Oracle Database 11*g*: SQL Fundamentals I

Electronic Presentation

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ORACLE

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Introduction

Lesson Objectives

After completing this lesson, you should be able to do the following:

- Understand the goals of the course
- List the features of Oracle Database 11*g*
- Discuss the theoretical and physical aspects of a relational database
- Describe Oracle server's implementation of RDBMS and object relational database management system (ORDBMS)
- Identify the development environments that can be used for this course
- Describe the database and schema used in this course

Lesson Agenda

- Course objectives, agenda, and appendixes used in the course
- Overview of Oracle Database 11*g* and related products
- Overview of relational database management concepts and terminologies
- Introduction to SQL and its development environments
- The HR schema and the tables used in this course
- Oracle Database 11*g* documentation and additional resources

Course Objectives

After completing this course, you should be able to:

- Identify the major components of Oracle Database 11*g*
- Retrieve row and column data from tables with the `SELECT` statement
- Create reports of sorted and restricted data
- Employ SQL functions to generate and retrieve customized data
- Run complex queries to retrieve data from multiple tables
- Run data manipulation language (DML) statements to update data in Oracle Database 11*g*
- Run data definition language (DDL) statements to create and manage schema objects

Course Agenda

- Day 1:
  - Introduction
  - Retrieving Data Using the SQL `SELECT` Statement
  - Restricting and Sorting Data
  - Using Single-Row Functions to Customize Output
  - Using Conversion Functions and Conditional Expressions
- Day 2:
  - Reporting Aggregated Data Using the Group Functions
  - Displaying Data from Multiple Tables
  - Using Subqueries to Solve Queries
  - Using the Set Operators

Course Agenda

- Day 3:
  - Manipulating Data
  - Using DDL Statements to Create and Manage Tables
  - Creating Other Schema Objects

Appendixes Used in the Course

- Appendix A: Practice Solutions
- Appendix B: Table Descriptions
- Appendix C: Oracle Join Syntax
- Appendix D: Using SQL*Plus
- Appendix E: Using SQL Developer
- Additional Practices
- Additional Practices Solutions

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Oracle Database 11*g*: Focus Areas

Infrastructure Grids

Information Management

Application Development

Oracle Database 11*g*

Manageability

High availability

Performance

Security

Information integration

Oracle Database 11*g*

Manageability

High availability

Performance

Security

Information integration

Oracle Fusion Middleware

Portfolio of leading, standards-based, and customer-proven software products that spans a range of tools and services from J2EE and developer tools, through integration services, business intelligence, collaboration, and content management

User Interaction
Portals, Content, Search, Desktop, Mobile, VoIP

Business Intelligence
ETL, Q&A, OLAP, Reports, Alerts, Real Time

Integration & Process Management
Messaging, ESB, BPM, B2B, BAM, MDM

Application Server
J2EE, WS-*, Events, Rules

Grid Infrastructure
Clusters, Metadata, Registry, Security

Development Tools
SOA Tools & Framework

Systems Management
System Application Services

Identity Management
Directory Provisioning, Single Sign-On, Identity Administration

Oracle Enterprise Manager Grid Control 10*g*

- Efficient Oracle Fusion Middleware management
- Simplifying application and infrastructure life cycle management
- Improved database administration and application management capabilities

Oracle BI Publisher

- Provides a central architecture for authoring, managing, and delivering information in secure and multiple formats
- Reduces complexity and time to develop, test, and deploy all kinds of reports
  - Financial Reports, Invoices, Sales or Purchase orders, XML, and EDI/EFT(eText documents)
- Enables flexible customizations
  - For example, a Microsoft Word document report can be generated in multiple formats such as PDF, HTML, Excel, RTF, and so on.

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- Course objectives, course agenda, and appendixes used in this course
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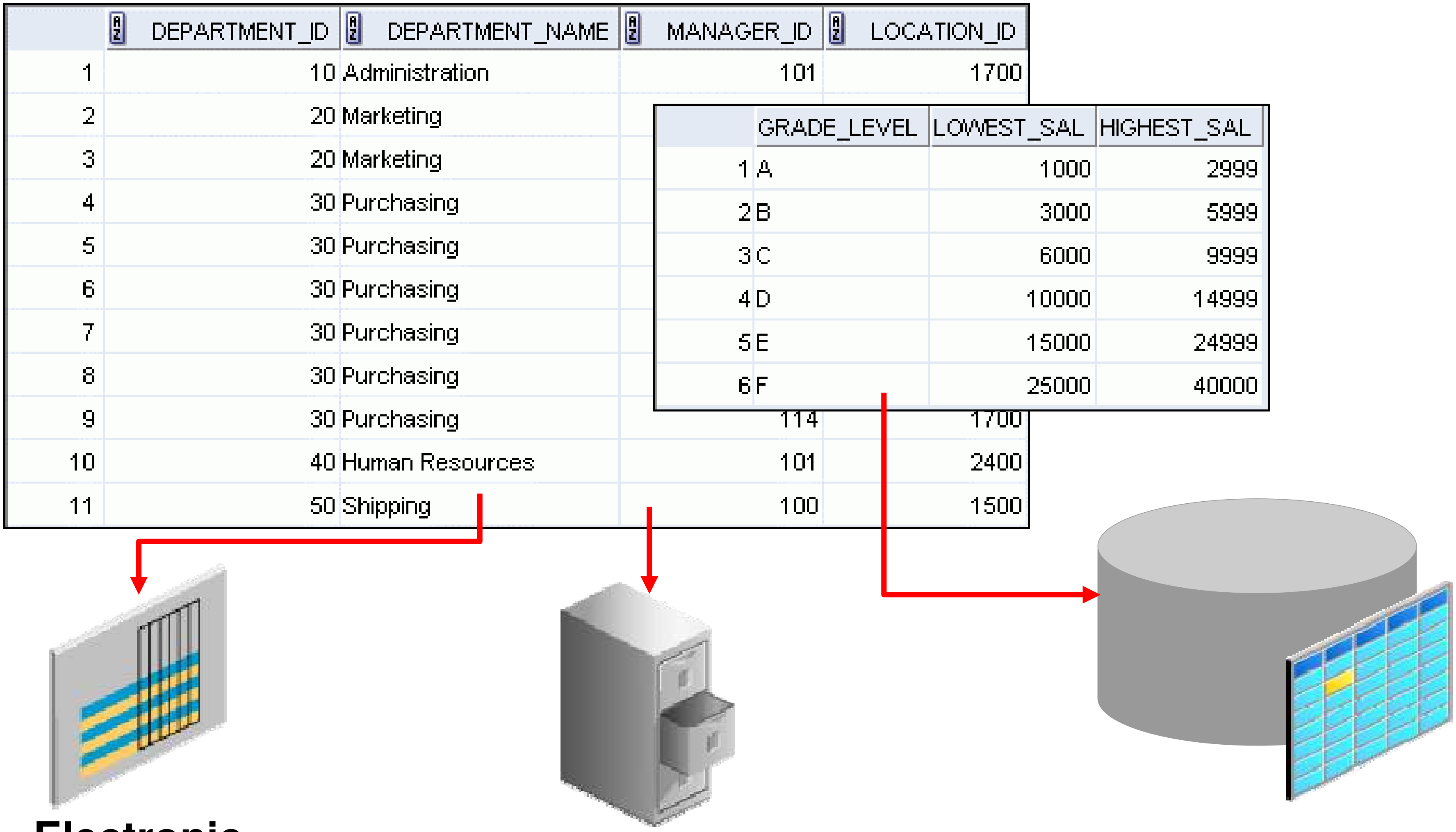
Relational and Object Relational Database Management Systems

- Relational model and object relational model
- User-defined data types and objects
- Fully compatible with relational database
- Supports multimedia and large objects
- High-quality database server features

Data Storage on Different Media



	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	101	1700
2	20	Marketing		
3	20	Marketing		
4	30	Purchasing		
5	30	Purchasing		
6	30	Purchasing		
7	30	Purchasing		
8	30	Purchasing		
9	30	Purchasing	114	1700
10	40	Human Resources	101	2400
11	50	Shipping	100	1500

	GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
1	A	1000	2999
2	B	3000	5999
3	C	6000	9999
4	D	10000	14999
5	E	15000	24999
6	F	25000	40000

Electronic spreadsheet

Filing cabinet

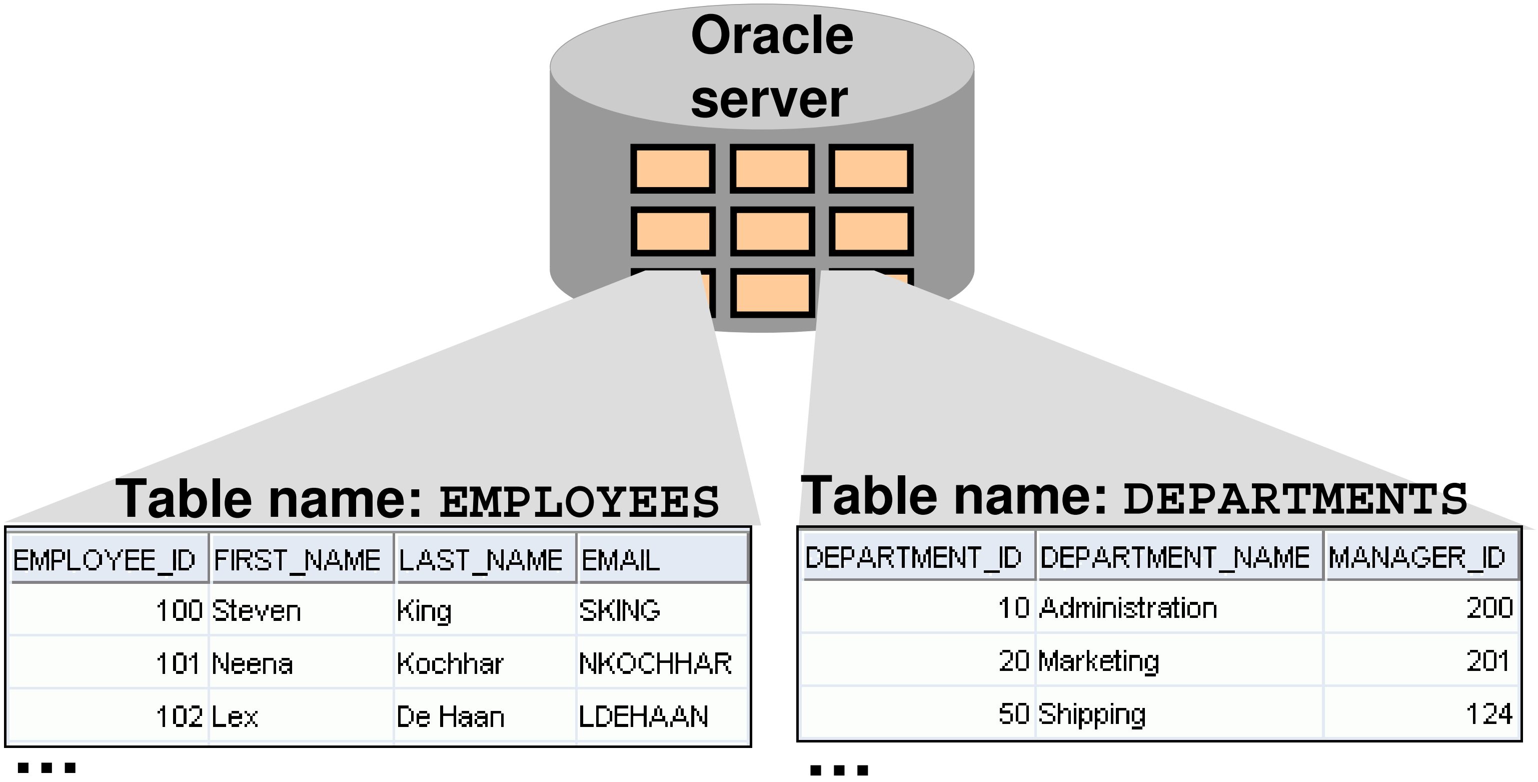
Database

Relational Database Concept

- Dr. E. F. Codd proposed the relational model for database systems in 1970.
- It is the basis for the relational database management system (RDBMS).
- The relational model consists of the following:
  - Collection of objects or relations
  - Set of operators to act on the relations
  - Data integrity for accuracy and consistency

Definition of a Relational Database

A relational database is a collection of relations or two-dimensional tables.



Oracle server

Table name: `EMPLOYEES`

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL
100	Steven	King	SKING
101	Neena	Kochhar	NKOCHHAR
102	Lex	De Haan	LDEHAAN

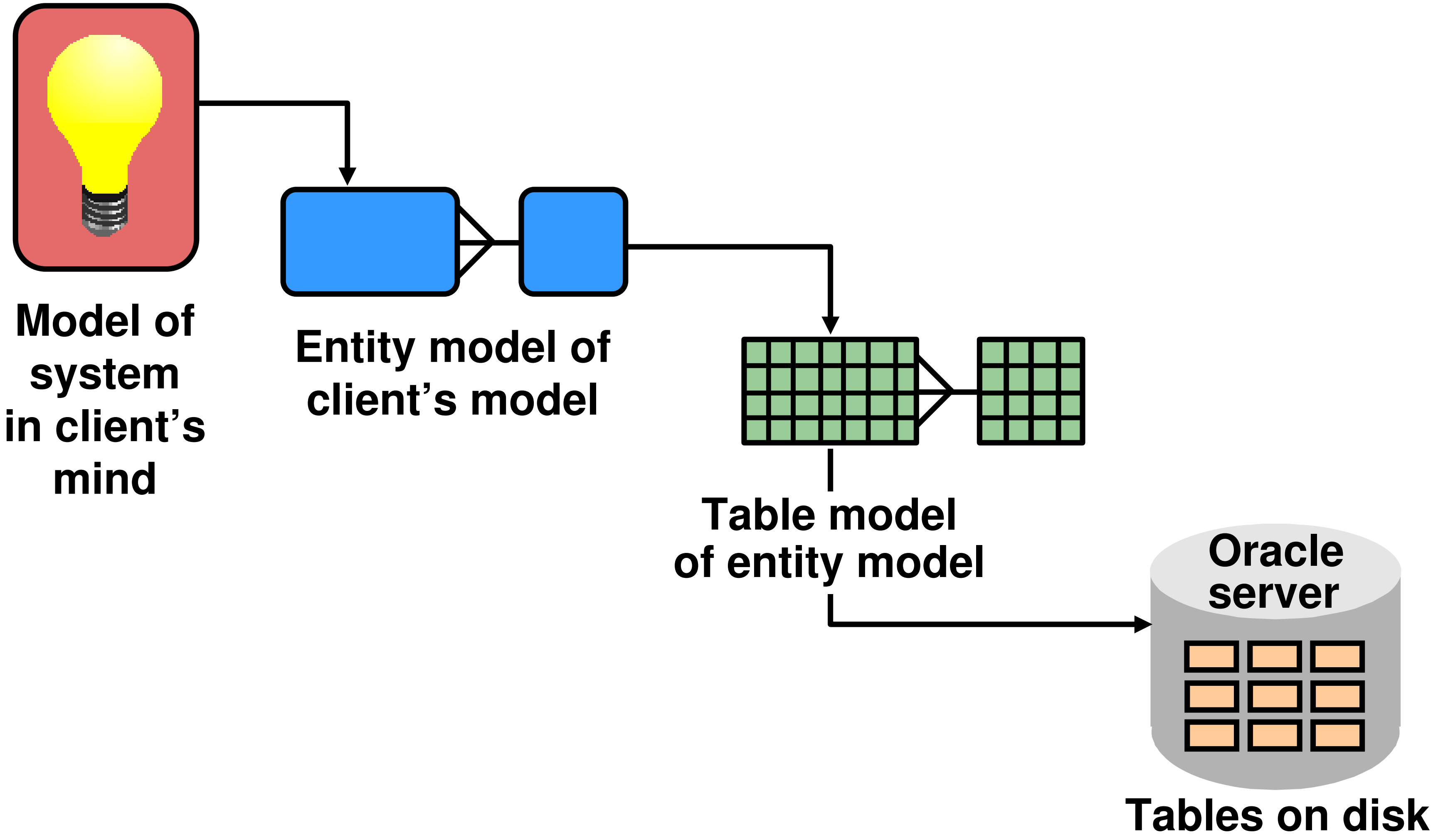
…

Table name: `DEPARTMENTS`

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID
10	Administration	200
20	Marketing	201
50	Shipping	124

…

Data Models



Model of system in client's mind

Entity model of client's model

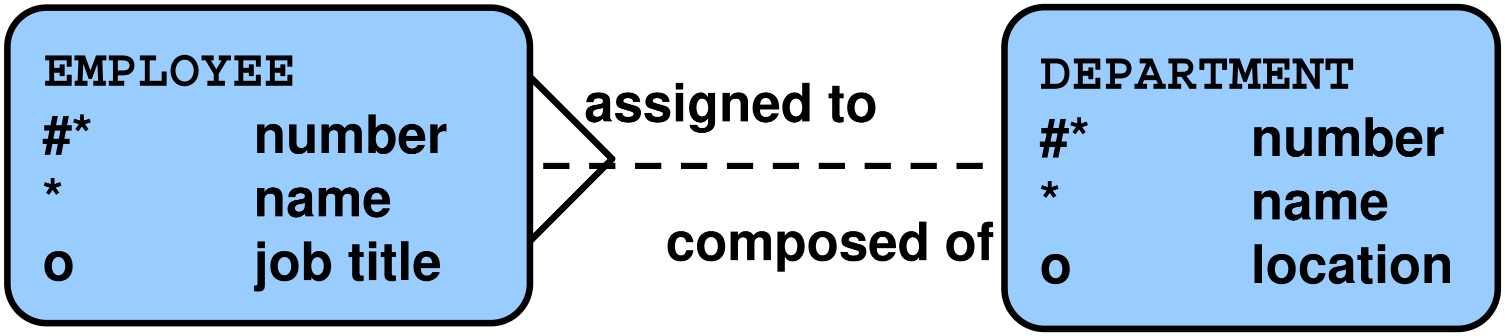
Table model of entity model

Oracle server

Tables on disk

Entity Relationship Model

- Create an entity relationship diagram from business specifications or narratives:



- Scenario:
  - "... Assign one or more employees to a department ..."
  - "... Some departments do not yet have assigned employees ..."

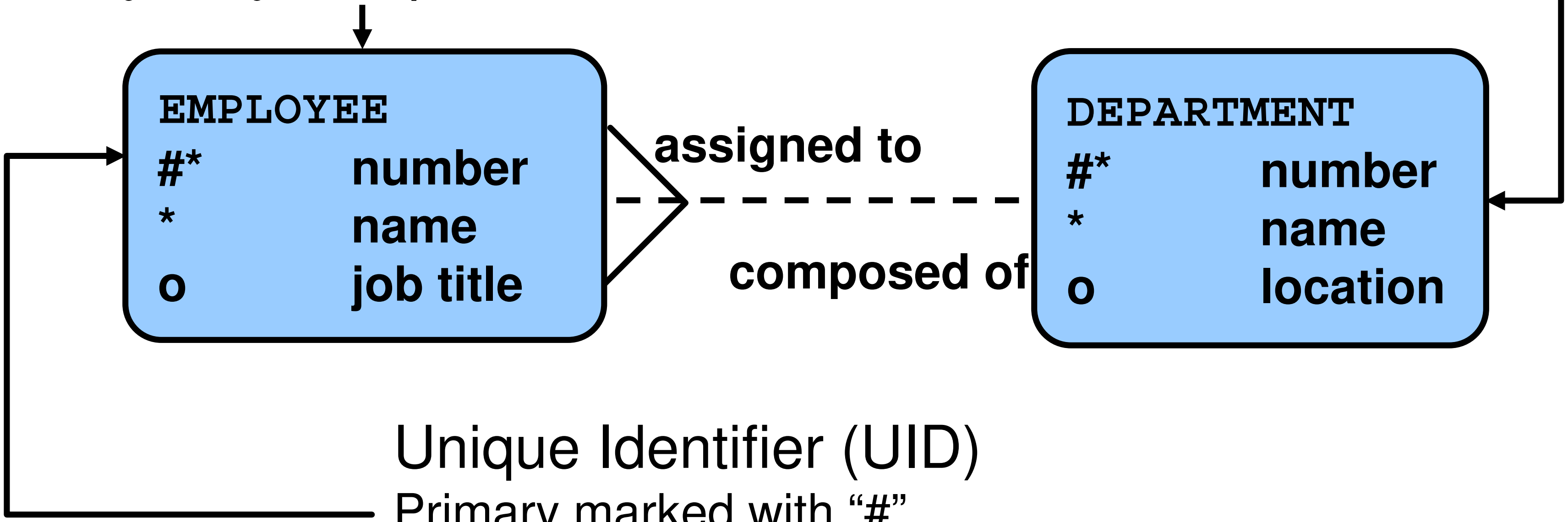
Entity Relationship Modeling Conventions

Entity:

- Singular, unique name
- Uppercase
- Soft box
- Synonym in parentheses

Attribute:

- Singular name
- Lowercase
- Mandatory marked with "*"
- Optional marked with "o"



Unique Identifier (UID)
Primary marked with "#"
Secondary marked with "(#)"

Relating Multiple Tables

- Each row of data in a table is uniquely identified by a primary key.
- You can logically relate data from multiple tables using foreign keys.

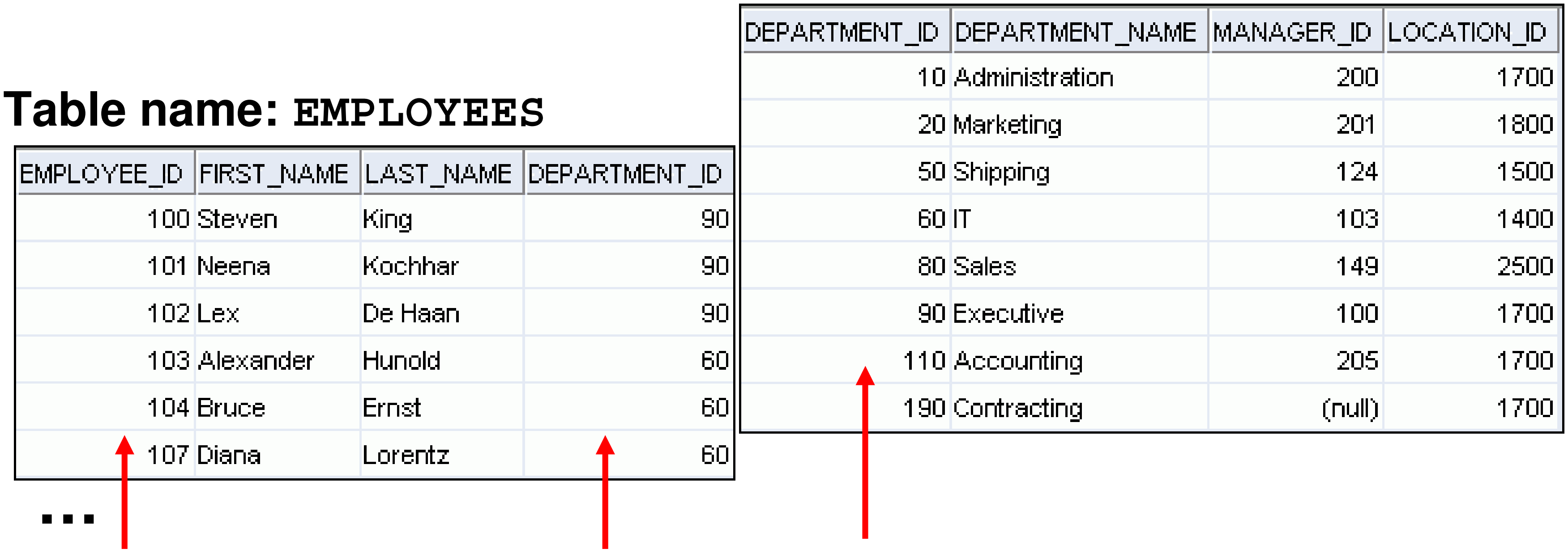


Table name: `DEPARTMENTS`

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
50	Shipping	124	1500
60	IT	103	1400
80	Sales	149	2500
90	Executive	100	1700
110	Accounting	205	1700
190	Contracting	(null)	1700

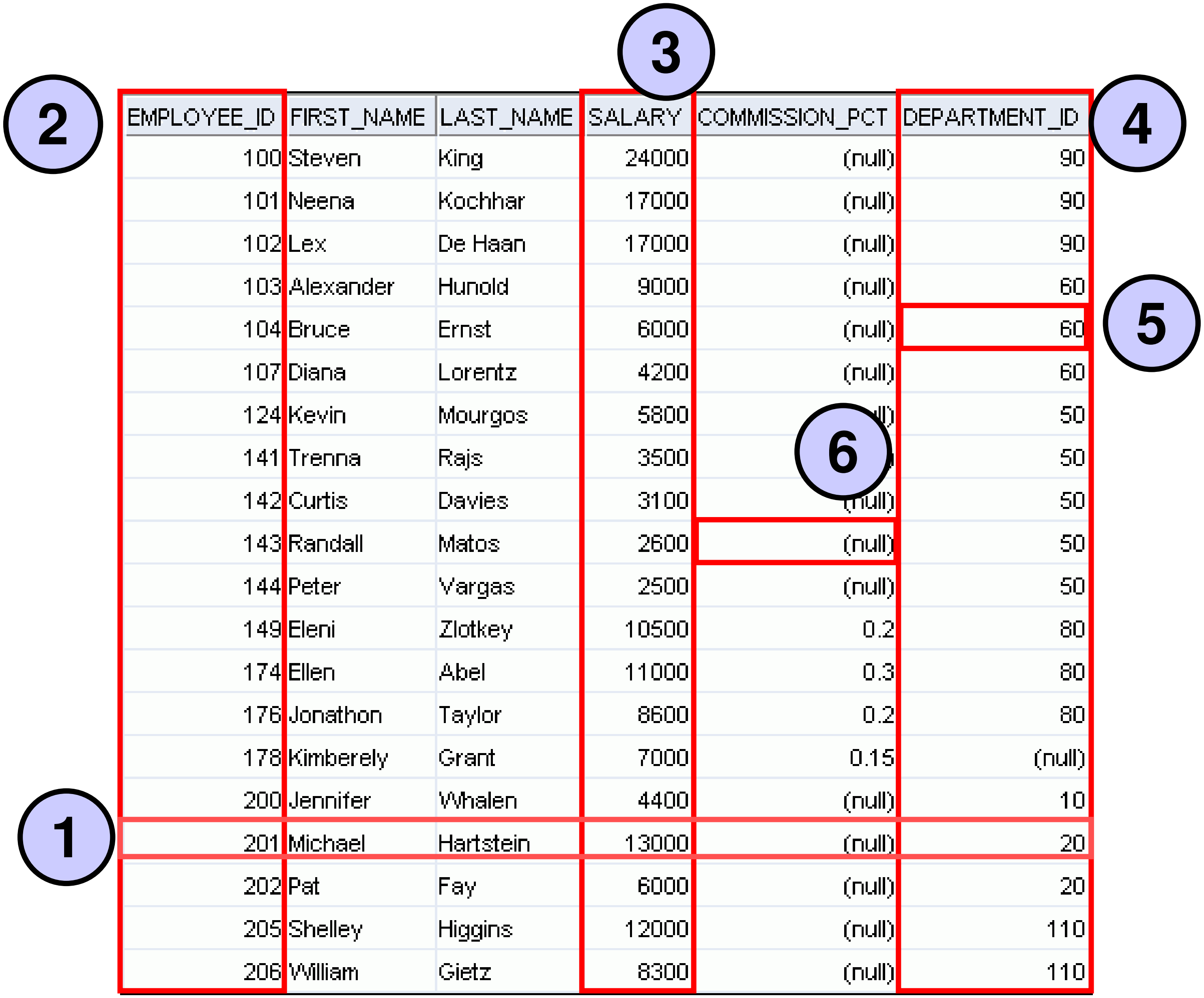
Table name: `EMPLOYEES`

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	DEPARTMENT_ID
100	Steven	King	90
101	Neena	Kochhar	90
102	Lex	De Haan	90
103	Alexander	Hunold	60
104	Bruce	Ernst	60
107	Diana	Lorentz	60

…

Primary key　**Foreign key**　**Primary key**

Relational Database Terminology



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	COMMISSION_PCT	DEPARTMENT_ID
100	Steven	King	24000	(null)	90
101	Neena	Kochhar	17000	(null)	90
102	Lex	De Haan	17000	(null)	90
103	Alexander	Hunold	9000	(null)	60
104	Bruce	Ernst	6000	(null)	60
107	Diana	Lorentz	4200	(null)	60
124	Kevin	Mourgos	5800	(null)	50
141	Trenna	Rajs	3500	[illegible]	50
142	Curtis	Davies	3100	(null)	50
143	Randall	Matos	2600	(null)	50
144	Peter	Vargas	2500	(null)	50
149	Eleni	Zlotkey	10500	0.2	80
174	Ellen	Abel	11000	0.3	80
176	Jonathon	Taylor	8600	0.2	80
178	Kimberely	Grant	7000	0.15	(null)
200	Jennifer	Whalen	4400	(null)	10
201	Michael	Hartstein	13000	(null)	20
202	Pat	Fay	6000	(null)	20
205	Shelley	Higgins	12000	(null)	110
206	William	Gietz	8300	(null)	110

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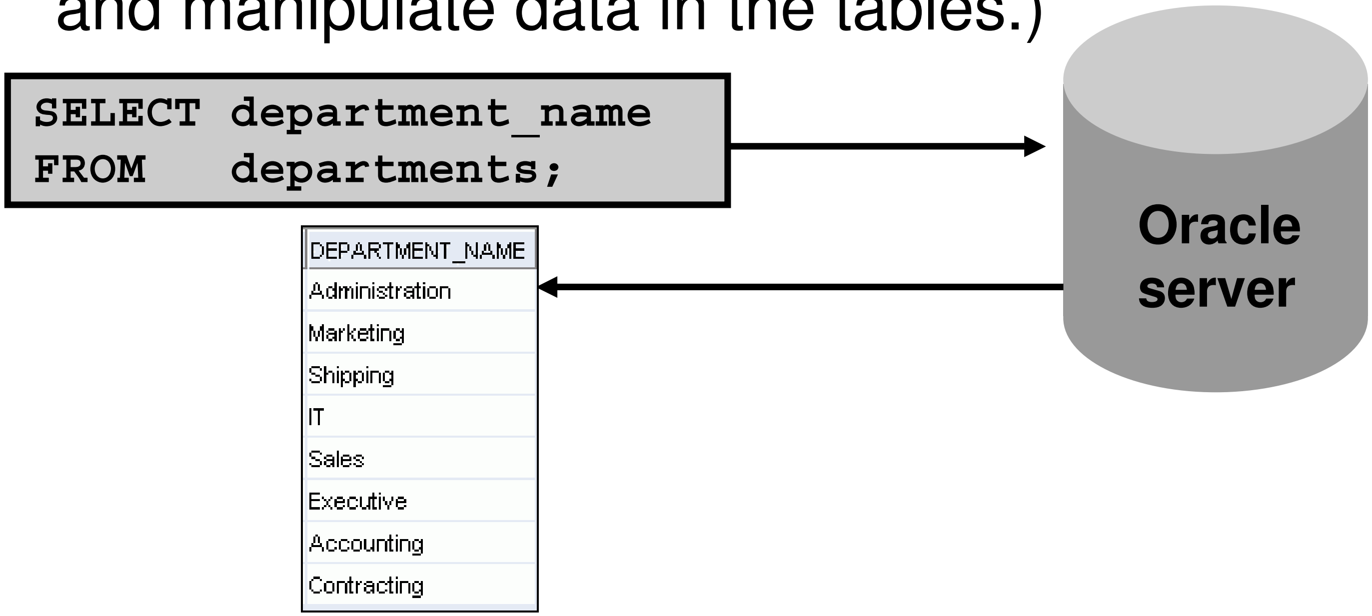
Using SQL to Query Your Database

Structured query language (SQL) is:

- The ANSI standard language for operating relational databases
- Efficient, easy to learn, and use
- Functionally complete (With SQL, you can define, retrieve, and manipulate data in the tables.)



```
SELECT department_name
FROM   departments;
```

DEPARTMENT_NAME
Administration
Marketing
Shipping
IT
Sales
Executive
Accounting
Contracting

SQL Statements

`SELECT`
`INSERT`
`UPDATE`
`DELETE`
`MERGE`
	Data manipulation language (DML)

`CREATE`
`ALTER`
`DROP`
`RENAME`
`TRUNCATE`
`COMMENT`
	Data definition language (DDL)

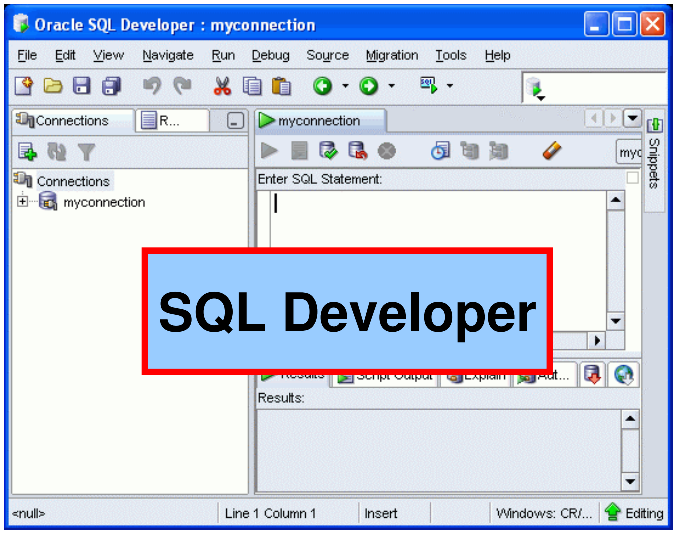
`GRANT` `REVOKE`	Data control language (DCL)

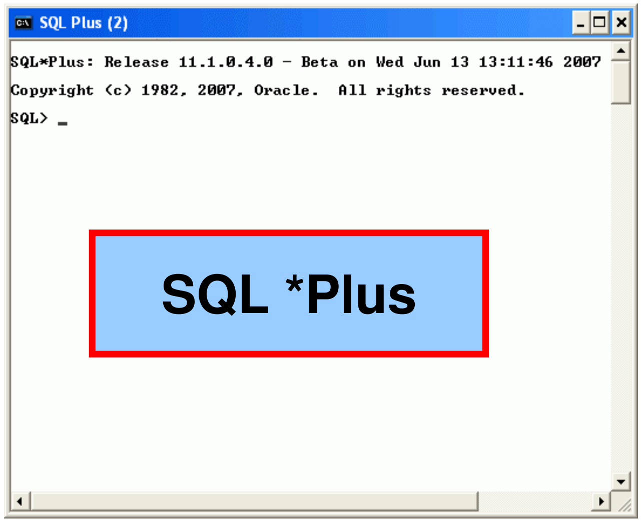
`COMMIT`
`ROLLBACK`
`SAVEPOINT`
	Transaction control

Development Environments for SQL

There are two development environments for this course:

- Primary tool is Oracle SQL Developer
- SQL*Plus command line interface may also be used





```
SQL*Plus: Release 11.1.0.4.0 - Beta on Wed Jun 13 13:11:46 2007

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SQL> _
```

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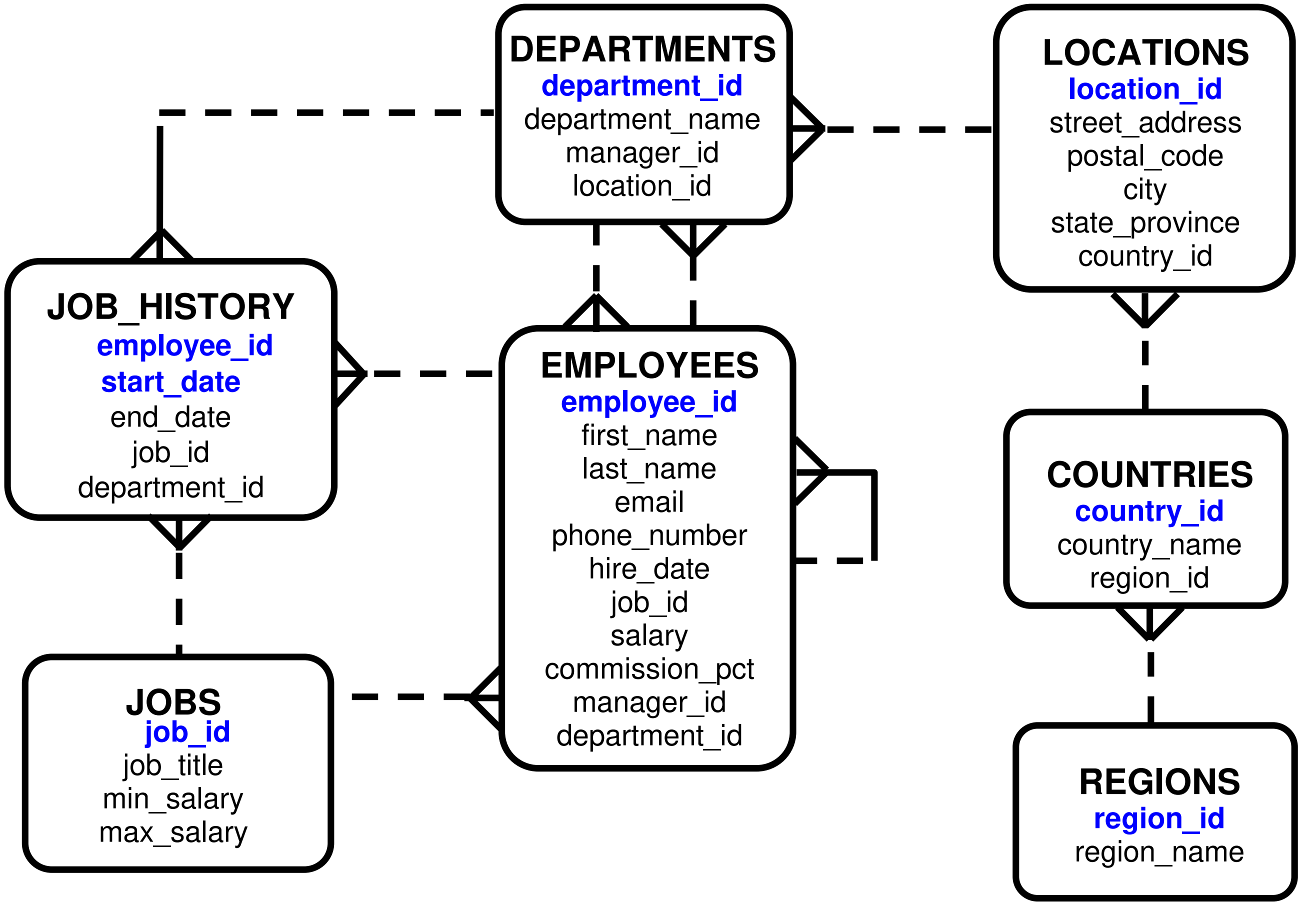
The `Human Resources (HR)` Schema



DEPARTMENTS
department_id
department_name
manager_id
location_id

LOCATIONS
location_id
street_address
postal_code
city
state_province
country_id

JOB_HISTORY
employee_id
start_date
end_date
job_id
department_id

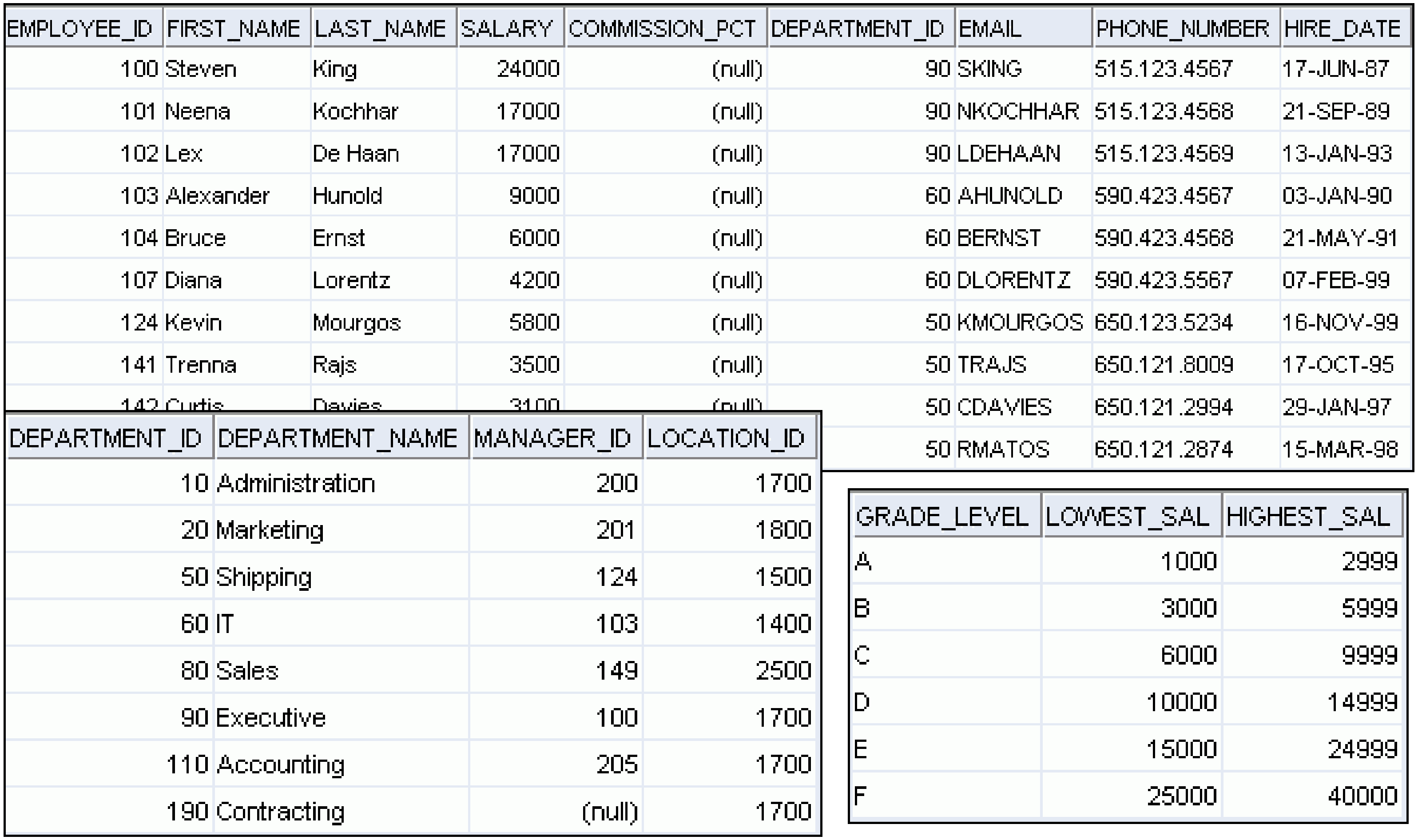
EMPLOYEES
employee_id
first_name
last_name
email
phone_number
hire_date
job_id
salary
commission_pct
manager_id
department_id

COUNTRIES
country_id
country_name
region_id

JOBS
job_id
job_title
min_salary
max_salary

REGIONS
region_id
region_name

Tables Used in the Course



EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	COMMISSION_PCT	DEPARTMENT_ID	EMAIL	PHONE_NUMBER	HIRE_DATE
100	Steven	King	24000	(null)	90	SKING	515.123.4567	17-JUN-87
101	Neena	Kochhar	17000	(null)	90	NKOCHHAR	515.123.4568	21-SEP-89
102	Lex	De Haan	17000	(null)	90	LDEHAAN	515.123.4569	13-JAN-93
103	Alexander	Hunold	9000	(null)	60	AHUNOLD	590.423.4567	03-JAN-90
104	Bruce	Ernst	6000	(null)	60	BERNST	590.423.4568	21-MAY-91
107	Diana	Lorentz	4200	(null)	60	DLORENTZ	590.423.5567	07-FEB-99
124	Kevin	Mourgos	5800	(null)	50	KMOURGOS	650.123.5234	16-NOV-99
141	Trenna	Rajs	3500	(null)	50	TRAJS	650.121.8009	17-OCT-95
142	Curtis	Davies	3100	(null)	50	CDAVIES	650.121.2994	29-JAN-97
					50	RMATOS	650.121.2874	15-MAR-98

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
50	Shipping	124	1500
60	IT	103	1400
80	Sales	149	2500
90	Executive	100	1700
110	Accounting	205	1700
190	Contracting	(null)	1700

GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
A	1000	2999
B	3000	5999
C	6000	9999
D	10000	14999
E	15000	24999
F	25000	40000

DEPARTMENTS

JOB_GRADES

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Oracle Database 11*g* Documentation

- *Oracle Database New Features Guide 11g, Release 1 (11.1)*
- *Oracle Database Reference 11g, Release 1 (11.1)*
- *Oracle Database SQL Language Reference 11g, Release 1 (11.1)*
- *Oracle Database Concepts 11g, Release 1 (11.1)*
- *Oracle Database SQL Developer User's Guide, Release 1.2*

Additional Resources

For additional information about the Oracle Database 11*g*, refer to the following:

- *Oracle Database 11g: New Features eStudies*
- *Oracle by Example series (OBE): Oracle Database 11g*
  - http://www.oracle.com/technology/obe/11gr1_db/index.htm

Summary

In this lesson, you should have learned that:

- Oracle Database 11*g* extends:
  - The benefits of infrastructure grids
  - The existing information management capabilities
  - The capabilities to use the major application development environments such as PL/SQL, Java/JDBC, .NET, XML, and so on
- The database is based on ORDBMS
- Relational databases are composed of relations, managed by relational operations, and governed by data integrity constraints
- With the Oracle server, you can store and manage information by using SQL

Practice I: Overview

This practice covers the following topics:

- Running the Oracle SQL Developer demo
- Starting Oracle SQL Developer, creating a new database connection, and browsing the HR tables

1

Retrieving Data Using the SQL `SELECT` Statement

Objectives

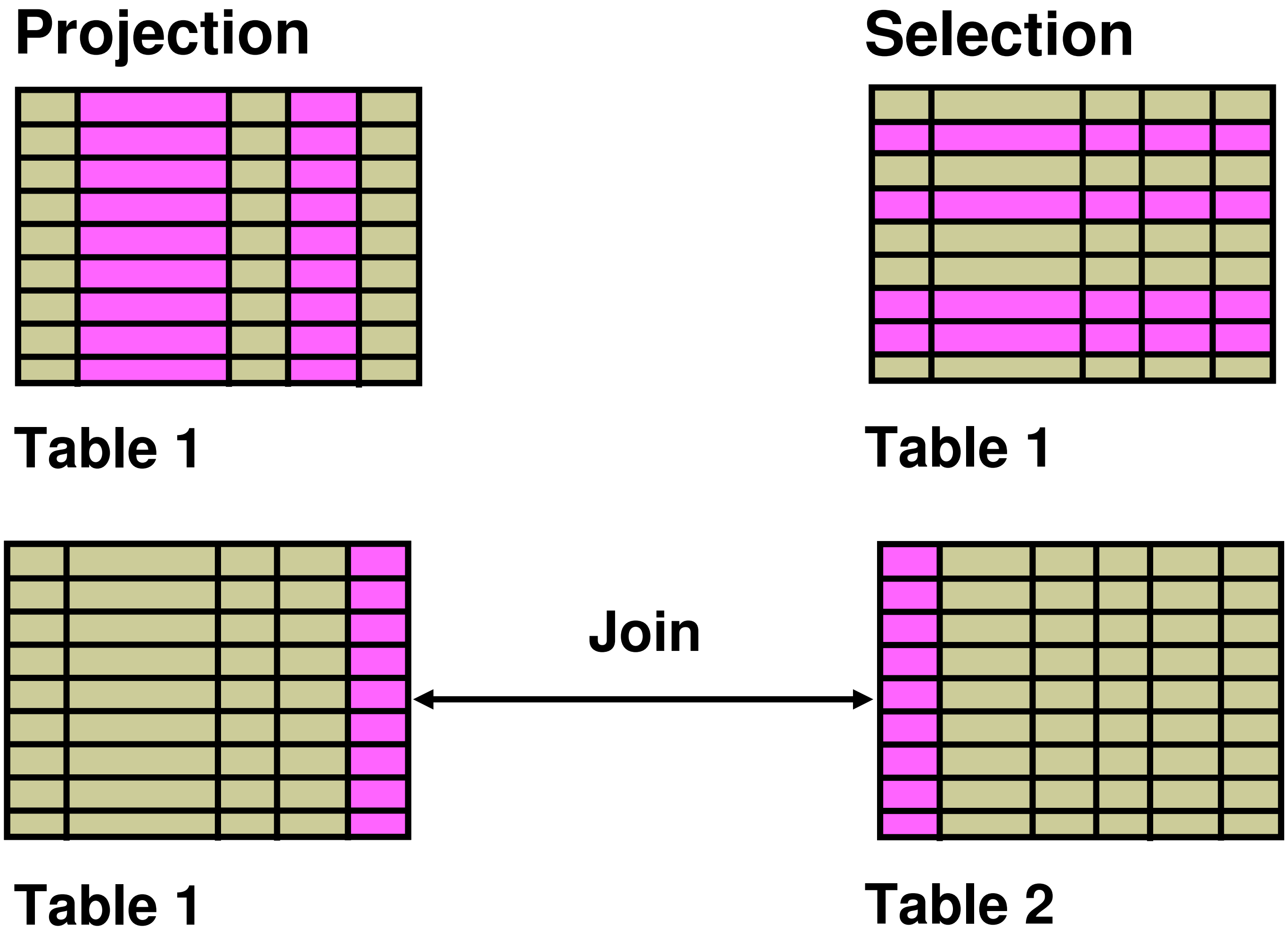
After completing this lesson, you should be able to do the following:

- List the capabilities of SQL `SELECT` statements
- Execute a basic `SELECT` statement

Lesson Agenda

- Basic `SELECT` statement
- Arithmetic expressions and `NULL` values in the `SELECT` statement
- Column aliases
- Use of concatenation operator, literal character strings, alternative quote operator, and the `DISTINCT` keyword
- `DESCRIBE` command

Capabilities of SQL `SELECT` Statements



Projection

Selection

Table 1

Table 1

Join

Table 1

Table 2

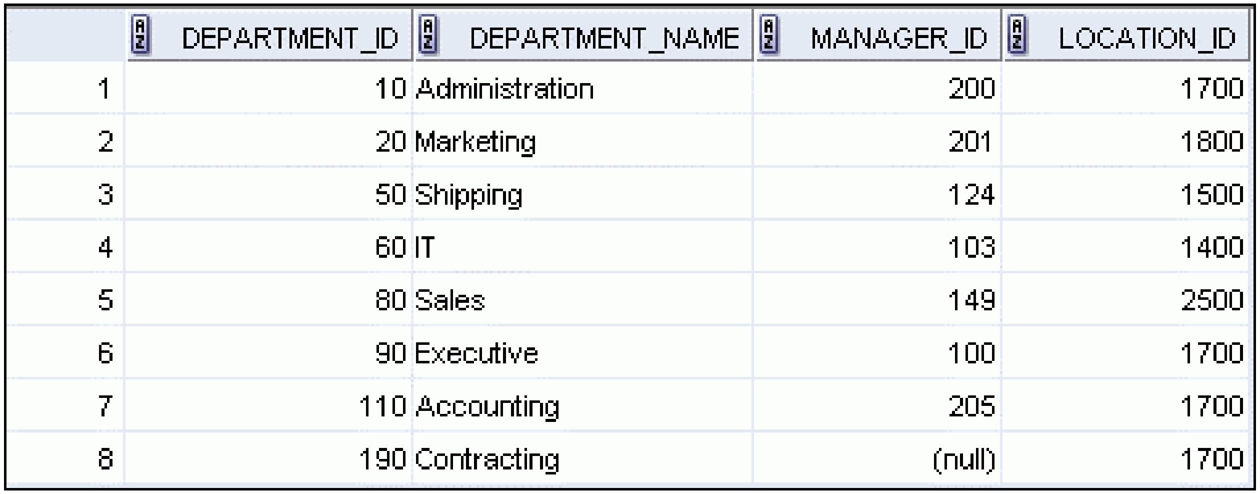
Basic `SELECT` Statement

```
SELECT *|{[DISTINCT] column|expression [alias],...}
FROM     table;
```

- `SELECT` identifies the columns to be displayed.
- `FROM` identifies the table containing those columns.

