V
    WHERE NAME = 'Home Furnishings';

Result:

NAME	CUSTOMERADDRESS
Home Furnishings	1900 Allard Ave.

SELECT Example Using a Function

- Using the COUNT *aggregate function* to find totals

  – **SELECT COUNT(*)**
  FROM ORDER_LINE_V
  WHERE ORDER_ID = 1004;

Result:

COUNT (*)
2

Note: With aggregate functions you can't have single-valued columns included in the SELECT clause

SELECT Example Using Boolean Operators

- **AND**, **OR**, and **NOT** operators for customizing conditions in WHERE clause
  - **SELECT** PRODUCT_DESCRIPTION, PRODUCT_FINISH, STANDARD_PRICE
    FROM PRODUCT_V
    WHERE (PRODUCT_DESCRIPTION **LIKE** '**%**Desk' **OR** PRODUCT_DESCRIPTION **LIKE** '**%**Table') **AND** UNIT_PRICE>300;

Output of this query is shown in next slide (i.e. S 41)

Note: The LIKE operator allows you to compare strings using wildcards. For example, the % wildcard in '%Desk' indicates that all string that have any number of characters preceding the word "Desk" will be allowed

Output

Query:

```
SELECT PRODUCT_DESCRIPTION, PRODUCT_FINISH,
STANDARD_PRICE
FROM PRODUCT_V
WHERE (PRODUCT_DESCRIPTION LIKE '%Desk' OR
PRODUCT_DESCRIPTION LIKE '%Table') AND
UNIT_PRICE>300;
```

Result:

PRODUCTDESCRIPTION	PRODUCTFINISH	PRODUCTSTANDARDPRICE
Computer Desk	Natural Ash	375
Writer's Desk	Cherry	325
8-Drawer Desk	White Ash	750
Dining Table	Natural Ash	800
Computer Desk	Walnut	250

SELECT Example – Sorting Results with the ORDER BY Clause

- Sort the results first by STATE, and within a state by CUSTOMER_NAME

  - **SELECT** CUSTOMER_NAME, CITY, STATE
    FROM CUSTOMER_V
    WHERE STATE **IN** ('FL', 'TX', 'CA', 'HI')
    ORDER BY STATE, CUSTOMER_NAME;

Output of this query is shown in next slide (i.e. S 43)

Note: The IN operator in this example allows you to include rows whose STATE value is either FL, TX, CA, or HI. It is more efficient than separate OR conditions

Output

```
SELECT CUSTOMER_NAME, CITY, STATE
FROM CUSTOMER_V
WHERE STATE IN ('FL', 'TX', 'CA', 'HI')
ORDER BY STATE, CUSTOMER_NAME;
```

Result:

CUSTOMERNAME	CUSTOMERCITY	CUSTOMERSTATE
California Classics	Santa Clara	CA
Impressions	Sacramento	CA
Contemporary Casuals	Gainesville	FL
M and H Casual Furniture	Clearwater	FL
Seminole Interiors	Seminole	FL
Kaneohe Homes	Kaneohe	HI
Value Furniture	Plano	TX
7 rows selected.		

SELECT Example – Categorizing Results Using the GROUP BY Clause

- For use with aggregate functions
  - *Scalar aggregate:* single value returned from SQL query with aggregate function
  - *Vector aggregate:* multiple values returned from SQL query with aggregate function (via GROUP BY)

```
SELECT STATE, COUNT(STATE)
FROM CUSTOMER_V
GROUP BY STATE;
```

Output of this query is shown in next slide (i.e. S 45)

Note: You can use single-value fields with aggregate functions if they are included in the GROUP BY clause

Output

```
SELECT STATE, COUNT(STATE)
FROM CUSTOMER_V
GROUP BY STATE;
```

Result:

CUSTOMERSTATE	COUNT(CUSTOMERSTATE)
CA	2
CO	1
FL	3
HI	1
MI	1
NJ	2
NY	1
PA	1
TX	1
UT	1
WA	1
11 rows selected.	

SELECT Example – Qualifying Results by Categories Using the HAVING Clause

- For use with GROUP BY

```
SELECT STATE, COUNT(STATE)
FROM CUSTOMER_V
GROUP BY STATE
HAVING COUNT(STATE) > 1;
```

Result:

CUSTOMERSTATE	COUNT(CUSTOMERSTATE)
CA	2
FL	3
NJ	2

Like a WHERE clause, but it operates on groups (categories), not on individual rows. Here, only those groups with total numbers greater than 1 will be included in final result.

Creating Index

```
mysql> describe employee;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| emp_id   | int(11)     | NO   | PRI | NULL    |       |
| emp_name | varchar(30) | NO   |     | NULL    |       |
| emp_job  | varchar(30) | NO   |     | NULL    |       |
| dep_ID   | int(5)      | YES  | MUL | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.01 sec)

mysql> create index e_job on employee (emp_job);
Query OK, 0 rows affected (1.01 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| emp_id   | int(11)     | NO   | PRI | NULL    |       |
| emp_name | varchar(30) | NO   |     | NULL    |       |
| emp_job  | varchar(30) | NO   | MUL | NULL    |       |
| dep_ID   | int(5)      | YES  | MUL | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.01 sec)
```

Dropping Index

```
mysql> drop index e_job on employee;
Query OK, 0 rows affected (0.25 sec)
Records: 0  Duplicates: 0  Warnings: 0

mysql> describe employee;
+----------+-------------+------+-----+---------+-------+
| Field    | Type        | Null | Key | Default | Extra |
+----------+-------------+------+-----+---------+-------+
| emp_id   | int(11)     | NO   | PRI | NULL    |       |
| emp_name | varchar(30) | NO   |     | NULL    |       |
| emp_job  | varchar(30) | NO   |     | NULL    |       |
| dep_ID   | int(5)      | YES  | MUL | NULL    |       |
+----------+-------------+------+-----+---------+-------+
4 rows in set (0.01 sec)
```

Use of BETWEEN Operator

Query: Which products in the Product table have a standard price between $200 and $300?

```
SELECT ProductDescription, ProductStandardPrice
  FROM Product_T
    WHERE ProductStandardPrice > 199 AND ProductStandardPrice < 301;
```

Result:

PRODUCTDESCRIPTION	PRODUCTSTANDARDPRICE
Coffee Table	200
Computer Desk	250

The same result will be returned by the following query.

Query: Which products in the PRODUCT table have a standard price between $200 and $300?

```
SELECT ProductDescription, ProductStandardPrice
  FROM Product_T
    WHERE ProductStandardPrice BETWEEN 200 AND 300;
```

Result: Same as previous query.

Use of IS NULL Operator

```
mysql> select * from employee;
+--------+----------+---------------------+--------+
| emp_id | emp_name | emp_job             | dep_ID |
+--------+----------+---------------------+--------+
|      1 | BCA      | Lecturer            |     10 |
|      2 | ABD      | Lecturer            |     35 |
|      3 | XYZ      | Assitant Professor  |     10 |
|      4 | CVA      | Lecturer            |     50 |
|      5 | VAC      | Assistant Professor |     50 |
|      6 | ACB      | Assistant Professor |     35 |
|      8 | XZY      | Assistant Professor |     70 |
|      9 | ABS      | Assistant Professor |     70 |
|     11 | FGJ      | Assistant Professor |     25 |
|     16 | OOP      | Lecturer            |   NULL |
|     17 | HHA      | Lab Engineer        |     35 |
|     18 | HBV      | Lab Engineer        |     70 |
|     19 | HCA      | Lab Engineer        |     35 |
+--------+----------+---------------------+--------+
13 rows in set (0.00 sec)

mysql> select * from employee where dep_ID is null;
+--------+----------+----------+--------+
| emp_id | emp_name | emp_job  | dep_ID |
+--------+----------+----------+--------+
|     16 | OOP      | Lecturer |   NULL |
+--------+----------+----------+--------+
1 row in set (0.04 sec)
```

More Aggregate Functions

Query: What is the average standard price for all products in inventory?

```
SELECT AVG (ProductStandardPrice) AS AveragePrice
FROM Product_T;
```

Result:

AVERAGEPRICE
440.625

Query: Display for each product the difference between its standard price and the overall average standard price of all products.

```
SELECT ProductStandardPrice – PriceAvg AS Difference
  FROM Product_T, (SELECT AVG(ProductStandardPrice) AS PriceAvg
    FROM Product_T);
```

Result:

DIFFERENCE
–240.63
–65.63
–265.63
–190.63
359.38
–115.63
209.38
309.38

Summary

- Introduced SQL, Data Definition & Manipulation Language, various commands along with examples