Selecting All Columns

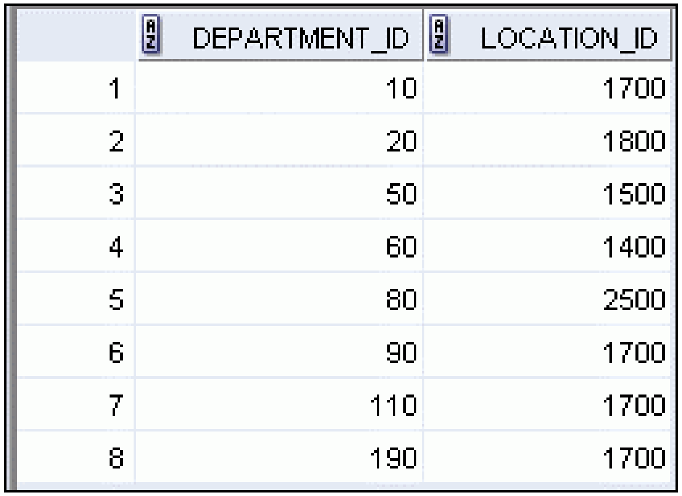
```
SELECT *
FROM   departments;
```



	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

Selecting Specific Columns

```
SELECT department_id, location_id
FROM   departments;
```



	DEPARTMENT_ID	LOCATION_ID
1	10	1700
2	20	1800
3	50	1500
4	60	1400
5	80	2500
6	90	1700
7	110	1700
8	190	1700

Writing SQL Statements

- SQL statements are not case-sensitive.
- SQL statements can be entered on one or more lines.
- Keywords cannot be abbreviated or split across lines.
- Clauses are usually placed on separate lines.
- Indents are used to enhance readability.
- In SQL Developer, SQL statements can optionally be terminated by a semicolon (;). Semicolons are required when you execute multiple SQL statements.
- In SQL*Plus, you are required to end each SQL statement with a semicolon (;).

Column Heading Defaults

- SQL Developer:
  - Default heading alignment: Left-aligned
  - Default heading display: Uppercase
- SQL*Plus:
  - Character and Date column headings are left-aligned.
  - Number column headings are right-aligned.
  - Default heading display: Uppercase

Lesson Agenda

- Basic `SELECT` statement
- Arithmetic expressions and `NULL` values in the `SELECT` statement
- Column Aliases
- Use of concatenation operator, literal character strings, alternative quote operator, and the `DISTINCT` keyword
- `DESCRIBE` command

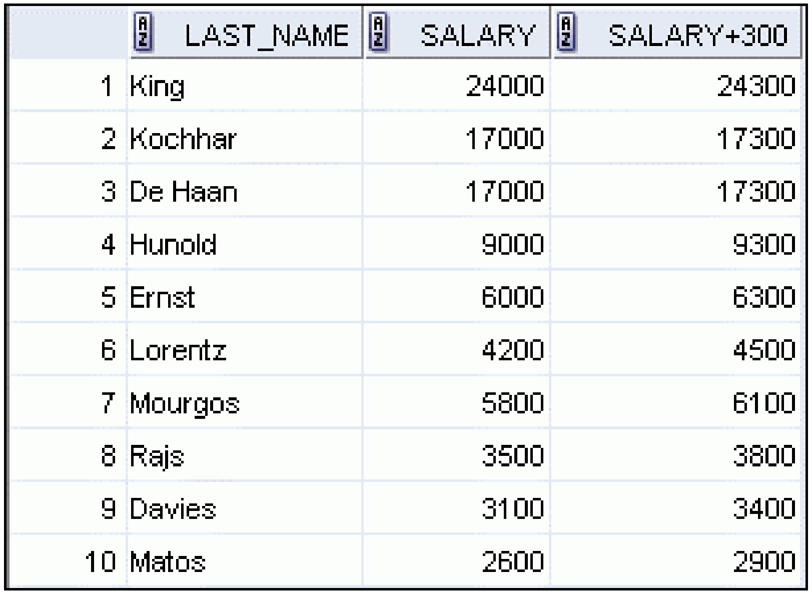
Arithmetic Expressions

Create expressions with number and date data by using arithmetic operators.

Operator	Description
+	Add
-	Subtract
*	Multiply
/	Divide

Using Arithmetic Operators

```
SELECT last_name, salary, salary + 300
FROM   employees;
```



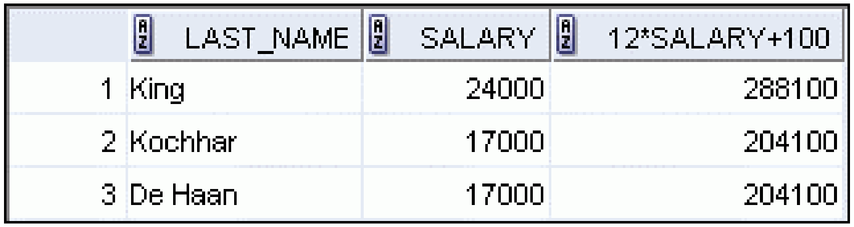
	LAST_NAME	SALARY	SALARY+300
1	King	24000	24300
2	Kochhar	17000	17300
3	De Haan	17000	17300
4	Hunold	9000	9300
5	Ernst	6000	6300
6	Lorentz	4200	4500
7	Mourgos	5800	6100
8	Rajs	3500	3800
9	Davies	3100	3400
10	Matos	2600	2900

…

Operator Precedence

```
SELECT last_name, salary, 12*salary+100
FROM   employees;
```

①

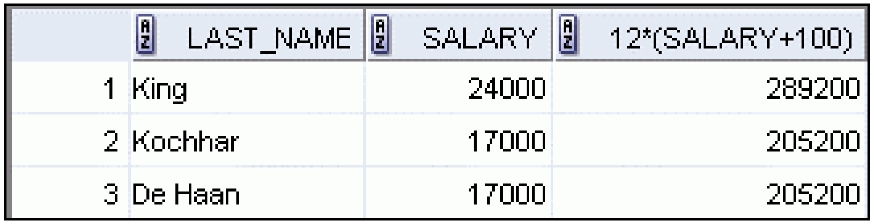


	LAST_NAME	SALARY	12*SALARY+100
1	King	24000	288100
2	Kochhar	17000	204100
3	De Haan	17000	204100

…

```
SELECT last_name, salary, 12*(salary+100)
FROM   employees;
```

②



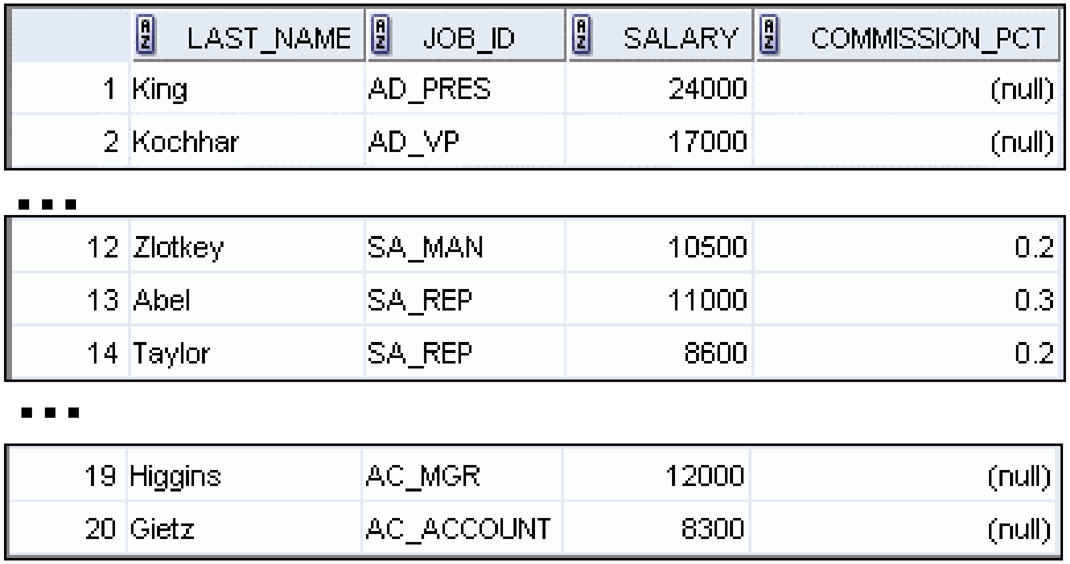
	LAST_NAME	SALARY	12*(SALARY+100)
1	King	24000	289200
2	Kochhar	17000	205200
3	De Haan	17000	205200

…

Defining a Null Value

- Null is a value that is unavailable, unassigned, unknown, or inapplicable.
- Null is not the same as zero or a blank space.

```
SELECT last_name, job_id, salary, commission_pct
FROM   employees;
```



	LAST_NAME	JOB_ID	SALARY	COMMISSION_PCT
1	King	AD_PRES	24000	(null)
2	Kochhar	AD_VP	17000	(null)

…

12	Zlotkey	SA_MAN	10500	0.2
13	Abel	SA_REP	11000	0.3
14	Taylor	SA_REP	8600	0.2

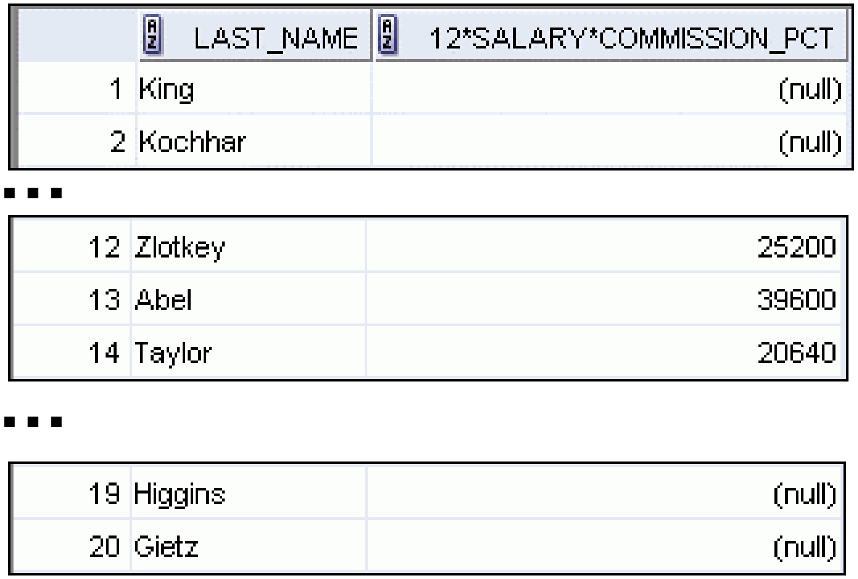
…

19	Higgins	AC_MGR	12000	(null)
20	Gietz	AC_ACCOUNT	8300	(null)

Null Values in Arithmetic Expressions

Arithmetic expressions containing a null value evaluate to null.

```
SELECT last_name, 12*salary*commission_pct
FROM   employees;
```



	LAST_NAME	12*SALARY*COMMISSION_PCT
1	King	(null)
2	Kochhar	(null)
…		
12	Zlotkey	25200
13	Abel	39600
14	Taylor	20640
…		
19	Higgins	(null)
20	Gietz	(null)

Lesson Agenda

- Basic `SELECT` statement
- Arithmetic expressions and `NULL` values in the `SELECT` statement
- Column aliases
- Use of concatenation operator, literal character strings, alternative quote operator, and the `DISTINCT` keyword
- `DESCRIBE` command

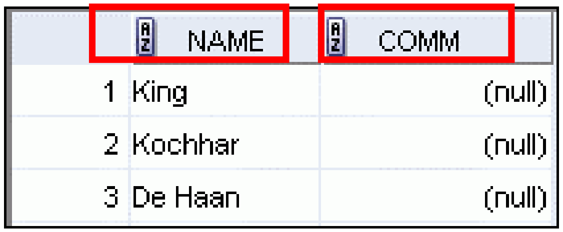
Defining a Column Alias

A column alias:

- Renames a column heading
- Is useful with calculations
- Immediately follows the column name (There can also be the optional `AS` keyword between the column name and alias.)
- Requires double quotation marks if it contains spaces or special characters, or if it is case-sensitive

Using Column Aliases

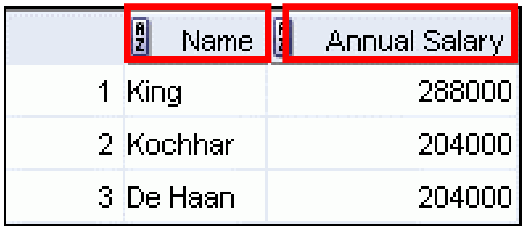
```
SELECT last_name AS name, commission_pct comm
FROM   employees;
```



	NAME	COMM
1	King	(null)
2	Kochhar	(null)
3	De Haan	(null)

…

```
SELECT last_name "Name" , salary*12 "Annual Salary"
FROM   employees;
```



	Name	Annual Salary
1	King	288000
2	Kochhar	204000
3	De Haan	204000

…

Lesson Agenda

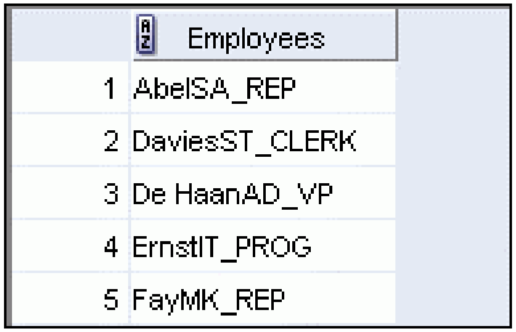
- Basic `SELECT` Statement
- Arithmetic Expressions and NULL values in `SELECT` statement
- Column Aliases
- Use of concatenation operator, literal character strings, alternative quote operator, and the `DISTINCT` keyword
- `DESCRIBE` command

Concatenation Operator

A concatenation operator:

- Links columns or character strings to other columns
- Is represented by two vertical bars (||)
- Creates a resultant column that is a character expression

```
SELECT   last_name||job_id AS "Employees"
FROM     employees;
```



	Employees
1	AbelSA_REP
2	DaviesST_CLERK
3	De HaanAD_VP
4	ErnstIT_PROG
5	FayMK_REP

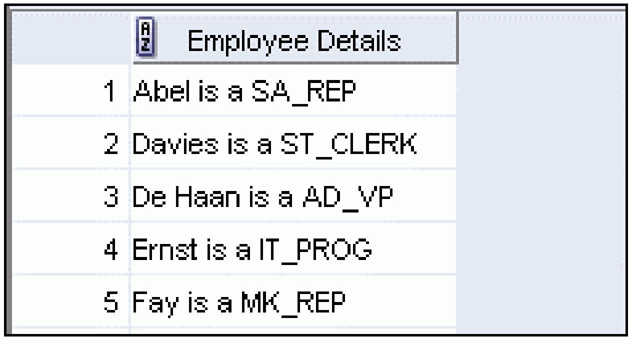
…

Literal Character Strings

- A literal is a character, a number, or a date that is included in the `SELECT` statement.
- Date and character literal values must be enclosed within single quotation marks.
- Each character string is output once for each row returned.

Using Literal Character Strings

```
SELECT last_name ||' is a '||job_id
       AS "Employee Details"
FROM   employees;
```



	Employee Details
1	Abel is a SA_REP
2	Davies is a ST_CLERK
3	De Haan is a AD_VP
4	Ernst is a IT_PROG
5	Fay is a MK_REP

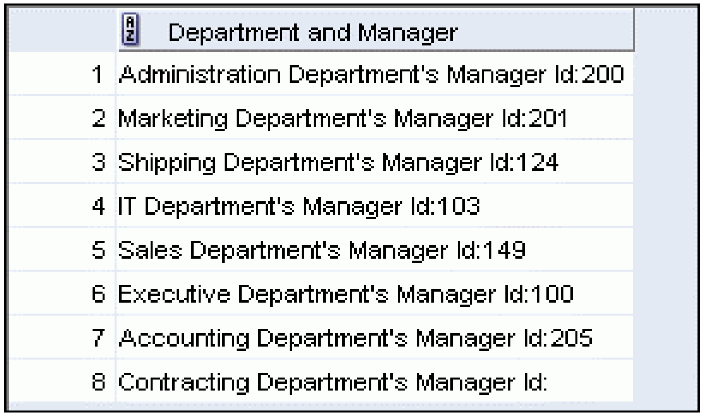
…

18	Vargas is a ST_CLERK
19	Whalen is a AD_ASST
20	Zlotkey is a SA_MAN

Alternative Quote (q) Operator

- Specify your own quotation mark delimiter.
- Select any delimiter.
- Increase readability and usability.

```
SELECT department_name || q'[ Department's Manager Id: ]'
       || manager_id
       AS "Department and Manager"
FROM departments;
```



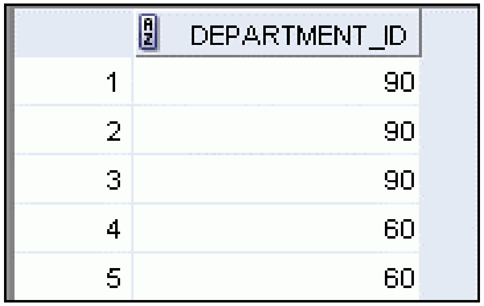
	Department and Manager
1	Administration Department's Manager Id:200
2	Marketing Department's Manager Id:201
3	Shipping Department's Manager Id:124
4	IT Department's Manager Id:103
5	Sales Department's Manager Id:149
6	Executive Department's Manager Id:100
7	Accounting Department's Manager Id:205
8	Contracting Department's Manager Id:

Duplicate Rows

The default display of queries is all rows, including duplicate rows.

```
SELECT department_id
FROM   employees;
```

①

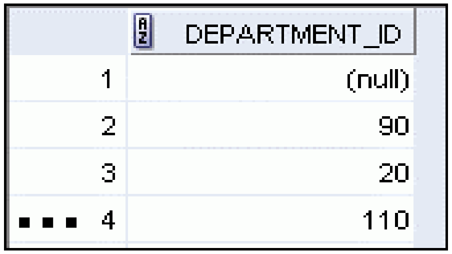


	DEPARTMENT_ID
1	90
2	90
3	90
4	60
5	60

…

```
SELECT DISTINCT department_id
FROM   employees;
```

②



	DEPARTMENT_ID
1	(null)
2	90
3	20
4	110

…

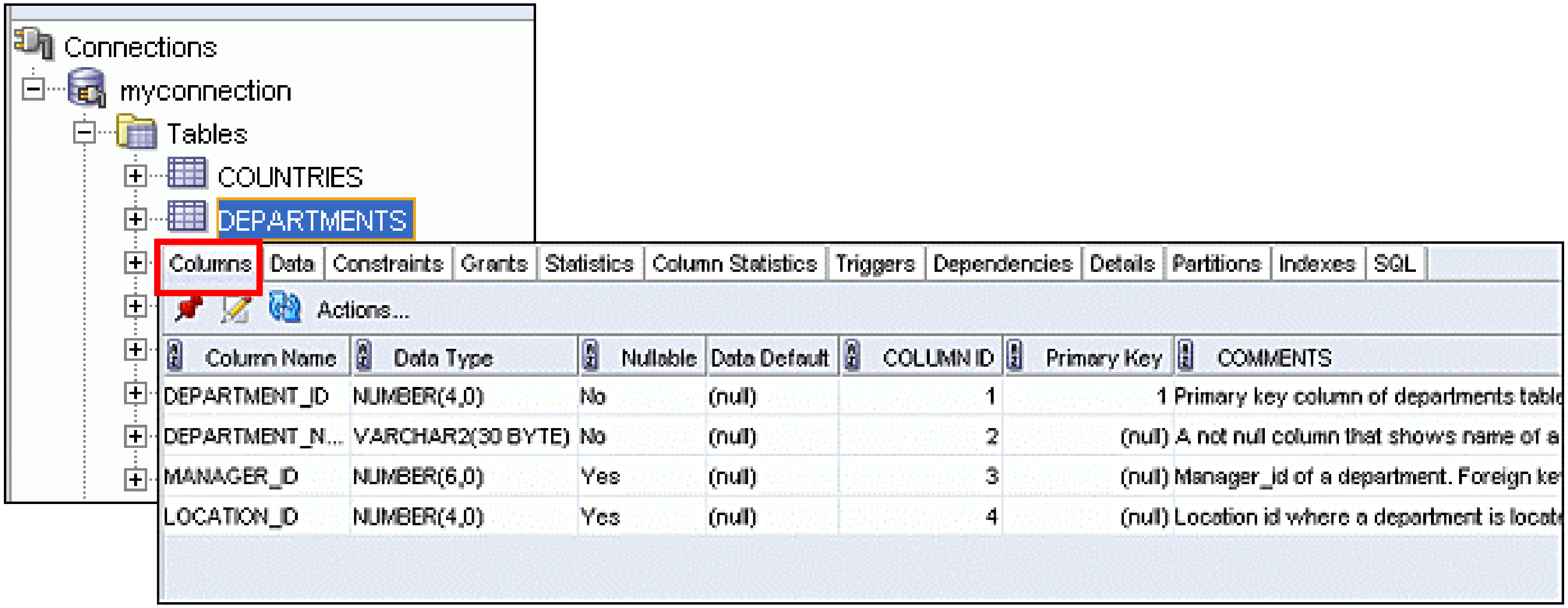
Lesson Agenda

- Basic `SELECT` statement
- Arithmetic expressions and `NULL` values in the `SELECT` statement
- Column aliases
- Use of concatenation operator, literal character strings, alternative quote operator, and the `DISTINCT` keyword
- `DESCRIBE` command

Displaying the Table Structure

- Use the `DESCRIBE` command to display the structure of a table.
- Or, select the table in the Connections tree and use the Columns tab to view the table structure.

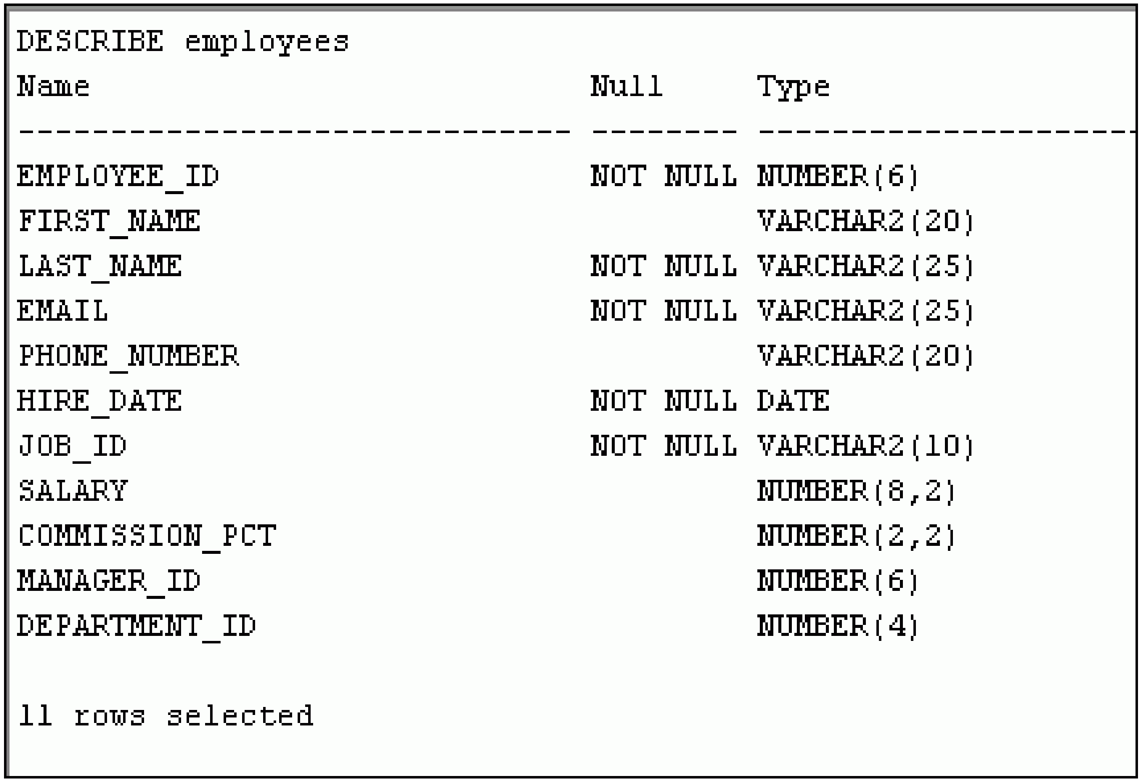
```
DESC[RIBE] tablename
```



Column Name	Data Type	Nullable	Data Default	COLUMN ID	Primary Key	COMMENTS
DEPARTMENT_ID	NUMBER(4,0)	No	(null)	1	1	Primary key column of departments tabl
DEPARTMENT_N...	VARCHAR2(30 BYTE)	No	(null)	2	(null)	A not null column that shows name of a
MANAGER_ID	NUMBER(6,0)	Yes	(null)	3	(null)	Manager_id of a department. Foreign ke
LOCATION_ID	NUMBER(4,0)	Yes	(null)	4	(null)	Location id where a department is locat

Using the `DESCRIBE` Command

```
DESCRIBE employees
```



```
DESCRIBE employees
Name                           Null     Type
------------------------------ -------- --------------------
EMPLOYEE_ID                    NOT NULL NUMBER(6)
FIRST_NAME                              VARCHAR2(20)
LAST_NAME                      NOT NULL VARCHAR2(25)
EMAIL                          NOT NULL VARCHAR2(25)
PHONE_NUMBER                            VARCHAR2(20)
HIRE_DATE                      NOT NULL DATE
JOB_ID                         NOT NULL VARCHAR2(10)
SALARY                                  NUMBER(8,2)
COMMISSION_PCT                          NUMBER(2,2)
MANAGER_ID                              NUMBER(6)
DEPARTMENT_ID                           NUMBER(4)

11 rows selected
```

Quiz

Identify the `SELECT` statements that execute successfully.

1.

```
SELECT first_name, last_name, job_id, salary*12
 AS Yearly Sal
FROM   employees;
```

2.

```
SELECT first_name, last_name, job_id, salary*12
 yearly sal
FROM   employees;
```

3.

```
SELECT first_name, last_name, job_id, salary AS
 yearly sal
FROM   employees;
```

4.

```
SELECT first_name+last_name AS name, job_Id,
 salary*12 yearly sal
FROM   employees;
```

Summary

In this lesson, you should have learned how to:

- Write a `SELECT` statement that:
  - Returns all rows and columns from a table
  - Returns specified columns from a table
  - Uses column aliases to display more descriptive column headings

```
SELECT *|{[DISTINCT] column|expression [alias],...}
FROM table;
```

Practice 1: Overview

This practice covers the following topics:

- Selecting all data from different tables
- Describing the structure of tables
- Performing arithmetic calculations and specifying column names

2

Restricting and Sorting Data

Objectives

After completing this lesson, you should be able to do the following:

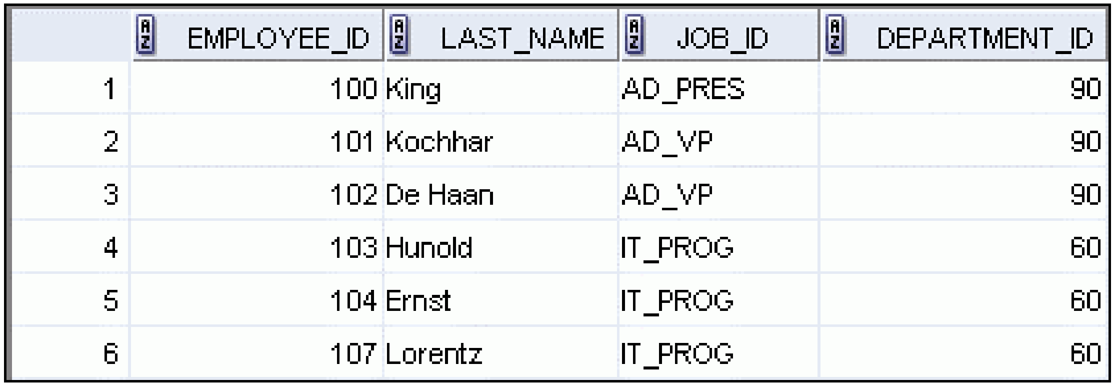
- Limit the rows that are retrieved by a query
- Sort the rows that are retrieved by a query
- Use ampersand substitution to restrict and sort output at run time

Lesson Agenda

- Limiting rows with:
  - The `WHERE` clause
  - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` conditions
  - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
- Sorting rows using the `ORDER BY` clause
- Substitution variables
- `DEFINE` and `VERIFY` commands

Limiting Rows Using a Selection

EMPLOYEES



	EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
1	100	King	AD_PRES	90
2	101	Kochhar	AD_VP	90
3	102	De Haan	AD_VP	90
4	103	Hunold	IT_PROG	60
5	104	Ernst	IT_PROG	60
6	107	Lorentz	IT_PROG	60

…

“retrieve all employees in department 90”

	EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
1	100	King	AD_PRES	90
2	101	Kochhar	AD_VP	90
3	102	De Haan	AD_VP	90

Limiting the Rows That Are Selected

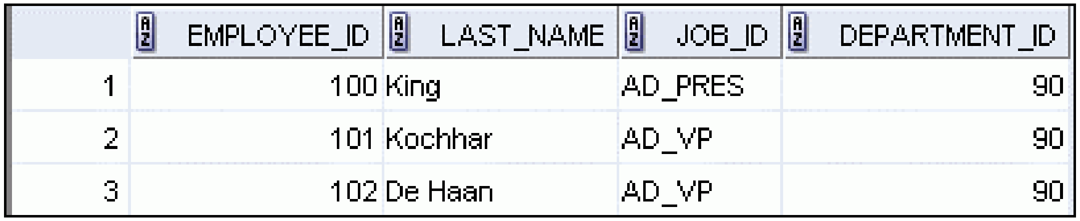
- Restrict the rows that are returned by using the `WHERE` clause:

```
SELECT *|{[DISTINCT] column|expression [alias],...}
FROM   table
[WHERE condition(s)];
```

- The `WHERE` clause follows the `FROM` clause.

Using the WHERE Clause

```
SELECT employee_id, last_name, job_id, department_id
FROM   employees
WHERE  department_id = 90 ;
```



	EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
1	100	King	AD_PRES	90
2	101	Kochhar	AD_VP	90
3	102	De Haan	AD_VP	90

Character Strings and Dates

- Character strings and date values are enclosed with single quotation marks.
- Character values are case-sensitive and date values are format-sensitive.
- The default date display format is `DD-MON-RR`.

```
SELECT last_name, job_id, department_id
FROM   employees
WHERE  last_name = 'Whalen' ;
```

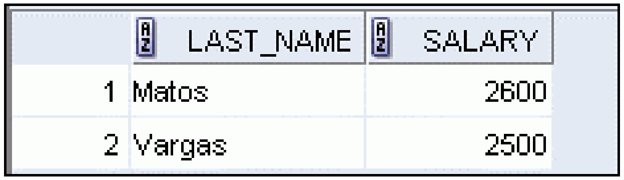
```
SELECT last_name
FROM   employees
WHERE  hire_date = '17-FEB-96' ;
```

Comparison Operators

Operator	Meaning
=	Equal to
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
<>	Not equal to
`BETWEEN ...AND...`	Between two values (inclusive)
`IN(set)`	Match any of a list of values
`LIKE`	Match a character pattern
`IS NULL`	Is a null value

Using Comparison Operators

```
SELECT last_name, salary
FROM   employees
WHERE  salary <= 3000 ;
```



	LAST_NAME	SALARY
1	Matos	2600
2	Vargas	2500

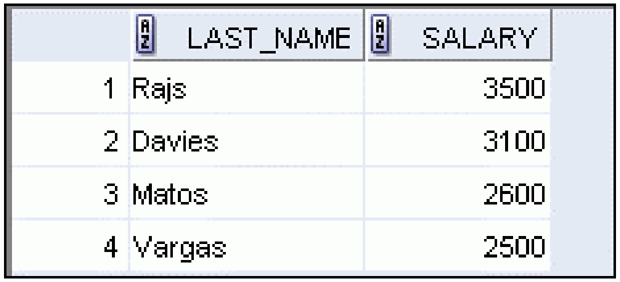
Range Conditions Using the `BETWEEN` Operator

Use the `BETWEEN` operator to display rows based on a range of values:

```
SELECT last_name, salary
FROM   employees
WHERE  salary BETWEEN 2500 AND 3500 ;
```

Lower limit

Upper limit

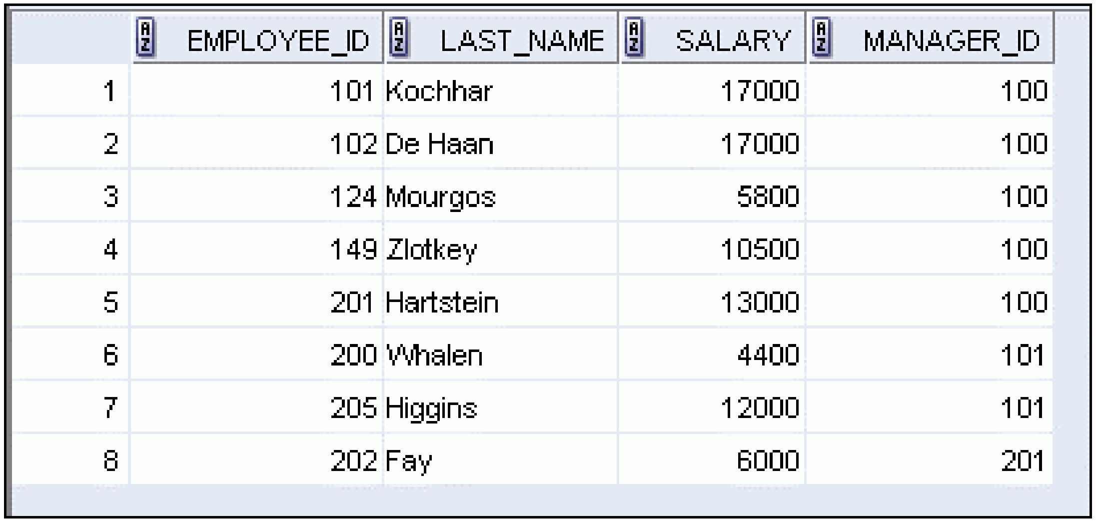


	LAST_NAME	SALARY
1	Rajs	3500
2	Davies	3100
3	Matos	2600
4	Vargas	2500

Membership Condition Using the `IN` Operator

Use the `IN` operator to test for values in a list:

```
SELECT employee_id, last_name, salary, manager_id
FROM   employees
WHERE  manager_id IN (100, 101, 201) ;
```



	EMPLOYEE_ID	LAST_NAME	SALARY	MANAGER_ID
1	101	Kochhar	17000	100
2	102	De Haan	17000	100
3	124	Mourgos	5800	100
4	149	Zlotkey	10500	100
5	201	Hartstein	13000	100
6	200	Whalen	4400	101
7	205	Higgins	12000	101
8	202	Fay	6000	201

Pattern Matching Using the `LIKE` Operator

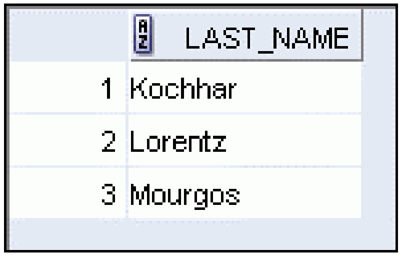
- Use the `LIKE` operator to perform wildcard searches of valid search string values.
- Search conditions can contain either literal characters or numbers:
  - `%` denotes zero or many characters.
  - _ denotes one character.

```
SELECT   first_name
FROM     employees
WHERE    first_name LIKE 'S%' ;
```

Combining Wildcard Characters

- You can combine the two wildcard characters (%, _) with literal characters for pattern matching:

```
SELECT last_name
FROM   employees
WHERE  last_name LIKE '_o%' ;
```



	LAST_NAME
1	Kochhar
2	Lorentz
3	Mourgos

- You can use the `ESCAPE` identifier to search for the actual `%` and _ symbols.

Using the `NULL` Conditions

Test for nulls with the `IS NULL` operator.

```
SELECT last_name, manager_id
FROM   employees
WHERE  manager_id IS NULL ;
```

	LAST_NAME	MANAGER_ID
1	King	(null)

Defining Conditions Using the Logical Operators

Operator	Meaning
`AND`	Returns `TRUE` if *both* component conditions are true
`OR`	Returns `TRUE` if *either* component condition is true
`NOT`	Returns `TRUE` if the condition is false

Using the `AND` Operator

`AND` requires both the component conditions to be true:

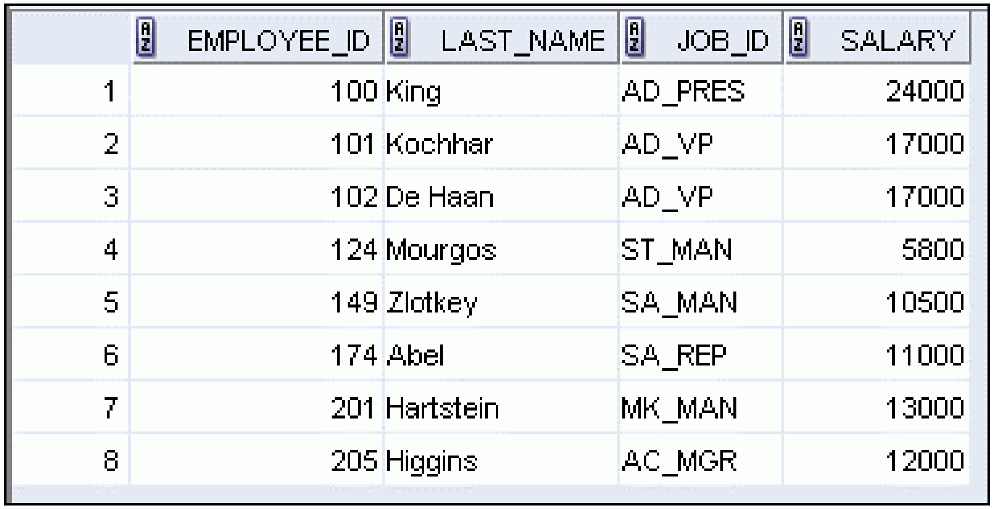
```
SELECT employee_id, last_name, job_id, salary
FROM   employees
WHERE  salary >= 10000
AND    job_id LIKE '%MAN%' ;
```

	EMPLOYEE_ID	LAST_NAME	JOB_ID	SALARY
1	149	Zlotkey	SA_MAN	10500
2	201	Hartstein	MK_MAN	13000

Using the `OR` Operator

`OR` requires either component condition to be true:

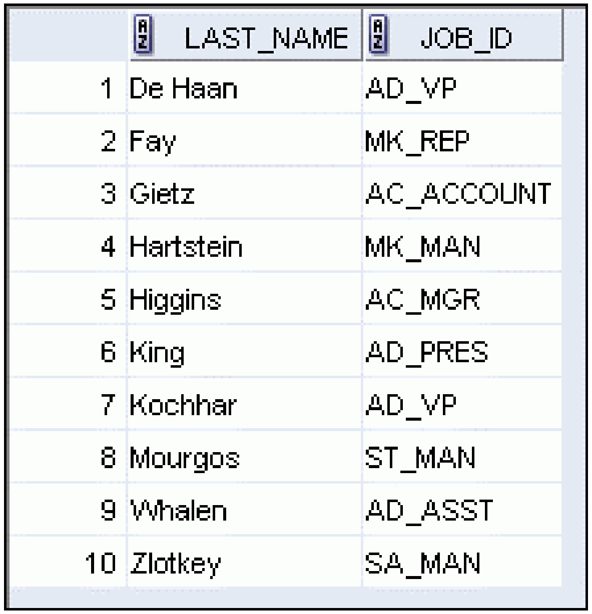
```
SELECT employee_id, last_name, job_id, salary
FROM   employees
WHERE  salary >= 10000
OR     job_id LIKE '%MAN%' ;
```



	EMPLOYEE_ID	LAST_NAME	JOB_ID	SALARY
1	100	King	AD_PRES	24000
2	101	Kochhar	AD_VP	17000
3	102	De Haan	AD_VP	17000
4	124	Mourgos	ST_MAN	5800
5	149	Zlotkey	SA_MAN	10500
6	174	Abel	SA_REP	11000
7	201	Hartstein	MK_MAN	13000
8	205	Higgins	AC_MGR	12000

Using the NOT Operator

```
SELECT last_name, job_id
FROM   employees
WHERE  job_id
       NOT IN ('IT_PROG', 'ST_CLERK', 'SA_REP') ;
```



	LAST_NAME	JOB_ID
1	De Haan	AD_VP
2	Fay	MK_REP
3	Gietz	AC_ACCOUNT
4	Hartstein	MK_MAN
5	Higgins	AC_MGR
6	King	AD_PRES
7	Kochhar	AD_VP
8	Mourgos	ST_MAN
9	Whalen	AD_ASST
10	Zlotkey	SA_MAN

Lesson Agenda

- Limiting rows with:
  - The `WHERE` clause
  - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
  - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
- Sorting rows using the `ORDER BY` clause
- Substitution variables
- `DEFINE` and `VERIFY` commands

Rules of Precedence

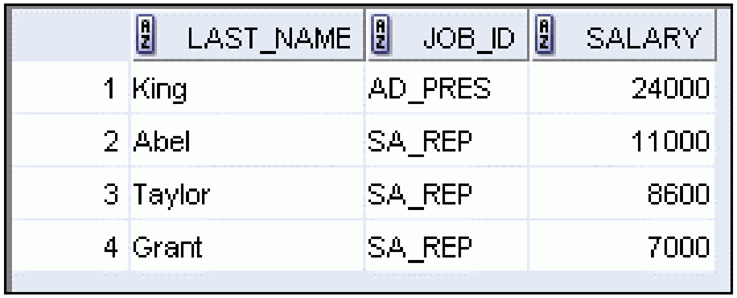
Operator	Meaning
1	Arithmetic operators
2	Concatenation operator
3	Comparison conditions
4	`IS [NOT] NULL`, `LIKE`, `[NOT] IN`
5	`[NOT] BETWEEN`
6	Not equal to
7	`NOT` logical condition
8	`AND` logical condition
9	`OR` logical condition

You can use parentheses to override rules of precedence.

Rules of Precedence

①

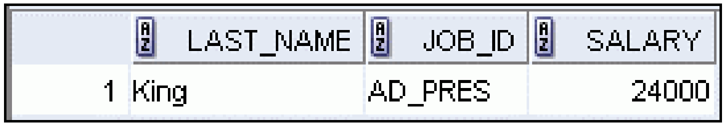
```
SELECT last_name, job_id, salary
FROM   employees
WHERE  job_id = 'SA_REP'
OR     job_id = 'AD_PRES'
AND    salary > 15000;
```



	LAST_NAME	JOB_ID	SALARY
1	King	AD_PRES	24000
2	Abel	SA_REP	11000
3	Taylor	SA_REP	8600
4	Grant	SA_REP	7000

②

```
SELECT last_name, job_id, salary
FROM   employees
WHERE  (job_id = 'SA_REP'
OR     job_id = 'AD_PRES')
AND    salary > 15000;
```



	LAST_NAME	JOB_ID	SALARY
1	King	AD_PRES	24000

Lesson Agenda

- Limiting rows with:
  - The `WHERE` clause
  - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
  - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
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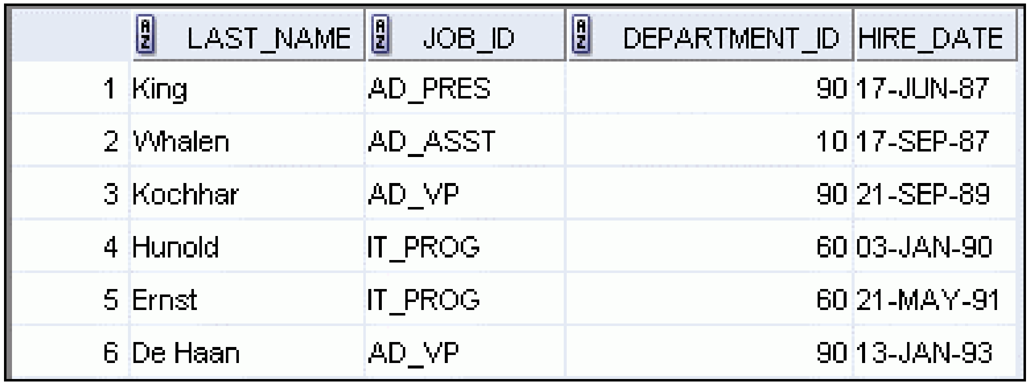
Using the `ORDER BY` Clause

- Sort retrieved rows with the `ORDER BY` clause:
  - `ASC`: Ascending order, default
  - `DESC`: Descending order
- The `ORDER BY` clause comes last in the `SELECT` statement:

```
SELECT    last_name, job_id, department_id, hire_date
FROM      employees
ORDER BY hire_date ;
```



	LAST_NAME	JOB_ID	DEPARTMENT_ID	HIRE_DATE
1	King	AD_PRES	90	17-JUN-87
2	Whalen	AD_ASST	10	17-SEP-87
3	Kochhar	AD_VP	90	21-SEP-89
4	Hunold	IT_PROG	60	03-JAN-90
5	Ernst	IT_PROG	60	21-MAY-91
6	De Haan	AD_VP	90	13-JAN-93

...

Sorting

- Sorting in descending order:

```
SELECT   last_name, job_id, department_id, hire_date
FROM     employees
ORDER BY hire_date DESC ;
```

①

- Sorting by column alias:

```
SELECT employee_id, last_name, salary*12 annsal
FROM   employees
ORDER BY annsal ;
```

②

Sorting

- Sorting by using the column’s numeric position:

```
SELECT   last_name, job_id, department_id, hire_date
FROM     employees
ORDER BY 3;
```

③

- Sorting by multiple columns:

```
SELECT last_name, department_id, salary
FROM   employees
ORDER BY department_id, salary DESC;
```

④

Lesson Agenda

- Limiting rows with:
  - The `WHERE` clause
  - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
  - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
- Sorting rows using the `ORDER BY` clause
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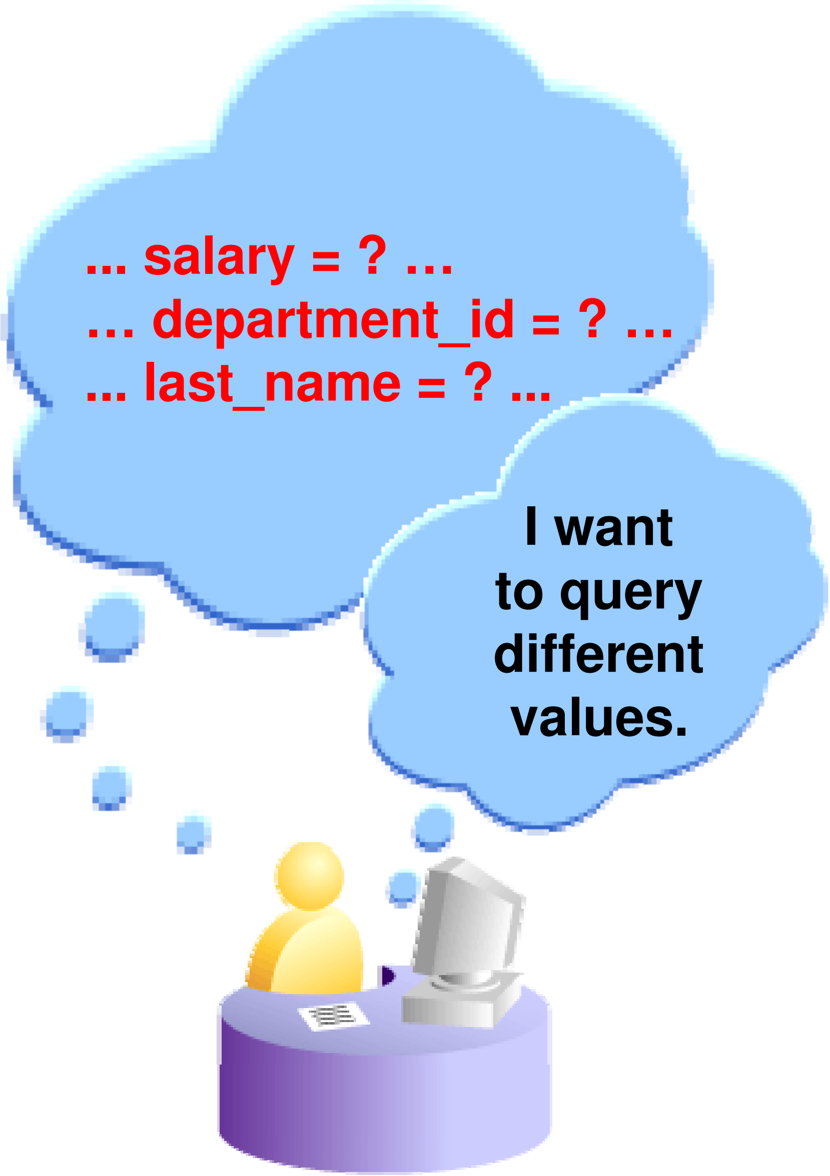
Substitution Variables



... salary = ? …
… department_id = ? …
... last_name = ? ...

I want
to query
different
values.

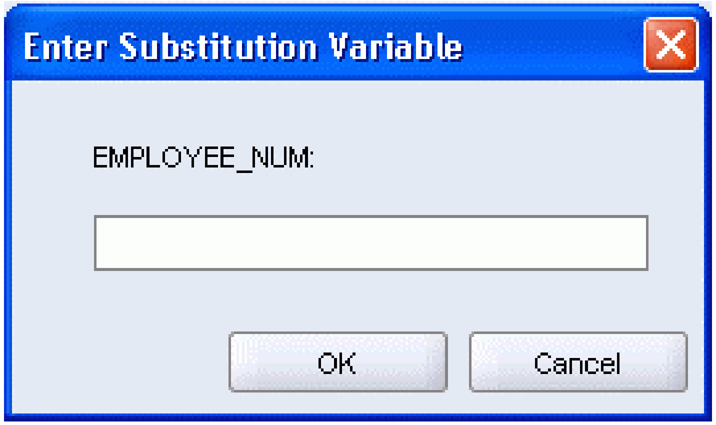
Substitution Variables

- Use substitution variables to:
  - Temporarily store values with single-ampersand (`&`) and double-ampersand (`&&`) substitution
- Use substitution variables to supplement the following:
  - `WHERE` conditions
  - `ORDER BY` clauses
  - Column expressions
  - Table names
  - Entire `SELECT` statements

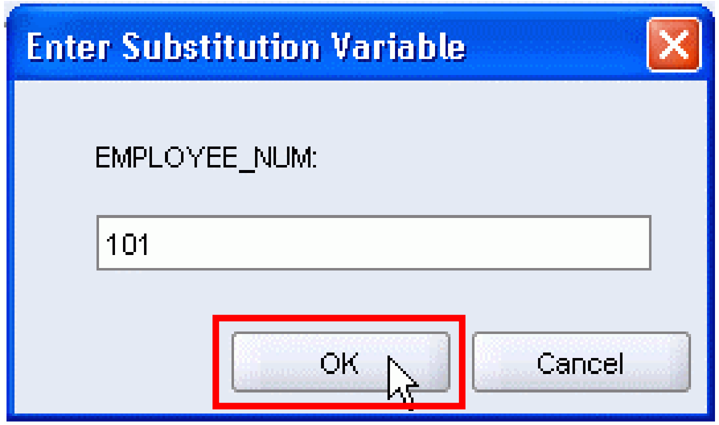
Using the Single-Ampersand Substitution Variable

Use a variable prefixed with an ampersand (&) to prompt the user for a value:

```
SELECT employee_id, last_name, salary, department_id
FROM   employees
WHERE  employee_id = &employee_num ;
```



Using the Single-Ampersand Substitution Variable



Enter Substitution Variable

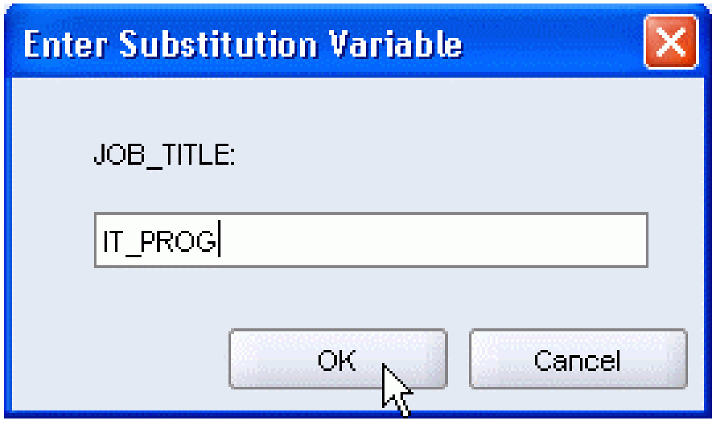
EMPLOYEE_NUM: 101

	EMPLOYEE_ID	LAST_NAME	SALARY	DEPARTMENT_ID
1	101	Kochhar	17000	90

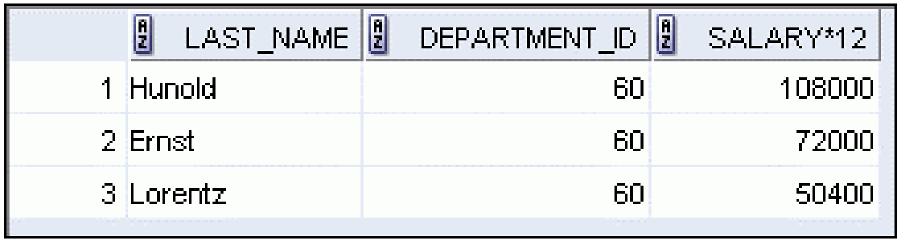
Character and Date Values with Substitution Variables

Use single quotation marks for date and character values:

```
SELECT last_name, department_id, salary*12
FROM   employees
WHERE  job_id = '&job_title' ;
```



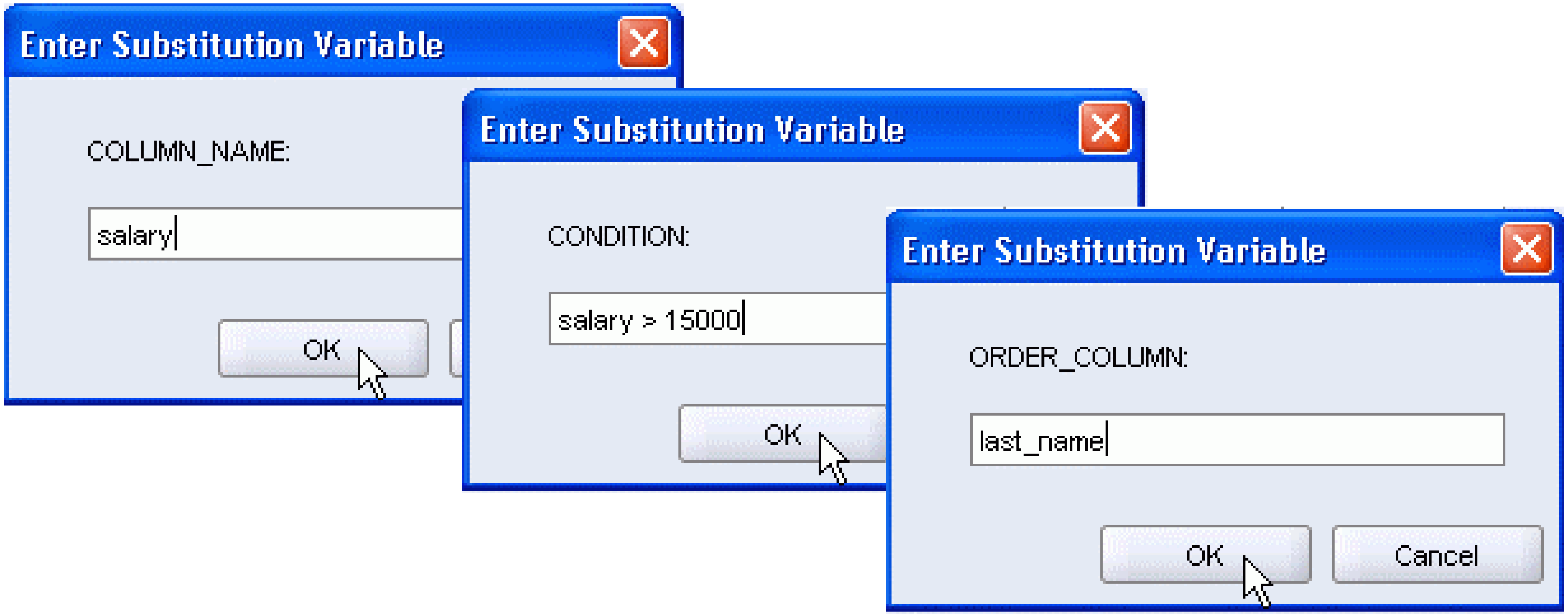
JOB_TITLE: IT_PROG



	LAST_NAME	DEPARTMENT_ID	SALARY*12
1	Hunold	60	108000
2	Ernst	60	72000
3	Lorentz	60	50400

Specifying Column Names, Expressions, and Text

```
SELECT  employee_id, last_name, job_id,&column_name
FROM    employees
WHERE   &condition
ORDER BY &order_column ;
```



Enter Substitution Variable

COLUMN_NAME: salary

Enter Substitution Variable

CONDITION: salary > 15000

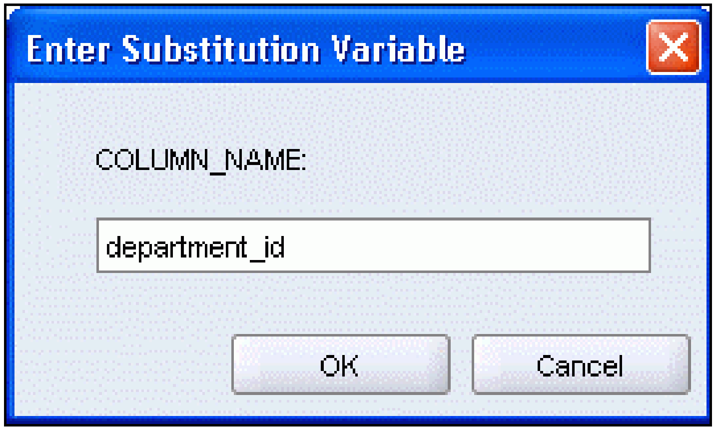
Enter Substitution Variable

ORDER_COLUMN: last_name

Using the Double-Ampersand Substitution Variable

Use double ampersand (`&&`) if you want to reuse the variable value without prompting the user each time:

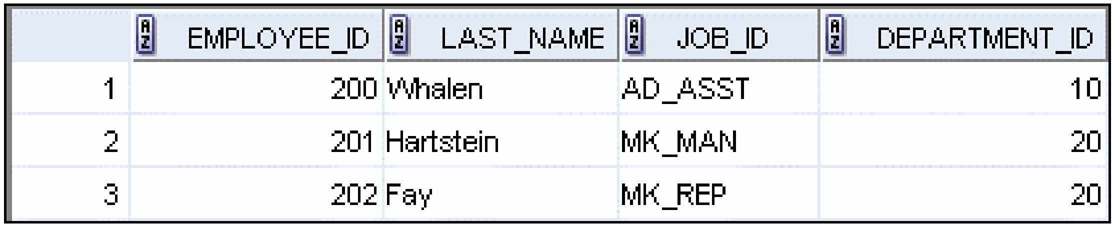
```
SELECT    employee_id, last_name, job_id, &&column_name
FROM      employees
ORDER BY &column_name ;
```



Enter Substitution Variable

COLUMN_NAME:

department_id



	EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
1	200	Whalen	AD_ASST	10
2	201	Hartstein	MK_MAN	20
3	202	Fay	MK_REP	20

…

Lesson Agenda

- Limiting rows with:
  - The `WHERE` clause
  - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
  - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
- Sorting rows using the `ORDER BY` clause
- Substitution variables
- `DEFINE` and `VERIFY` commands

Using the `DEFINE` Command

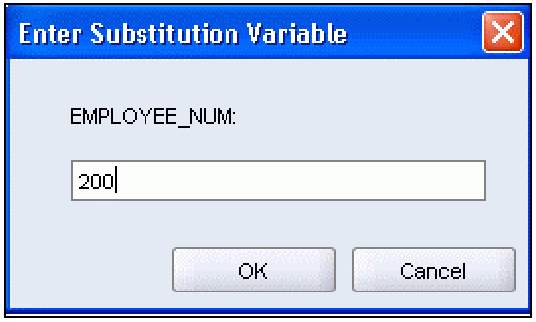
- Use the `DEFINE` command to create and assign a value to a variable.
- Use the `UNDEFINE` command to remove a variable.

```
DEFINE employee_num = 200

SELECT employee_id, last_name, salary, department_id
FROM   employees
WHERE  employee_id = &employee_num ;

UNDEFINE employee_num
```

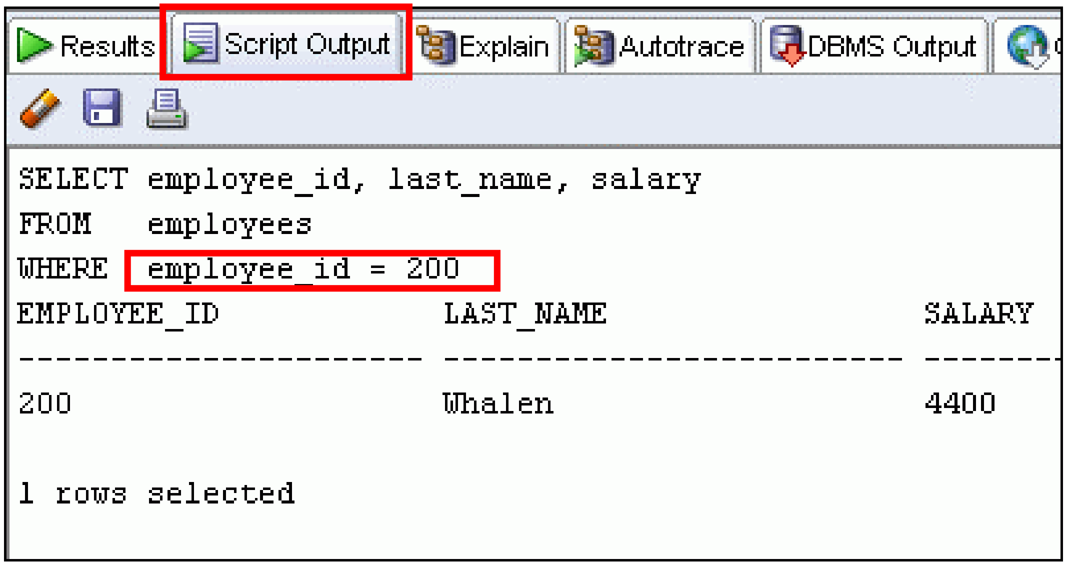
Using the `VERIFY` Command

Use the `VERIFY` command to toggle the display of the substitution variable, both before and after SQL Developer replaces substitution variables with values:

```
SET VERIFY ON
SELECT employee_id, last_name, salary
FROM   employees
WHERE  employee_id = &employee_num;
```



EMPLOYEE_NUM: 200



```
SELECT employee_id, last_name, salary
FROM   employees
WHERE  employee_id = 200
EMPLOYEE_ID            LAST_NAME                 SALARY
---------------------- ------------------------- --------
200                    Whalen                    4400

1 rows selected
```

Quiz

Which of the following are valid operators for the `WHERE` clause?

1. `>=`
2. `IS NULL`
3. `!=`
4. `IS LIKE`
5. `IN BETWEEN`
6. `<>`

Summary

In this lesson, you should have learned how to:

- Use the `WHERE` clause to restrict rows of output:
  - Use the comparison conditions
  - Use the `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
  - Apply the logical `AND`, `OR`, and `NOT` operators
- Use the `ORDER BY` clause to sort rows of output:

```
SELECT   *|{[DISTINCT] column|expression [alias],...}
FROM     table
[WHERE   condition(s)]
[ORDER BY {column, expr, alias} [ASC|DESC]] ;
```

- Use ampersand substitution to restrict and sort output at run time

Practice 2: Overview

This practice covers the following topics:

- Selecting data and changing the order of the rows that are displayed
- Restricting rows by using the `WHERE` clause
- Sorting rows by using the `ORDER BY` clause
- Using substitution variables to add flexibility to your SQL `SELECT` statements

3

Using Single-Row Functions to Customize Output

Objectives

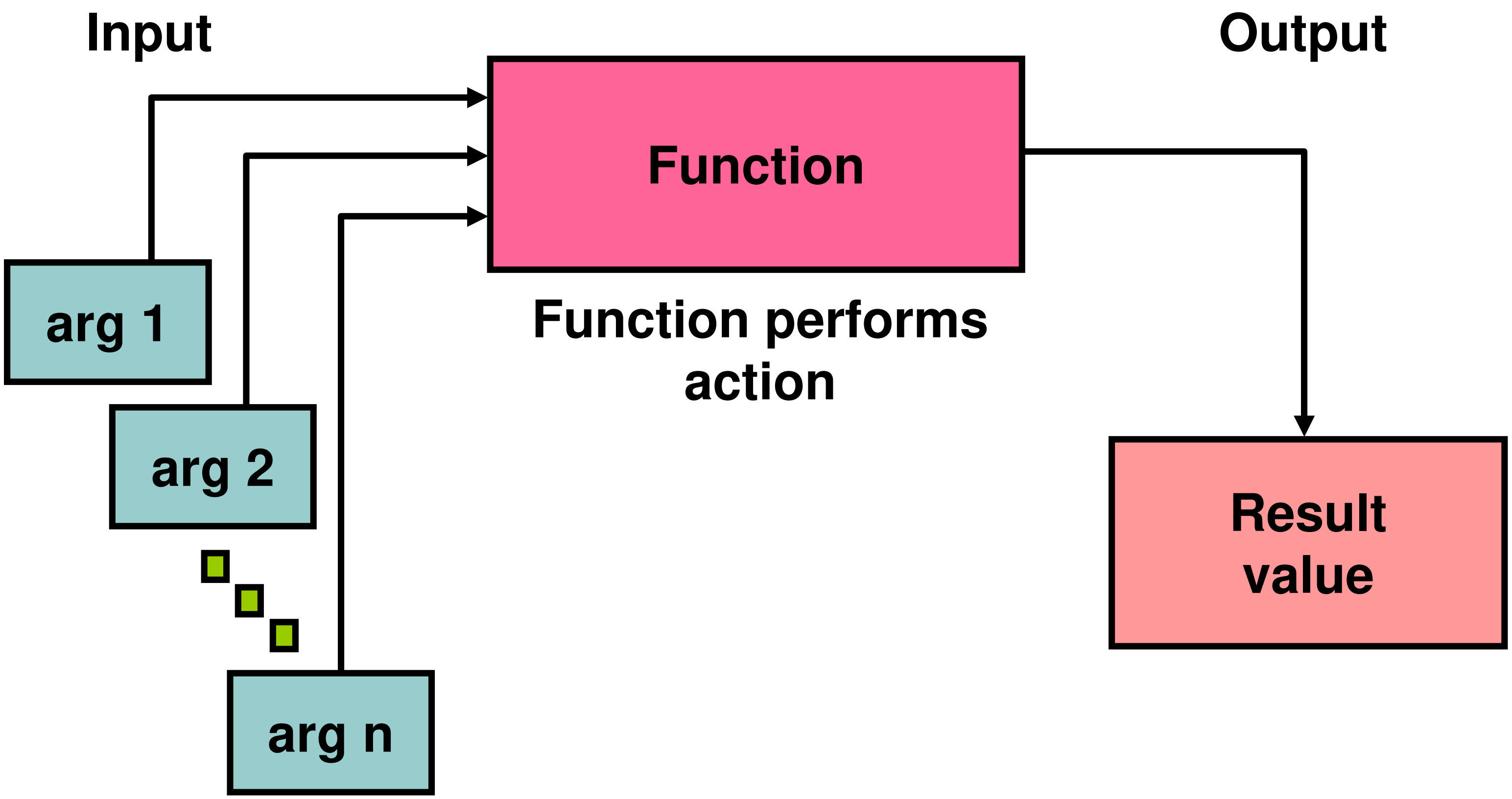
After completing this lesson, you should be able to do the following:

- Describe various types of functions available in SQL
- Use character, number, and date functions in `SELECT` statements

Lesson Agenda

- Single-row SQL functions
- Character functions
- Number functions
- Working with dates
- Date functions

SQL Functions



Input

Output

Function

Function performs action

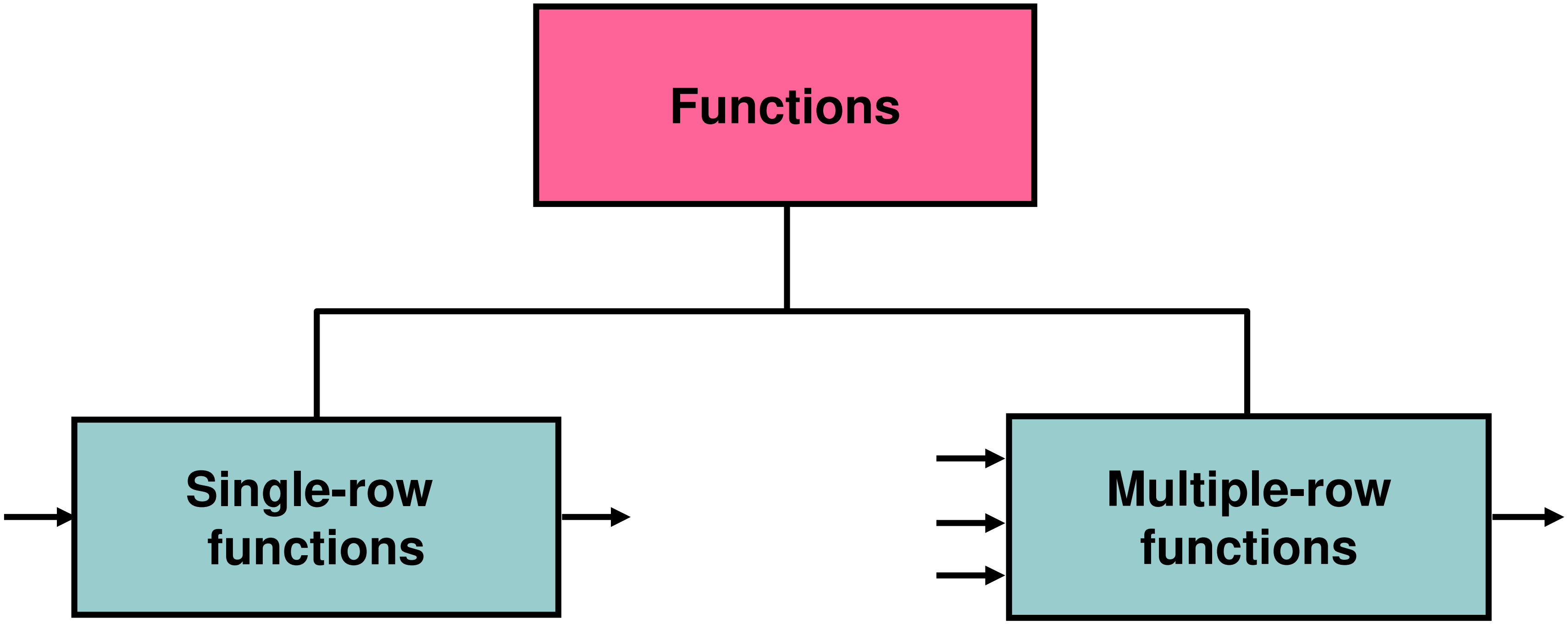
arg 1

arg 2

arg n

Result value

Two Types of SQL Functions



Functions

Single-row functions

Multiple-row functions

Return one result per row

Return one result per set of rows

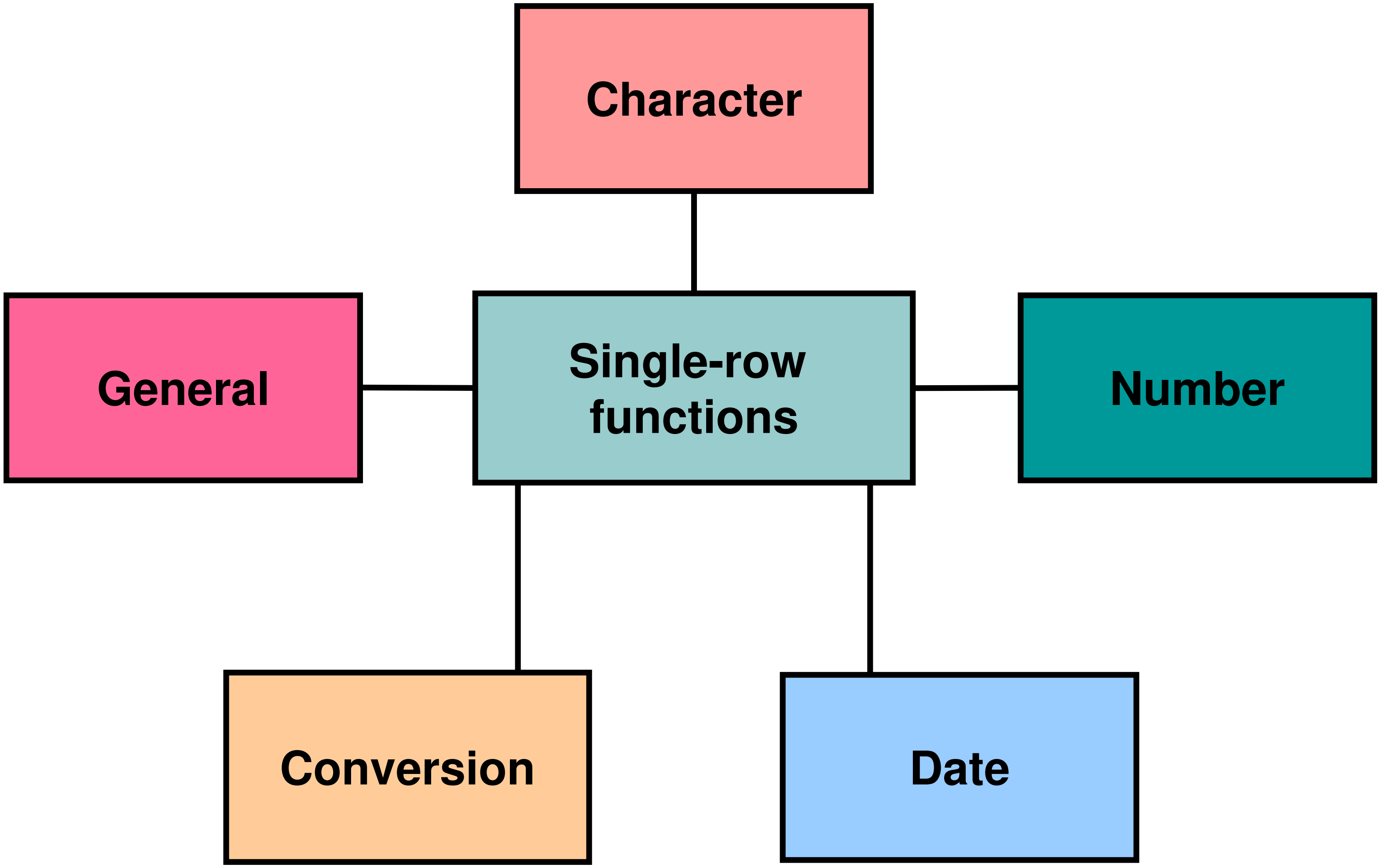
Single-Row Functions

Single-row functions:

- Manipulate data items
- Accept arguments and return one value
- Act on each row that is returned
- Return one result per row
- May modify the data type
- Can be nested
- Accept arguments that can be a column or an expression

```
function_name [(arg1, arg2,...)]
```

Single-Row Functions



Character

General

Single-row functions

Number

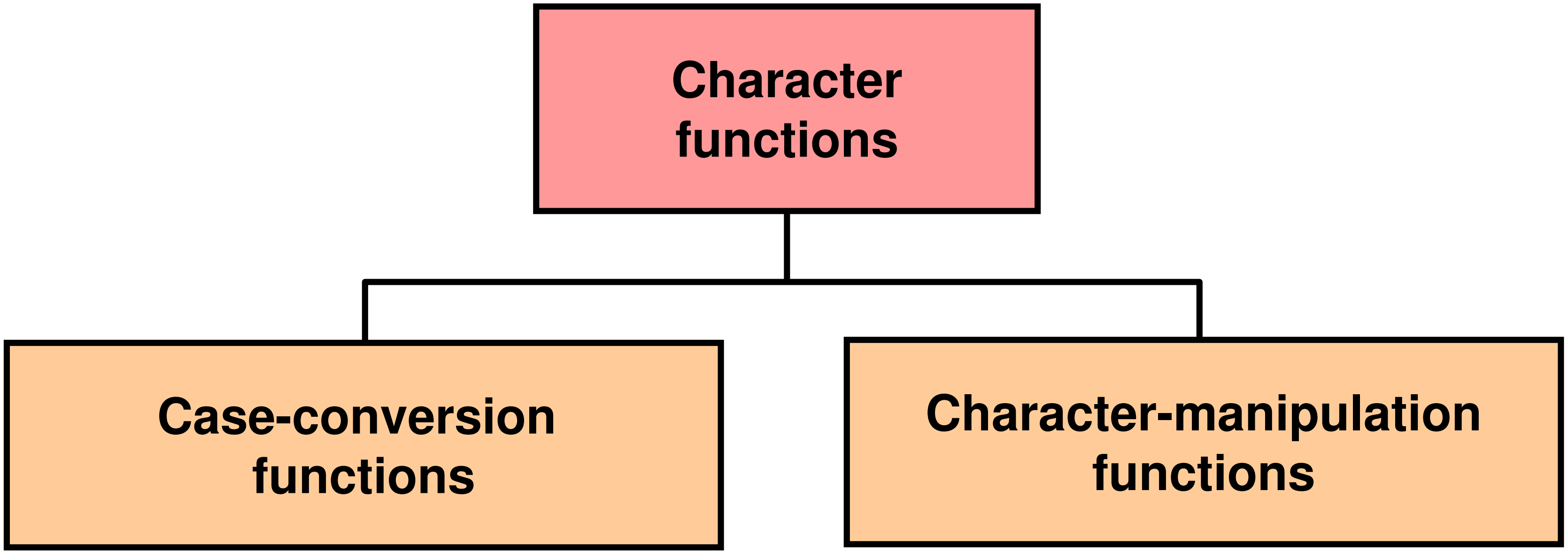
Conversion

Date

Lesson Agenda

- Single-row SQL functions
- Character functions
- Number functions
- Working with dates
- Date functions

Character Functions



Character functions

Case-conversion functions

Character-manipulation functions

`LOWER`

`UPPER`

`INITCAP`

`CONCAT`

`SUBSTR`

`LENGTH`

`INSTR`

`LPAD` | `RPAD`

`TRIM`

`REPLACE`

Case-Conversion Functions

These functions convert the case for character strings:

Function	**Result**
`LOWER('SQL Course')`	`sql course`
`UPPER('SQL Course')`	`SQL COURSE`
`INITCAP('SQL Course')`	`Sql Course`

Using Case-Conversion Functions

Display the employee number, name, and department number for employee Higgins:

```
SELECT employee_id, last_name, department_id
FROM   employees
WHERE  last_name = 'higgins';
```

```
0 rows selected
```

```
SELECT employee_id, last_name, department_id
FROM   employees
WHERE  LOWER(last_name) = 'higgins';
```

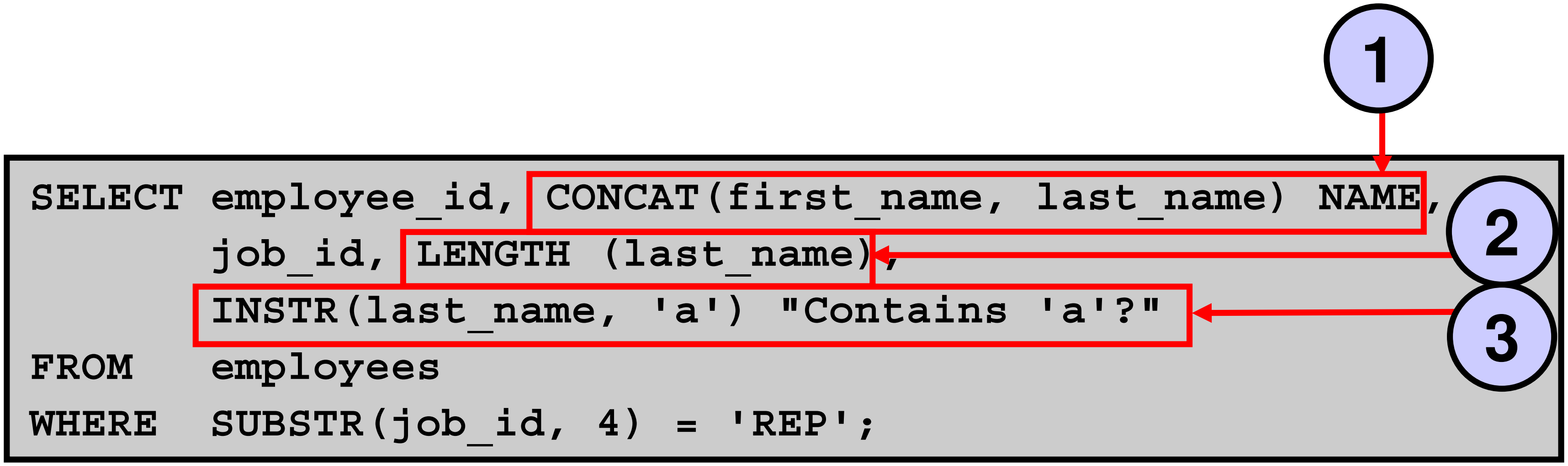
	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	205	Higgins	110

Character-Manipulation Functions

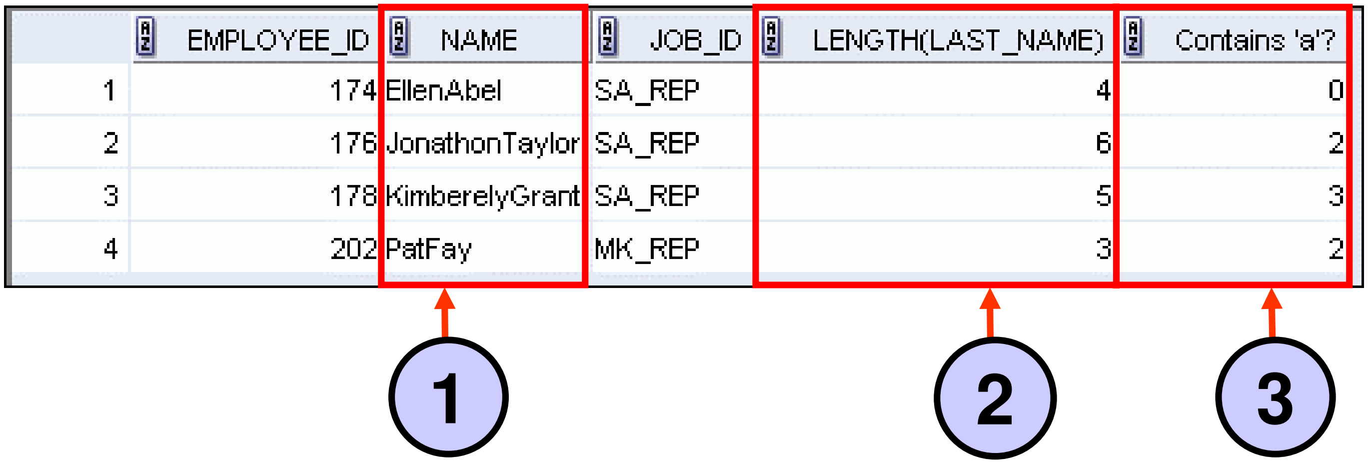
These functions manipulate character strings:

Function	**Result**
`CONCAT('Hello', 'World')`	`HelloWorld`
`SUBSTR('HelloWorld',1,5)`	`Hello`
`LENGTH('HelloWorld')`	`10`
`INSTR('HelloWorld', 'W')`	`6`
`LPAD(salary,10,'*')`	`*****24000`
`RPAD(salary, 10, '*')`	`24000*****`
`REPLACE` `('JACK and JUE','J','BL')`	`BLACK and BLUE`
`TRIM('H' FROM 'HelloWorld')`	`elloWorld`

Using the Character-Manipulation Functions



```
SELECT employee_id, CONCAT(first_name, last_name) NAME,
       job_id, LENGTH (last_name),
       INSTR(last_name, 'a') "Contains 'a'?"
FROM   employees
WHERE  SUBSTR(job_id, 4) = 'REP';
```



	EMPLOYEE_ID	NAME	JOB_ID	LENGTH(LAST_NAME)	Contains 'a'?
1	174	EllenAbel	SA_REP	4	0
2	176	JonathonTaylor	SA_REP	6	2
3	178	KimberelyGrant	SA_REP	5	3
4	202	PatFay	MK_REP	3	2

Lesson Agenda

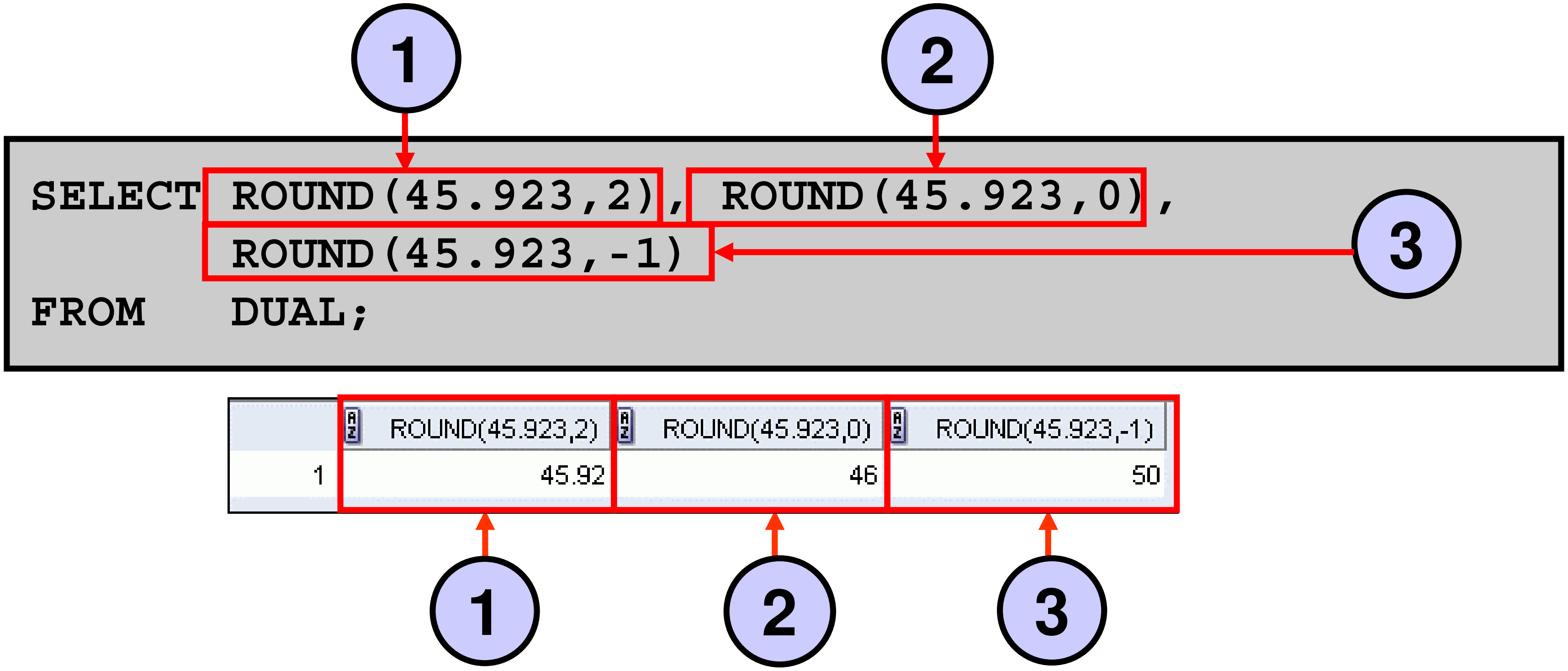
- Single-row SQL functions
- Character functions
- Number functions
- Working with dates
- Date Functions

Number Functions

- `ROUND`: Rounds value to a specified decimal
- `TRUNC`: Truncates value to a specified decimal
- `MOD`: Returns remainder of division

Function	**Result**
`ROUND(45.926, 2)`	`45.93`
`TRUNC(45.926, 2)`	`45.92`
`MOD(1600, 300)`	`100`

Using the `ROUND` Function



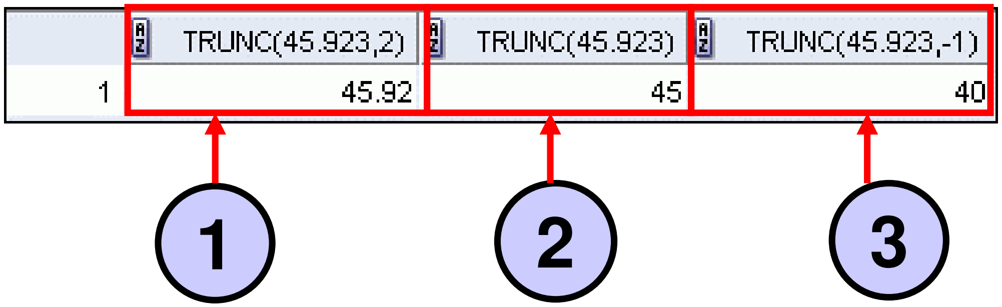
```
SELECT  ROUND(45.923,2), ROUND(45.923,0),
        ROUND(45.923,-1)
FROM    DUAL;
```

	ROUND(45.923,2)	ROUND(45.923,0)	ROUND(45.923,-1)
1	45.92	46	50

`DUAL` is a dummy table that you can use to view results from functions and calculations.

Using the `TRUNC` Function

```
SELECT  TRUNC(45.923,2), TRUNC(45.923),
        TRUNC(45.923,-1)
FROM    DUAL;
```

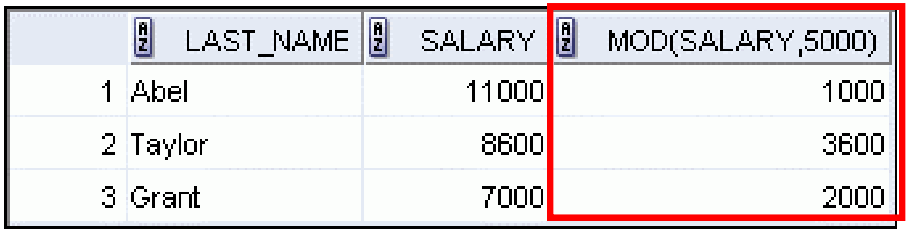


	TRUNC(45.923,2)	TRUNC(45.923)	TRUNC(45.923,-1)
1	45.92	45	40

Using the `MOD` Function

For all employees with the job title of Sales Representative, calculate the remainder of the salary after it is divided by 5,000.

```
SELECT last_name, salary, MOD(salary, 5000)
FROM   employees
WHERE  job_id = 'SA_REP';
```



	LAST_NAME	SALARY	MOD(SALARY,5000)
1	Abel	11000	1000
2	Taylor	8600	3600
3	Grant	7000	2000

Lesson Agenda

- Single-row SQL functions
- Character functions
- Number functions
- Working with dates
- Date functions

Working with Dates

- The Oracle database stores dates in an internal numeric format: century, year, month, day, hours, minutes, and seconds.
- The default date display format is DD-MON-RR.
  - Enables you to store 21st-century dates in the 20th century by specifying only the last two digits of the year
  - Enables you to store 20th-century dates in the 21st century in the same way

```
SELECT last_name, hire_date
FROM   employees
WHERE  hire_date < '01-FEB-88';
```

	LAST_NAME	HIRE_DATE
1	King	17-JUN-87
2	Whalen	17-SEP-87

`RR` Date Format

Current Year	Specified Date	RR Format	YY Format
1995	27-OCT-95	1995	1995
1995	27-OCT-17	2017	1917
2001	27-OCT-17	2017	2017
2001	27-OCT-95	1995	2095

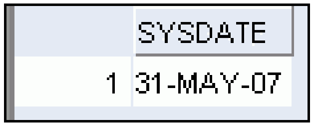
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">If the specified two-digit year is:</td></tr>
<tr><td>0–49</td><td>50–99</td></tr>
<tr><td rowspan="2">If two digits of the current year are:</td><td>0–49</td><td>The return date is in the current century</td><td>The return date is in the century before the current one</td></tr>
<tr><td>50–99</td><td>The return date is in the century after the current one</td><td>The return date is in the current century</td></tr>
</table>

Using the `SYSDATE` Function

`SYSDATE` is a function that returns:

- Date
- Time

```
SELECT sysdate
FROM   dual;
```



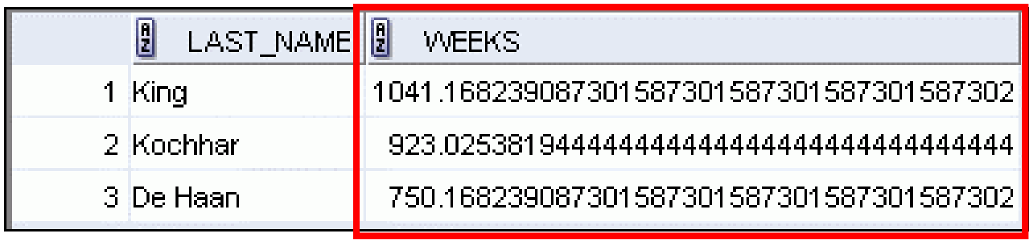
	SYSDATE
1	31-MAY-07

Arithmetic with Dates

- Add or subtract a number to or from a date for a resultant date value.
- Subtract two dates to find the number of days between those dates.
- Add hours to a date by dividing the number of hours by 24.

Using Arithmetic Operators with Dates

```
SELECT last_name, (SYSDATE-hire_date)/7 AS WEEKS
FROM   employees
WHERE  department_id = 90;
```



	LAST_NAME	WEEKS
1	King	1041.168239087301587301587301587301587302
2	Kochhar	923.02538194444444444444444444444444444
3	De Haan	750.168239087301587301587301587301587302

Lesson Agenda

- Single-row SQL functions
- Character functions
- Number functions
- Working with dates
- Date functions

Date-Manipulation Functions

Function	Result
`MONTHS_BETWEEN`	Number of months between two dates
`ADD_MONTHS`	Add calendar months to date
`NEXT_DAY`	Next day of the date specified
`LAST_DAY`	Last day of the month
`ROUND`	Round date
`TRUNC`	Truncate date

Using Date Functions

Function	Result
`MONTHS_BETWEEN ('01-SEP-95','11-JAN-94')`	`19.6774194`
`ADD_MONTHS ('31-JAN-96',1)`	`'29-FEB-96'`
`NEXT_DAY ('01-SEP-95','FRIDAY')`	`'08-SEP-95'`
`LAST_DAY ('01-FEB-95')`	`'28-FEB-95'`

Using `ROUND` and `TRUNC` Functions with Dates

Assume `SYSDATE = '25-JUL-03'`:

Function	Result
`ROUND(SYSDATE,'MONTH')`	`01-AUG-03`
`ROUND(SYSDATE ,'YEAR')`	`01-JAN-04`
`TRUNC(SYSDATE ,'MONTH')`	`01-JUL-03`
`TRUNC(SYSDATE ,'YEAR')`	`01-JAN-03`

Quiz

Which of the following statements are true about single-row functions?

1. Manipulate data items
2. Accept arguments and return one value per argument
3. Act on each row that is returned
4. Return one result per set of rows
5. May not modify the data type
6. Can be nested
7. Accept arguments that can be a column or an expression

Summary

In this lesson, you should have learned how to:

- Perform calculations on data using functions
- Modify individual data items using functions

Practice 3: Overview

This practice covers the following topics:

- Writing a query that displays the current date
- Creating queries that require the use of numeric, character, and date functions
- Performing calculations of years and months of service for an employee

4

Using Conversion Functions and Conditional Expressions

Objectives

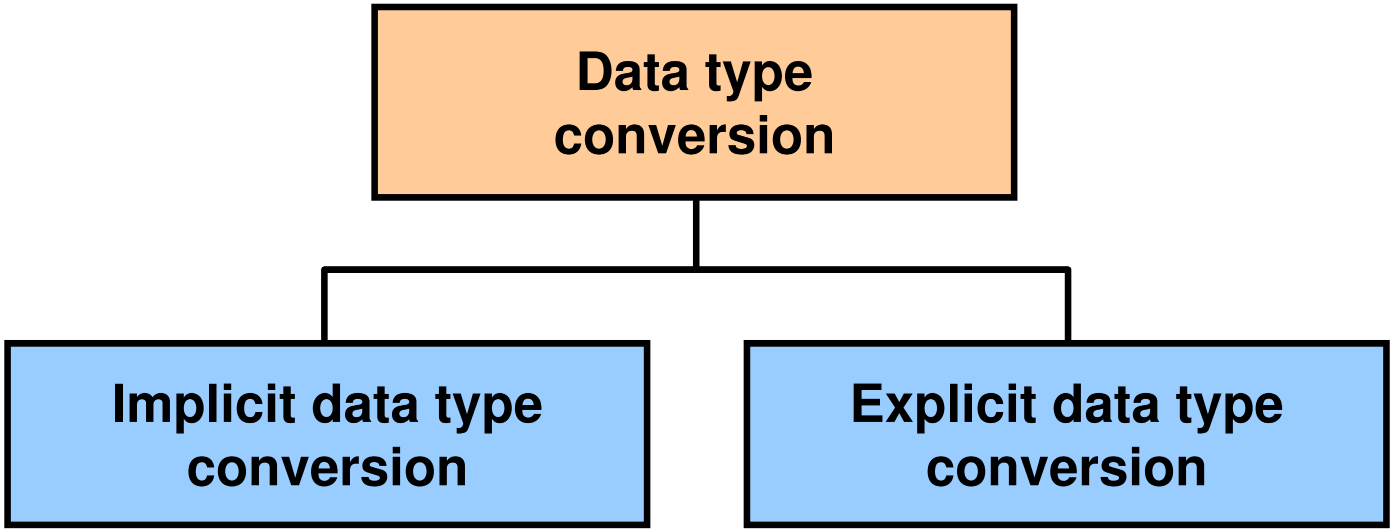
After completing this lesson, you should be able to do the following:

- Describe various types of conversion functions that are available in SQL
- Use the `TO_CHAR`, `TO_NUMBER`, and `TO_DATE` conversion functions
- Apply conditional expressions in a `SELECT` statement

Lesson Agenda

- Implicit and explicit data type conversion
- `TO_CHAR`, `TO_DATE`, `TO_NUMBER` functions
- Nesting functions
- General functions:
  - `NVL`
  - `NVL2`
  - `NULLIF`
  - `COALESCE`
- Conditional expressions:
  - `CASE`
  - `DECODE`

Conversion Functions



Data type conversion

Implicit data type conversion

Explicit data type conversion

Implicit Data Type Conversion

In expressions, the Oracle server can automatically convert the following:

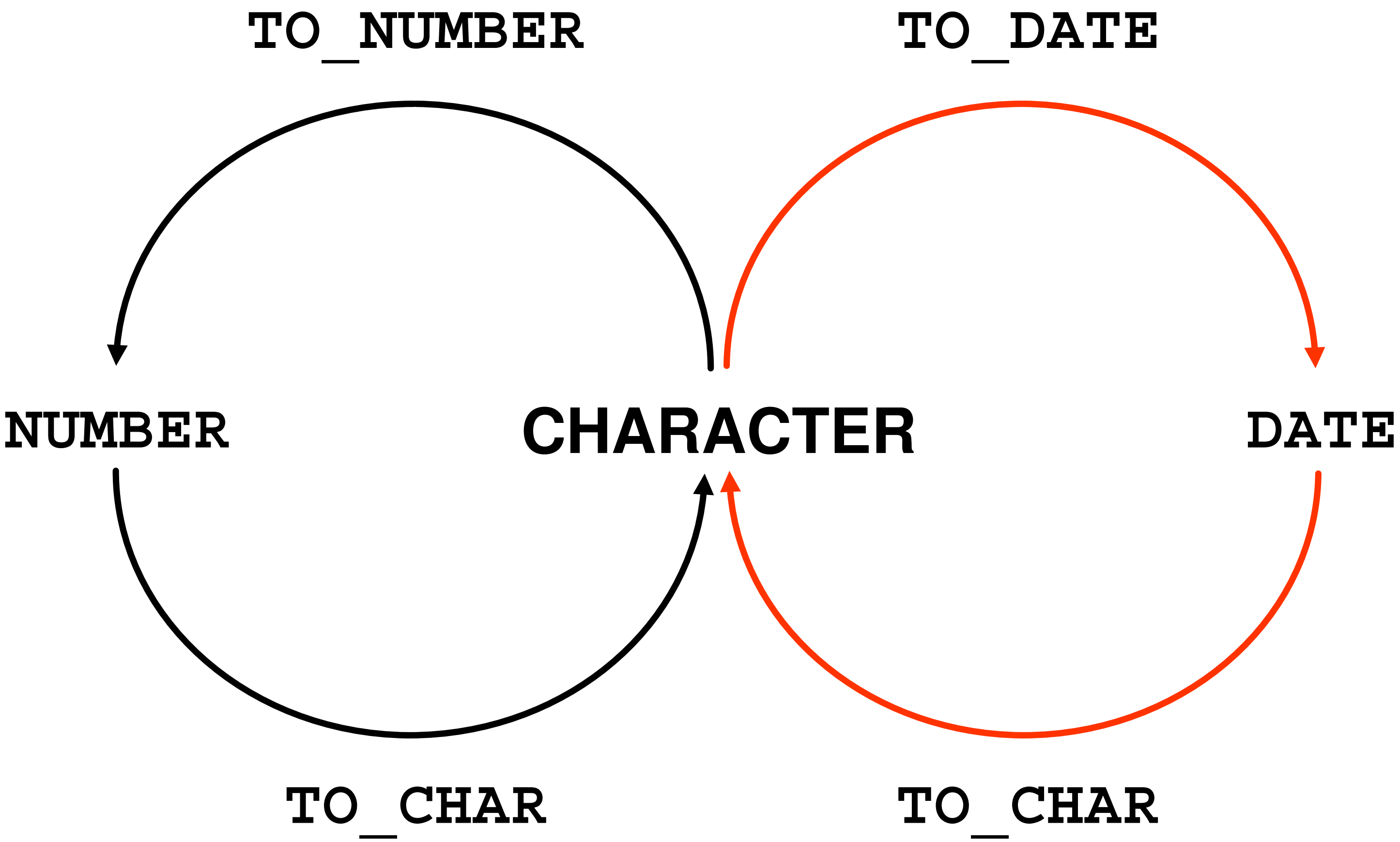
From	To
`VARCHAR2 or CHAR`	`NUMBER`
`VARCHAR2 or CHAR`	`DATE`

Implicit Data Type Conversion

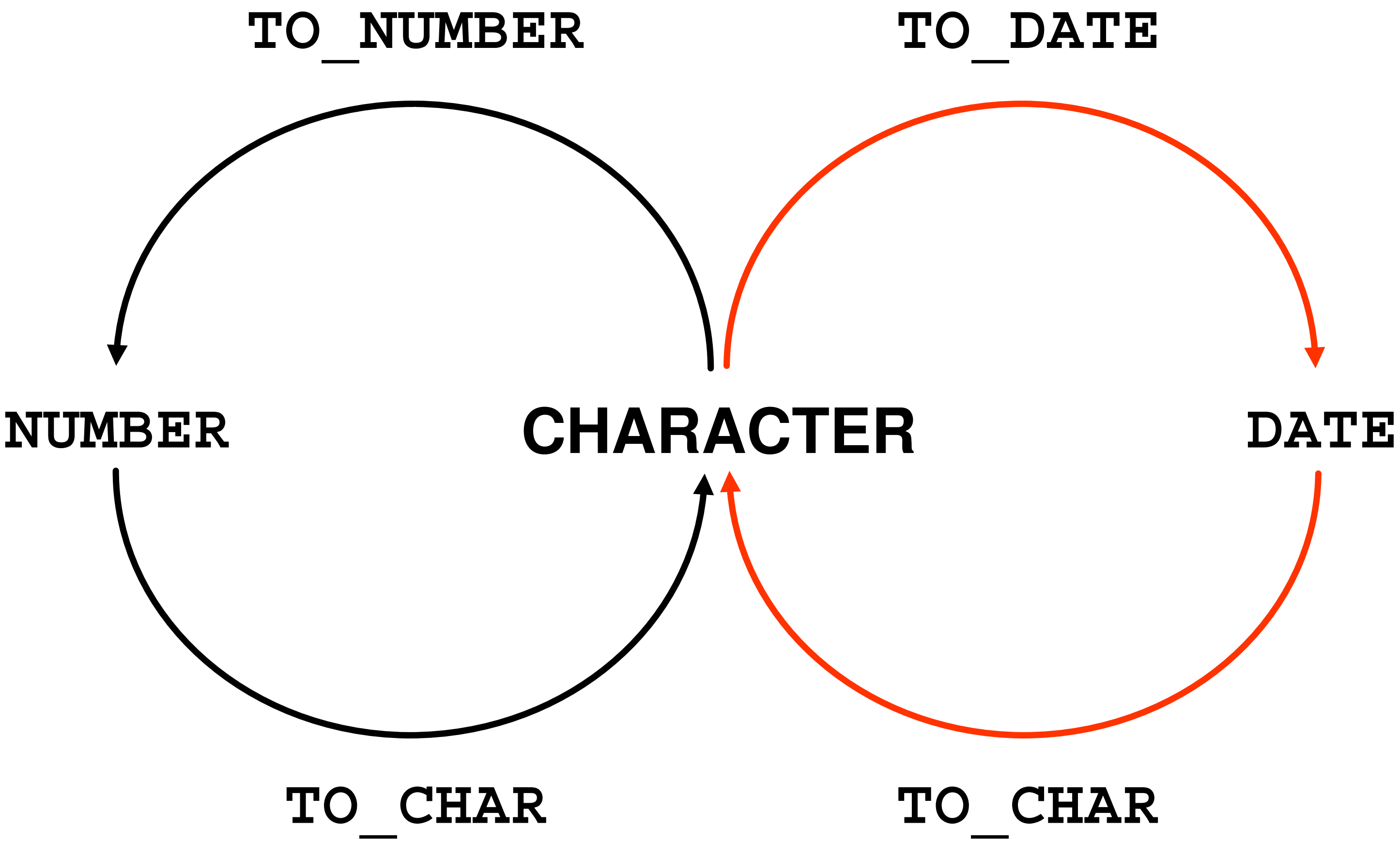
For expression evaluation, the Oracle server can automatically convert the following:

From	To
`NUMBER`	`VARCHAR2 or CHAR`
`DATE`	`VARCHAR2 or CHAR`

Explicit Data Type Conversion



Explicit Data Type Conversion



TO_NUMBER

TO_DATE

NUMBER

CHARACTER

DATE

TO_CHAR

TO_CHAR

Lesson Agenda

- Implicit and explicit data type conversion
- `TO_CHAR`, `TO_DATE`, `TO_NUMBER` functions
- Nesting functions
- General functions:
  - `NVL`
  - `NVL2`
  - `NULLIF`
  - `COALESCE`
- Conditional expressions:
  - `CASE`
  - `DECODE`

Using the `TO_CHAR` Function with Dates

```
TO_CHAR(date, 'format_model')
```

The format model:

- Must be enclosed with single quotation marks
- Is case-sensitive
- Can include any valid date format element
- Has an `fm` element to remove padded blanks or suppress leading zeros
- Is separated from the date value by a comma

Elements of the Date Format Model

Element	Result
`YYYY`	Full year in numbers
`YEAR`	Year spelled out (in English)
`MM`	Two-digit value for the month
`MONTH`	Full name of the month
`MON`	Three-letter abbreviation of the month
`DY`	Three-letter abbreviation of the day of the week
`DAY`	Full name of the day of the week
`DD`	Numeric day of the month

Elements of the Date Format Model

- Time elements format the time portion of the date:

`HH24:MI:SS AM`	`15:45:32 PM`

- Add character strings by enclosing them with double quotation marks:

`DD "of" MONTH`	`12 of OCTOBER`

- Number suffixes spell out numbers:

`ddspth`	`fourteenth`

Using the `TO_CHAR` Function with Dates

```
SELECT last_name,
       TO_CHAR(hire_date, 'fmDD Month YYYY')
       AS HIREDATE
FROM   employees;
```

	LAST_NAME	HIREDATE
1	King	17 June 1987
2	Kochhar	21 September 1989
3	De Haan	13 January 1993
4	Hunold	3 January 1990
5	Ernst	21 May 1991
6	Lorentz	7 February 1999
7	Mourgos	16 November 1999
8	Rajs	17 October 1995
9	Davies	29 January 1997
10	Matos	15 March 1998

...

19	Higgins	7 June 1994
20	Gietz	7 June 1994

Using the `TO_CHAR` Function with Numbers

```
TO_CHAR(number, 'format_model')
```

These are some of the format elements that you can use with the `TO_CHAR` function to display a number value as a character:

Element	Result
`9`	Represents a number
`0`	Forces a zero to be displayed
`$`	Places a floating dollar sign
`L`	Uses the floating local currency symbol
`.`	Prints a decimal point
`,`	Prints a comma as a thousands indicator

Using the `TO_CHAR` Function with Numbers

```
SELECT TO_CHAR(salary, '$99,999.00') SALARY
FROM   employees
WHERE  last_name = 'Ernst';
```

	SALARY
1	$6,000.00

Using the `TO_NUMBER` and `TO_DATE` Functions

- Convert a character string to a number format using the `TO_NUMBER` function:

```
TO_NUMBER(char[, 'format_model'])
```

- Convert a character string to a date format using the `TO_DATE` function:

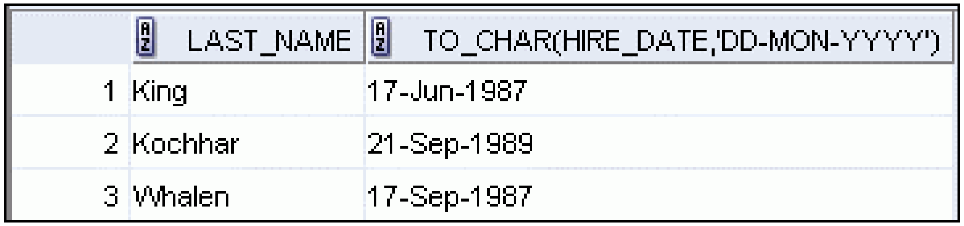
```
TO_DATE(char[, 'format_model'])
```

- These functions have an `fx` modifier. This modifier specifies the exact match for the character argument and date format model of a `TO_DATE` function.

Using the `TO_CHAR` and `TO_DATE` Function with `RR` Date Format

To find employees hired before 1990, use the `RR` date format, which produces the same results whether the command is run in 1999 or now:

```
SELECT last_name, TO_CHAR(hire_date, 'DD-Mon-YYYY')
FROM  employees
WHERE hire_date < TO_DATE('01-Jan-90','DD-Mon-RR');
```



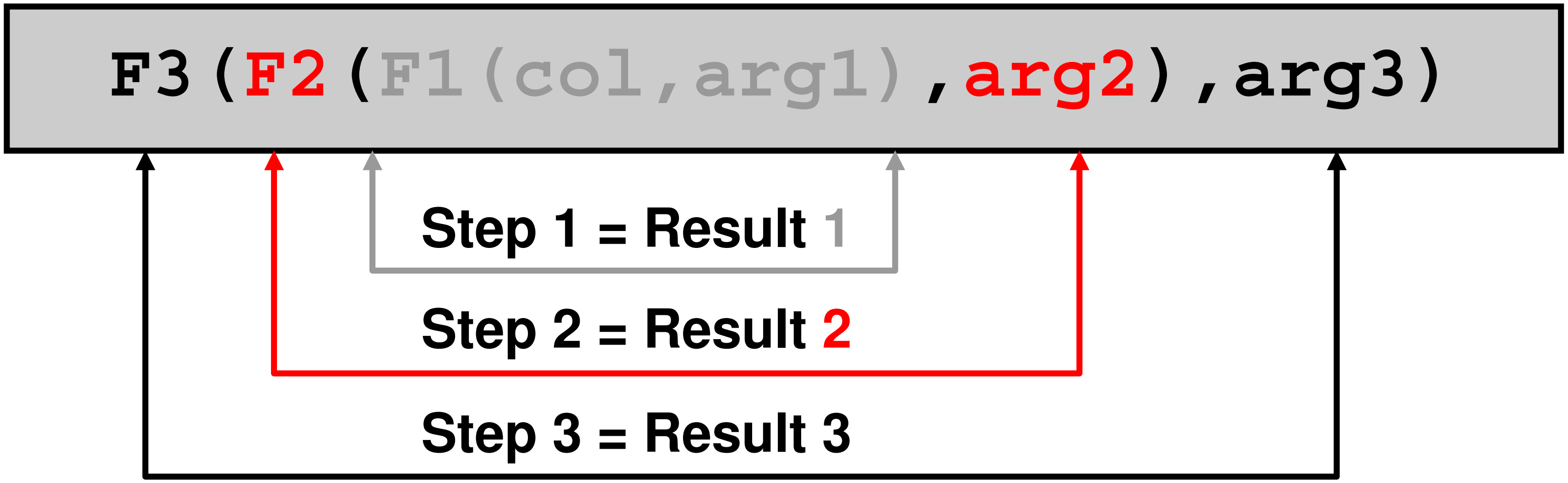
	LAST_NAME	TO_CHAR(HIRE_DATE,'DD-MON-YYYY')
1	King	17-Jun-1987
2	Kochhar	21-Sep-1989
3	Whalen	17-Sep-1987

Lesson Agenda

- Implicit and explicit data type conversion
- `TO_CHAR`, `TO_DATE`, `TO_NUMBER` functions
- Nesting functions
- General functions:
  - `NVL`
  - `NVL2`
  - `NULLIF`
  - `COALESCE`
- Conditional expressions:
  - `CASE`
  - `DECODE`

Nesting Functions

- Single-row functions can be nested to any level.
- Nested functions are evaluated from the deepest level to the least deep level.



```
F3(F2(F1(col,arg1),arg2),arg3)
```

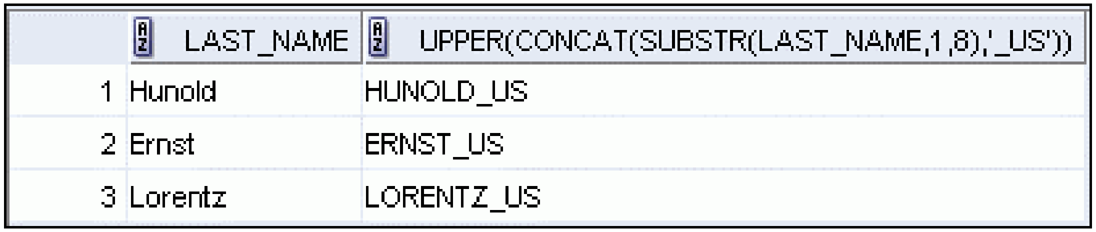
Step 1 = Result 1

Step 2 = Result 2

Step 3 = Result 3

Nesting Functions

```
SELECT last_name,
  UPPER(CONCAT(SUBSTR (LAST_NAME, 1, 8), '_US'))
FROM   employees
WHERE  department_id = 60;
```



	LAST_NAME	UPPER(CONCAT(SUBSTR(LAST_NAME,1,8),'_US'))
1	Hunold	HUNOLD_US
2	Ernst	ERNST_US
3	Lorentz	LORENTZ_US

Lesson Agenda

- Implicit and explicit data type conversion
- `TO_CHAR`, `TO_DATE`, `TO_NUMBER` functions
- Nesting functions
- General functions:
  - `NVL`
  - `NVL2`
  - `NULLIF`
  - `COALESCE`
- Conditional expressions:
  - `CASE`
  - `DECODE`

General Functions

The following functions work with any data type and pertain to using nulls:

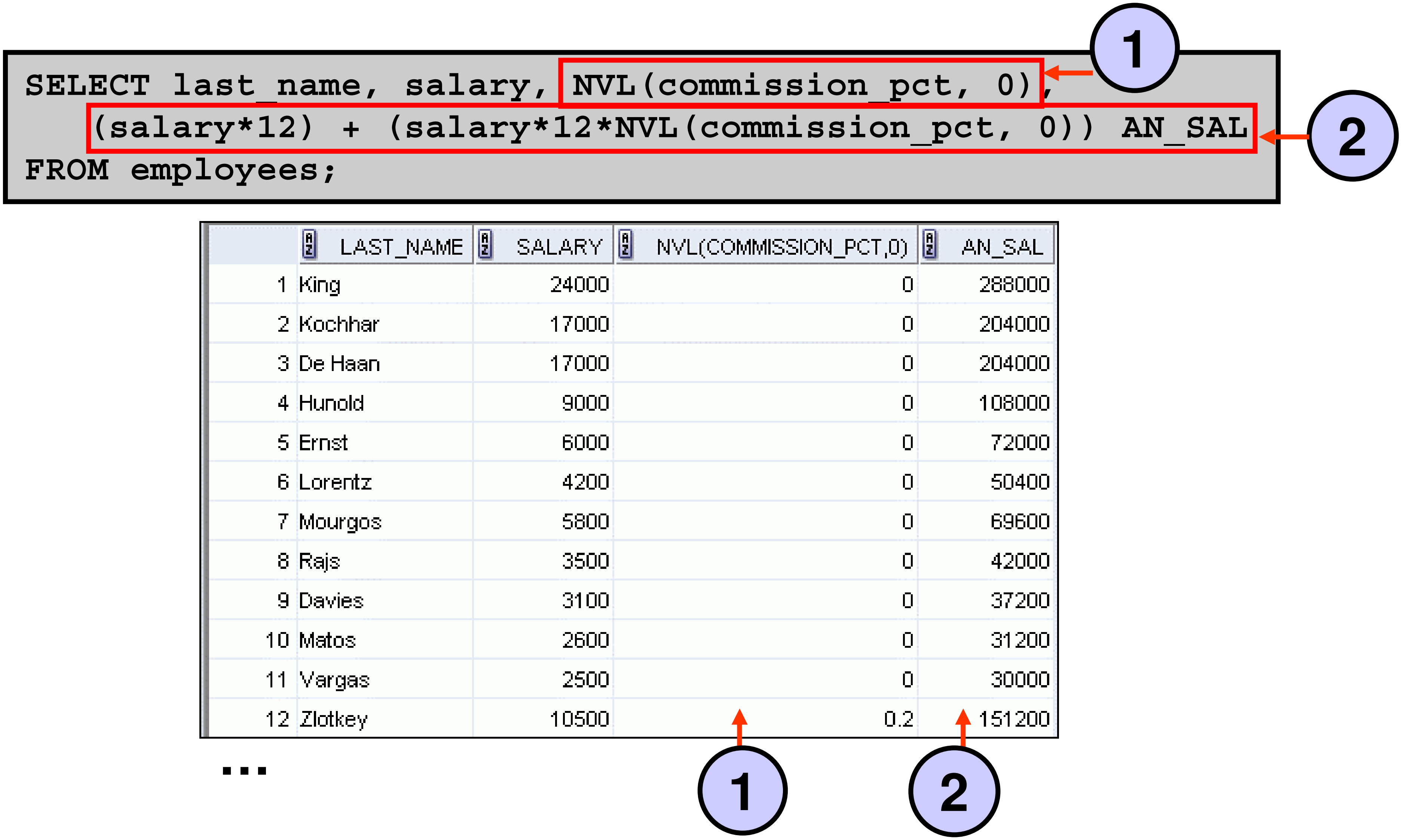
- `NVL (expr1, expr2)`
- `NVL2 (expr1, expr2, expr3)`
- `NULLIF (expr1, expr2)`
- `COALESCE (expr1, expr2, ..., exprn)`

`NVL` Function

Converts a null value to an actual value:

- Data types that can be used are date, character, and number.
- Data types must match:
  - `NVL(commission_pct,0)`
  - `NVL(hire_date,'01-JAN-97')`
  - `NVL(job_id,'No Job Yet')`

Using the NVL Function

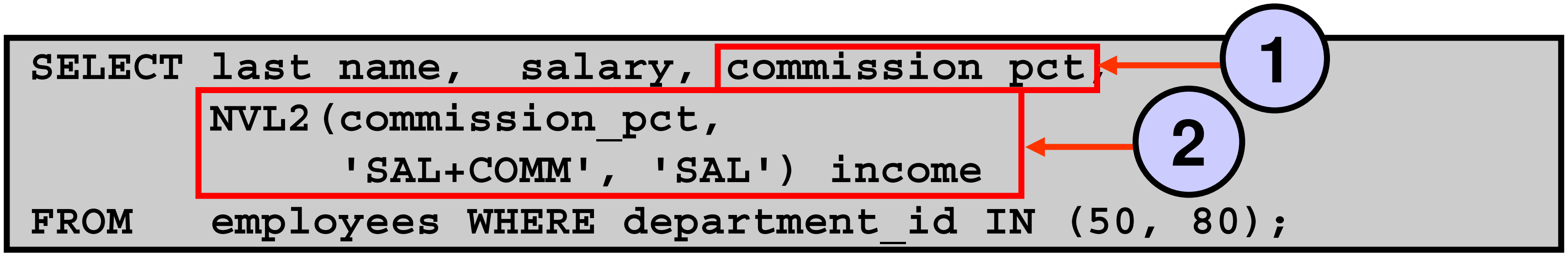


```
SELECT last_name, salary, NVL(commission_pct, 0),
   (salary*12) + (salary*12*NVL(commission_pct, 0)) AN_SAL
FROM employees;
```

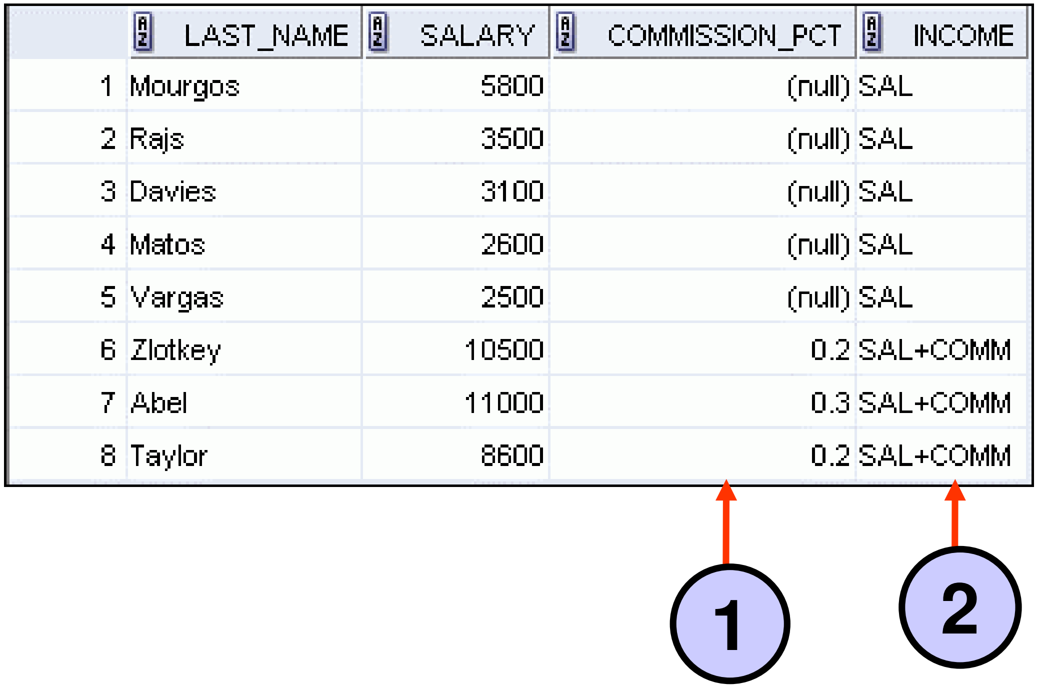
	LAST_NAME	SALARY	NVL(COMMISSION_PCT,0)	AN_SAL
1	King	24000	0	288000
2	Kochhar	17000	0	204000
3	De Haan	17000	0	204000
4	Hunold	9000	0	108000
5	Ernst	6000	0	72000
6	Lorentz	4200	0	50400
7	Mourgos	5800	0	69600
8	Rajs	3500	0	42000
9	Davies	3100	0	37200
10	Matos	2600	0	31200
11	Vargas	2500	0	30000
12	Zlotkey	10500	0.2	151200

…

Using the `NVL2` Function

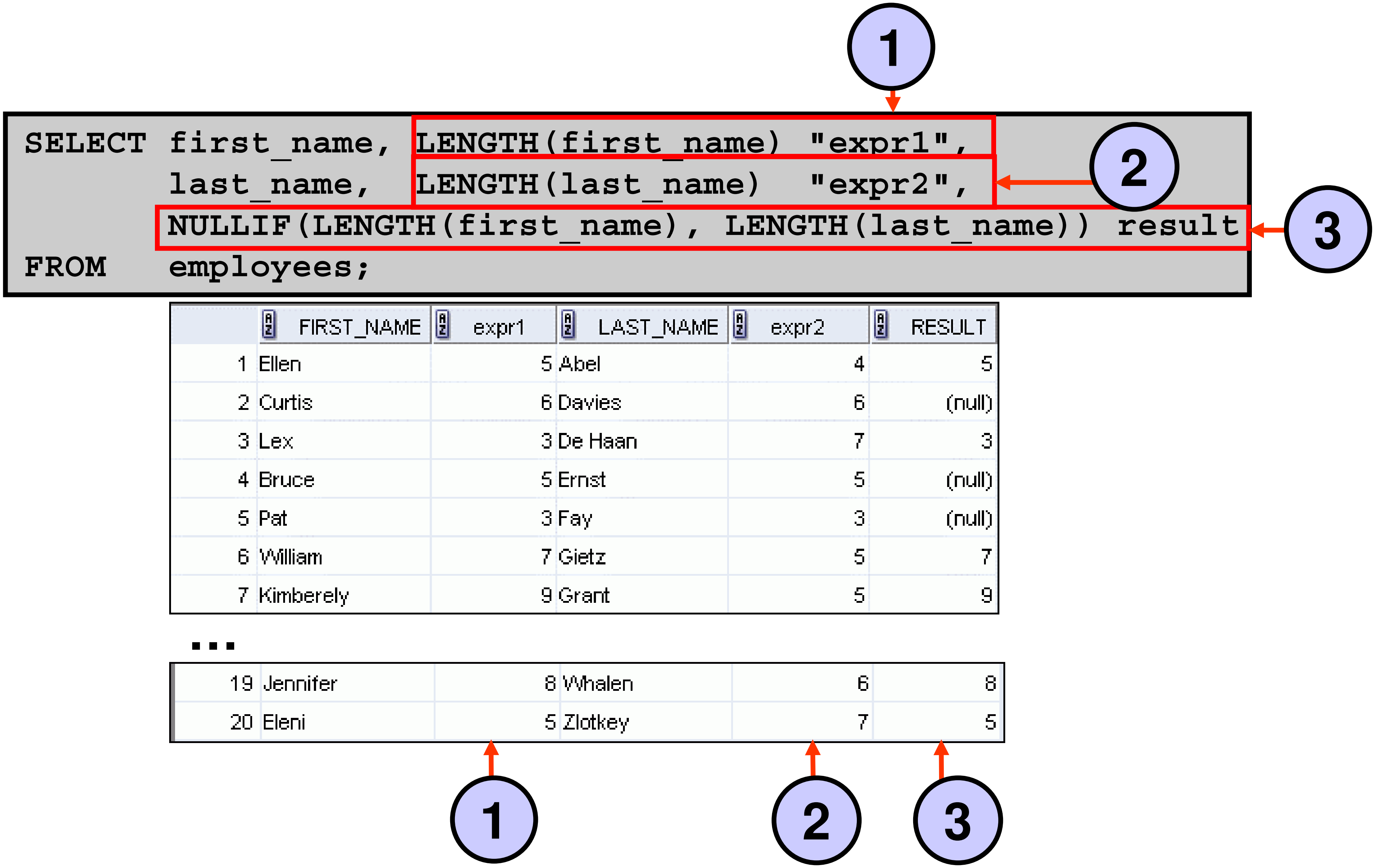


```
SELECT last name,  salary, commission pct,
       NVL2(commission_pct,
            'SAL+COMM', 'SAL') income
FROM   employees WHERE department_id IN (50, 80);
```



	LAST_NAME	SALARY	COMMISSION_PCT	INCOME
1	Mourgos	5800	(null)	SAL
2	Rajs	3500	(null)	SAL
3	Davies	3100	(null)	SAL
4	Matos	2600	(null)	SAL
5	Vargas	2500	(null)	SAL
6	Zlotkey	10500	0.2	SAL+COMM
7	Abel	11000	0.3	SAL+COMM
8	Taylor	8600	0.2	SAL+COMM

Using the NULLIF Function



```
SELECT first_name, LENGTH(first_name) "expr1",
       last_name,  LENGTH(last_name)  "expr2",
       NULLIF(LENGTH(first_name), LENGTH(last_name)) result
FROM   employees;
```

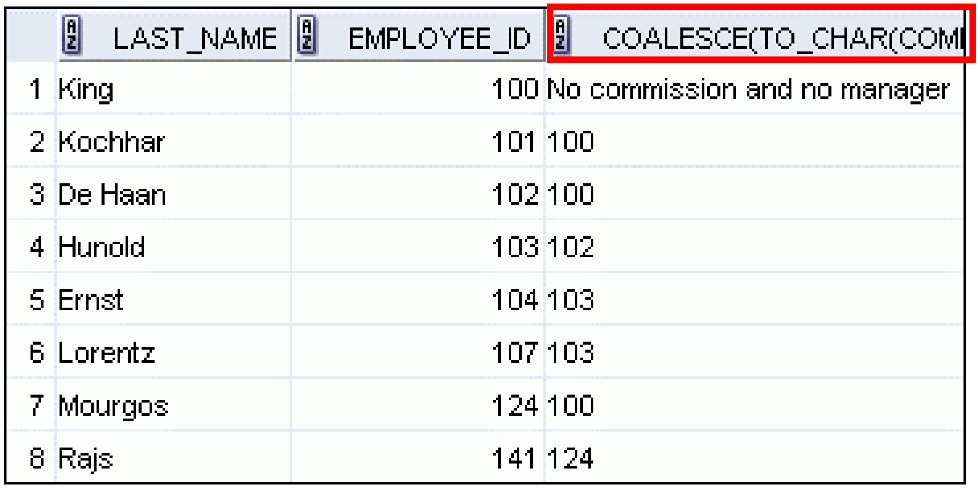
	FIRST_NAME	expr1	LAST_NAME	expr2	RESULT
1	Ellen	5	Abel	4	5
2	Curtis	6	Davies	6	(null)
3	Lex	3	De Haan	7	3
4	Bruce	5	Ernst	5	(null)
5	Pat	3	Fay	3	(null)
6	William	7	Gietz	5	7
7	Kimberely	9	Grant	5	9
...					
19	Jennifer	8	Whalen	6	8
20	Eleni	5	Zlotkey	7	5

Using the `COALESCE` Function

- The advantage of the `COALESCE` function over the `NVL` function is that the `COALESCE` function can take multiple alternate values.
- If the first expression is not null, the `COALESCE` function returns that expression; otherwise, it does a `COALESCE` of the remaining expressions.

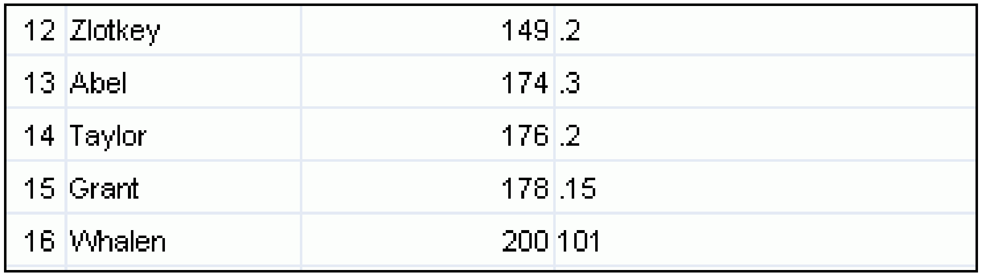
Using the `COALESCE` Function

```
SELECT last_name, employee_id,
COALESCE(TO_CHAR(commission_pct),TO_CHAR(manager_id),
         'No commission and no manager')
FROM employees;
```



	LAST_NAME	EMPLOYEE_ID	COALESCE(TO_CHAR(COM
1	King	100	No commission and no manager
2	Kochhar	101	100
3	De Haan	102	100
4	Hunold	103	102
5	Ernst	104	103
6	Lorentz	107	103
7	Mourgos	124	100
8	Rajs	141	124

…



12	Zlotkey	149	.2
13	Abel	174	.3
14	Taylor	176	.2
15	Grant	178	.15
16	Whalen	200	101

…

Lesson Agenda

- Implicit and explicit data type conversion
- `TO_CHAR`, `TO_DATE`, `TO_NUMBER` functions
- Nesting functions
- General functions:
  - `NVL`
  - `NVL2`
  - `NULLIF`
  - `COALESCE`
- Conditional expressions:
  - `CASE`
  - `DECODE`

Conditional Expressions

- Provide the use of the `IF-THEN-ELSE` logic within a SQL statement
- Use two methods:
  - `CASE` expression
  - `DECODE` function

`CASE` Expression

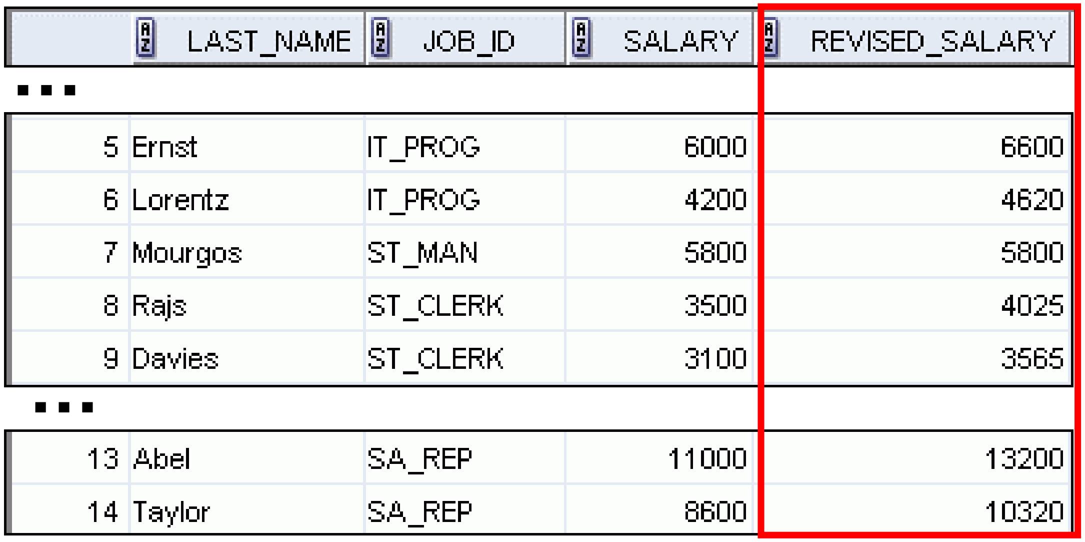
Facilitates conditional inquiries by doing the work of an `IF-THEN-ELSE` statement:

```
CASE expr WHEN comparison_expr1 THEN return_expr1
         [WHEN comparison_expr2 THEN return_expr2
          WHEN comparison_exprn THEN return_exprn
          ELSE else_expr]
END
```

Using the `CASE` Expression

Facilitates conditional inquiries by doing the work of an `IF-THEN-ELSE` statement:

```
SELECT last_name, job_id, salary,
       CASE job_id WHEN 'IT_PROG'  THEN  1.10*salary
                   WHEN 'ST_CLERK' THEN  1.15*salary
                   WHEN 'SA_REP'   THEN  1.20*salary
       ELSE      salary END     "REVISED_SALARY"
FROM   employees;
```



	LAST_NAME	JOB_ID	SALARY	REVISED_SALARY
…				
5	Ernst	IT_PROG	6000	6600
6	Lorentz	IT_PROG	4200	4620
7	Mourgos	ST_MAN	5800	5800
8	Rajs	ST_CLERK	3500	4025
9	Davies	ST_CLERK	3100	3565
…				
13	Abel	SA_REP	11000	13200
14	Taylor	SA_REP	8600	10320
…				

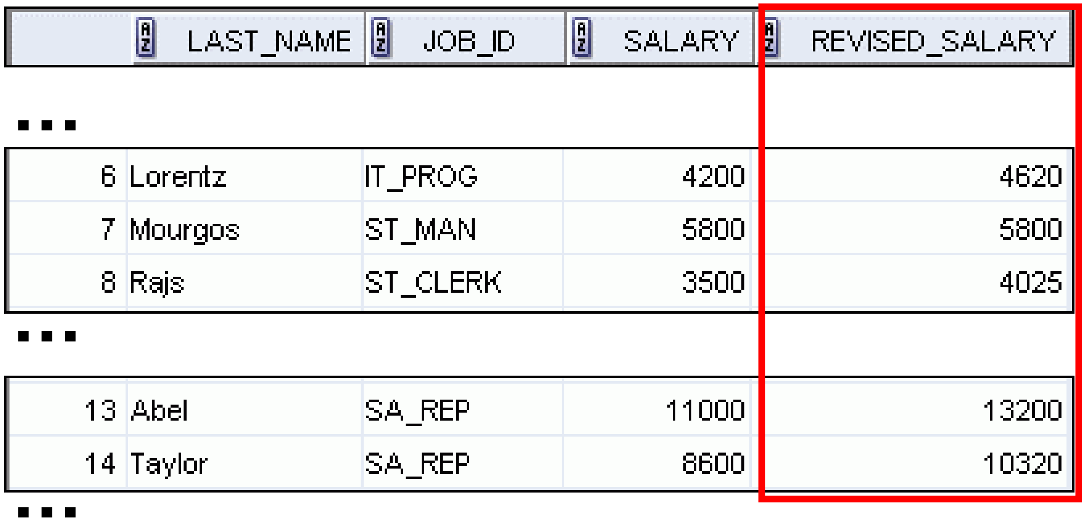
`DECODE` Function

Facilitates conditional inquiries by doing the work of a `CASE` expression or an `IF-THEN-ELSE` statement:

```
DECODE(col|expression, search1, result1
                        [, search2, result2,...,]
                        [, default])
```

Using the `DECODE` Function

```
SELECT last name, job id, salary,
       DECODE(job_id, 'IT_PROG',   1.10*salary,
                      'ST_CLERK', 1.15*salary,
                      'SA_REP',   1.20*salary,
              salary)
       REVISED_SALARY
FROM   employees;
```



	LAST_NAME	JOB_ID	SALARY	REVISED_SALARY
…				
6	Lorentz	IT_PROG	4200	4620
7	Mourgos	ST_MAN	5800	5800
8	Rajs	ST_CLERK	3500	4025
…				
13	Abel	SA_REP	11000	13200
14	Taylor	SA_REP	8600	10320
…				

Using the `DECODE` Function

Display the applicable tax rate for each employee in department 80:

```
SELECT last_name, salary,
       DECODE (TRUNC(salary/2000, 0),
                         0, 0.00,
                         1, 0.09,
                         2, 0.20,
                         3, 0.30,
                         4, 0.40,
                         5, 0.42,
                         6, 0.44,
                            0.45) TAX_RATE
FROM   employees
WHERE  department_id = 80;
```

Quiz

The `TO_NUMBER` function converts either character strings or date values to a number in the format specified by the optional format model.

1. True
2. False

Summary

In this lesson, you should have learned how to:

- Alter date formats for display using functions
- Convert column data types using functions
- Use `NVL` functions
- Use `IF-THEN-ELSE` logic and other conditional expressions in a `SELECT` statement

Practice 4: Overview

This practice covers the following topics:

- Creating queries that use `TO_CHAR`, `TO_DATE`, and other `DATE` functions
- Creating queries that use conditional expressions such as `DECODE` and `CASE`

5

Reporting Aggregated Data Using the Group Functions

Objectives

After completing this lesson, you should be able to do the following:

- Identify the available group functions
- Describe the use of group functions
- Group data by using the `GROUP BY` clause
- Include or exclude grouped rows by using the `HAVING` clause

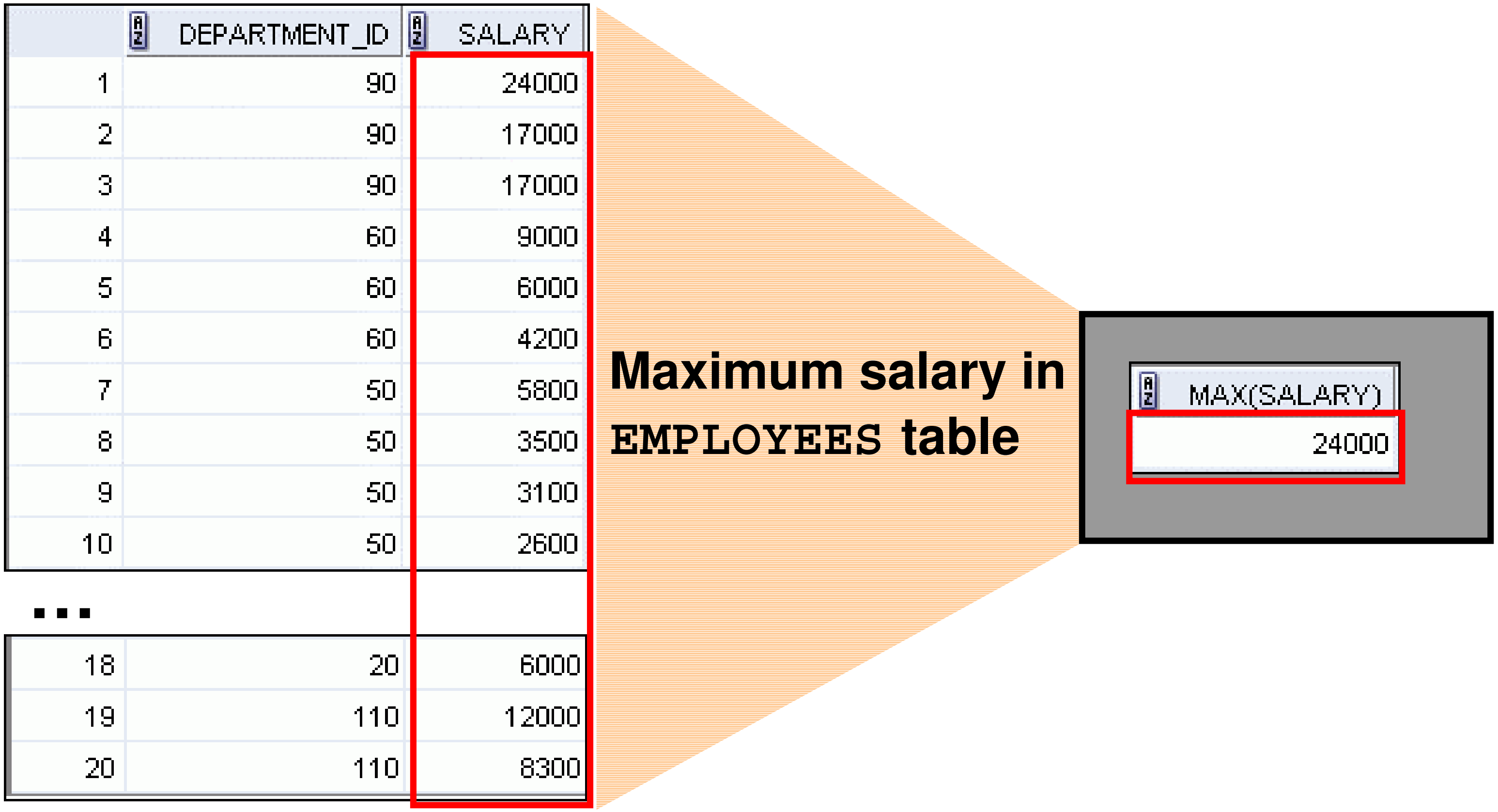
Lesson Agenda

- Group functions:
  - Types and syntax
  - Use `AVG`, `SUM`, `MIN`, `MAX`, `COUNT`
  - Use `DISTINCT` keyword within group functions
  - `NULL` values in a group function
- Grouping rows:
  - `GROUP BY` clause
  - `HAVING` clause
- Nesting group functions

What Are Group Functions?

Group functions operate on sets of rows to give one result per group.

EMPLOYEES



	DEPARTMENT_ID	SALARY
1	90	24000
2	90	17000
3	90	17000
4	60	9000
5	60	6000
6	60	4200
7	50	5800
8	50	3500
9	50	3100
10	50	2600

…

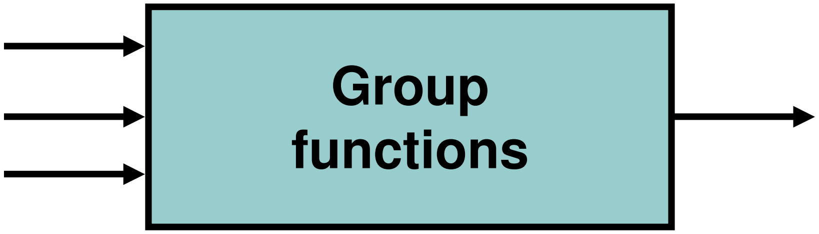
18	20	6000
19	110	12000
20	110	8300

Maximum salary in `EMPLOYEES` table

MAX(SALARY)
24000

Types of Group Functions

- `AVG`
- `COUNT`
- `MAX`
- `MIN`
- `STDDEV`
- `SUM`
- `VARIANCE`



Group functions

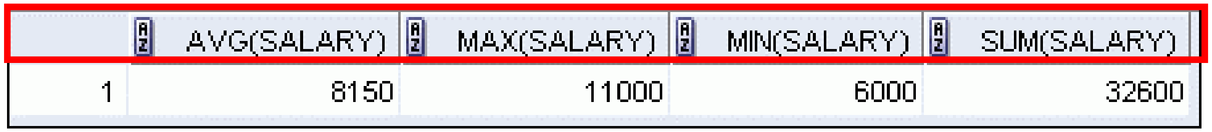
Group Functions: Syntax

```
SELECT      group_function(column), ...
FROM        table
[WHERE      condition]
[ORDER BY   column];
```

Using the `AVG` and `SUM` Functions

You can use `AVG` and `SUM` for numeric data.

```
SELECT AVG(salary), MAX(salary),
       MIN(salary), SUM(salary)
FROM   employees
WHERE  job_id LIKE '%REP%';
```



	AVG(SALARY)	MAX(SALARY)	MIN(SALARY)	SUM(SALARY)
1	8150	11000	6000	32600

Using the `MIN` and `MAX` Functions

You can use `MIN` and `MAX` for numeric, character, and date data types.

```
SELECT MIN(hire_date), MAX(hire_date)
FROM        employees;
```

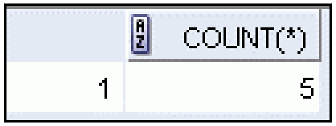
	MIN(HIRE_DATE)	MAX(HIRE_DATE)
1	17-JUN-87	29-JAN-00

Using the `COUNT` Function

`COUNT(*)` returns the number of rows in a table:

1

```
SELECT COUNT(*)
FROM   employees
WHERE  department_id = 50;
```



	COUNT(*)
1	5

`COUNT(`*`expr`*`)` returns the number of rows with non-null values for *`expr`*:

2

```
SELECT COUNT(commission_pct)
FROM   employees
WHERE  department_id = 80;
```

	COUNT(COMMISSION_PCT)
1	3

Using the `DISTINCT` Keyword

- `COUNT(DISTINCT expr)` returns the number of distinct non-null values of *`expr`*.
- To display the number of distinct department values in the `EMPLOYEES` table:

```
SELECT COUNT(DISTINCT department_id)
FROM   employees;
```

	COUNT(DISTINCTDEPARTMENT_ID)
1	7

Group Functions and Null Values

Group functions ignore null values in the column:

1

```
SELECT AVG(commission_pct)
FROM   employees;
```

	AVG(COMMISSION_PCT)
1	0.2125

The `NVL` function forces group functions to include null values:

2

```
SELECT AVG(NVL(commission_pct, 0))
FROM   employees;
```

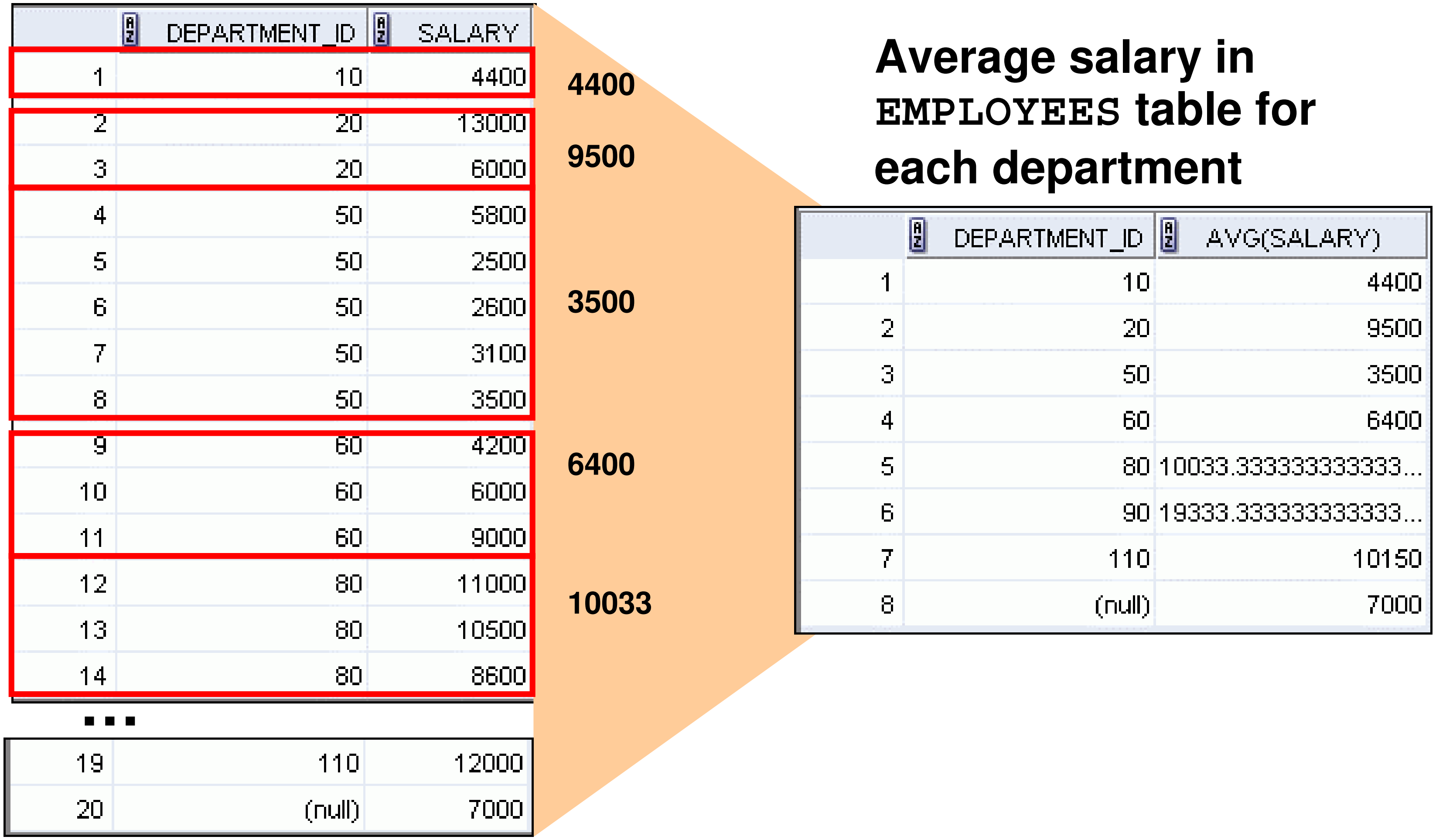
	AVG(NVL(COMMISSION_PCT,0))
1	0.0425

Lesson Agenda

- Group functions:
  - Types and syntax
  - Use `AVG`, `SUM`, `MIN`, `MAX`, `COUNT`
  - Use `DISTINCT` keyword within group functions
  - `NULL` values in a group function
- Grouping rows:
  - `GROUP BY` clause
  - `HAVING` clause
- Nesting group functions

Creating Groups of Data

EMPLOYEES



	DEPARTMENT_ID	SALARY
1	10	4400
2	20	13000
3	20	6000
4	50	5800
5	50	2500
6	50	2600
7	50	3100
8	50	3500
9	60	4200
10	60	6000
11	60	9000
12	80	11000
13	80	10500
14	80	8600

…

19	110	12000
20	(null)	7000

Average salary in `EMPLOYEES` table for each department

	DEPARTMENT_ID	AVG(SALARY)
1	10	4400
2	20	9500
3	50	3500
4	60	6400
5	80	10033.3333333333...
6	90	19333.3333333333...
7	110	10150
8	(null)	7000

Creating Groups of Data: `GROUP BY` Clause Syntax

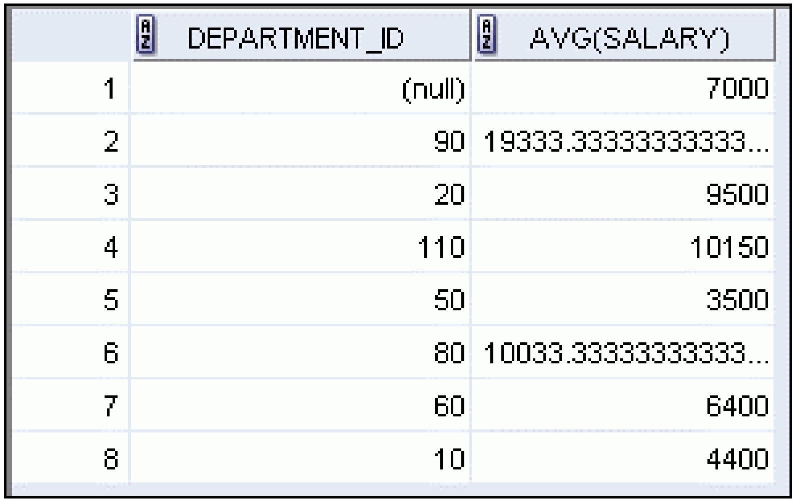
```
SELECT     column, group_function(column)
FROM       table
[WHERE     condition]
[GROUP BY group_by_expression]
[ORDER BY column];
```

You can divide rows in a table into smaller groups by using the `GROUP BY` clause.

Using the `GROUP BY` Clause

All columns in the `SELECT` list that are not in group functions must be in the `GROUP BY` clause.

```
SELECT    department_id, AVG(salary)
FROM      employees
GROUP BY department_id ;
```

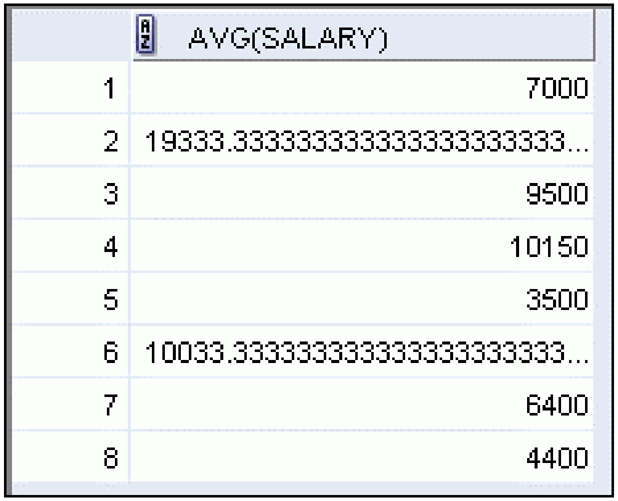


	DEPARTMENT_ID	AVG(SALARY)
1	(null)	7000
2	90	19333.33333333333...
3	20	9500
4	110	10150
5	50	3500
6	80	10033.33333333333...
7	60	6400
8	10	4400

Using the `GROUP BY` Clause

The `GROUP BY` column does not have to be in the `SELECT` list.

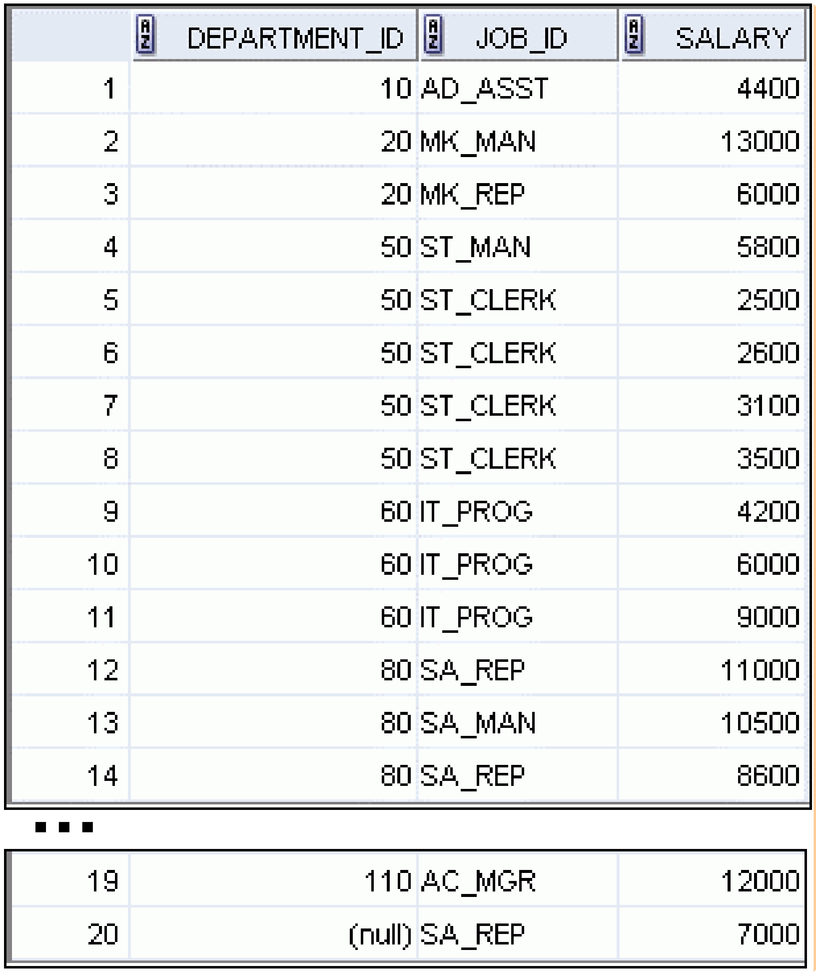
```
SELECT    AVG(salary)
FROM      employees
GROUP BY department_id ;
```



	AVG(SALARY)
1	7000
2	19333.3333333333333333333...
3	9500
4	10150
5	3500
6	10033.3333333333333333333...
7	6400
8	4400

Grouping by More than One Column

`EMPLOYEES`

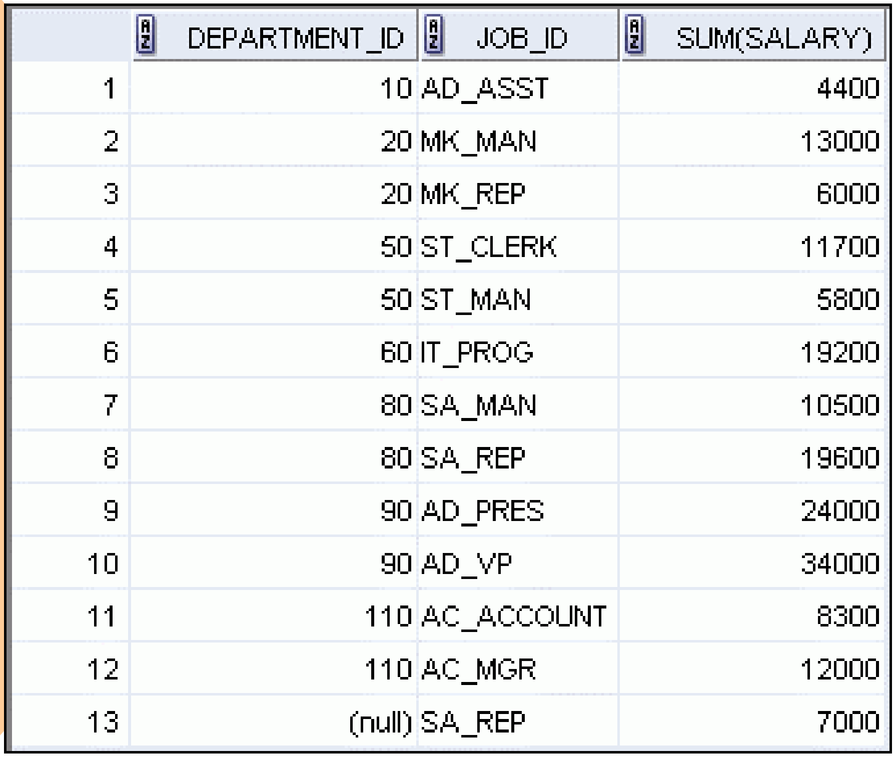


	DEPARTMENT_ID	JOB_ID	SALARY
1	10	AD_ASST	4400
2	20	MK_MAN	13000
3	20	MK_REP	6000
4	50	ST_MAN	5800
5	50	ST_CLERK	2500
6	50	ST_CLERK	2600
7	50	ST_CLERK	3100
8	50	ST_CLERK	3500
9	60	IT_PROG	4200
10	60	IT_PROG	6000
11	60	IT_PROG	9000
12	80	SA_REP	11000
13	80	SA_MAN	10500
14	80	SA_REP	8600

...

19	110	AC_MGR	12000
20	(null)	SA_REP	7000

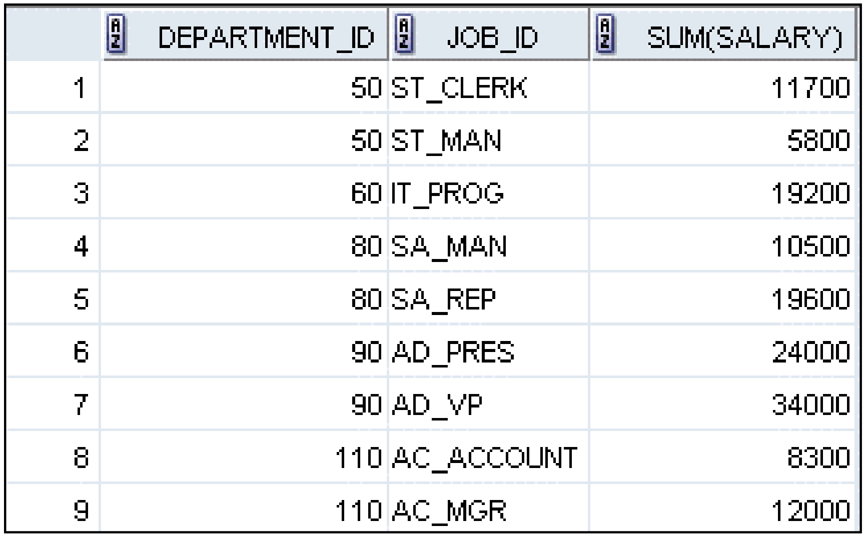
Add the salaries in the `EMPLOYEES` table for each job, grouped by department.



	DEPARTMENT_ID	JOB_ID	SUM(SALARY)
1	10	AD_ASST	4400
2	20	MK_MAN	13000
3	20	MK_REP	6000
4	50	ST_CLERK	11700
5	50	ST_MAN	5800
6	60	IT_PROG	19200
7	80	SA_MAN	10500
8	80	SA_REP	19600
9	90	AD_PRES	24000
10	90	AD_VP	34000
11	110	AC_ACCOUNT	8300
12	110	AC_MGR	12000
13	(null)	SA_REP	7000

Using the `GROUP BY` Clause on Multiple Columns

```
SELECT    department_id, job_id, SUM(salary)
FROM      employees
WHERE      department_id > 40
GROUP BY department_id, job_id
ORDER BY department_id;
```

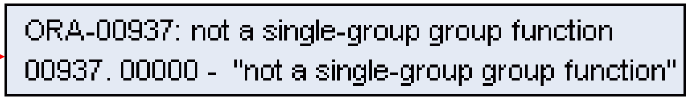


	DEPARTMENT_ID	JOB_ID	SUM(SALARY)
1	50	ST_CLERK	11700
2	50	ST_MAN	5800
3	60	IT_PROG	19200
4	80	SA_MAN	10500
5	80	SA_REP	19600
6	90	AD_PRES	24000
7	90	AD_VP	34000
8	110	AC_ACCOUNT	8300
9	110	AC_MGR	12000

Illegal Queries Using Group Functions

Any column or expression in the `SELECT` list that is not an aggregate function must be in the `GROUP BY` clause:

```
SELECT department_id, COUNT(last_name)
FROM   employees;
```



```
ORA-00937: not a single-group group function
00937. 00000 -  "not a single-group group function"
```

A `GROUP BY` clause must be added to count the last names for each `department_id`.

```
SELECT department_id, job_id, COUNT(last_name)
FROM   employees
GROUP BY department_id;
```

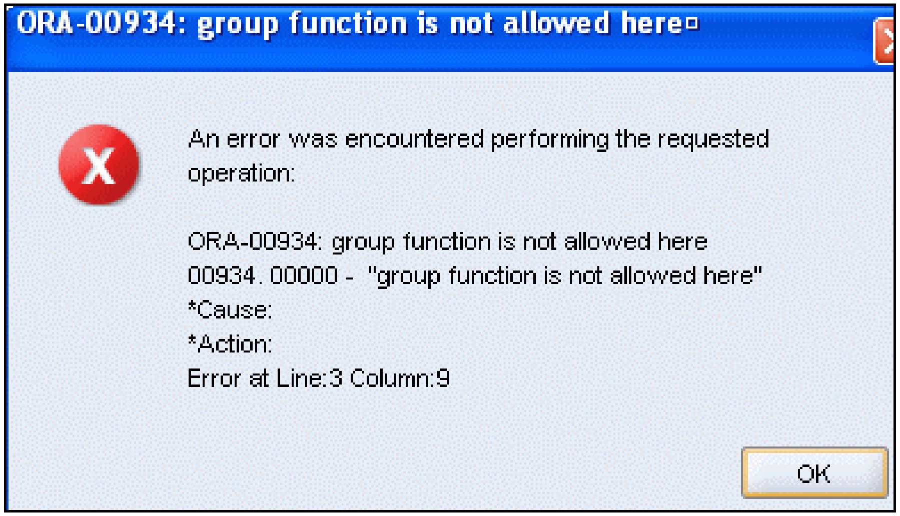
```
ORA-00979: not a GROUP BY expression
00979. 00000 -  "not a GROUP BY expression"
```

Either add `job_id` in the `GROUP BY` or remove the `job_id` column from the `SELECT` list.

Illegal Queries
Using Group Functions

- You cannot use the `WHERE` clause to restrict groups.
- You use the `HAVING` clause to restrict groups.
- You cannot use group functions in the `WHERE` clause.

```
SELECT    department_id, AVG(salary)
FROM      employees
WHERE     AVG(salary) > 8000
GROUP BY department_id;
```



ORA-00934: group function is not allowed here

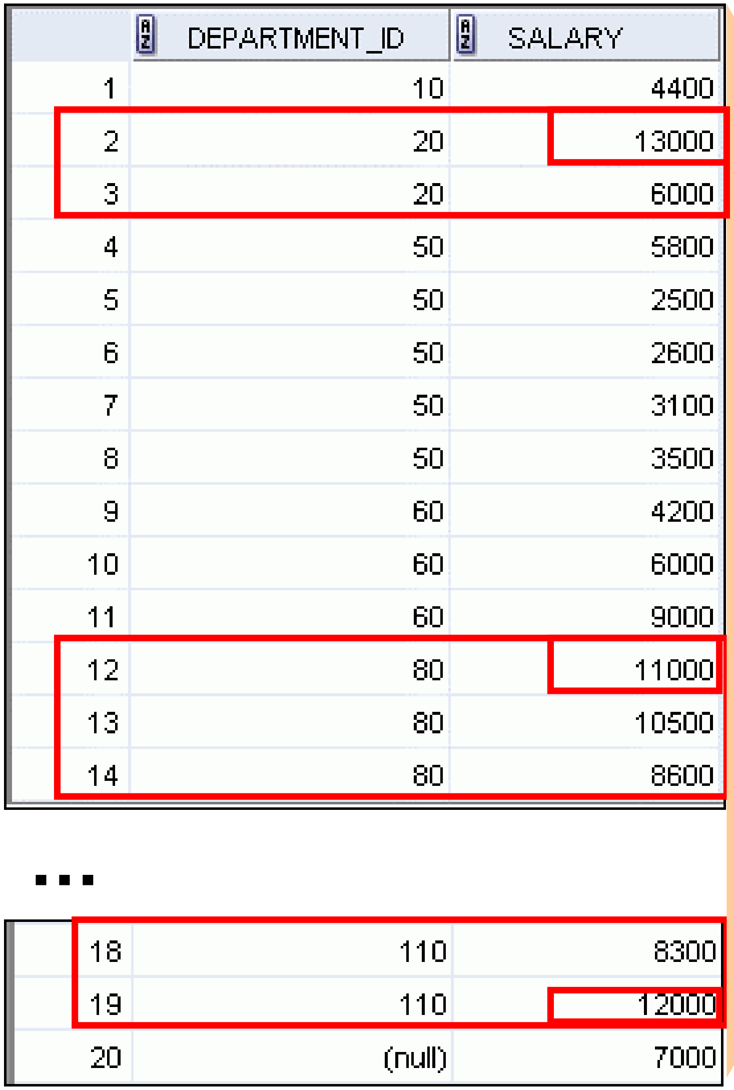
An error was encountered performing the requested operation:

ORA-00934: group function is not allowed here
00934. 00000 - "group function is not allowed here"
*Cause:
*Action:
Error at Line:3 Column:9

Cannot use the `WHERE` clause to restrict groups

Restricting Group Results

EMPLOYEES

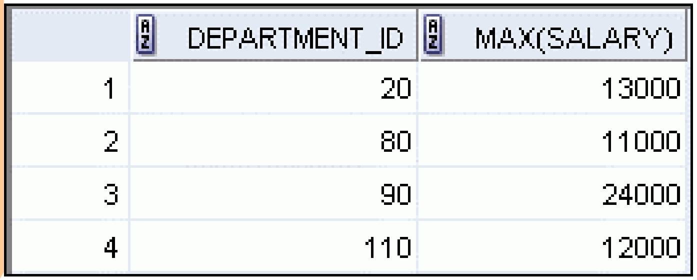


	DEPARTMENT_ID	SALARY
1	10	4400
2	20	13000
3	20	6000
4	50	5800
5	50	2500
6	50	2600
7	50	3100
8	50	3500
9	60	4200
10	60	6000
11	60	9000
12	80	11000
13	80	10500
14	80	8600

…

18	110	8300
19	110	12000
20	(null)	7000

The maximum salary per department when it is greater than $10,000



	DEPARTMENT_ID	MAX(SALARY)
1	20	13000
2	80	11000
3	90	24000
4	110	12000

Restricting Group Results with the `HAVING` Clause

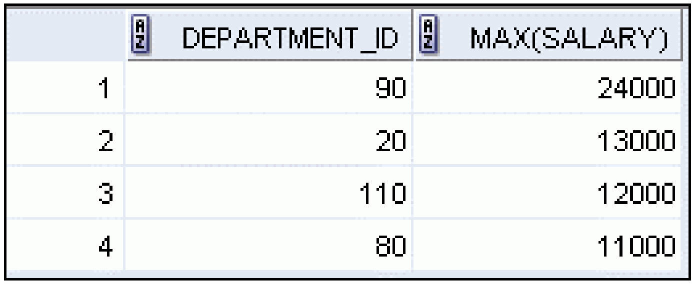
When you use the `HAVING` clause, the Oracle server restricts groups as follows:

1. Rows are grouped.
2. The group function is applied.
3. Groups matching the `HAVING` clause are displayed.

```
SELECT     column, group_function
FROM       table
[WHERE     condition]
[GROUP BY group_by_expression]
[HAVING    group_condition]
[ORDER BY column];
```

Using the `HAVING` Clause

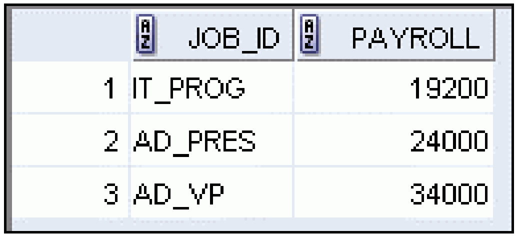
```
SELECT    department_id, MAX(salary)
FROM      employees
GROUP BY department_id
HAVING    MAX(salary)>10000 ;
```



	DEPARTMENT_ID	MAX(SALARY)
1	90	24000
2	20	13000
3	110	12000
4	80	11000

Using the `HAVING` Clause

```
SELECT    job_id, SUM(salary) PAYROLL
FROM      employees
WHERE     job_id NOT LIKE '%REP%'
GROUP BY job_id
HAVING    SUM(salary) > 13000
ORDER BY SUM(salary);
```



	JOB_ID	PAYROLL
1	IT_PROG	19200
2	AD_PRES	24000
3	AD_VP	34000

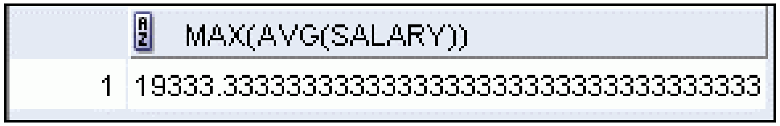
Lesson Agenda

- Group functions:
  - Types and syntax
  - Use `AVG`, `SUM`, `MIN`, `MAX`, `COUNT`
  - Use `DISTINCT` keyword within group functions
  - `NULL` values in a group function
- Grouping rows:
  - `GROUP BY` clause
  - `HAVING` clause
- Nesting group functions

Nesting Group Functions

Display the maximum average salary:

```
SELECT   MAX(AVG(salary))
FROM     employees
GROUP BY department_id;
```



	MAX(AVG(SALARY))
1	19333.3333333333333333333333333333333333

Quiz

Identify the guidelines for group functions and the `GROUP BY` clause.

1. You cannot use a column alias in the `GROUP BY` clause.
2. The `GROUP BY` column must be in the `SELECT` clause.
3. By using a `WHERE` clause, you can exclude rows before dividing them into groups.
4. The `GROUP BY` clause groups rows and ensures order of the result set.
5. If you include a group function in a `SELECT` clause, you cannot select individual results as well.

Summary

In this lesson, you should have learned how to:

- Use the group functions `COUNT`, `MAX`, `MIN`, `SUM`, and `AVG`
- Write queries that use the `GROUP BY` clause
- Write queries that use the `HAVING` clause

```
SELECT     column, group_function
FROM       table
[WHERE     condition]
[GROUP BY  group_by_expression]
[HAVING    group_condition]
[ORDER BY  column];
```

Practice 5: Overview

This practice covers the following topics:

- Writing queries that use the group functions
- Grouping by rows to achieve more than one result
- Restricting groups by using the `HAVING` clause

6

Displaying Data from Multiple Tables

Objectives

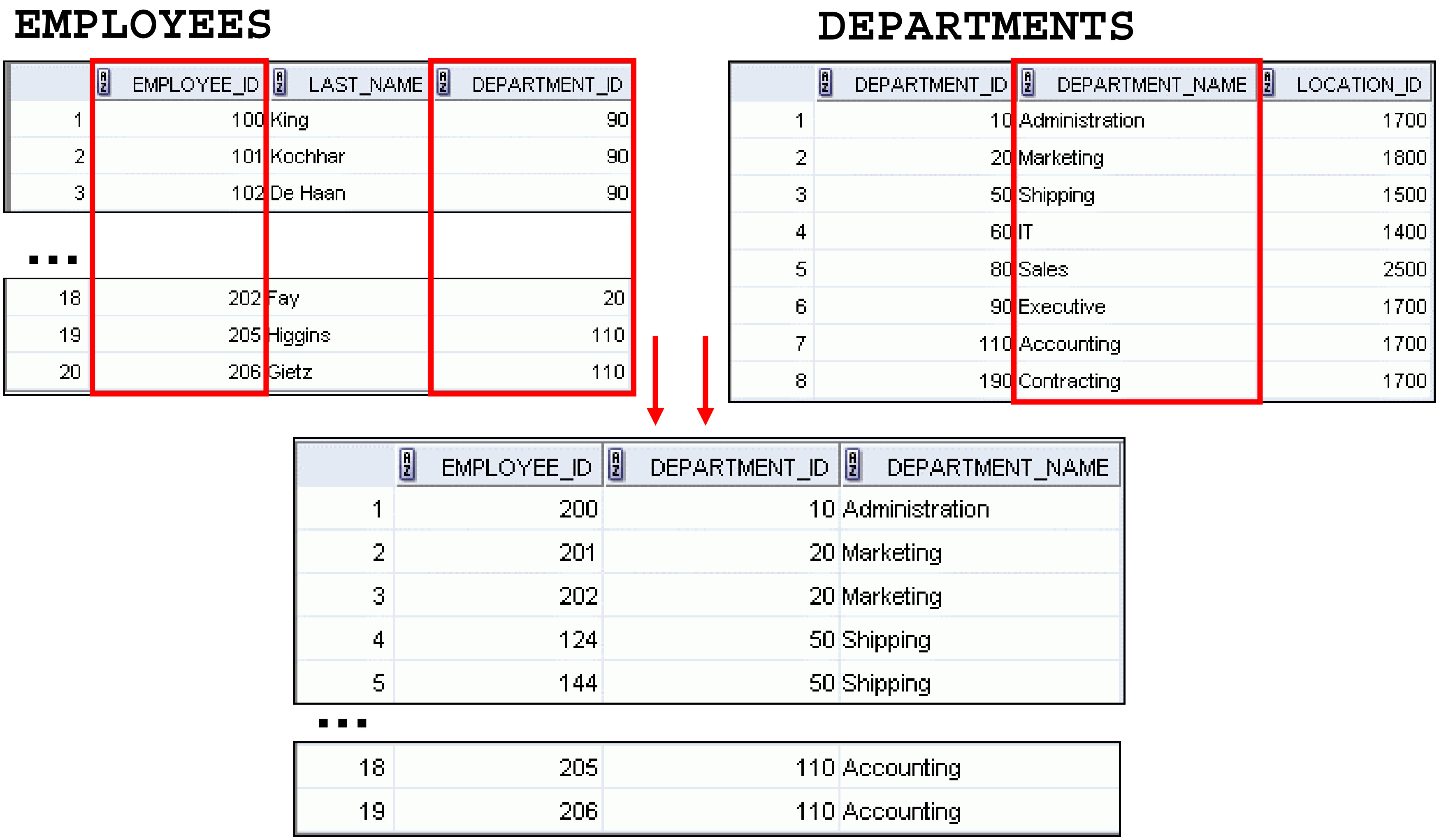
After completing this lesson, you should be able to do the following:

- Write `SELECT` statements to access data from more than one table using equijoins and nonequijoins
- Join a table to itself by using a self-join
- View data that generally does not meet a join condition by using `OUTER` joins
- Generate a Cartesian product of all rows from two or more tables

Lesson Agenda

- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequijoins
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Obtaining Data from Multiple Tables



EMPLOYEES

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90

…

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
18	202	Fay	20
19	205	Higgins	110
20	206	Gietz	110

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

	EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
1	200	10	Administration
2	201	20	Marketing
3	202	20	Marketing
4	124	50	Shipping
5	144	50	Shipping

…

	EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
18	205	110	Accounting
19	206	110	Accounting

Types of Joins

Joins that are compliant with the SQL:1999 standard include the following:

- Natural joins:
  - `NATURAL JOIN` clause
  - `USING` clause
  - `ON` clause
- `OUTER` joins:
  - `LEFT OUTER JOIN`
  - `RIGHT OUTER JOIN`
  - `FULL OUTER JOIN`
- Cross joins

Joining Tables Using SQL:1999 Syntax

Use a join to query data from more than one table:

```
SELECT   table1.column, table2.column
FROM     table1
[NATURAL JOIN table2] |
[JOIN table2 USING (column_name)] |
[JOIN table2
  ON (table1.column_name = table2.column_name)]|
[LEFT|RIGHT|FULL OUTER JOIN table2
  ON (table1.column_name = table2.column_name)]|
[CROSS JOIN table2];
```

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Use table prefixes to improve performance.
- Instead of full table name prefixes, use table aliases.
- Table alias gives a table a shorter name:
  - Keeps SQL code smaller, uses less memory
- Use column aliases to distinguish columns that have identical names, but reside in different tables.

Lesson Agenda

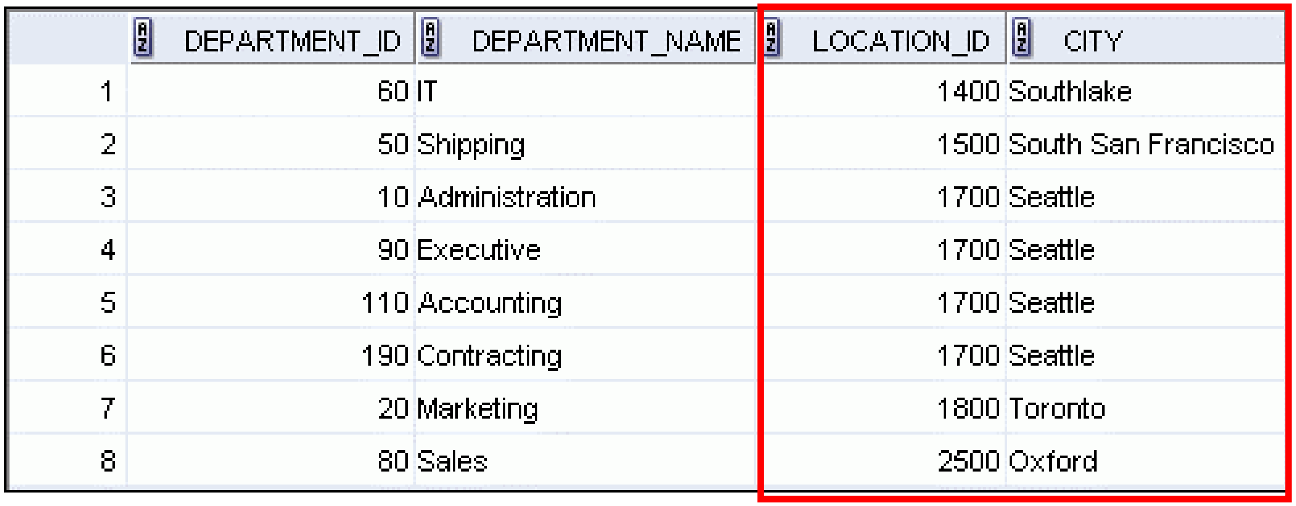
- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequijoins
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Creating Natural Joins

- The `NATURAL JOIN` clause is based on all columns in the two tables that have the same name.
- It selects rows from the two tables that have equal values in all matched columns.
- If the columns having the same names have different data types, an error is returned.

Retrieving Records with Natural Joins

```
SELECT department_id, department_name,
       location_id, city
FROM   departments
NATURAL JOIN locations ;
```

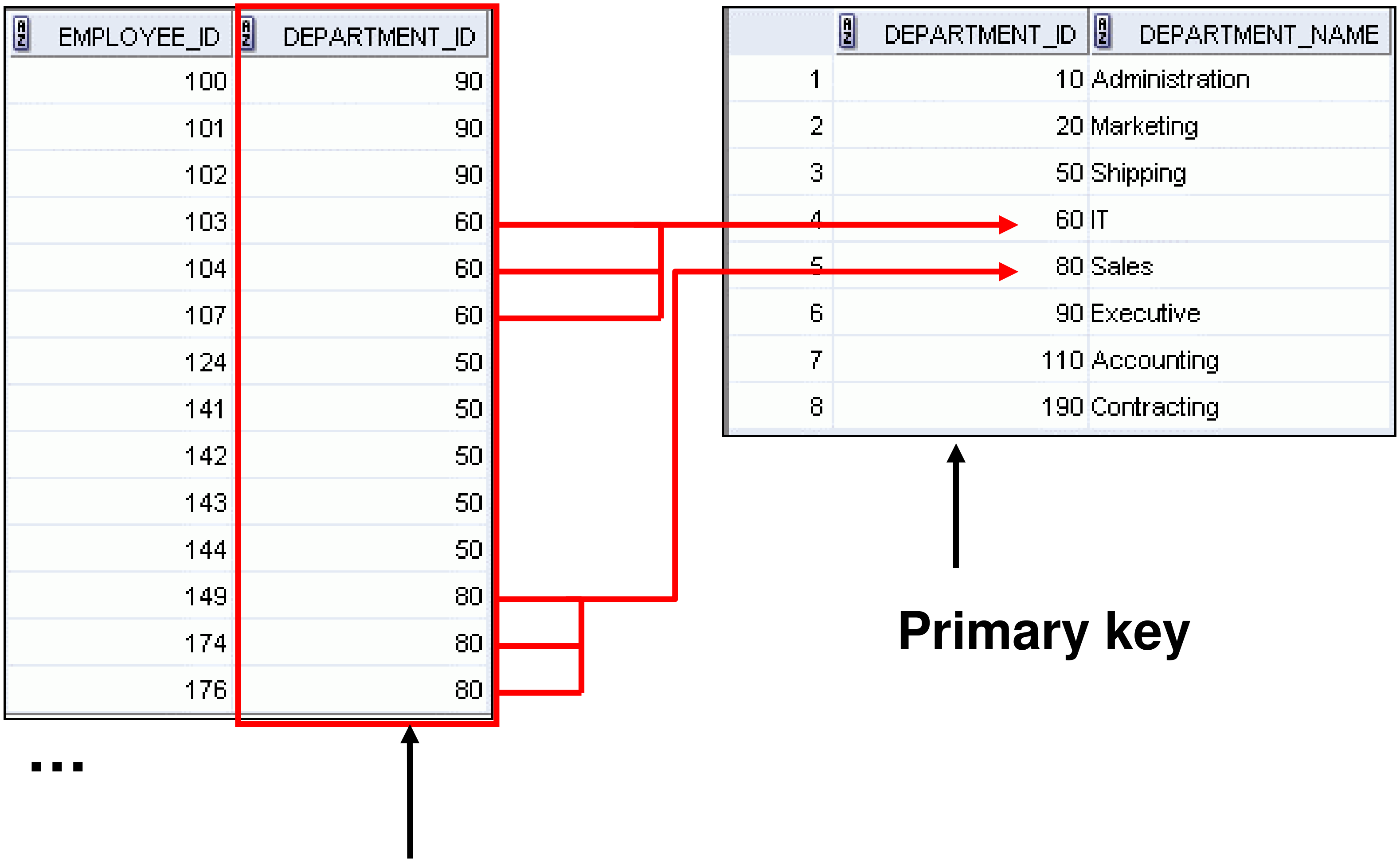


	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
1	60	IT	1400	Southlake
2	50	Shipping	1500	South San Francisco
3	10	Administration	1700	Seattle
4	90	Executive	1700	Seattle
5	110	Accounting	1700	Seattle
6	190	Contracting	1700	Seattle
7	20	Marketing	1800	Toronto
8	80	Sales	2500	Oxford

Creating Joins with the `USING` Clause

- If several columns have the same names but the data types do not match, use the `USING` clause to specify the columns for the equijoin.
- Use the `USING` clause to match only one column when more than one column matches.
- The `NATURAL JOIN` and `USING` clauses are mutually exclusive.

Joining Column Names



EMPLOYEES

EMPLOYEE_ID	DEPARTMENT_ID
100	90
101	90
102	90
103	60
104	60
107	60
124	50
141	50
142	50
143	50
144	50
149	80
174	80
176	80

…

DEPARTMENTS

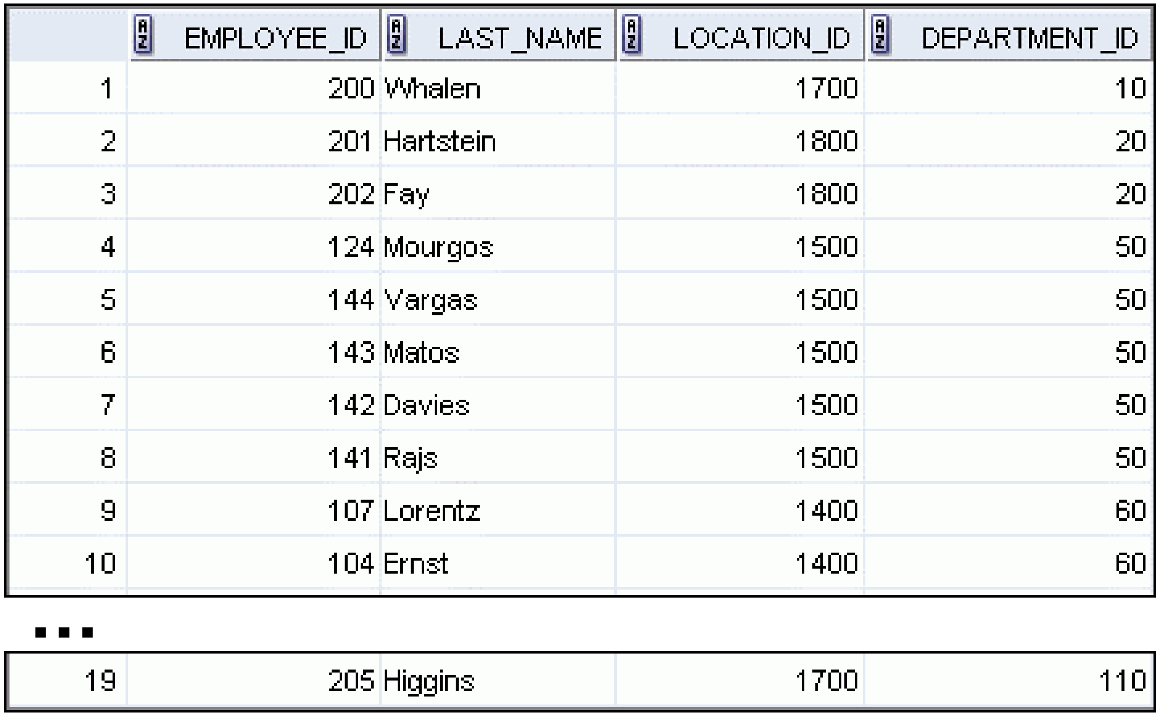
	DEPARTMENT_ID	DEPARTMENT_NAME
1	10	Administration
2	20	Marketing
3	50	Shipping
4	60	IT
5	80	Sales
6	90	Executive
7	110	Accounting
8	190	Contracting

Primary key

Foreign key

Retrieving Records with the `USING` Clause

```
SELECT employee_id, last_name,
       location_id, department_id
FROM   employees JOIN departments
USING (department_id) ;
```

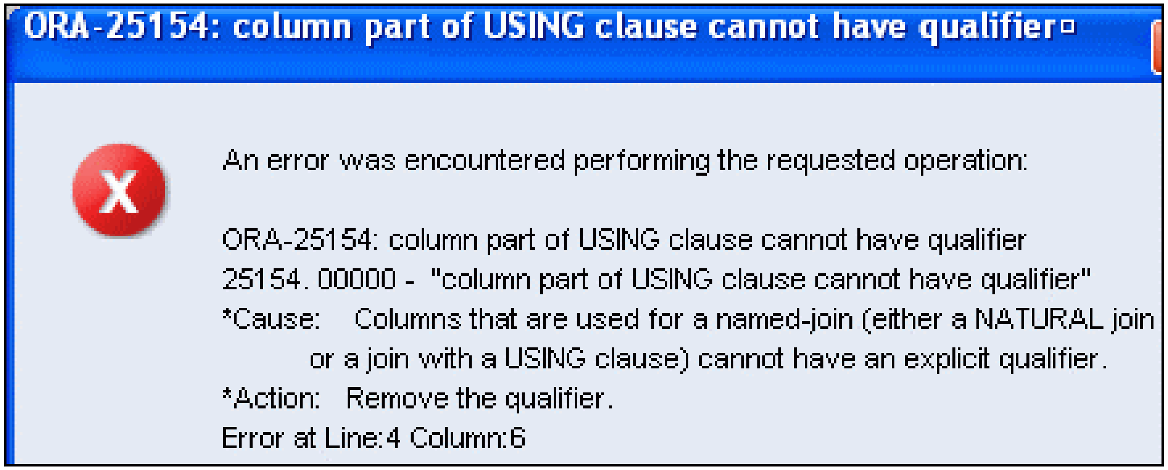


	EMPLOYEE_ID	LAST_NAME	LOCATION_ID	DEPARTMENT_ID
1	200	Whalen	1700	10
2	201	Hartstein	1800	20
3	202	Fay	1800	20
4	124	Mourgos	1500	50
5	144	Vargas	1500	50
6	143	Matos	1500	50
7	142	Davies	1500	50
8	141	Rajs	1500	50
9	107	Lorentz	1400	60
10	104	Ernst	1400	60
...				
19	205	Higgins	1700	110

Using Table Aliases with the `USING` Clause

- Do not qualify a column that is used in the `USING` clause.
- If the same column is used elsewhere in the SQL statement, do not alias it.

```
SELECT l.city, d.department_name
FROM   locations l JOIN departments d
USING (location_id)
WHERE d.location_id = 1400;
```



ORA-25154: column part of USING clause cannot have qualifier

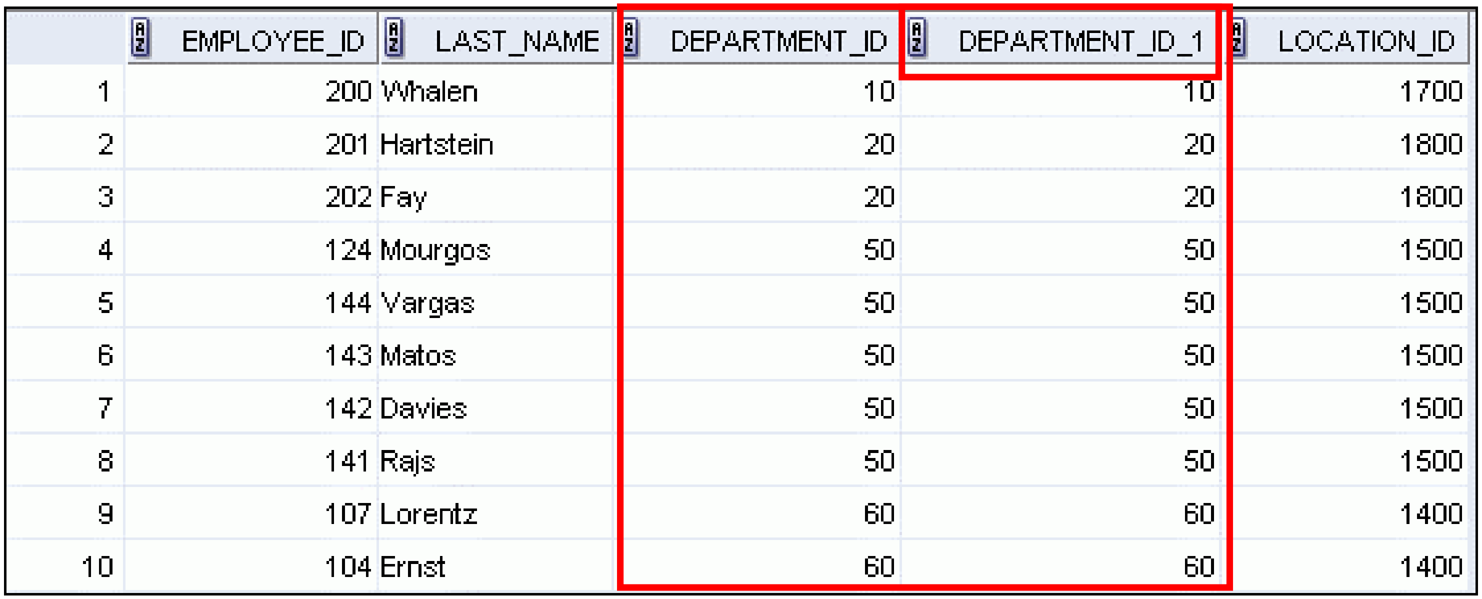
```
An error was encountered performing the requested operation:

ORA-25154: column part of USING clause cannot have qualifier
25154. 00000 -  "column part of USING clause cannot have qualifier"
*Cause:    Columns that are used for a named-join (either a NATURAL join
           or a join with a USING clause) cannot have an explicit qualifier.
*Action:   Remove the qualifier.
Error at Line:4 Column:6
```

Creating Joins with the `ON` Clause

- The join condition for the natural join is basically an equijoin of all columns with the same name.
- Use the `ON` clause to specify arbitrary conditions or specify columns to join.
- The join condition is separated from other search conditions.
- The `ON` clause makes code easy to understand.

Retrieving Records with the `ON` Clause

```
SELECT e.employee_id, e.last_name, e.department_id,
       d.department_id, d.location_id
FROM   employees e JOIN departments d
ON     (e.department_id = d.department_id);
```

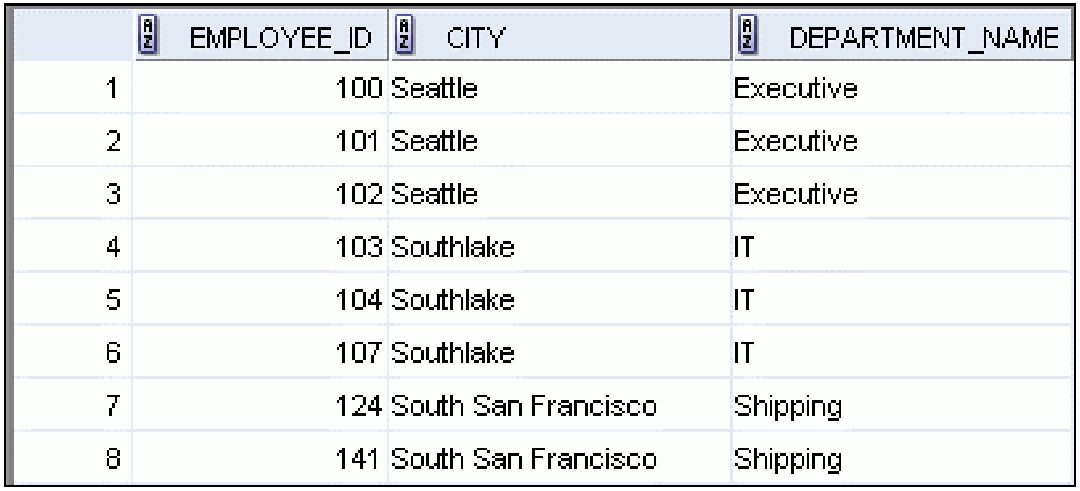


	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID_1	LOCATION_ID
1	200	Whalen	10	10	1700
2	201	Hartstein	20	20	1800
3	202	Fay	20	20	1800
4	124	Mourgos	50	50	1500
5	144	Vargas	50	50	1500
6	143	Matos	50	50	1500
7	142	Davies	50	50	1500
8	141	Rajs	50	50	1500
9	107	Lorentz	60	60	1400
10	104	Ernst	60	60	1400

…

Creating Three-Way Joins with the ON Clause

```
SELECT employee_id, city, department_name
FROM   employees e
JOIN   departments d
ON     d.department_id = e.department_id
JOIN   locations l
ON     d.location_id = l.location_id;
```



	EMPLOYEE_ID	CITY	DEPARTMENT_NAME
1	100	Seattle	Executive
2	101	Seattle	Executive
3	102	Seattle	Executive
4	103	Southlake	IT
5	104	Southlake	IT
6	107	Southlake	IT
7	124	South San Francisco	Shipping
8	141	South San Francisco	Shipping

…

Applying Additional Conditions to a Join

Use the `AND` clause or the `WHERE` clause to apply additional conditions:

```
SELECT e.employee_id, e.last_name, e.department_id,
       d.department_id, d.location_id
FROM   employees e JOIN departments d
ON     (e.department_id = d.department_id)
AND    e.manager id = 149 ;
```

Or

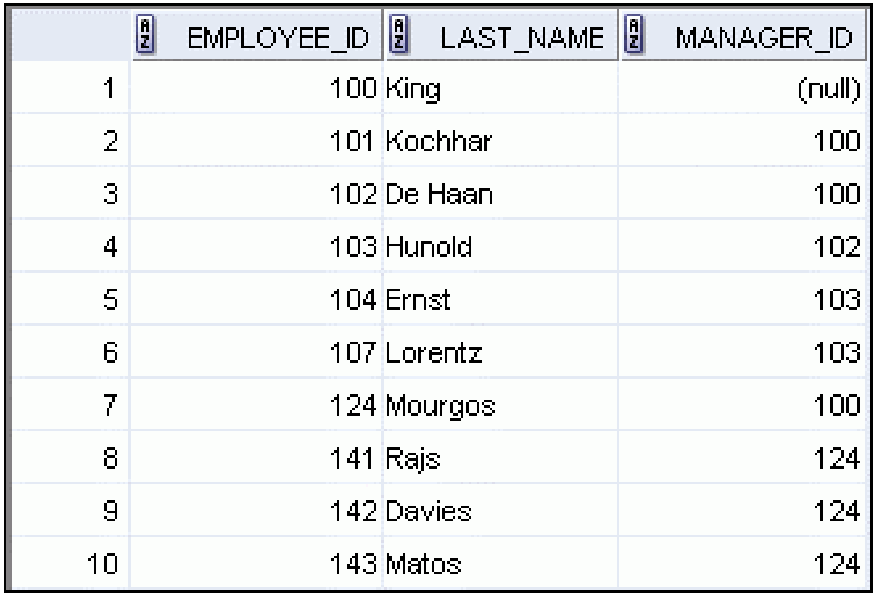
```
SELECT e.employee_id, e.last_name, e.department_id,
       d.department_id, d.location_id
FROM   employees e JOIN departments d
ON     (e.department_id = d.department_id)
WHERE   e.manager_id = 149 ;
```

Lesson Agenda

- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequijoins
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Joining a Table to Itself

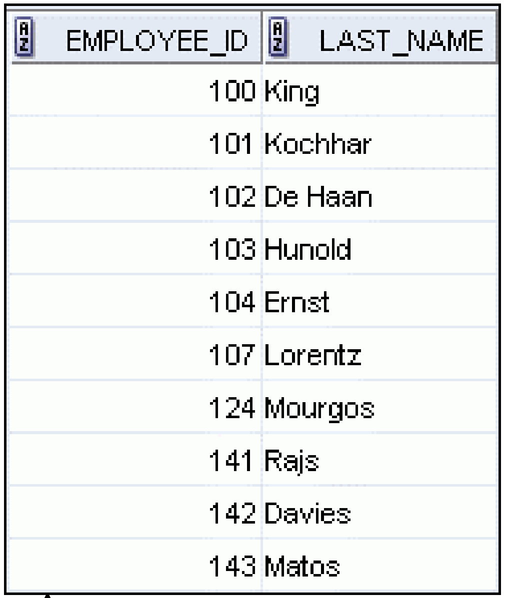
`EMPLOYEES (WORKER)`



	EMPLOYEE_ID	LAST_NAME	MANAGER_ID
1	100	King	(null)
2	101	Kochhar	100
3	102	De Haan	100
4	103	Hunold	102
5	104	Ernst	103
6	107	Lorentz	103
7	124	Mourgos	100
8	141	Rajs	124
9	142	Davies	124
10	143	Matos	124

…

`EMPLOYEES (MANAGER)`



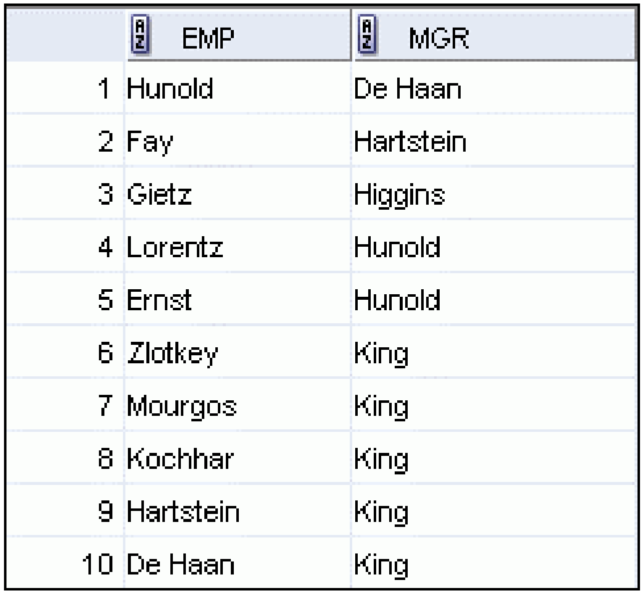
EMPLOYEE_ID	LAST_NAME
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst
107	Lorentz
124	Mourgos
141	Rajs
142	Davies
143	Matos

…

`MANAGER_ID` in the `WORKER` table is equal to `EMPLOYEE_ID` in the `MANAGER` table.

Self-Joins Using the `ON` Clause

```
SELECT worker.last_name emp, manager.last_name mgr
FROM   employees worker JOIN employees manager
ON    (worker.manager_id = manager.employee_id);
```



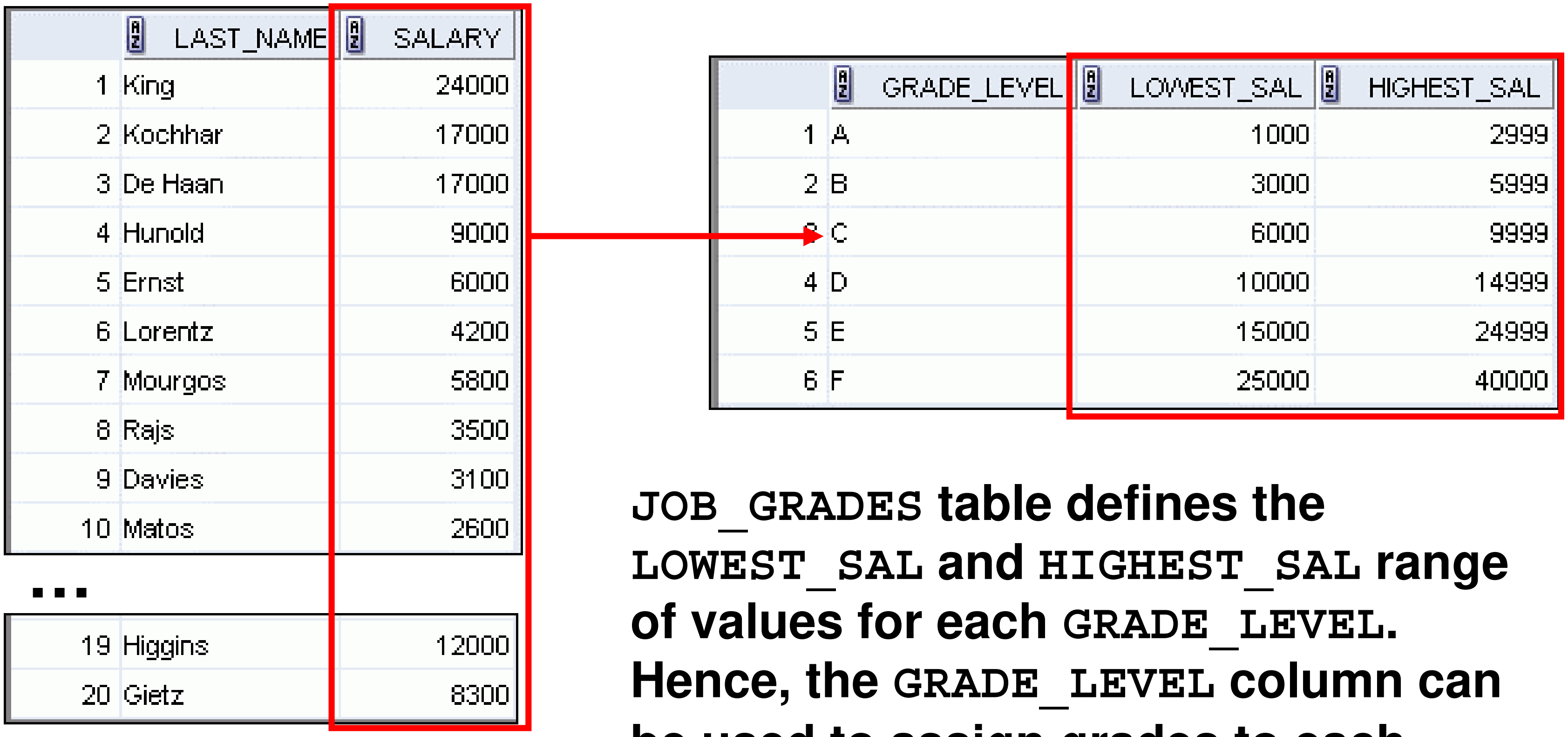
	EMP	MGR
1	Hunold	De Haan
2	Fay	Hartstein
3	Gietz	Higgins
4	Lorentz	Hunold
5	Ernst	Hunold
6	Zlotkey	King
7	Mourgos	King
8	Kochhar	King
9	Hartstein	King
10	De Haan	King

…

Lesson Agenda

- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequijoins
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Nonequijoins



EMPLOYEES

	LAST_NAME	SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Hunold	9000
5	Ernst	6000
6	Lorentz	4200
7	Mourgos	5800
8	Rajs	3500
9	Davies	3100
10	Matos	2600

…

19	Higgins	12000
20	Gietz	8300

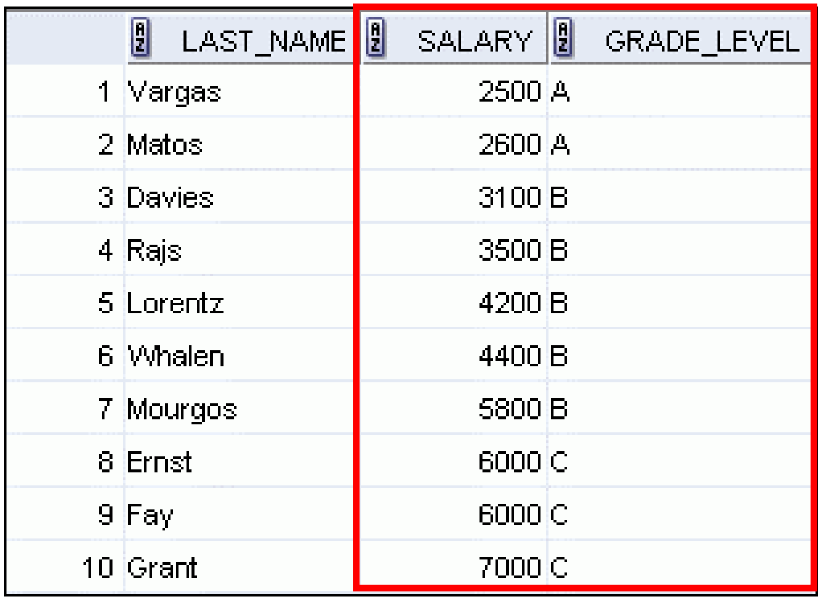
JOB_GRADES

	GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
1	A	1000	2999
2	B	3000	5999
3	C	6000	9999
4	D	10000	14999
5	E	15000	24999
6	F	25000	40000

`JOB_GRADES` table defines the `LOWEST_SAL` and `HIGHEST_SAL` range of values for each `GRADE_LEVEL`. Hence, the `GRADE_LEVEL` column can be used to assign grades to each employee.

Retrieving Records with Nonequijoins

```
SELECT e.last_name, e.salary, j.grade_level
FROM   employees e JOIN job_grades j
ON     e.salary
       BETWEEN j.lowest_sal AND j.highest_sal;
```



	LAST_NAME	SALARY	GRADE_LEVEL
1	Vargas	2500	A
2	Matos	2600	A
3	Davies	3100	B
4	Rajs	3500	B
5	Lorentz	4200	B
6	Whalen	4400	B
7	Mourgos	5800	B
8	Ernst	6000	C
9	Fay	6000	C
10	Grant	7000	C

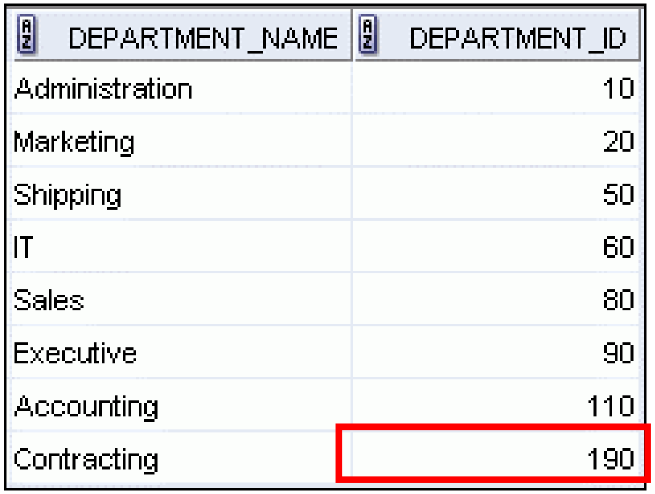
…

Lesson Agenda

- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequijoins
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Returning Records with No Direct Match Using `OUTER` Joins

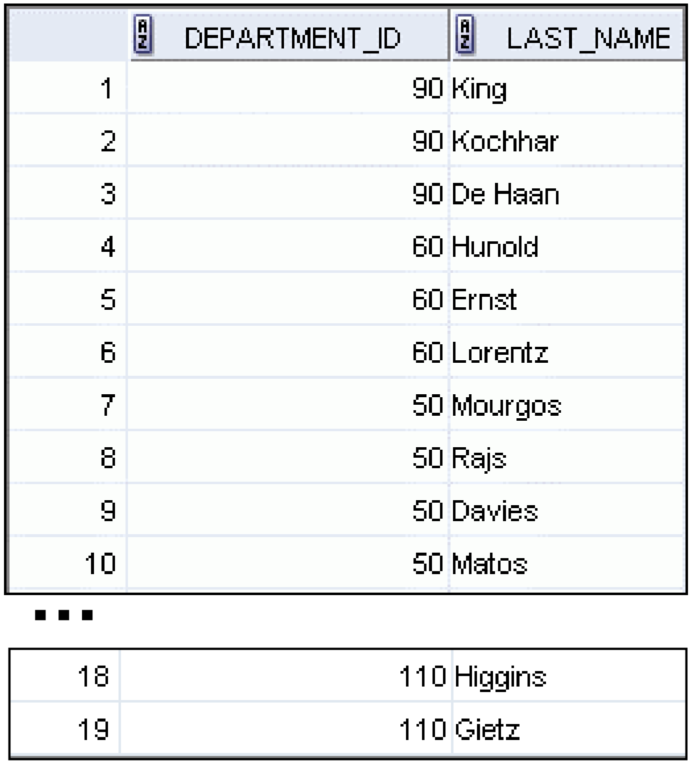
`DEPARTMENTS`



DEPARTMENT_NAME	DEPARTMENT_ID
Administration	10
Marketing	20
Shipping	50
IT	60
Sales	80
Executive	90
Accounting	110
Contracting	190

There are no employees in department 190.

Equijoin with `EMPLOYEES`



	DEPARTMENT_ID	LAST_NAME
1	90	King
2	90	Kochhar
3	90	De Haan
4	60	Hunold
5	60	Ernst
6	60	Lorentz
7	50	Mourgos
8	50	Rajs
9	50	Davies
10	50	Matos

…

18	110	Higgins
19	110	Gietz

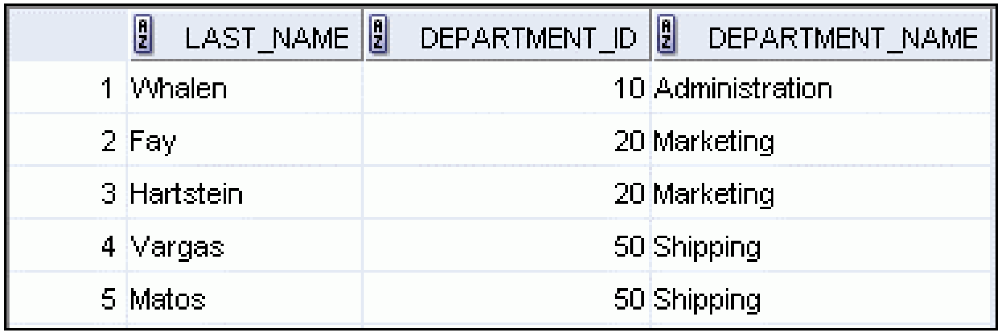
Employee "Grant" has not been assigned a department ID.

`INNER` Versus `OUTER` Joins

- In SQL:1999, the join of two tables returning only matched rows is called an `INNER` join.
- A join between two tables that returns the results of the `INNER` join as well as the unmatched rows from the left (or right) table is called a left (or right) `OUTER` join.
- A join between two tables that returns the results of an `INNER` join as well as the results of a left and right join is a full `OUTER` join.

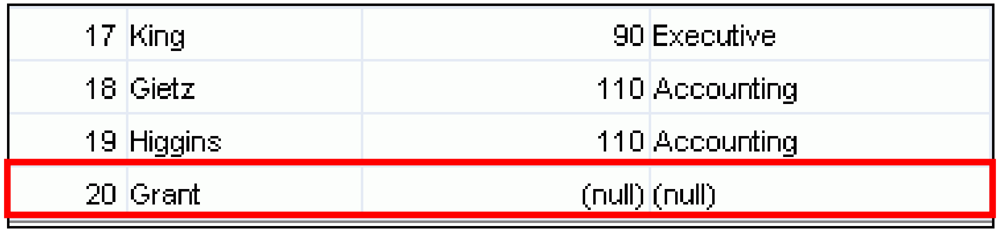
LEFT OUTER JOIN

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e LEFT OUTER JOIN departments d
ON   (e.department_id = d.department_id) ;
```



	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Fay	20	Marketing
3	Hartstein	20	Marketing
4	Vargas	50	Shipping
5	Matos	50	Shipping

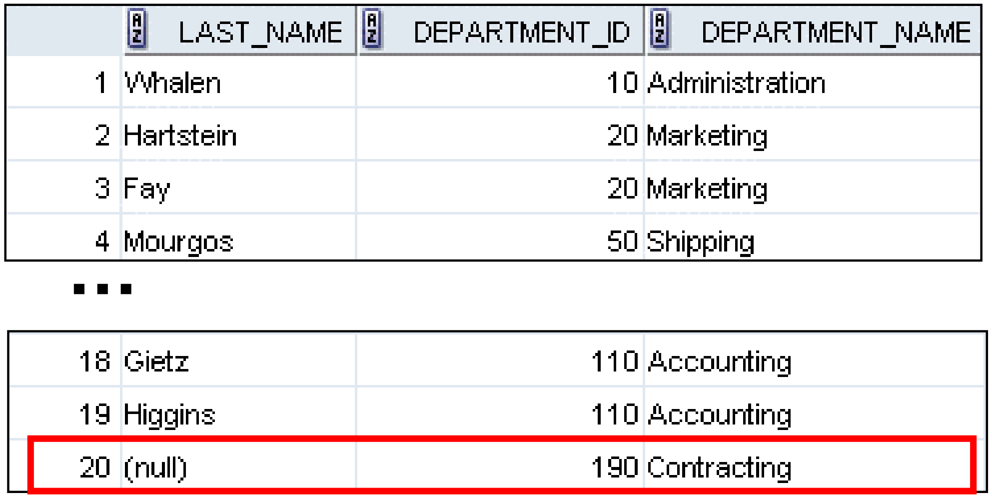
…



17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

RIGHT OUTER JOIN

```
SELECT e.last_name, d.department_id, d.department_name
FROM   employees e RIGHT OUTER JOIN departments d
ON    (e.department_id = d.department_id) ;
```



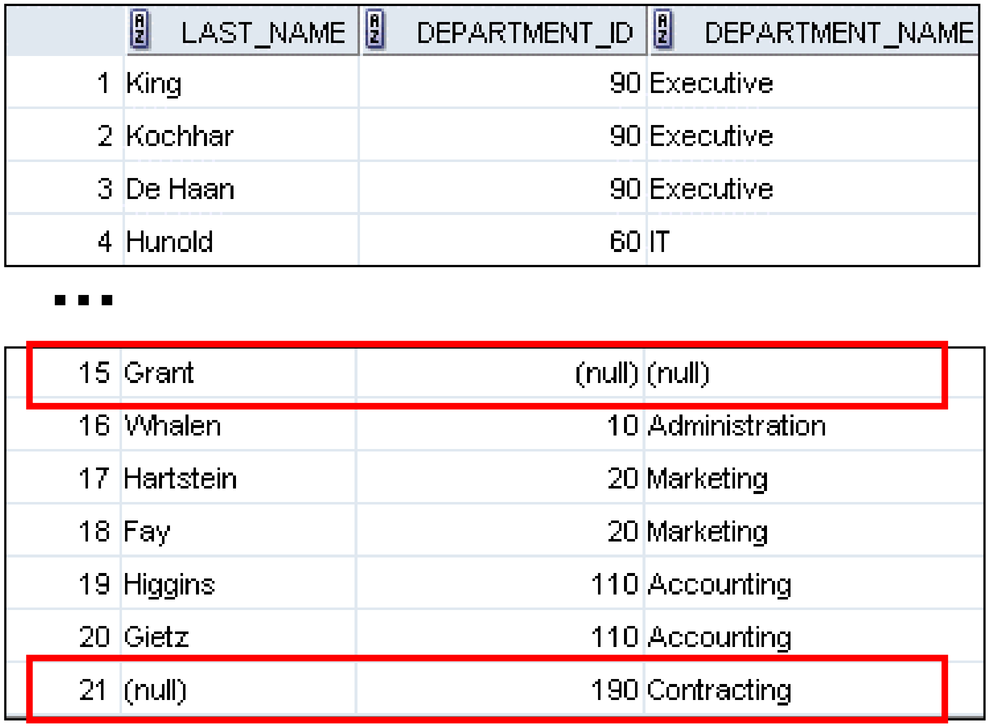
	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Mourgos	50	Shipping

▪▪▪

18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	(null)	190	Contracting

FULL OUTER JOIN

```
SELECT e.last_name, d.department_id, d.department_name
FROM   employees e FULL OUTER JOIN departments d
ON   (e.department_id = d.department_id) ;
```



	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	King	90	Executive
2	Kochhar	90	Executive
3	De Haan	90	Executive
4	Hunold	60	IT

...

15	Grant	(null)	(null)
16	Whalen	10	Administration
17	Hartstein	20	Marketing
18	Fay	20	Marketing
19	Higgins	110	Accounting
20	Gietz	110	Accounting
21	(null)	190	Contracting

Lesson Agenda

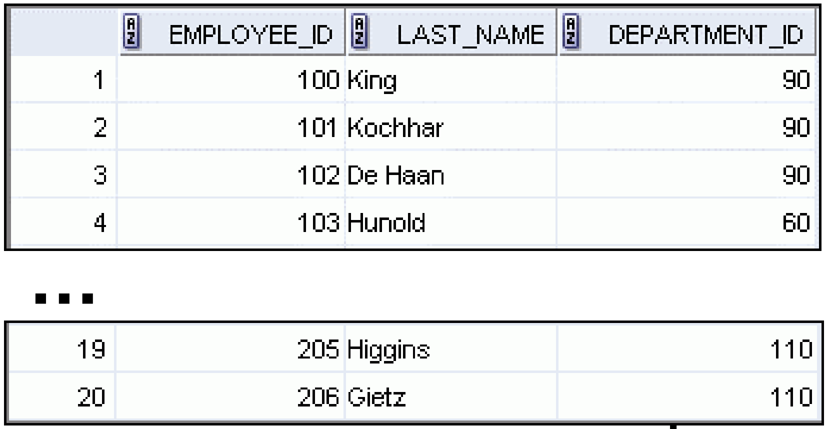
- Types of `JOINS` and its syntax
- Natural join:
  - `USING` clause
  - `ON` clause
- Self-join
- Nonequiijoin
- `OUTER` join:
  - `LEFT OUTER` join
  - `RIGHT OUTER` join
  - `FULL OUTER` join
- Cartesian product
  - Cross join

Cartesian Products

- A Cartesian product is formed when:
  - A join condition is omitted
  - A join condition is invalid
  - All rows in the first table are joined to all rows in the second table
- To avoid a Cartesian product, always include a valid join condition.

Generating a Cartesian Product

`EMPLOYEES` (20 rows)

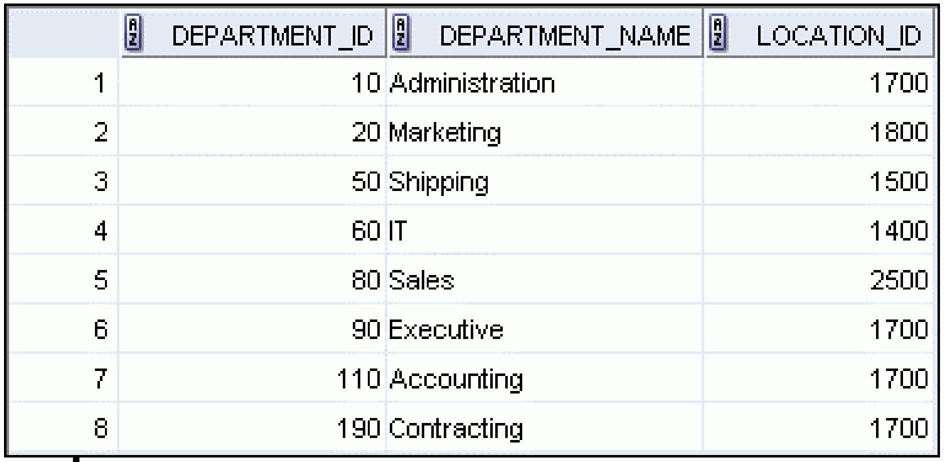


	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60

…

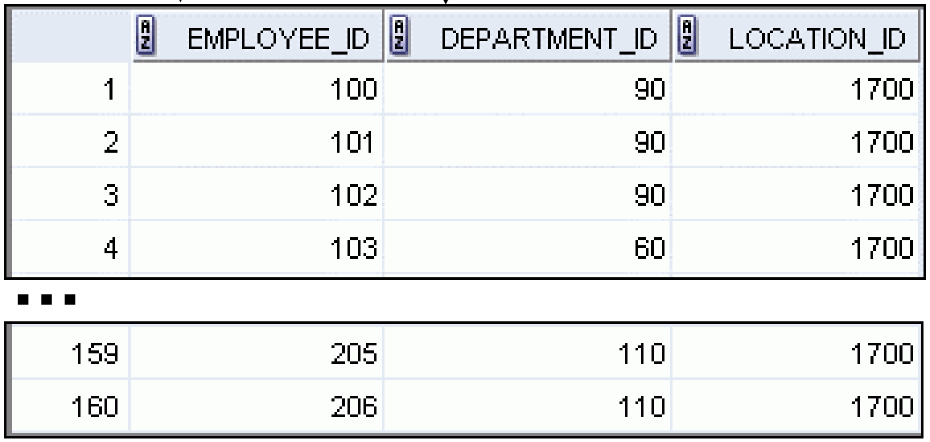
19	205	Higgins	110
20	206	Gietz	110

`DEPARTMENTS` (8 rows)



	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

Cartesian product:
20 x 8 = 160 rows



	EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
1	100	90	1700
2	101	90	1700
3	102	90	1700
4	103	60	1700

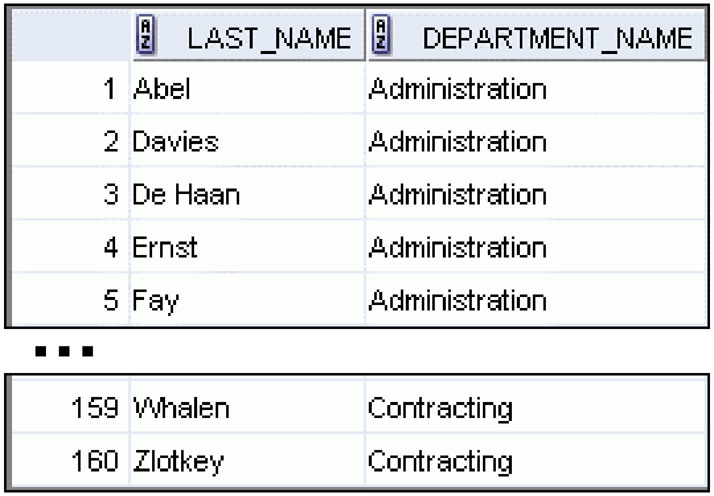
…

159	205	110	1700
160	206	110	1700

Creating Cross Joins

- The `CROSS JOIN` clause produces the cross-product of two tables.
- This is also called a Cartesian product between the two tables.

```
SELECT last_name, department_name
FROM   employees
CROSS JOIN departments ;
```



	LAST_NAME	DEPARTMENT_NAME
1	Abel	Administration
2	Davies	Administration
3	De Haan	Administration
4	Ernst	Administration
5	Fay	Administration
...		
159	Whalen	Contracting
160	Zlotkey	Contracting

Quiz

The SQL:1999 standard join syntax supports the following types of joins. Which of these join types does Oracle join syntax support?

1. Equijoins
2. Nonequijoins
3. Left `OUTER` join
4. Right `OUTER` join
5. Full `OUTER` join
6. Self joins
7. Natural joins
8. Cartesian products

Summary

In this lesson, you should have learned how to use joins to display data from multiple tables by using:

- Equijoins
- Nonequijoins
- `OUTER` joins
- Self-joins
- Cross joins
- Natural joins
- Full (or two-sided) `OUTER` joins

Practice 6: Overview

This practice covers the following topics:

- Joining tables using an equijoin
- Performing outer and self-joins
- Adding conditions

7

Using Subqueries to Solve Queries

Objectives

After completing this lesson, you should be able to do the following:

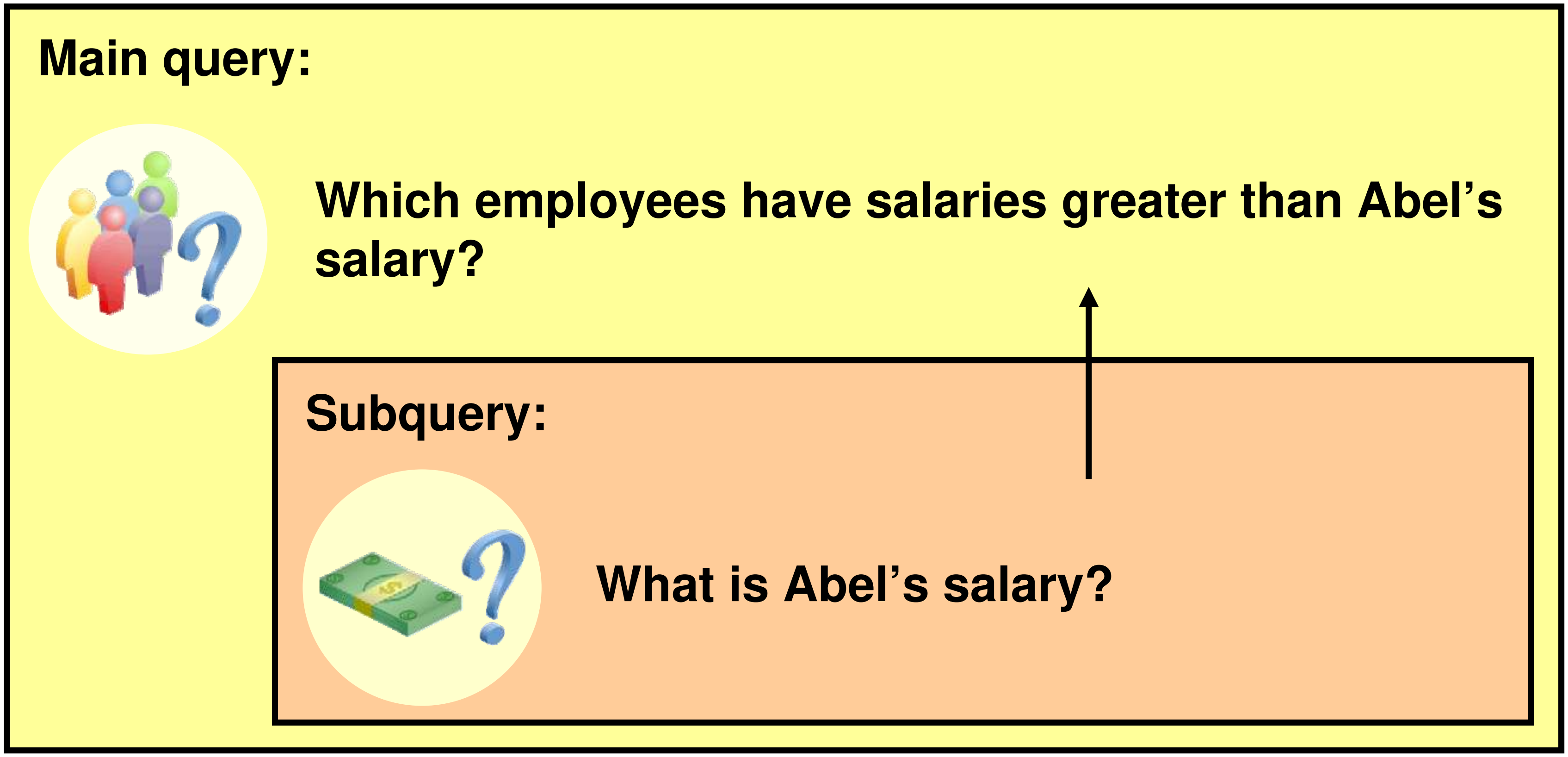
- Define subqueries
- Describe the types of problems that the subqueries can solve
- List the types of subqueries
- Write single-row and multiple-row subqueries

Lesson Agenda

- Subquery: Types, syntax, and guidelines
- Single-row subqueries:
  - Group functions in a subquery
  - `HAVING` clause with subqueries
- Multiple-row subqueries
  - Use `ALL` or `ANY` operator.
- Null values in a subquery

Using a Subquery to Solve a Problem

Who has a salary greater than Abel's?



Main query:

Which employees have salaries greater than Abel's salary?

Subquery:

What is Abel's salary?

Subquery Syntax

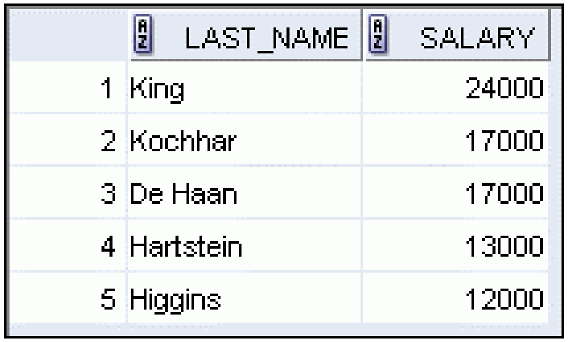
```
SELECT   select_list
FROM     table
WHERE    expr operator
                     (SELECT      select_list
                      FROM        table);
```

- The subquery (inner query) executes *before* the main query (outer query).
- The result of the subquery is used by the main query.

Using a Subquery

```
SELECT last_name, salary
FROM   employees
WHERE  salary >
                 (SELECT salary
                  FROM   employees
                  WHERE  last_name = 'Abel');
```

11000



	LAST_NAME	SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Hartstein	13000
5	Higgins	12000

Guidelines for Using Subqueries

- Enclose subqueries in parentheses.
- Place subqueries on the right side of the comparison condition for readability (However, the subquery can appear on either side of the comparison operator.).
- Use single-row operators with single-row subqueries and multiple-row operators with multiple-row subqueries.

Types of Subqueries

- Single-row subquery

`ST_CLERK`

- Multiple-row subquery

`ST_CLERK`
`SA_MAN`

Lesson Agenda

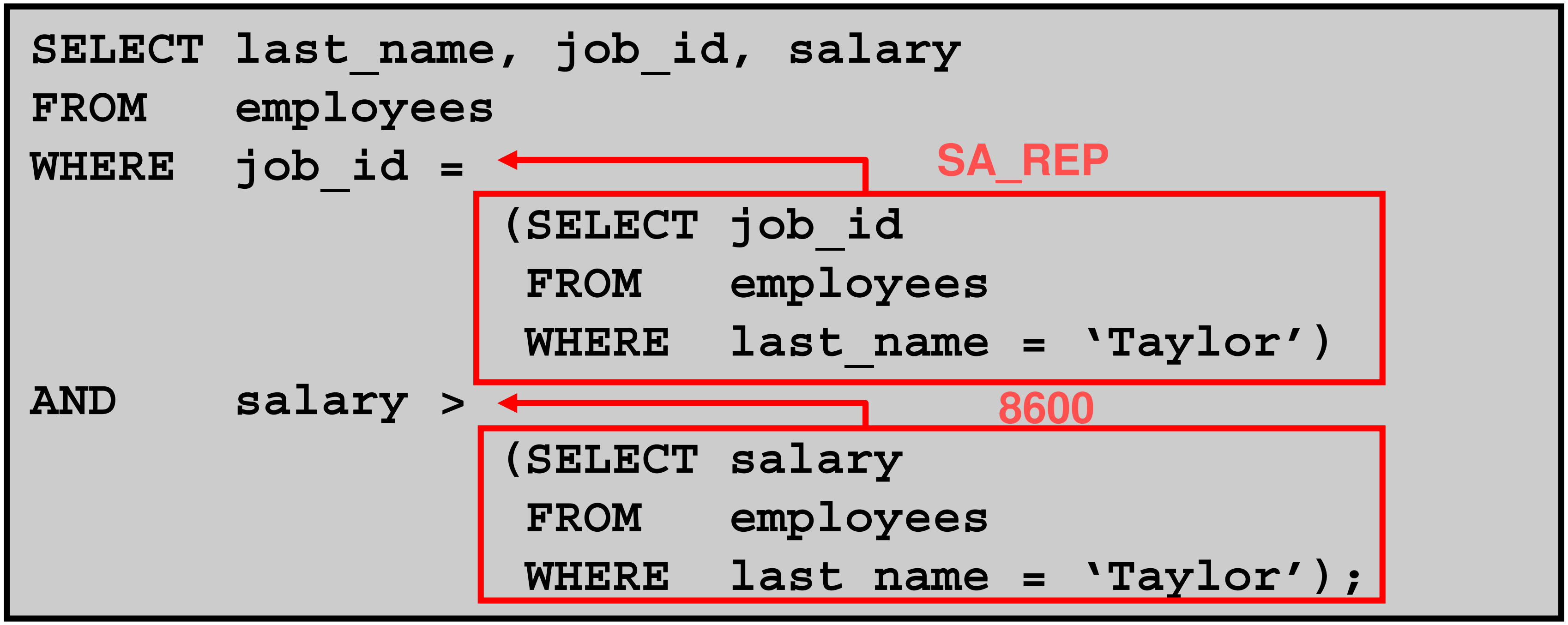
- Subquery: Types, syntax, and guidelines
- Single-row subqueries:
  - Group functions in a subquery
  - `HAVING` clause with subqueries
- Multiple-row subqueries
  - Use `ALL` or `ANY` operator
- Null values in a subquery

Single-Row Subqueries

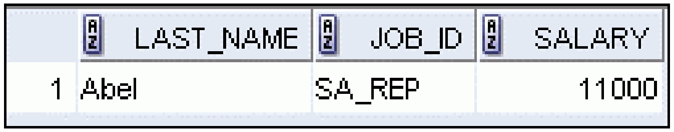
- Return only one row
- Use single-row comparison operators

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

Executing Single-Row Subqueries



```
SELECT last_name, job_id, salary
FROM   employees
WHERE  job_id =
                (SELECT job_id
                 FROM   employees
                 WHERE  last_name = ‘Taylor’)
AND    salary >
                (SELECT salary
                 FROM   employees
                 WHERE  last name = ‘Taylor’);
```



	LAST_NAME	JOB_ID	SALARY
1	Abel	SA_REP	11000

Using Group Functions in a Subquery

```
SELECT last_name, job_id, salary
FROM   employees
WHERE  salary =
                (SELECT MIN(salary)
                 FROM   employees);
```

2500

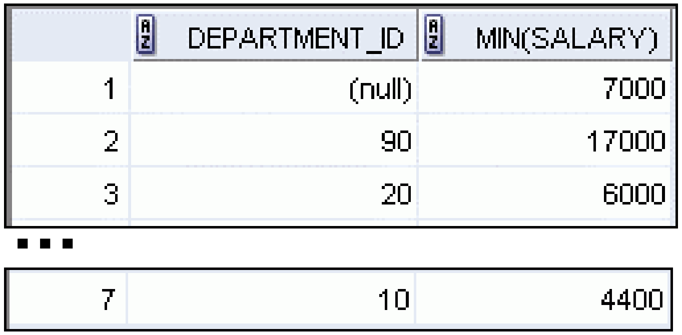
	LAST_NAME	JOB_ID	SALARY
1	Vargas	ST_CLERK	2500

The `HAVING` Clause with Subqueries

- The Oracle server executes the subqueries first.
- The Oracle server returns results into the `HAVING` clause of the main query.

```
SELECT   department_id, MIN(salary)
FROM     employees
GROUP BY department_id
HAVING   MIN(salary)  >
                       (SELECT  MIN(salary)
                        FROM    employees
                        WHERE   department_id = 50);
```

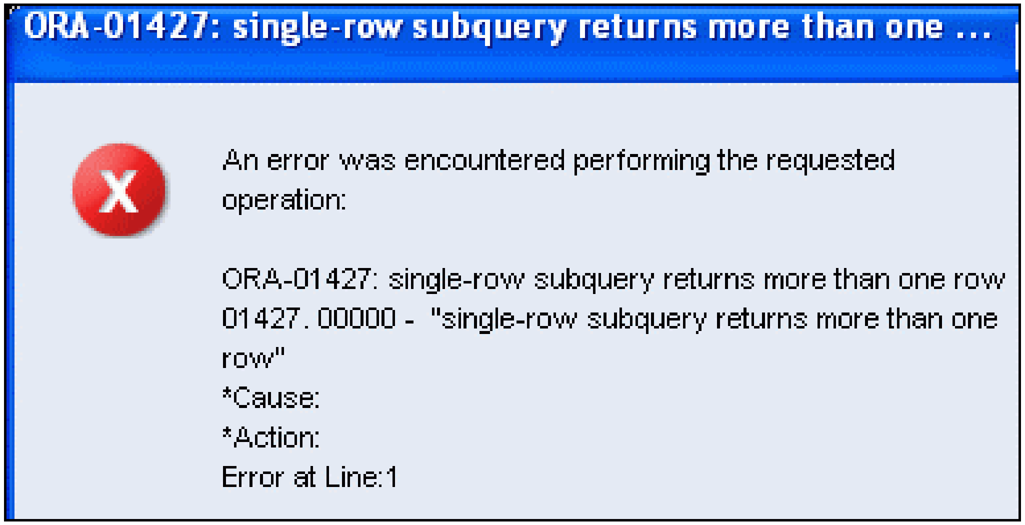
2500



	DEPARTMENT_ID	MIN(SALARY)
1	(null)	7000
2	90	17000
3	20	6000
...		
7	10	4400

What Is Wrong with This Statement?

```
SELECT employee_id, last_name
FROM   employees
WHERE  salary =
                (SELECT   MIN(salary)
                 FROM     employees
                 GROUP BY department_id);
```



ORA-01427: single-row subquery returns more than one ...

An error was encountered performing the requested operation:

ORA-01427: single-row subquery returns more than one row
01427. 00000 - "single-row subquery returns more than one row"
*Cause:
*Action:
Error at Line:1

Single-row operator with multiple-row subquery

No Rows Returned by the Inner Query

```
SELECT last_name, job_id
FROM   employees
WHERE  job_id =
                (SELECT job_id
                 FROM   employees
                 WHERE  last_name = 'Haas');
```

```
0 rows selected
```

Subquery returns no rows because there is no employee named “Haas.”

Lesson Agenda

- Subquery: Types, syntax, and guidelines
- Single-row subqueries:
  - Group functions in a subquery
  - `HAVING` clause with subqueries
- Multiple-row subqueries
  - Use `ALL` or `ANY` operator
- Null values in a subquery

Multiple-Row Subqueries

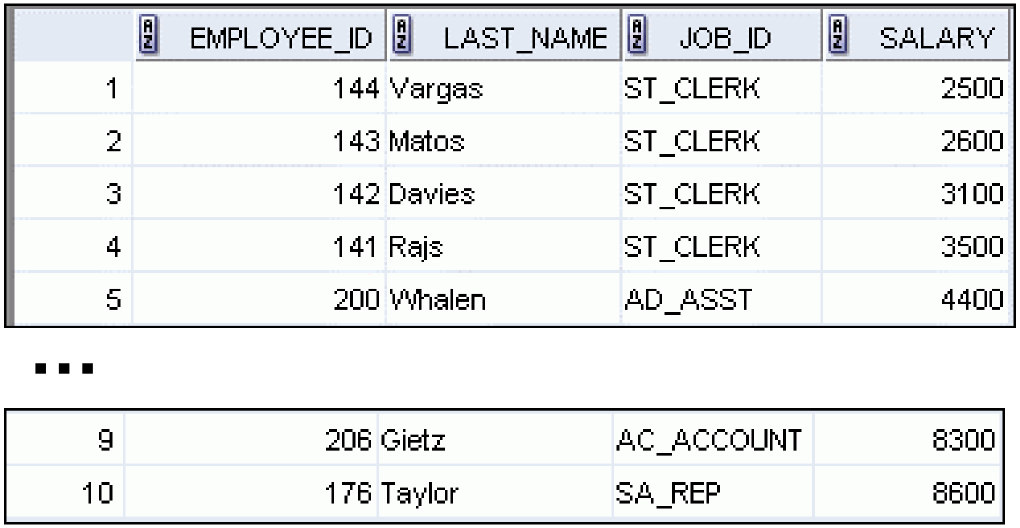
- Return more than one row
- Use multiple-row comparison operators

Operator	Meaning
`IN`	Equal to any member in the list
`ANY`	Must be preceded by `=`, `!=`, `>`, `<`, `<=`, `>=`. Compares a value to each value in a list or returned by a query. Evaluates to `FALSE` if the query returns no rows.
`ALL`	Must be preceded by `=`, `!=`, `>`, `<`, `<=`, `>=`. Compares a value to every value in a list or returned by a query. Evaluates to `TRUE` if the query returns no rows.

Using the ANY Operator in Multiple-Row Subqueries

```
SELECT employee_id, last_name, job_id, salary
FROM   employees
WHERE  salary < ANY
                    (SELECT salary
                     FROM   employees
                     WHERE  job_id = 'IT_PROG')
AND    job_id <> 'IT_PROG';
```

9000, 6000, 4200



	EMPLOYEE_ID	LAST_NAME	JOB_ID	SALARY
1	144	Vargas	ST_CLERK	2500
2	143	Matos	ST_CLERK	2600
3	142	Davies	ST_CLERK	3100
4	141	Rajs	ST_CLERK	3500
5	200	Whalen	AD_ASST	4400

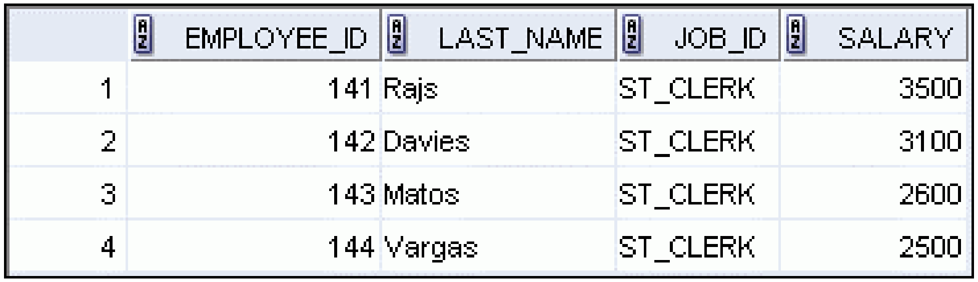
…

9	206	Gietz	AC_ACCOUNT	8300
10	176	Taylor	SA_REP	8600

Using the `ALL` Operator in Multiple-Row Subqueries

```
SELECT employee_id, last_name, job_id, salary
FROM   employees
WHERE  salary < ALL
                    (SELECT salary
                     FROM   employees
                     WHERE  job_id = 'IT_PROG')
AND    job_id <> 'IT_PROG';
```

9000, 6000, 4200



	EMPLOYEE_ID	LAST_NAME	JOB_ID	SALARY
1	141	Rajs	ST_CLERK	3500
2	142	Davies	ST_CLERK	3100
3	143	Matos	ST_CLERK	2600
4	144	Vargas	ST_CLERK	2500

Lesson Agenda

- Subquery: Types, syntax, and guidelines
- Single-row subqueries:
  - Group functions in a subquery
  - `HAVING` clause with subqueries
- Multiple-row subqueries
  - Use `ALL` or `ANY` operator
- Null values in a subquery

Null Values in a Subquery

```
SELECT emp.last_name
FROM   employees emp
WHERE  emp.employee_id NOT IN
                           (SELECT mgr.manager_id
                            FROM   employees mgr);
```

```
0 rows selected
```

Quiz

Using a subquery is equivalent to performing two sequential queries and using the result of the first query as the search value(s) in the second query.

1. True
2. False

Summary

In this lesson, you should have learned how to:

- Identify when a subquery can help solve a problem
- Write subqueries when a query is based on unknown values

```
SELECT   select_list
FROM     table
WHERE    expr operator
                     (SELECT select_list
                      FROM    table);
```

Practice 7: Overview

This practice covers the following topics:

- Creating subqueries to query values based on unknown criteria
- Using subqueries to find out the values that exist in one set of data and not in another

8

Using the Set Operators

Objectives

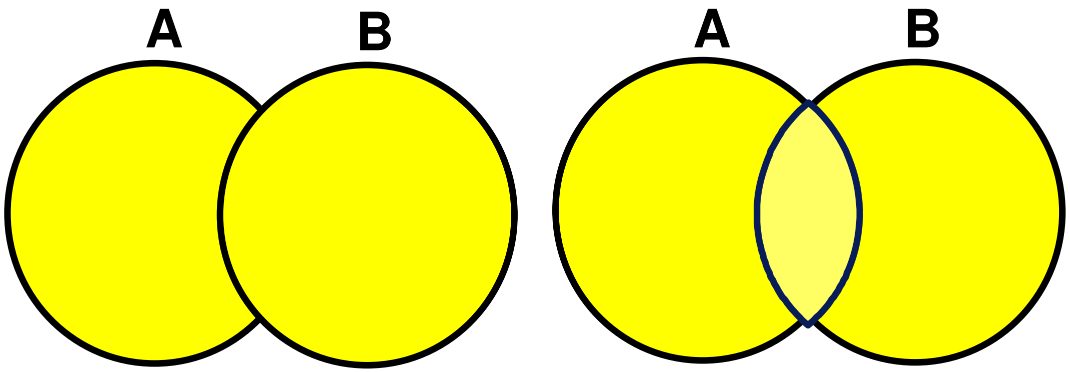
After completing this lesson, you should be able to do the following:

- Describe set operators
- Use a set operator to combine multiple queries into a single query
- Control the order of rows returned

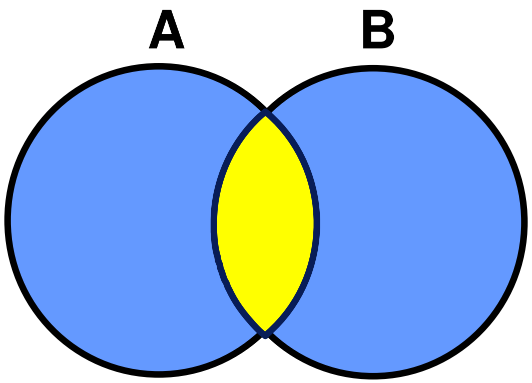
Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using the `ORDER BY` clause in set operations

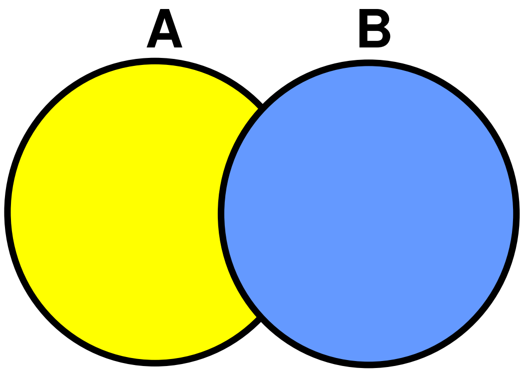
Set Operators



`UNION/UNION ALL`



`INTERSECT`



`MINUS`

Set Operator Guidelines

- The expressions in the `SELECT` lists must match in number.
- The data type of each column in the second query must match the data type of its corresponding column in the first query.
- Parentheses can be used to alter the sequence of execution.
- `ORDER BY` clause can appear only at the very end of the statement.

The Oracle Server and Set Operators

- Duplicate rows are automatically eliminated except in `UNION ALL`.
- Column names from the first query appear in the result.
- The output is sorted in ascending order by default except in `UNION ALL`.

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using the `ORDER BY` clause in set operations

Tables Used in This Lesson

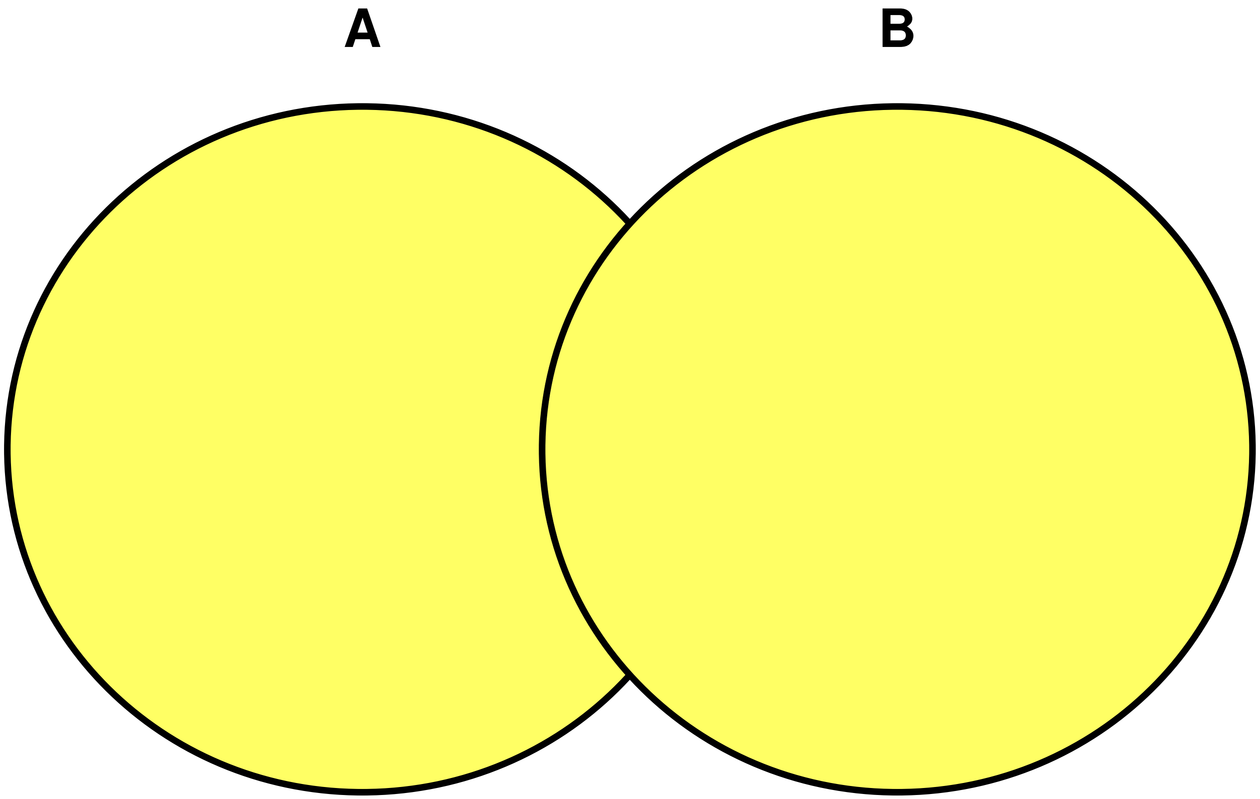
The tables used in this lesson are:

- `EMPLOYEES`: Provides details regarding all current employees
- `JOB_HISTORY`: Records the details of the start date and end date of the former job, and the job identification number and department when an employee switches jobs

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using the `ORDER BY` clause in set operations

`UNION` Operator

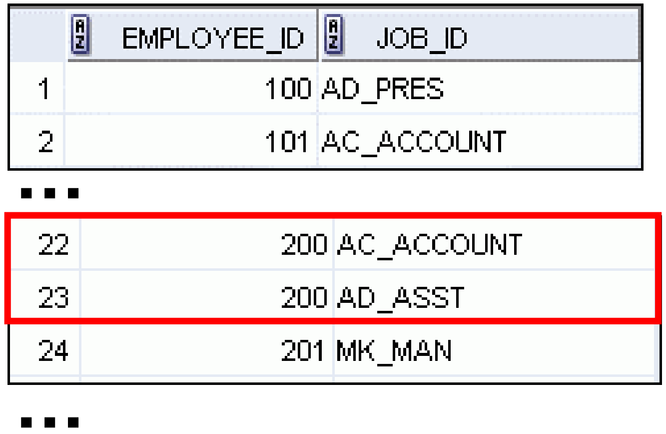


The `UNION` operator returns rows from both queries after eliminating duplications.

Using the UNION Operator

Display the current and previous job details of all employees. Display each employee only once.

```
SELECT employee_id, job_id
FROM   employees
UNION
SELECT employee_id, job_id
FROM   job_history;
```



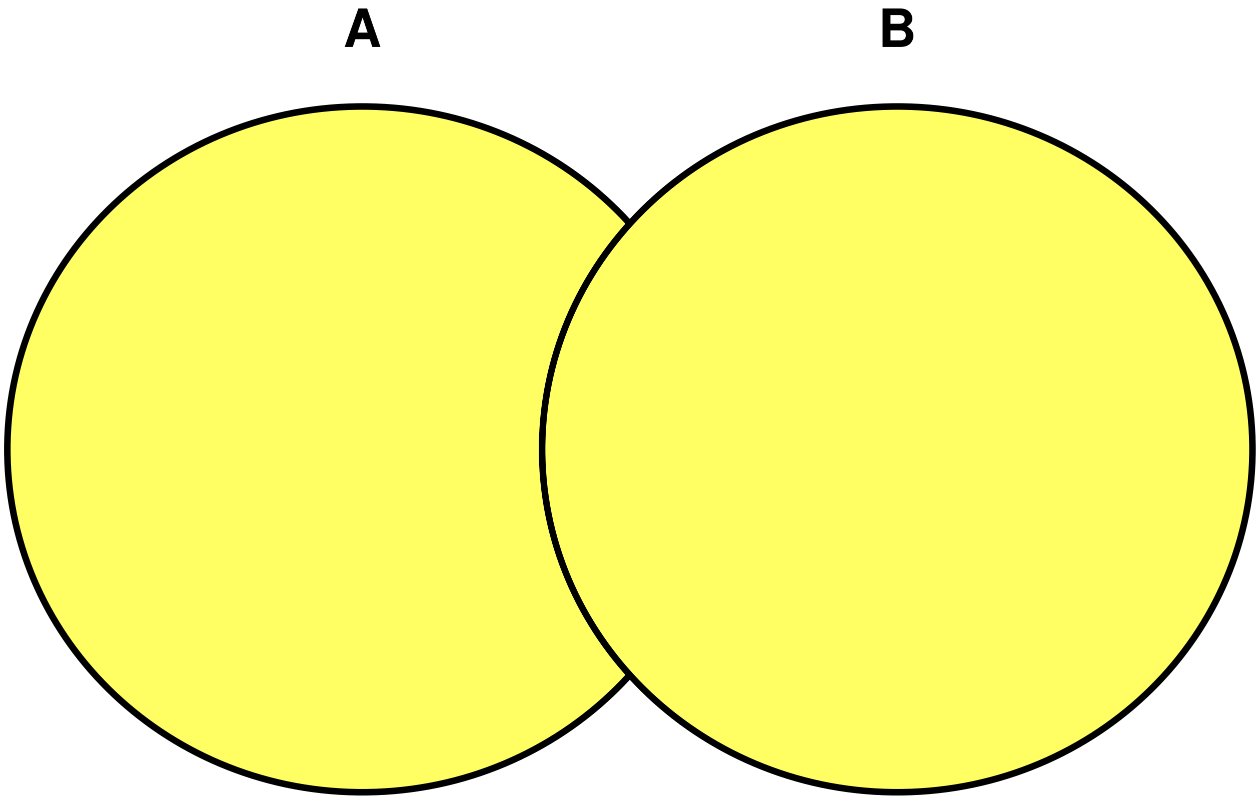
	EMPLOYEE_ID	JOB_ID
1	100	AD_PRES
2	101	AC_ACCOUNT

…

	EMPLOYEE_ID	JOB_ID
22	200	AC_ACCOUNT
23	200	AD_ASST
24	201	MK_MAN

…

`UNION ALL` Operator

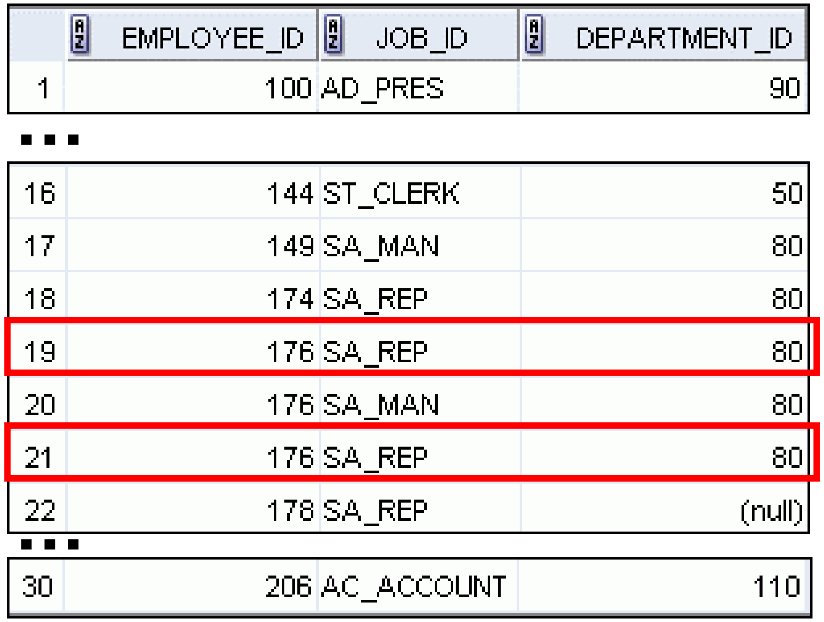


The `UNION ALL` operator returns rows from both queries, including all duplications.

Using the `UNION ALL` Operator

Display the current and previous departments of all employees.

```
SELECT employee_id, job_id, department_id
FROM   employees
UNION ALL
SELECT employee_id, job_id, department_id
FROM   job_history
ORDER BY  employee_id;
```



	EMPLOYEE_ID	JOB_ID	DEPARTMENT_ID
1	100	AD_PRES	90

■ ■ ■

16	144	ST_CLERK	50
17	149	SA_MAN	80
18	174	SA_REP	80
19	176	SA_REP	80
20	176	SA_MAN	80
21	176	SA_REP	80
22	178	SA_REP	(null)

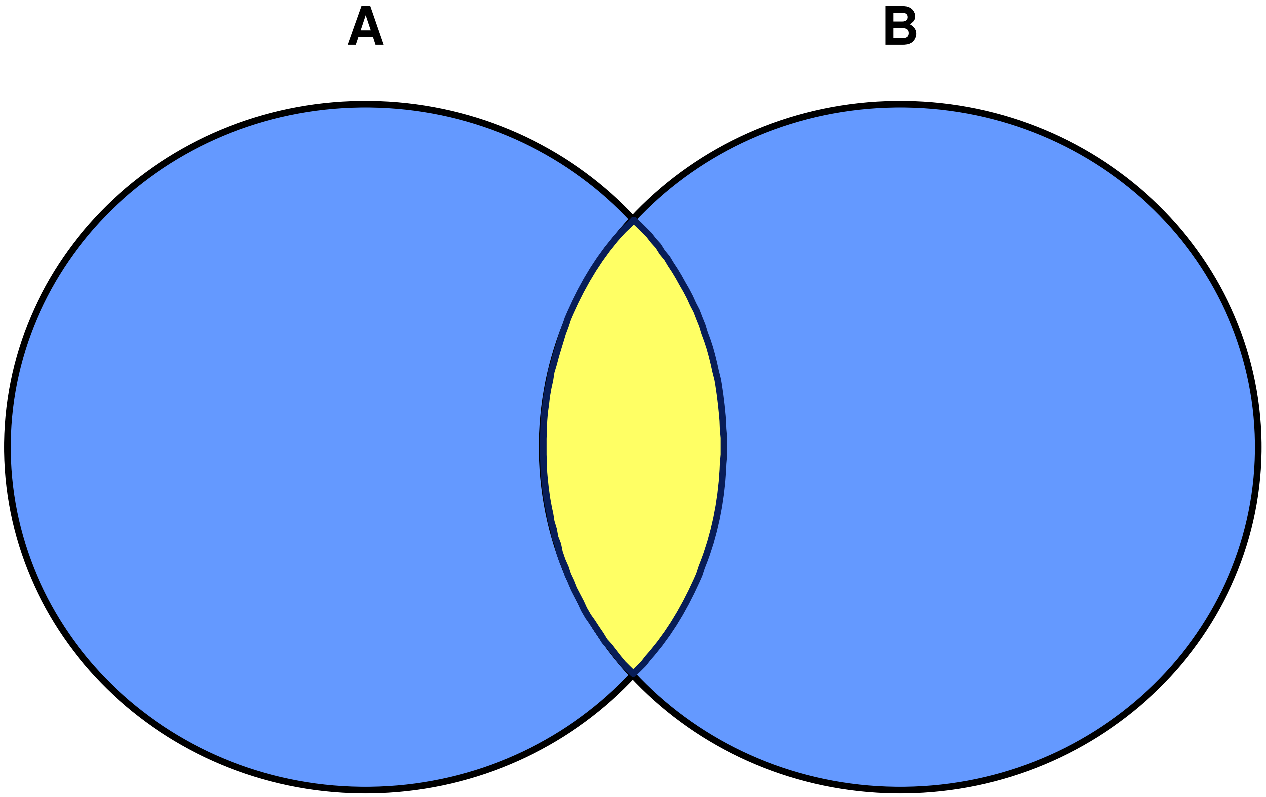
■ ■ ■

30	206	AC_ACCOUNT	110

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using `ORDER BY` clause in set operations

`INTERSECT` Operator

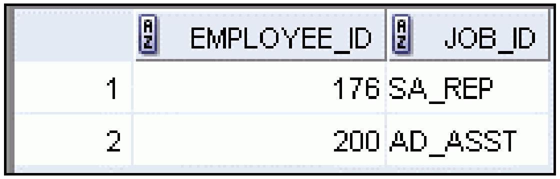


The `INTERSECT` operator returns rows that are common to both queries.

Using the `INTERSECT` Operator

Display the employee IDs and job IDs of those employees who currently have a job title that is the same as their previous one (that is, they changed jobs but have now gone back to doing the same job they did previously).

```
SELECT employee_id, job_id
FROM   employees
INTERSECT
SELECT employee_id, job_id
FROM   job_history;
```

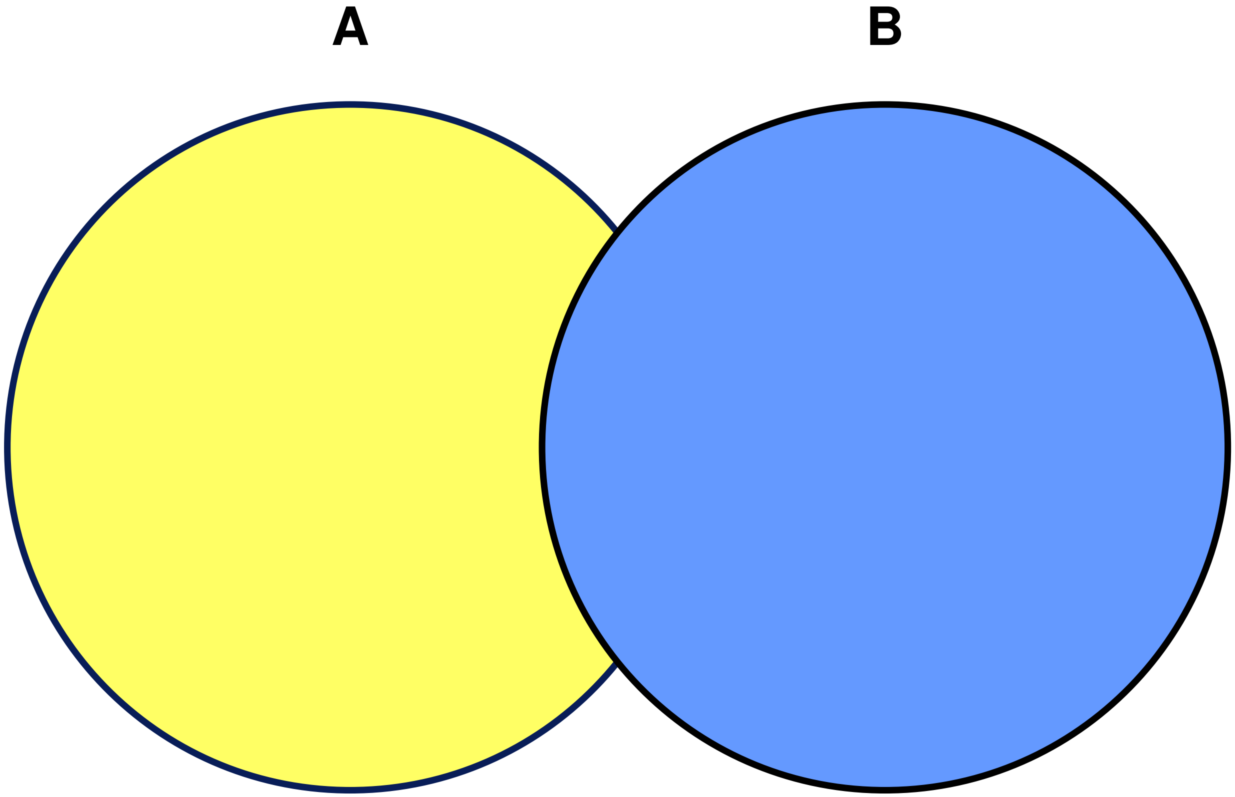


	EMPLOYEE_ID	JOB_ID
1	176	SA_REP
2	200	AD_ASST

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using the `ORDER BY` clause in set operations

`MINUS` Operator

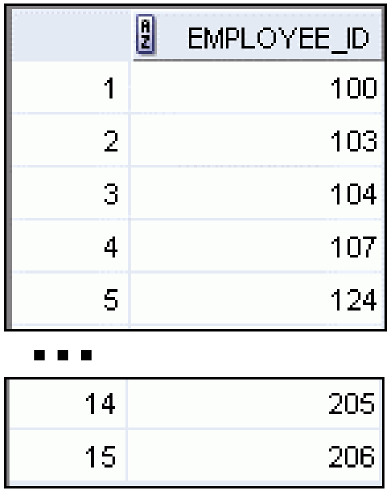


The `MINUS` operator returns all the distinct rows selected by the first query, but not present in the second query result set.

Using the `MINUS` Operator

Display the employee IDs of those employees who have not changed their jobs even once.

```
SELECT employee_id
FROM   employees
MINUS
SELECT employee_id
FROM   job_history;
```



	EMPLOYEE_ID
1	100
2	103
3	104
4	107
5	124
...	
14	205
15	206

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using `ORDER BY` clause in set operations

Matching the `SELECT` Statements

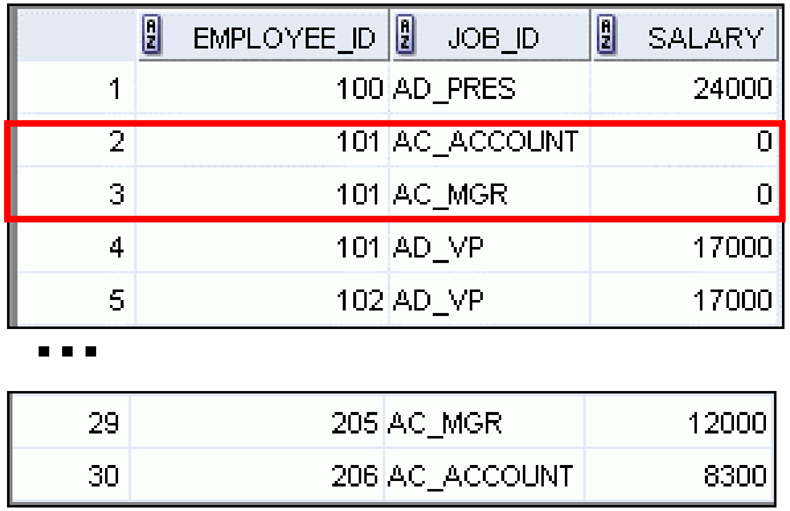
- Using the `UNION` operator, display the location ID, department name, and the state where it is located.
- You must match the data type (using the `TO_CHAR` function or any other conversion functions) when columns do not exist in one or the other table.

```
SELECT location_id, department_name "Department",
   TO_CHAR(NULL) "Warehouse location"
FROM departments
UNION
SELECT location_id, TO_CHAR(NULL) "Department",
   state_province
FROM locations;
```

Matching the `SELECT` Statement: Example

Using the `UNION` operator, display the employee ID, job ID, and salary of all employees.

```
SELECT employee_id, job_id,salary
FROM   employees
UNION
SELECT employee_id, job_id,0
FROM   job_history;
```



	EMPLOYEE_ID	JOB_ID	SALARY
1	100	AD_PRES	24000
2	101	AC_ACCOUNT	0
3	101	AC_MGR	0
4	101	AD_VP	17000
5	102	AD_VP	17000

…

29	205	AC_MGR	12000
30	206	AC_ACCOUNT	8300

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
- `UNION` and `UNION ALL` operator
- `INTERSECT` operator
- `MINUS` operator
- Matching the `SELECT` statements
- Using the `ORDER BY` clause in set operations

Using the `ORDER BY` Clause in Set Operations

- The `ORDER BY` clause can appear only once at the end of the compound query.
- Component queries cannot have individual `ORDER BY` clauses.
- `ORDER BY` clause recognizes only the columns of the first `SELECT` query.
- By default, the first column of the first `SELECT` query is used to sort the output in an ascending order.

Quiz

Identify the set operator guidelines.

1. The expressions in the `SELECT` lists must match in number.
2. Parentheses may not be used to alter the sequence of execution.
3. The data type of each column in the second query must match the data type of its corresponding column in the first query.
4. The `ORDER BY` clause can be used only once in a compound query, unless a `UNION ALL` operator is used.

Summary

In this lesson, you should have learned how to use:

- `UNION` to return all distinct rows
- `UNION ALL` to return all rows, including duplicates
- `INTERSECT` to return all rows that are shared by both queries
- `MINUS` to return all distinct rows that are selected by the first query, but not by the second
- `ORDER BY` only at the very end of the statement

Practice 8: Overview

In this practice, you create reports by using:

- The `UNION` operator
- The `INTERSECTION` operator
- The `MINUS` operator

9

Manipulating Data

Objectives

After completing this lesson, you should be able to do the following:

- Describe each data manipulation language (DML) statement
- Insert rows into a table
- Update rows in a table
- Delete rows from a table
- Control transactions

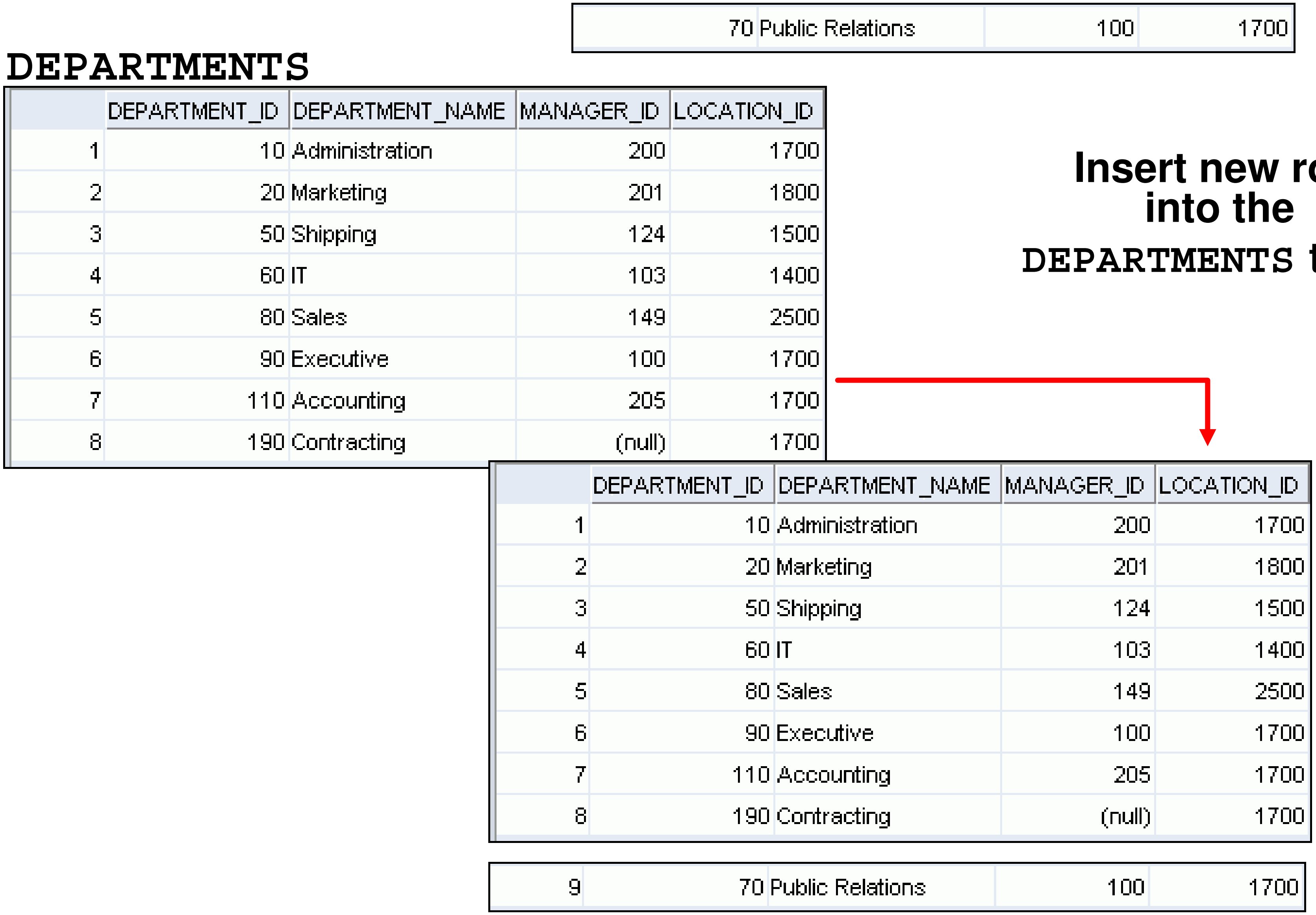
Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

Data Manipulation Language

- A DML statement is executed when you:
  - Add new rows to a table
  - Modify existing rows in a table
  - Remove existing rows from a table
- A *transaction* consists of a collection of DML statements that form a logical unit of work.

Adding a New Row to a Table



70	Public Relations	100	1700

New row

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

Insert new row into the `DEPARTMENTS` table.

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700
9	70	Public Relations	100	1700

`INSERT` Statement Syntax

- Add new rows to a table by using the `INSERT` statement:

```
INSERT INTO   table [(column [, column...])]
VALUES         (value [, value...]);
```

- With this syntax, only one row is inserted at a time.

Inserting New Rows

- Insert a new row containing values for each column.
- List values in the default order of the columns in the table.
- Optionally, list the columns in the `INSERT` clause.

```
INSERT INTO departments(department_id,
       department_name, manager_id, location_id)
VALUES (70, 'Public Relations', 100, 1700);
```

```
1 rows inserted
```

- Enclose character and date values within single quotation marks.

Inserting Rows with Null Values

- Implicit method: Omit the column from the column list.

```
INSERT INTO   departments (department_id,
                           department_name)
VALUES        (30, 'Purchasing');
```

```
1 rows inserted
```

- Explicit method: Specify the `NULL` keyword in the `VALUES` clause.

```
INSERT INTO   departments
VALUES        (100, 'Finance', NULL, NULL);
```

```
1 rows inserted
```

Inserting Special Values

The `SYSDATE` function records the current date and time.

```
INSERT INTO employees (employee_id,
                  first_name, last_name,
                  email, phone_number,
                  hire_date, job_id, salary,
                  commission_pct, manager_id,
                  department_id)
VALUES            (113,
                  'Louis', 'Popp',
                  'LPOPP', '515.124.4567',
                  SYSDATE, 'AC_ACCOUNT', 6900,
                  NULL, 205, 110);
```

```
1 rows inserted
```

Inserting Specific Date and Time Values

- Add a new employee.

```
INSERT INTO employees
VALUES      (114,
             'Den', 'Raphealy',
             'DRAPHEAL', '515.127.4561',
             TO_DATE('FEB 3, 1999', 'MON DD, YYYY'),
             'SA_REP', 11000, 0.2, 100, 60);
```

```
1 rows inserted
```

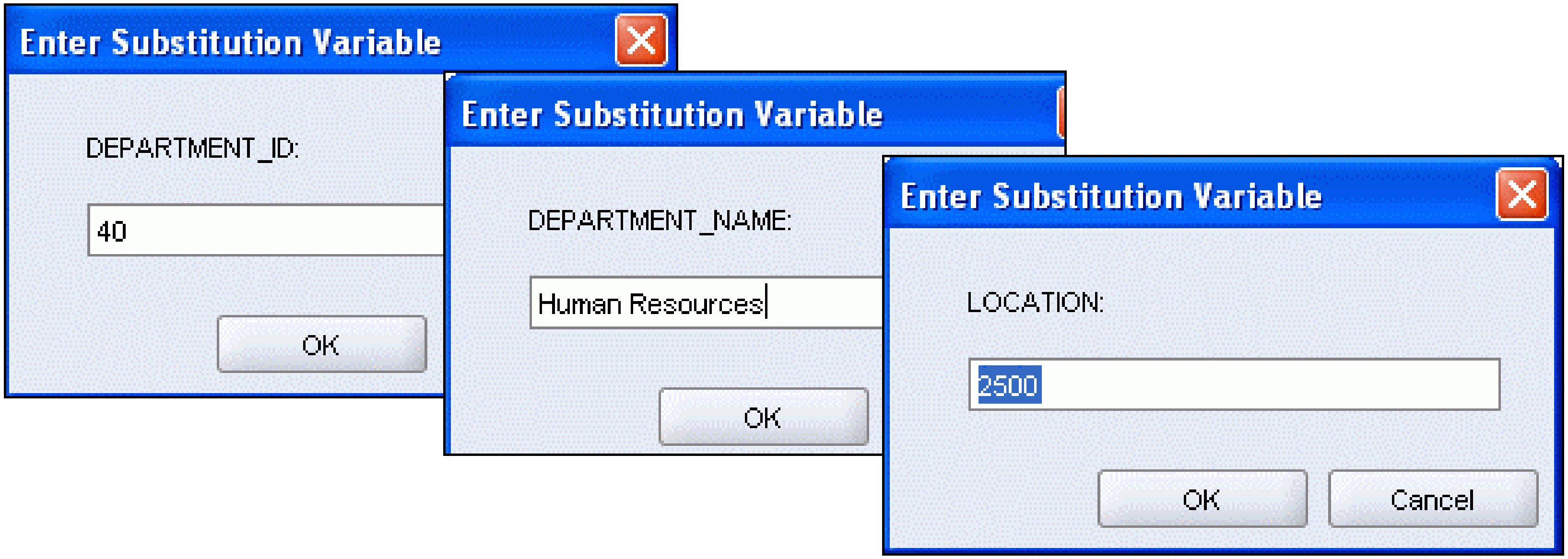
- Verify your addition.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT
114	Den	Raphealy	DRAPHEAL	515.127.4561	03-FEB-99	SA_REP	11000	0.2

Creating a Script

- Use `&` substitution in a SQL statement to prompt for values.
- `&` is a placeholder for the variable value.

```
INSERT INTO departments
             (department_id, department_name, location_id)
VALUES       (&department_id, '&department_name',&location);
```



DEPARTMENT_ID: 40

DEPARTMENT_NAME: Human Resources

LOCATION: 2500

Copying Rows from Another Table

- Write your `INSERT` statement with a subquery:

```
INSERT INTO sales_reps(id, name, salary, commission_pct)
  SELECT employee_id, last_name, salary, commission_pct
  FROM   employees
  WHERE  job_id LIKE '%REP%';
```

```
4 rows inserted
```

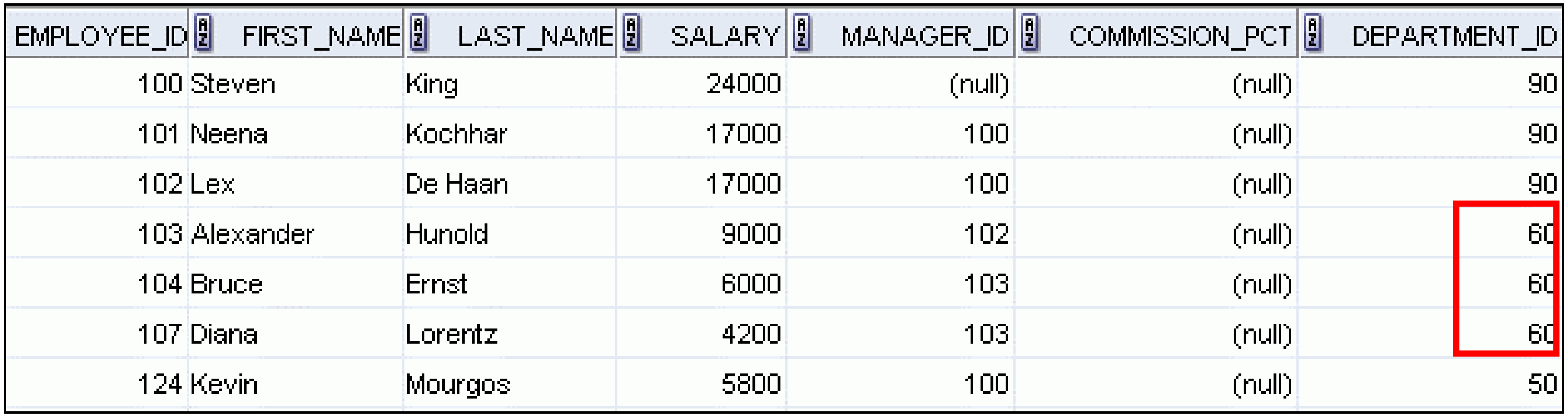
- Do not use the `VALUES` clause.
- Match the number of columns in the `INSERT` clause to those in the subquery.
- Inserts all the rows returned by the subquery in the table, `sales_reps`.

Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

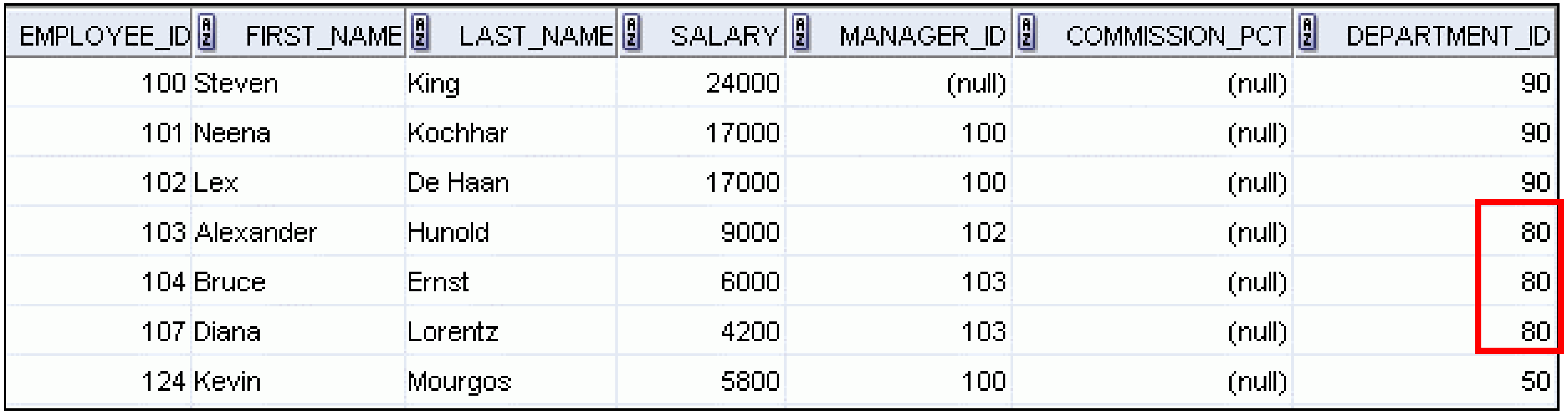
Changing Data in a Table

EMPLOYEES



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	MANAGER_ID	COMMISSION_PCT	DEPARTMENT_ID
100	Steven	King	24000	(null)	(null)	90
101	Neena	Kochhar	17000	100	(null)	90
102	Lex	De Haan	17000	100	(null)	90
103	Alexander	Hunold	9000	102	(null)	60
104	Bruce	Ernst	6000	103	(null)	60
107	Diana	Lorentz	4200	103	(null)	60
124	Kevin	Mourgos	5800	100	(null)	50

Update rows in the `EMPLOYEES` table:



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	MANAGER_ID	COMMISSION_PCT	DEPARTMENT_ID
100	Steven	King	24000	(null)	(null)	90
101	Neena	Kochhar	17000	100	(null)	90
102	Lex	De Haan	17000	100	(null)	90
103	Alexander	Hunold	9000	102	(null)	80
104	Bruce	Ernst	6000	103	(null)	80
107	Diana	Lorentz	4200	103	(null)	80
124	Kevin	Mourgos	5800	100	(null)	50

`UPDATE` Statement Syntax

- Modify existing values in a table with the `UPDATE` statement:

```
UPDATE        table
SET           column = value [, column = value, ...]
[WHERE        condition];
```

- Update more than one row at a time (if required).

Updating Rows in a Table

- Values for a specific row or rows are modified if you specify the `WHERE` clause:

```
UPDATE employees
SET    department_id = 50
WHERE  employee id = 113;
```

```
1 rows updated
```

- Values for all the rows in the table are modified if you omit the `WHERE` clause:

```
UPDATE   copy_emp
SET      department_id = 110;
```

```
22 rows updated
```

- Specify `SET` *`column_name`*`= NULL` to update a column value to `NULL`.

Updating Two Columns with a Subquery

Update employee 113’s job and salary to match those of employee 205.

```
UPDATE   employees
SET      job_id   = (SELECT  job_id
                     FROM    employees
                     WHERE   employee_id = 205),
         salary   = (SELECT  salary
                     FROM    employees
                     WHERE   employee_id = 205)
WHERE    employee_id    =   113;
```

```
1 rows updated
```

Updating Rows Based on Another Table

Use the subqueries in the `UPDATE` statements to update row values in a table based on values from another table:

```
UPDATE   copy_emp
SET      department_id  =  (SELECT department_id
                            FROM employees
                            WHERE employee id = 100)
WHERE    job_id         =  (SELECT job_id
                            FROM employees
                            WHERE employee_id = 200);
```

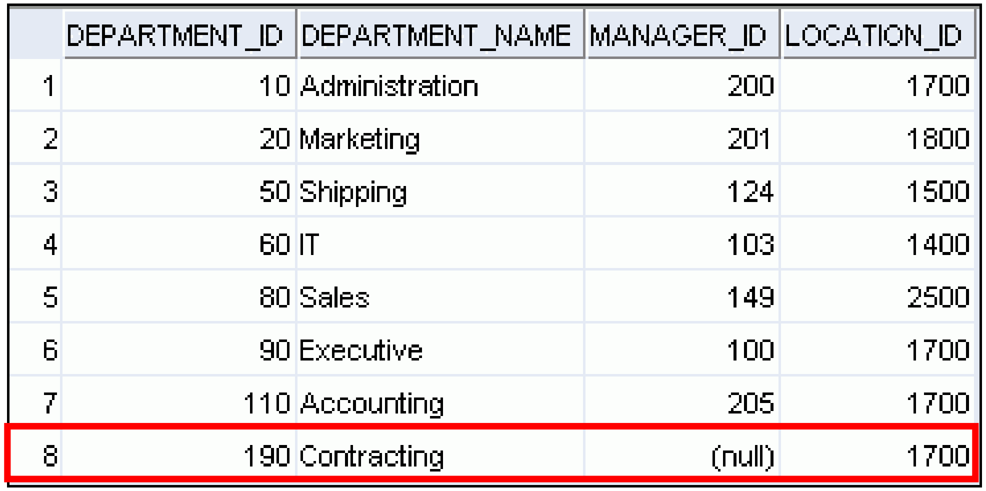
```
1 rows updated
```

Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

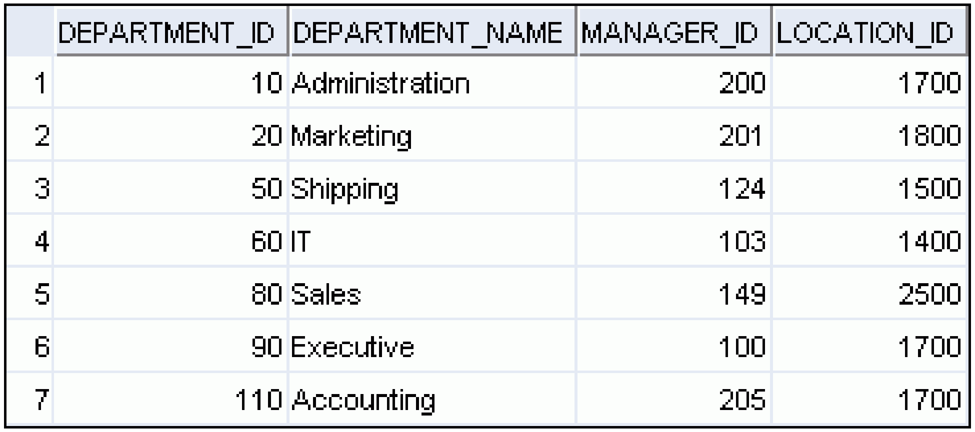
Removing a Row from a Table

`DEPARTMENTS`



	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

Delete a row from the `DEPARTMENTS` table:



	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700

`DELETE` Statement

You can remove existing rows from a table by using the `DELETE` statement:

```
DELETE [FROM]   table
 [WHERE         condition];
```

Deleting Rows from a Table

- Specific rows are deleted if you specify the `WHERE` clause:

```
DELETE FROM departments
WHERE  department_name = ‘Finance';
```

```
1 rows deleted
```

- All rows in the table are deleted if you omit the `WHERE` clause:

```
DELETE FROM  copy_emp;
```

```
22 rows deleted
```

Deleting Rows Based on Another Table

Use the subqueries in the `DELETE` statements to remove rows from a table based on values from another table:

```
DELETE FROM employees
WHERE  department_id =
                (SELECT department_id
                 FROM   departments
                 WHERE  department_name
                        LIKE '%Public%');
```

```
1 rows deleted
```

`TRUNCATE` Statement

- Removes all rows from a table, leaving the table empty and the table structure intact
- Is a data definition language (DDL) statement rather than a DML statement; cannot easily be undone
- Syntax:

```
TRUNCATE TABLE table_name;
```

- Example:

```
TRUNCATE TABLE copy_emp;
```

Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

Database Transactions

A database transaction consists of one of the following:

- DML statements that constitute one consistent change to the data
- One DDL statement
- One data control language (DCL) statement

Database Transactions: Start and End

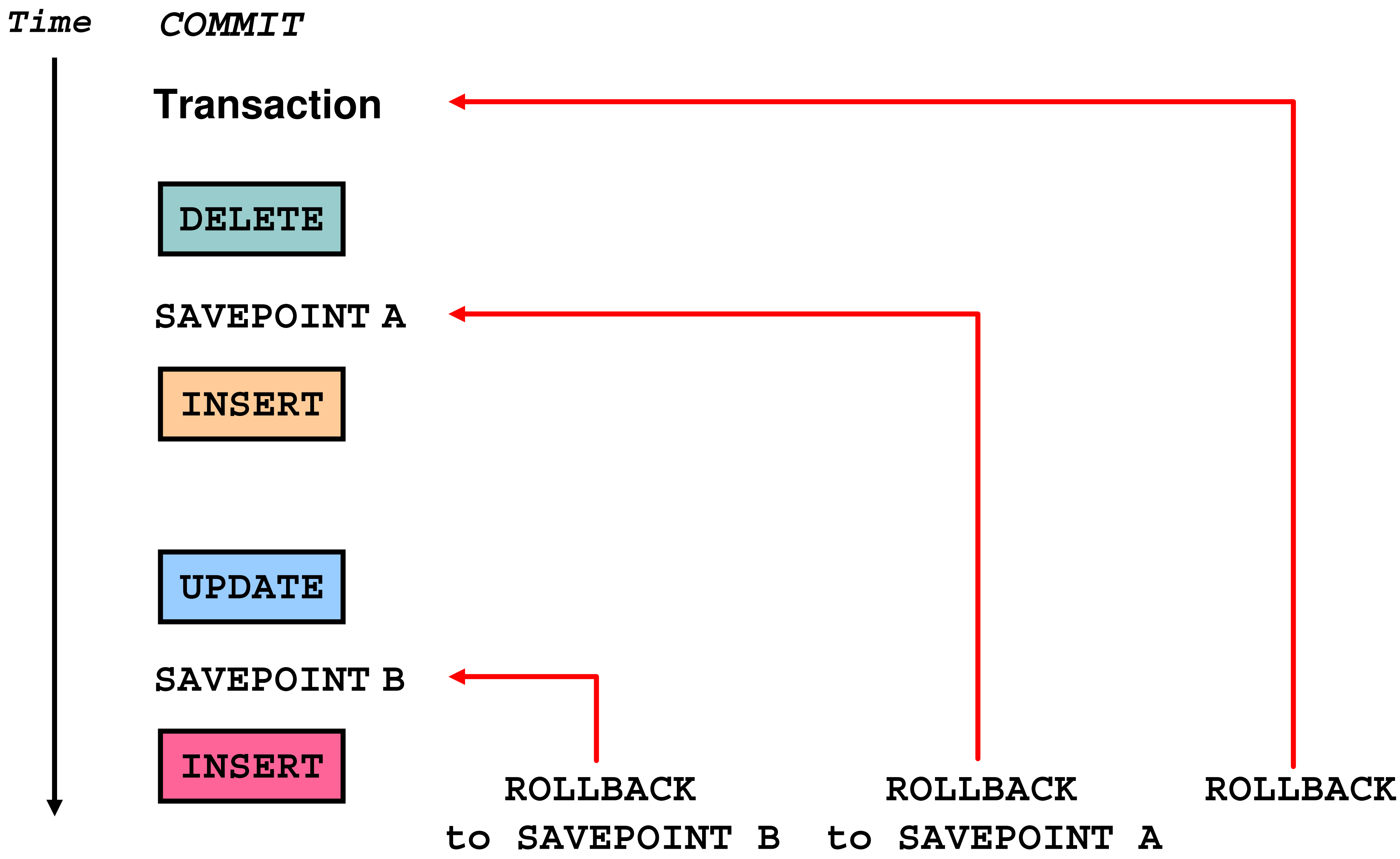
- Begin when the first DML SQL statement is executed.
- End with one of the following events:
  - A `COMMIT` or `ROLLBACK` statement is issued.
  - A DDL or DCL statement executes (automatic commit).
  - The user exits SQL Developer or SQL*Plus.
  - The system crashes.

Advantages of `COMMIT` and `ROLLBACK` Statements

With `COMMIT` and `ROLLBACK` statements, you can:

- Ensure data consistency
- Preview data changes before making changes permanent
- Group logically-related operations

Explicit Transaction Control Statements



Time

COMMIT

Transaction

`DELETE`

`SAVEPOINT A`

`INSERT`

`UPDATE`

`SAVEPOINT B`

`INSERT`

`ROLLBACK to SAVEPOINT B`

`ROLLBACK to SAVEPOINT A`

`ROLLBACK`

Rolling Back Changes to a Marker

- Create a marker in the current transaction by using the `SAVEPOINT` statement.
- Roll back to that marker by using the `ROLLBACK TO SAVEPOINT` statement.

```
UPDATE...
SAVEPOINT update_done;
```

```
SAVEPOINT update_done succeeded.
```

```
INSERT...
ROLLBACK TO update_done;
```

```
ROLLBACK TO succeeded.
```

Implicit Transaction Processing

- An automatic commit occurs in the following circumstances:
  - A DDL statement is issued
  - A DCL statement is issued
  - Normal exit from SQL Developer or SQL*Plus, without explicitly issuing `COMMIT` or `ROLLBACK` statements
- An automatic rollback occurs when there is an abnormal termination of SQL Developer or SQL*Plus or a system failure.

State of the Data
Before `COMMIT` or `ROLLBACK`

- The previous state of the data can be recovered.
- The current user can review the results of the DML operations by using the `SELECT` statement.
- Other users *cannot* view the results of the DML statements issued by the current user.
- The affected rows are *locked*; other users cannot change the data in the affected rows.

State of the Data After `COMMIT`

- Data changes are saved in the database.
- The previous state of the data is overwritten.
- All users can view the results.
- Locks on the affected rows are released; those rows are available for other users to manipulate.
- All savepoints are erased.

Committing Data

- Make the changes:

```
DELETE FROM employees
WHERE  employee_id = 99999;
1 rows deleted

INSERT INTO departments
VALUES (290, 'Corporate Tax', NULL, 1700);
1 rows inserted
```

- Commit the changes:

```
COMMIT;
COMMIT succeeded.
```

State of the Data After `ROLLBACK`

Discard all pending changes by using the `ROLLBACK` statement:

- Data changes are undone.
- Previous state of the data is restored.
- Locks on the affected rows are released.

```
DELETE FROM copy_emp;
ROLLBACK ;
```

State of the Data After `ROLLBACK`: Example

```
DELETE FROM test;
25,000 rows deleted.

ROLLBACK;
Rollback complete.

DELETE FROM test WHERE  id = 100;
1 row deleted.

SELECT * FROM   test WHERE  id = 100;
No rows selected.

COMMIT;
Commit complete.
```

Statement-Level Rollback

- If a single DML statement fails during execution, only that statement is rolled back.
- The Oracle server implements an implicit savepoint.
- All other changes are retained.
- The user should terminate transactions explicitly by executing a `COMMIT` or `ROLLBACK` statement.

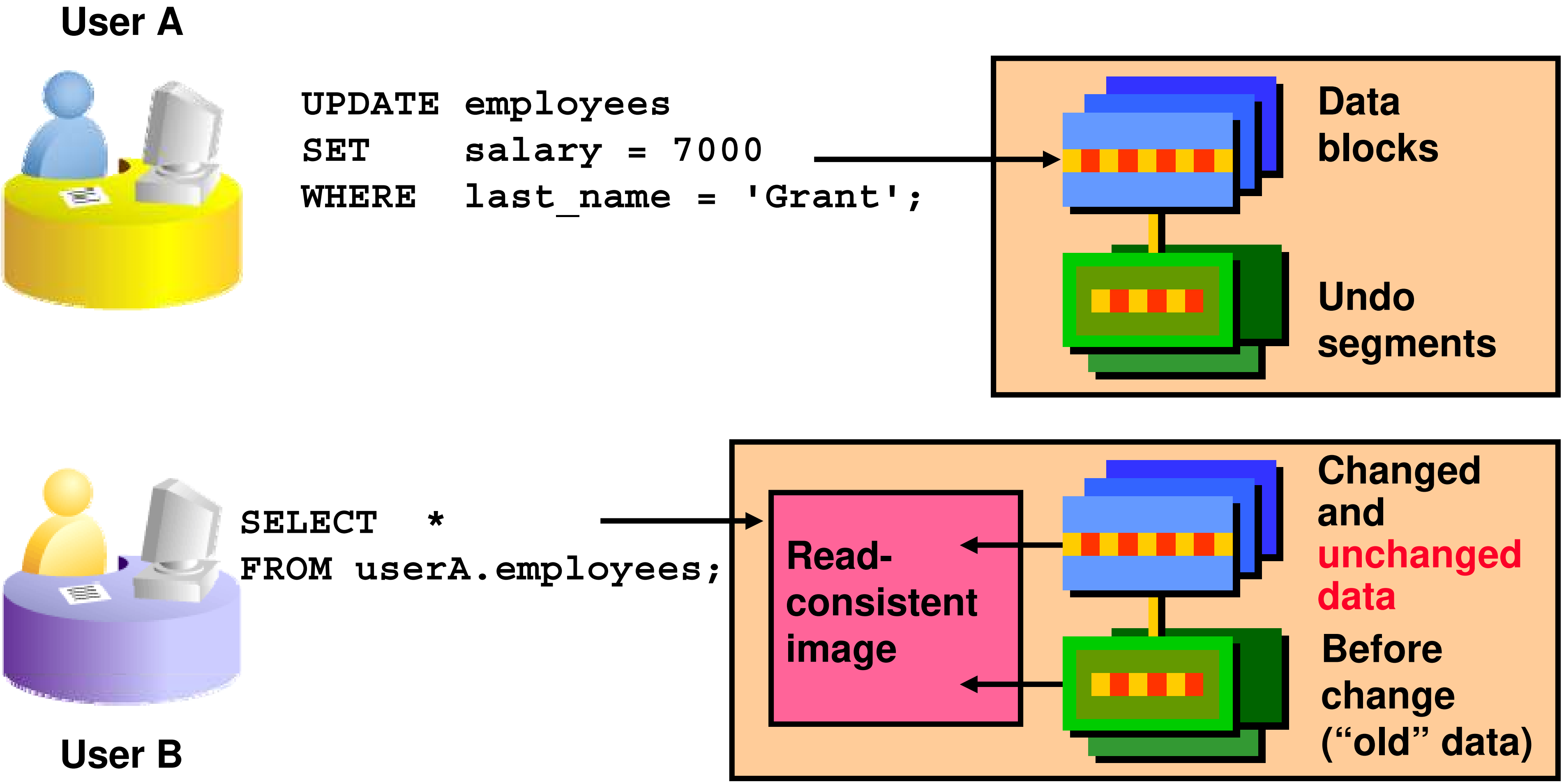
Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

Read Consistency

- Read consistency guarantees a consistent view of the data at all times.
- Changes made by one user do not conflict with the changes made by another user.
- Read consistency ensures that, on the same data:
  - Readers do not wait for writers
  - Writers do not wait for readers
  - Writers wait for writers

Implementing Read Consistency



User A

```
UPDATE employees
SET    salary = 7000
WHERE  last_name = 'Grant';
```

Data blocks

Undo segments

User B

```
SELECT  *
FROM userA.employees;
```

Read-consistent image

Changed and unchanged data

Before change (“old” data)

Lesson Agenda

- Adding new rows in a table
  - `INSERT` statement
- Changing data in a table
  - `UPDATE` statement
- Removing rows from a table:
  - `DELETE` statement
  - `TRUNCATE` statement
- Database transactions control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

`FOR UPDATE` Clause in a `SELECT` Statement

- Locks the rows in the `EMPLOYEES` table where `job_id` is `SA_REP`.

```
SELECT employee_id, salary, commission_pct, job_id
FROM employees
WHERE job_id = 'SA_REP'
FOR UPDATE
ORDER BY employee_id;
```

- Lock is released only when you issue a `ROLLBACK` or a `COMMIT`.
- If the `SELECT` statement attempts to lock a row that is locked by another user, then the database waits until the row is available, and then returns the results of the `SELECT` statement.

`FOR UPDATE` Clause: Examples

- You can use the `FOR UPDATE` clause in a `SELECT` statement against multiple tables.

```
SELECT e.employee_id, e.salary, e.commission_pct
FROM employees e JOIN departments d
USING (department_id)
WHERE job_id = 'ST_CLERK`
AND location_id = 1500
FOR UPDATE
ORDER BY e.employee_id;
```

- Rows from both the `EMPLOYEES` and `DEPARTMENTS` tables are locked.
- Use `FOR UPDATE OF` *`column_name`* to qualify the column you intend to change, then only the rows from that specific table are locked.

Quiz

The following statements produce the same results:

```
DELETE FROM copy_emp;
```

```
TRUNCATE TABLE copy_emp;
```

1. True
2. False

Summary

In this lesson, you should have learned how to use the following statements:

Function	Description
`INSERT`	Adds a new row to the table
`UPDATE`	Modifies existing rows in the table
`DELETE`	Removes existing rows from the table
`TRUNCATE`	Removes all rows from a table
`COMMIT`	Makes all pending changes permanent
`SAVEPOINT`	Is used to roll back to the savepoint marker
`ROLLBACK`	Discards all pending data changes
`FOR UPDATE` clause in `SELECT`	Locks rows identified by the `SELECT` query

Practice 9: Overview

This practice covers the following topics:

- Inserting rows into the tables
- Updating and deleting rows in the table
- Controlling transactions

10

Using DDL Statements to Create and Manage Tables

Objectives

After completing this lesson, you should be able to do the following:

- Categorize the main database objects
- Review the table structure
- List the data types that are available for columns
- Create a simple table
- Explain how constraints are created at the time of table creation
- Describe how schema objects work

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

Database Objects

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative name to an object

Naming Rules

Table names and column names:

- Must begin with a letter
- Must be 1–30 characters long
- Must contain only A–Z, a–z, 0–9, _, $, and #
- Must not duplicate the name of another object owned by the same user
- Must not be an Oracle server–reserved word

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
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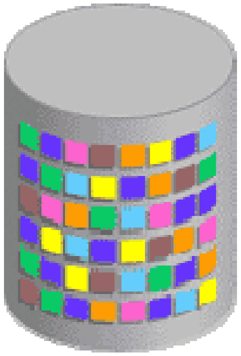
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

`CREATE TABLE` Statement

- You must have:
  - `CREATE TABLE` privilege
  - A storage area

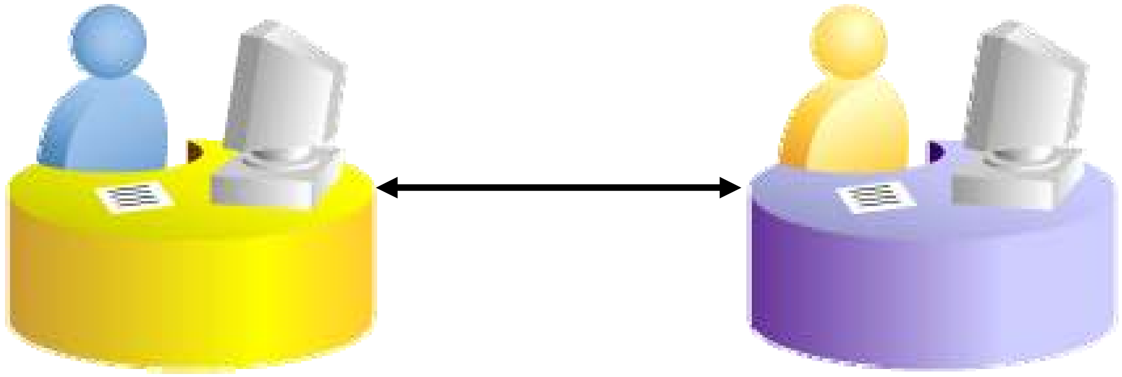
```
CREATE TABLE [schema.]table
             (column datatype [DEFAULT expr][, ...]);
```

- You specify:
  - Table name
  - Column name, column data type, and column size



Referencing Another User's Tables

- Tables belonging to other users are not in the user's schema.
- You should use the owner's name as a prefix to those tables.



USERA

```
SELECT *
FROM userB.employees;
```

USERB

```
SELECT *
FROM userA.employees;
```

DEFAULT Option

- Specify a default value for a column during an insert.

```
... hire_date DATE DEFAULT SYSDATE, ...
```

- Literal values, expressions, or SQL functions are legal values.
- Another column's name or a pseudocolumn are illegal values.
- The default data type must match the column data type.

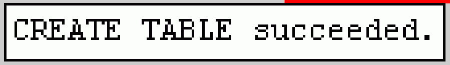
```
CREATE TABLE hire_dates
        (id           NUMBER(8),
         hire date DATE DEFAULT SYSDATE);
```

```
CREATE TABLE succeeded.
```

Creating Tables

- Create the table:

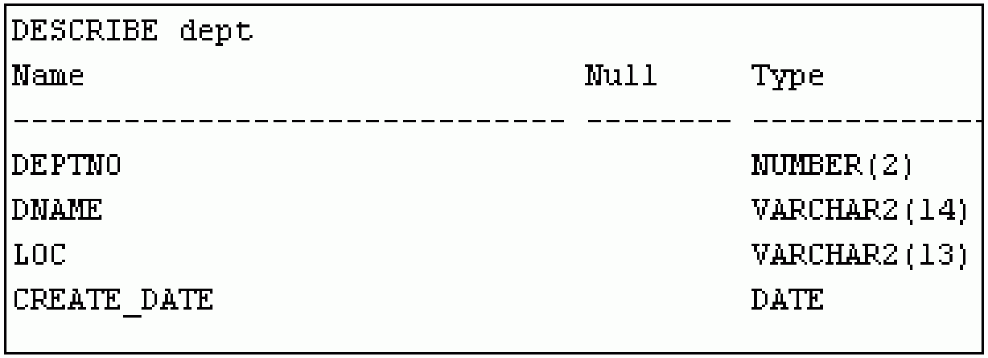
```
CREATE TABLE dept
          (deptno      NUMBER(2),
           dname       VARCHAR2(14),
           loc         VARCHAR2(13),
           create_date DATE DEFAULT SYSDATE);
```



```
CREATE TABLE succeeded.
```

- Confirm table creation:

```
DESCRIBE dept
```



```
DESCRIBE dept
Name                           Null     Type
------------------------------ -------- -------------
DEPTNO                                  NUMBER(2)
DNAME                                   VARCHAR2(14)
LOC                                     VARCHAR2(13)
CREATE_DATE                             DATE
```

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

Data Types

Data Type	Description
`VARCHAR2(`*`size`*`)`	Variable-length character data
`CHAR(`*`size`*`)`	Fixed-length character data
`NUMBER(`*`p,s`*`)`	Variable-length numeric data
`DATE`	Date and time values
`LONG`	Variable-length character data (up to 2 GB)
`CLOB`	Character data (up to 4 GB)
`RAW and LONG RAW`	Raw binary data
`BLOB`	Binary data (up to 4 GB)
`BFILE`	Binary data stored in an external file (up to 4 GB)
`ROWID`	A base-64 number system representing the unique address of a row in its table

Datetime Data Types

You can use several datetime data types:

Data Type	Description
`TIMESTAMP`	Date with fractional seconds
`INTERVAL YEAR TO MONTH`	Stored as an interval of years and months
`INTERVAL DAY TO SECOND`	Stored as an interval of days, hours, minutes, and seconds

Lesson Agenda

- Database objects
  - Naming rules
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- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

Including Constraints

- Constraints enforce rules at the table level.
- Constraints prevent the deletion of a table if there are dependencies.
- The following constraint types are valid:
  - `NOT NULL`
  - `UNIQUE`
  - `PRIMARY KEY`
  - `FOREIGN KEY`
  - `CHECK`

Constraint Guidelines

- You can name a constraint, or the Oracle server generates a name by using the `SYS_Cn` format.
- Create a constraint at either of the following times:
  - At the same time as the creation of the table
  - After the creation of the table
- Define a constraint at the column or table level.
- View a constraint in the data dictionary.

Defining Constraints

- Syntax:

```
CREATE TABLE [schema.]table
      (column datatype [DEFAULT expr]
      [column_constraint],
      ...
      [table_constraint][,...]);
```

- Column-level constraint syntax:

```
column [CONSTRAINT constraint_name] constraint_type,
```

- Table-level constraint syntax:

```
column,...
  [CONSTRAINT constraint_name] constraint_type
  (column, ...),
```

Defining Constraints

- Example of a column-level constraint:

```
CREATE TABLE employees(
  employee_id  NUMBER(6)
    CONSTRAINT emp_emp_id_pk PRIMARY KEY,
  first_name   VARCHAR2(20),
  ...);
```

①

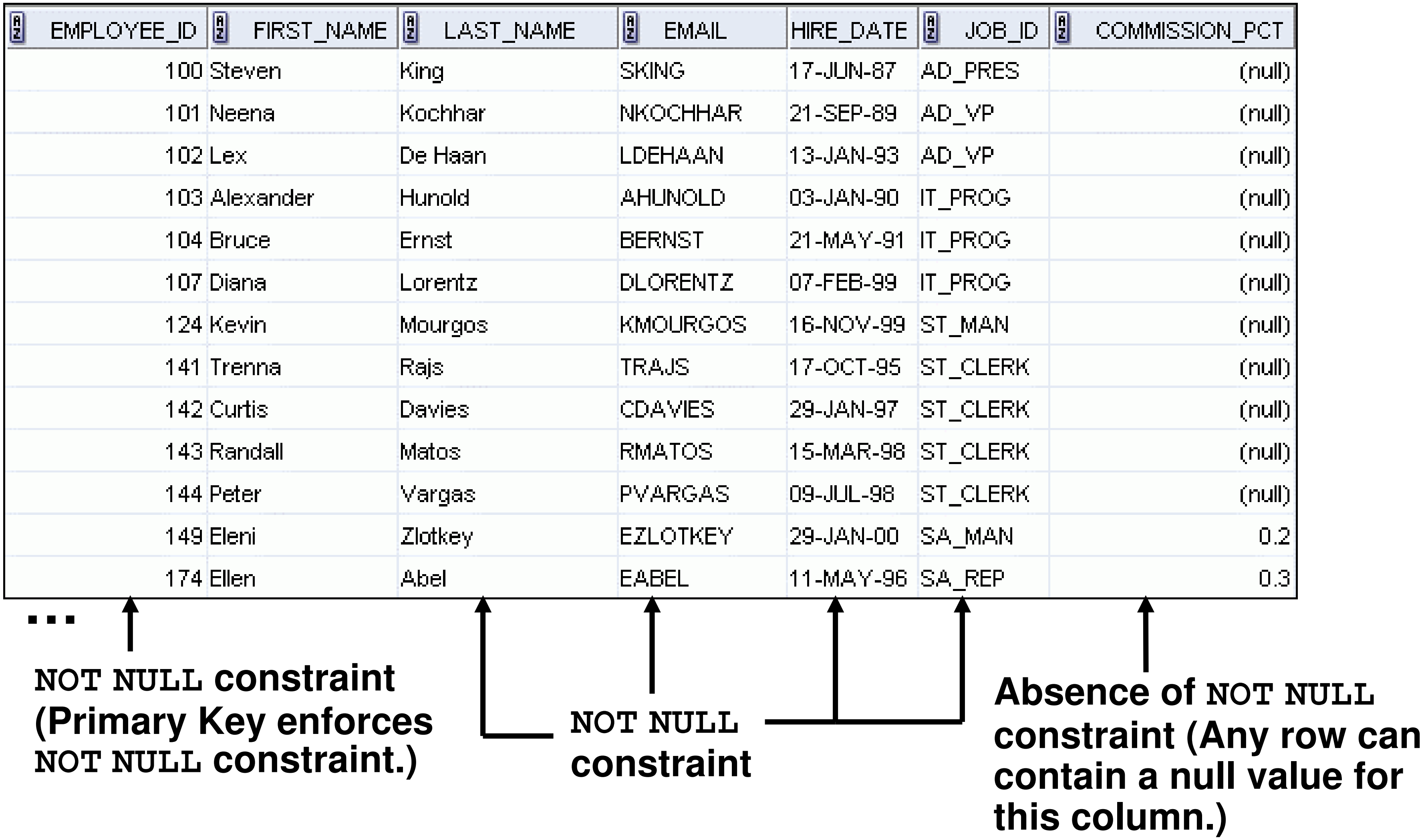
- Example of a table-level constraint:

```
CREATE TABLE employees(
  employee_id  NUMBER(6),
  first_name   VARCHAR2(20),
  ...
  job_id       VARCHAR2(10) NOT NULL,
  CONSTRAINT emp_emp_id_pk
    PRIMARY KEY (EMPLOYEE_ID));
```

②

`NOT NULL` Constraint

Ensures that null values are not permitted for the column:



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	HIRE_DATE	JOB_ID	COMMISSION_PCT
100	Steven	King	SKING	17-JUN-87	AD_PRES	(null)
101	Neena	Kochhar	NKOCHHAR	21-SEP-89	AD_VP	(null)
102	Lex	De Haan	LDEHAAN	13-JAN-93	AD_VP	(null)
103	Alexander	Hunold	AHUNOLD	03-JAN-90	IT_PROG	(null)
104	Bruce	Ernst	BERNST	21-MAY-91	IT_PROG	(null)
107	Diana	Lorentz	DLORENTZ	07-FEB-99	IT_PROG	(null)
124	Kevin	Mourgos	KMOURGOS	16-NOV-99	ST_MAN	(null)
141	Trenna	Rajs	TRAJS	17-OCT-95	ST_CLERK	(null)
142	Curtis	Davies	CDAVIES	29-JAN-97	ST_CLERK	(null)
143	Randall	Matos	RMATOS	15-MAR-98	ST_CLERK	(null)
144	Peter	Vargas	PVARGAS	09-JUL-98	ST_CLERK	(null)
149	Eleni	Zlotkey	EZLOTKEY	29-JAN-00	SA_MAN	0.2
174	Ellen	Abel	EABEL	11-MAY-96	SA_REP	0.3

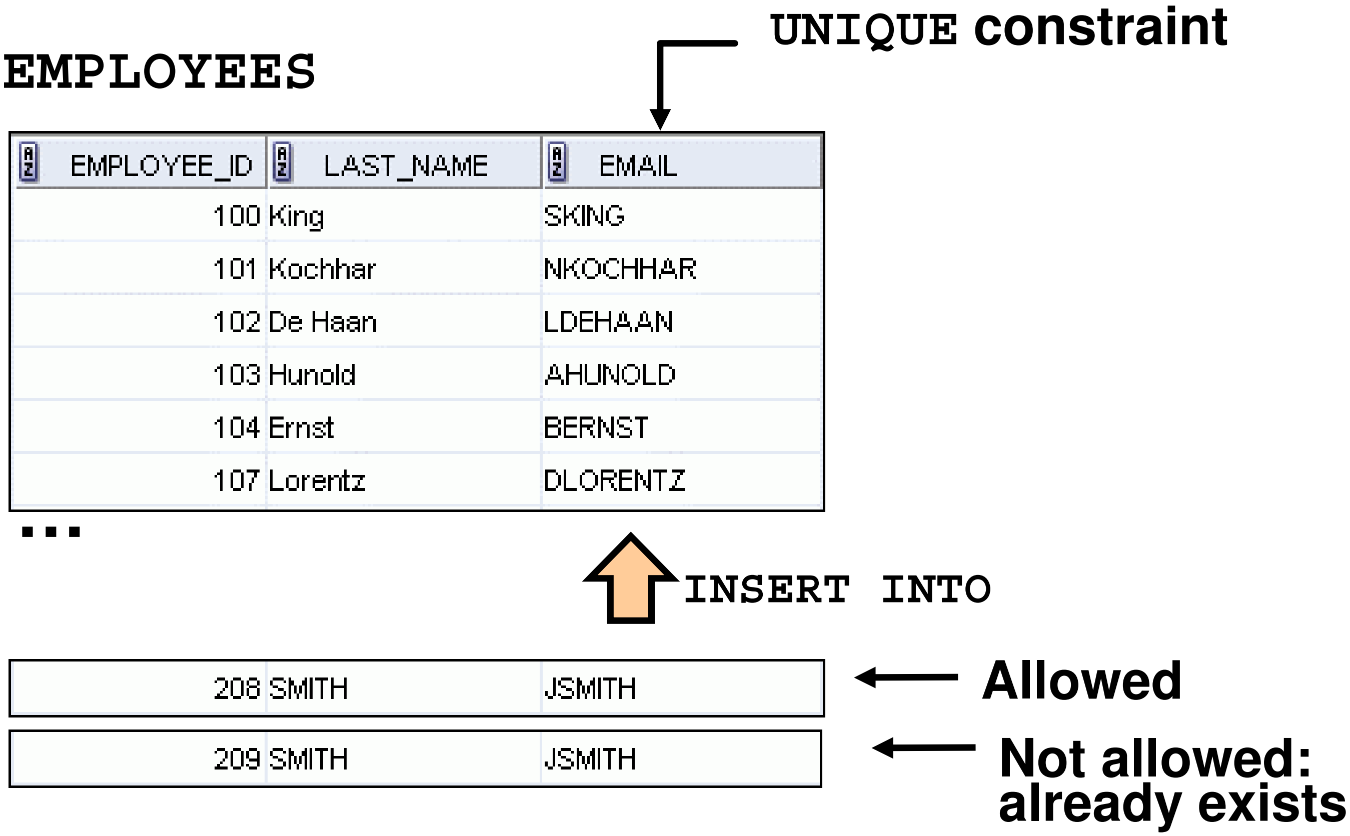
…

`NOT NULL` constraint (Primary Key enforces `NOT NULL` constraint.)

`NOT NULL` constraint

Absence of `NOT NULL` constraint (Any row can contain a null value for this column.)

`UNIQUE` Constraint



`UNIQUE` **constraint**

`EMPLOYEES`

EMPLOYEE_ID	LAST_NAME	EMAIL
100	King	SKING
101	Kochhar	NKOCHHAR
102	De Haan	LDEHAAN
103	Hunold	AHUNOLD
104	Ernst	BERNST
107	Lorentz	DLORENTZ

…

`INSERT INTO`

208	SMITH	JSMITH

Allowed

209	SMITH	JSMITH

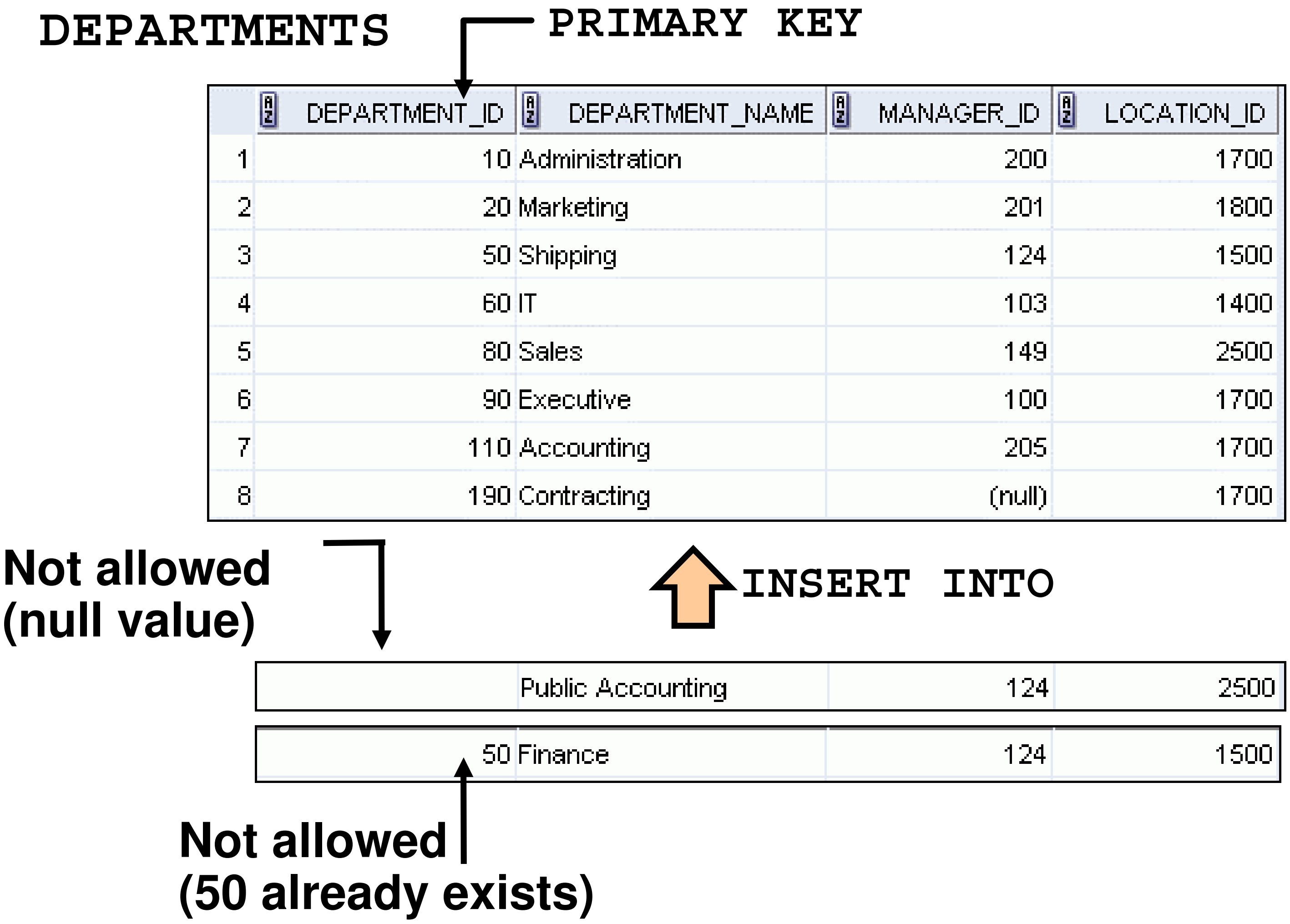
Not allowed: already exists

`UNIQUE` Constraint

Defined at either the table level or the column level:

```
CREATE TABLE employees(
    employee_id        NUMBER(6),
    last_name          VARCHAR2(25) NOT NULL,
    email              VARCHAR2(25),
    salary             NUMBER(8,2),
    commission_pct     NUMBER(2,2),
    hire_date          DATE NOT NULL,
...
    CONSTRAINT emp_email_uk UNIQUE(email));
```

`PRIMARY KEY` Constraint



`DEPARTMENTS`

`PRIMARY KEY`

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

`INSERT INTO`

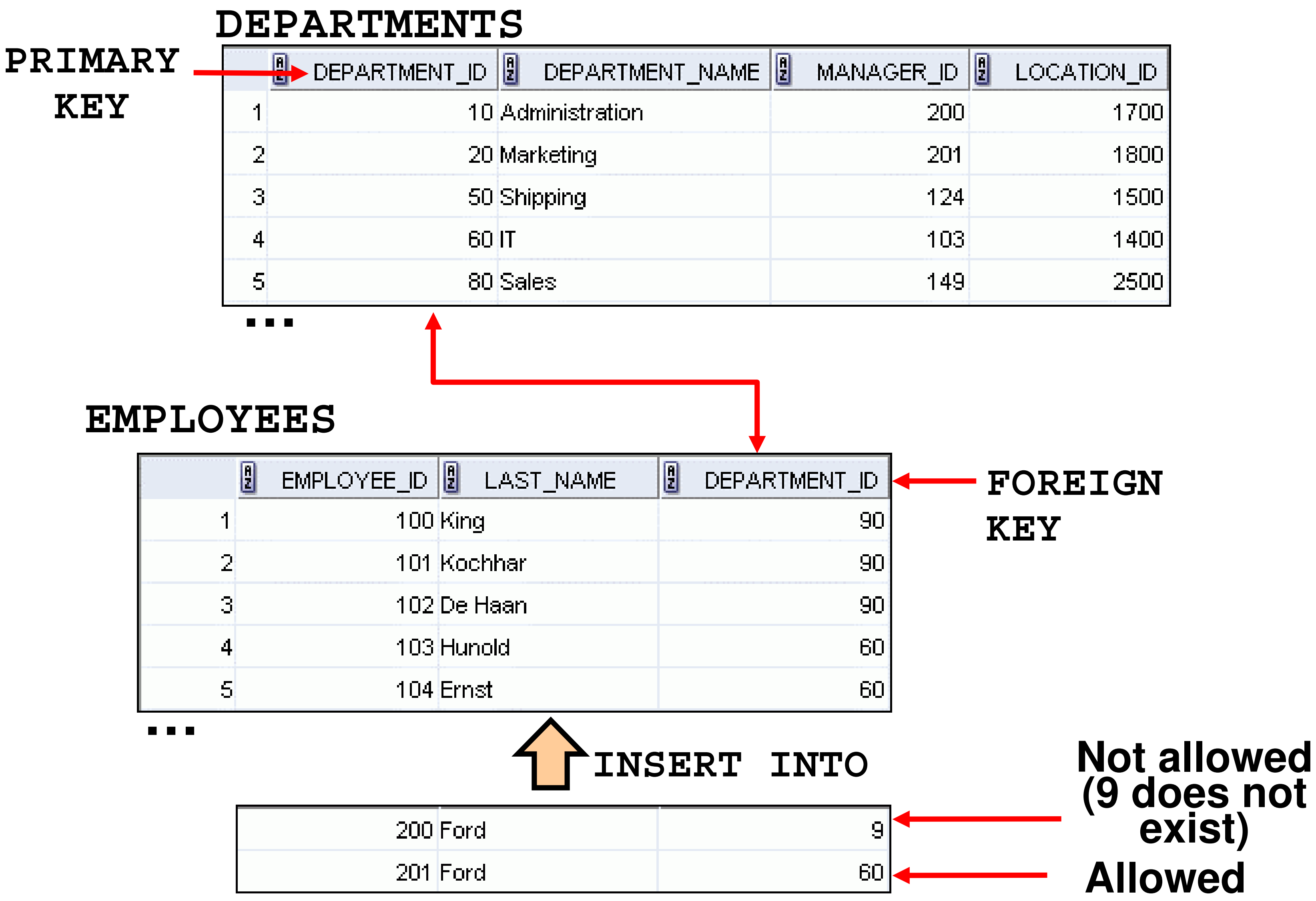
Not allowed
(null value)

	Public Accounting	124	2500

50	Finance	124	1500

Not allowed
(50 already exists)

FOREIGN KEY Constraint



DEPARTMENTS

PRIMARY KEY

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500

...

EMPLOYEES

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60
5	104	Ernst	60

...

FOREIGN KEY

INSERT INTO

200	Ford	9
201	Ford	60

Not allowed (9 does not exist)

Allowed

FOREIGN KEY Constraint

Defined at either the table level or the column level:

```
CREATE TABLE employees(
    employee_id      NUMBER(6),
    last_name        VARCHAR2(25) NOT NULL,
    email            VARCHAR2(25),
    salary           NUMBER(8,2),
    commission_pct   NUMBER(2,2),
    hire_date        DATE NOT NULL,
...
    department_id    NUMBER(4),
    CONSTRAINT emp_dept_fk FOREIGN KEY (department_id)
      REFERENCES departments(department_id),
    CONSTRAINT emp_email_uk UNIQUE(email));
```

`FOREIGN KEY` Constraint: Keywords

- `FOREIGN KEY`: Defines the column in the child table at the table-constraint level
- `REFERENCES`: Identifies the table and column in the parent table
- `ON DELETE CASCADE`: Deletes the dependent rows in the child table when a row in the parent table is deleted
- `ON DELETE SET NULL`: Converts dependent foreign key values to null

`CHECK` Constraint

- Defines a condition that each row must satisfy
- The following expressions are not allowed:
  - References to `CURRVAL`, `NEXTVAL`, `LEVEL`, and `ROWNUM` pseudocolumns
  - Calls to `SYSDATE`, `UID`, `USER`, and `USERENV` functions
  - Queries that refer to other values in other rows

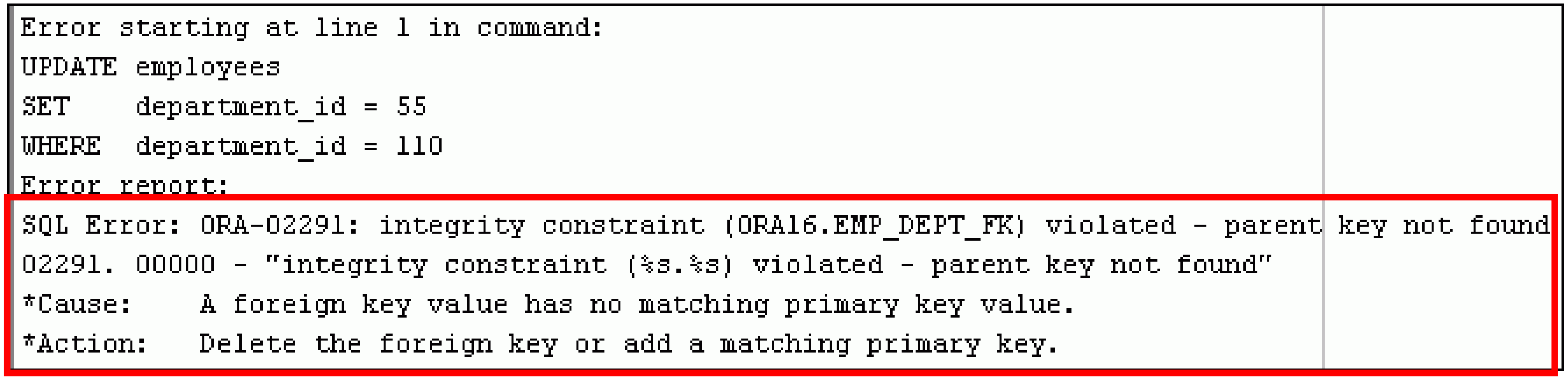
```
..., salary   NUMBER(2)
     CONSTRAINT emp_salary_min
             CHECK (salary > 0),...
```

CREATE TABLE: Example

```
CREATE TABLE employees
    ( employee_id    NUMBER(6)
        CONSTRAINT     emp_employee_id   PRIMARY KEY
    , first_name     VARCHAR2(20)
    , last_name      VARCHAR2(25)
        CONSTRAINT     emp_last_name_nn  NOT NULL
    , email          VARCHAR2(25)
        CONSTRAINT     emp_email_nn      NOT NULL
        CONSTRAINT     emp_email_uk      UNIQUE
    , phone_number   VARCHAR2(20)
    , hire_date      DATE
        CONSTRAINT     emp_hire_date_nn  NOT NULL
    , job_id         VARCHAR2(10)
        CONSTRAINT     emp_job_nn        NOT NULL
    , salary         NUMBER(8,2)
        CONSTRAINT     emp_salary_ck     CHECK (salary>0)
    , commission_pct NUMBER(2,2)
    , manager_id     NUMBER(6)
          CONSTRAINT emp_manager_fk REFERENCES
           employees (employee_id)
    , department_id  NUMBER(4)
        CONSTRAINT     emp_dept_fk       REFERENCES
           departments (department_id));
```

Violating Constraints

```
UPDATE employees
SET    department id = 55
WHERE  department_id = 110;
```



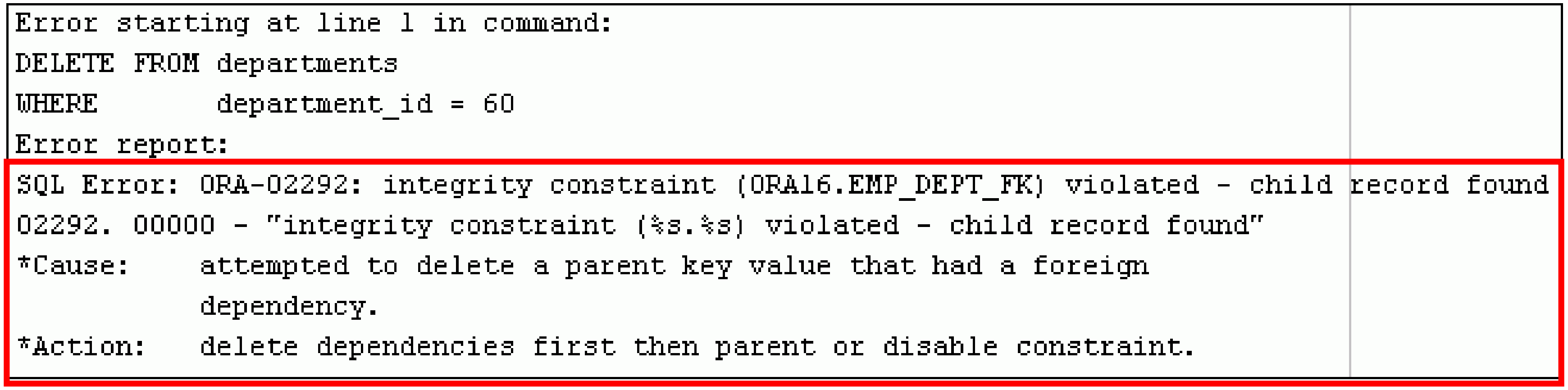
```
Error starting at line 1 in command:
UPDATE employees
SET    department_id = 55
WHERE  department_id = 110
Error report:
SQL Error: ORA-02291: integrity constraint (ORA16.EMP_DEPT_FK) violated - parent key not found
02291. 00000 - "integrity constraint (%s.%s) violated - parent key not found"
*Cause:    A foreign key value has no matching primary key value.
*Action:   Delete the foreign key or add a matching primary key.
```

Department 55 does not exist.

Violating Constraints

You cannot delete a row that contains a primary key that is used as a foreign key in another table.

```
DELETE FROM departments
WHERE department_id = 60;
```



```
Error starting at line 1 in command:
DELETE FROM departments
WHERE       department_id = 60
Error report:
SQL Error: ORA-02292: integrity constraint (ORA16.EMP_DEPT_FK) violated - child record found
02292. 00000 - "integrity constraint (%s.%s) violated - child record found"
*Cause:    attempted to delete a parent key value that had a foreign
           dependency.
*Action:   delete dependencies first then parent or disable constraint.
```

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user’s tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

Creating a Table Using a Subquery

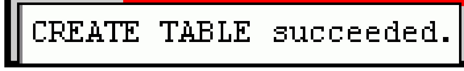
- Create a table and insert rows by combining the `CREATE TABLE` statement and the `AS` *`subquery`* option.

```
CREATE TABLE table
           [(column, column...)]
AS subquery;
```

- Match the number of specified columns to the number of subquery columns.
- Define columns with column names and default values.

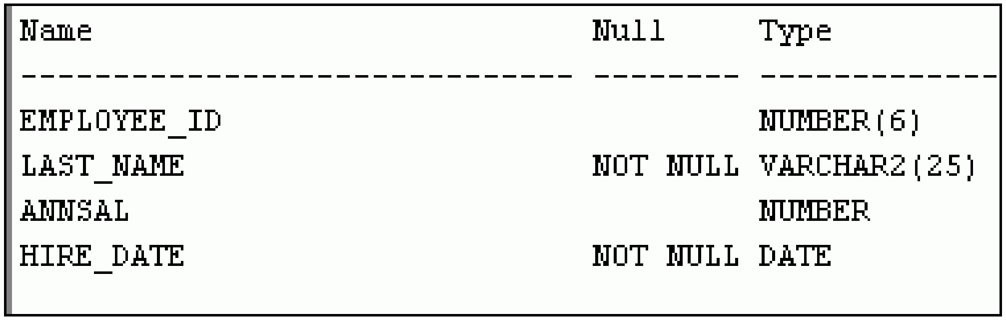
Creating a Table
Using a Subquery

```
CREATE TABLE  dept80
  AS
    SELECT  employee_id, last_name,
            salary*12 ANNSAL,
            hire_date
    FROM    employees
    WHERE   department id = 80;
```



```
CREATE TABLE succeeded.
```

```
DESCRIBE dept80
```



```
Name                           Null     Type
------------------------------ -------- -------------
EMPLOYEE_ID                             NUMBER(6)
LAST_NAME                      NOT NULL VARCHAR2(25)
ANNSAL                                  NUMBER
HIRE_DATE                      NOT NULL DATE
```

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user’s tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

`ALTER TABLE` Statement

Use the `ALTER TABLE` statement to:

- Add a new column
- Modify an existing column definition
- Define a default value for the new column
- Drop a column
- Rename a column
- Change table to read-only status

Read-Only Tables

You can use the `ALTER TABLE` syntax to:

- Put a table into read-only mode, which prevents DDL or DML changes during table maintenance
- Put the table back into read/write mode

```
ALTER TABLE employees READ ONLY;

-- perform table maintenance and then
-- return table back to read/write mode

ALTER TABLE employees READ WRITE;
```

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

Dropping a Table

- Moves a table to the recycle bin
- Removes the table and all its data entirely if the `PURGE` clause is specified
- Invalidates dependent objects and removes object privileges on the table

```
DROP TABLE dept80;
```

```
DROP TABLE dept80 succeeded.
```

Quiz

You can use constraints to do the following:

1. Enforce rules on the data in a table whenever a row is inserted, updated, or deleted.
2. Prevent the deletion of a table.
3. Prevent the creation of a table.
4. Prevent the creation of data in a table.

Summary

In this lesson, you should have learned how to use the `CREATE TABLE` statement to create a table and include constraints:

- Categorize the main database objects
- Review the table structure
- List the data types that are available for columns
- Create a simple table
- Explain how constraints are created at the time of table creation
- Describe how schema objects work

Practice 10: Overview

This practice covers the following topics:

- Creating new tables
- Creating a new table by using the `CREATE TABLE AS` syntax
- Verifying that tables exist
- Setting a table to read-only status
- Dropping tables

11

Creating Other Schema Objects

Objectives

After completing this lesson, you should be able to do the following:

- Create simple and complex views
- Retrieve data from views
- Create, maintain, and use sequences
- Create and maintain indexes
- Create private and public synonyms

Lesson Agenda

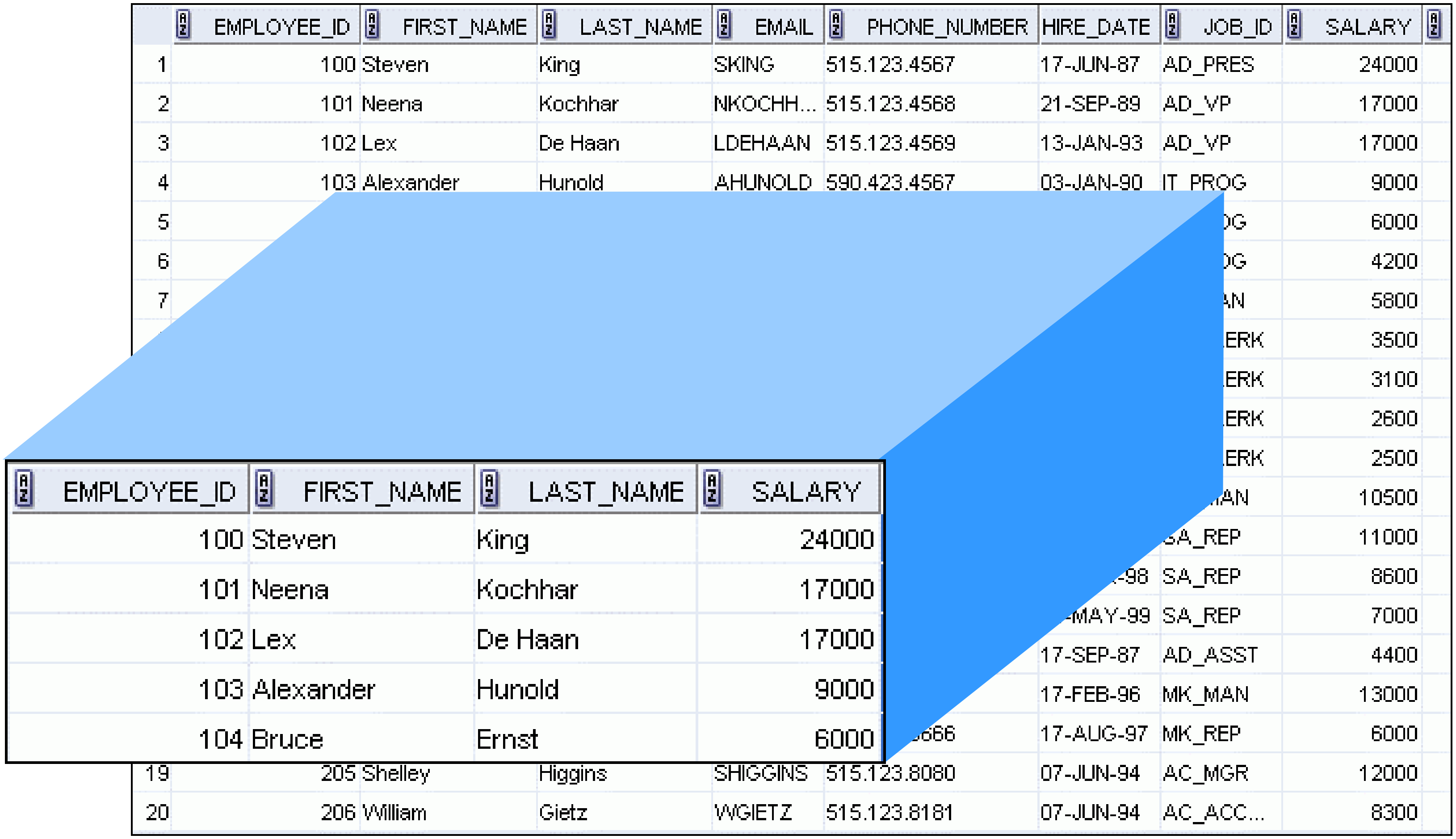
- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - Data manipulation language (DML) operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

Database Objects

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of data retrieval queries
Synonym	Gives alternative names to objects

What Is a View?

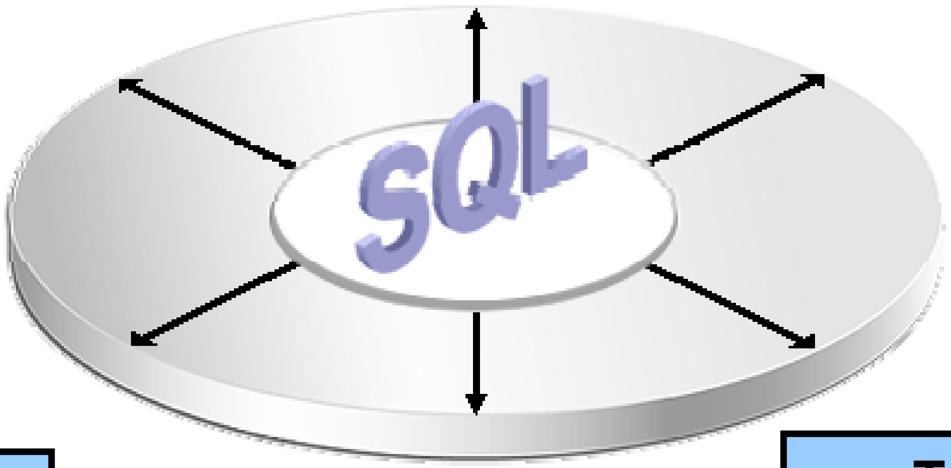
`EMPLOYEES` table



	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY
1	100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000
2	101	Neena	Kochhar	NKOCHH...	515.123.4568	21-SEP-89	AD_VP	17000
3	102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000
4	103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000
5							OG	6000
6							OG	4200
7							AN	5800
							ERK	3500
							ERK	3100
							ERK	2600
							ERK	2500
							IAN	10500
							SA_REP	11000
						-98	SA_REP	8600
						-MAY-99	SA_REP	7000
						17-SEP-87	AD_ASST	4400
						17-FEB-96	MK_MAN	13000
					666	17-AUG-97	MK_REP	6000
19	205	Shelley	Higgins	SHIGGINS	515.123.8080	07-JUN-94	AC_MGR	12000
20	206	William	Gietz	WGIETZ	515.123.8181	07-JUN-94	AC_ACC...	8300

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY
100	Steven	King	24000
101	Neena	Kochhar	17000
102	Lex	De Haan	17000
103	Alexander	Hunold	9000
104	Bruce	Ernst	6000

Advantages of Views



To restrict data access

To make complex queries easy

To provide data independence

To present different views of the same data

Simple Views and Complex Views

Feature	Simple Views	Complex Views
Number of tables	One	One or more
Contain functions	No	Yes
Contain groups of data	No	Yes
DML operations through a view	Yes	Not always

Creating a View

- You embed a subquery in the `CREATE VIEW` statement:

```
CREATE [OR REPLACE] [FORCE|NOFORCE] VIEW view
  [(alias[, alias]...)]
 AS subquery
[WITH CHECK OPTION [CONSTRAINT constraint]]
[WITH READ ONLY [CONSTRAINT constraint]];
```

- The subquery can contain complex `SELECT` syntax.

Creating a View

- Create the `EMPVU80` view, which contains details of the employees in department 80:

```
CREATE VIEW   empvu80
 AS SELECT   employee_id, last_name, salary
    FROM     employees
    WHERE    department_id = 80;
```

```
CREATE VIEW succeeded.
```

- Describe the structure of the view by using the *i*SQL*Plus `DESCRIBE` command:

```
DESCRIBE empvu80
```

Creating a View

- Create a view by using column aliases in the subquery:

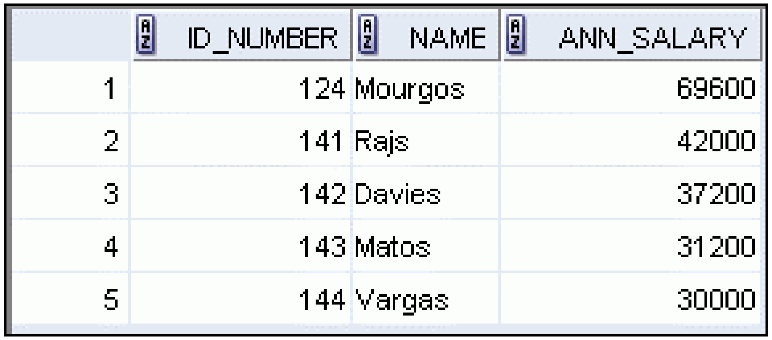
```
CREATE VIEW   salvu50
 AS SELECT   employee_id ID_NUMBER, last_name NAME,
             salary*12 ANN_SALARY
    FROM     employees
    WHERE    department_id = 50;
```

```
CREATE VIEW succeeded.
```

- Select the columns from this view by the given alias names.

Retrieving Data from a View

```
SELECT  *
FROM    salvu50;
```



	ID_NUMBER	NAME	ANN_SALARY
1	124	Mourgos	69600
2	141	Rajs	42000
3	142	Davies	37200
4	143	Matos	31200
5	144	Vargas	30000

Modifying a View

- Modify the `EMPVU80` view by using a `CREATE OR REPLACE VIEW` clause. Add an alias for each column name:

```
CREATE OR REPLACE VIEW empvu80
  (id_number, name, sal, department_id)
AS SELECT  employee_id, first_name || ' '
           || last_name, salary, department_id
   FROM    employees
   WHERE   department_id = 80;
```

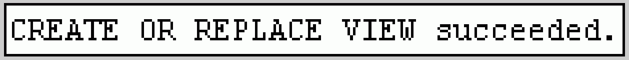
```
CREATE OR REPLACE VIEW succeeded.
```

- Column aliases in the `CREATE OR REPLACE VIEW` clause are listed in the same order as the columns in the subquery.

Creating a Complex View

Create a complex view that contains group functions to display values from two tables:

```
CREATE OR REPLACE VIEW dept_sum_vu
  (name, minsal, maxsal, avgsal)
AS SELECT   d.department_name, MIN(e.salary),
            MAX(e.salary),AVG(e.salary)
   FROM     employees e JOIN departments d
   ON       (e.department_id = d.department_id)
   GROUP BY d.department_name;
```



```
CREATE OR REPLACE VIEW succeeded.
```

Rules for Performing DML Operations on a View

- You can usually perform DML operations on simple views.
- You cannot remove a row if the view contains the following:
  - Group functions
  - A `GROUP BY` clause
  - The `DISTINCT` keyword
  - The pseudocolumn `ROWNUM` keyword

Rules for Performing DML Operations on a View

You cannot modify data in a view if it contains:

- Group functions
- A `GROUP BY` clause
- The `DISTINCT` keyword
- The pseudocolumn `ROWNUM` keyword
- Columns defined by expressions

Rules for Performing DML Operations on a View

You cannot add data through a view if the view includes:

- Group functions
- A `GROUP BY` clause
- The `DISTINCT` keyword
- The pseudocolumn `ROWNUM` keyword
- Columns defined by expressions
- `NOT NULL` columns in the base tables that are not selected by the view

Using the `WITH CHECK OPTION` Clause

- You can ensure that DML operations performed on the view stay in the domain of the view by using the `WITH CHECK OPTION` clause:

```
CREATE OR REPLACE VIEW empvu20
AS SELECT     *
   FROM       employees
   WHERE      department_id = 20
   WITH CHECK OPTION CONSTRAINT empvu20_ck ;
```

```
CREATE OR REPLACE VIEW succeeded.
```

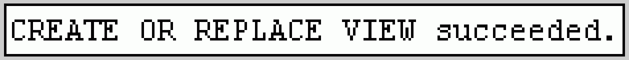
- Any attempt to `INSERT` a row with a `department_id` other than 20, or to `UPDATE` the department number for any row in the view fails because it violates the `WITH CHECK OPTION` constraint.

Denying DML Operations

- You can ensure that no DML operations occur by adding the `WITH READ ONLY` option to your view definition.
- Any attempt to perform a DML operation on any row in the view results in an Oracle server error.

Denying DML Operations

```
CREATE OR REPLACE VIEW empvu10
    (employee_number, employee_name, job_title)
AS SELECT    employee_id, last_name, job_id
   FROM      employees
   WHERE     department_id = 10
   WITH READ ONLY ;
```



```
CREATE OR REPLACE VIEW succeeded.
```

Removing a View

You can remove a view without losing data because a view is based on underlying tables in the database.

```
DROP VIEW view;
```

```
DROP VIEW empvu80;
```

```
DROP VIEW empvu80 succeeded.
```

Practice 11: Overview of Part 1

This practice covers the following topics:

- Creating a simple view
- Creating a complex view
- Creating a view with a check constraint
- Attempting to modify data in the view
- Removing views

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

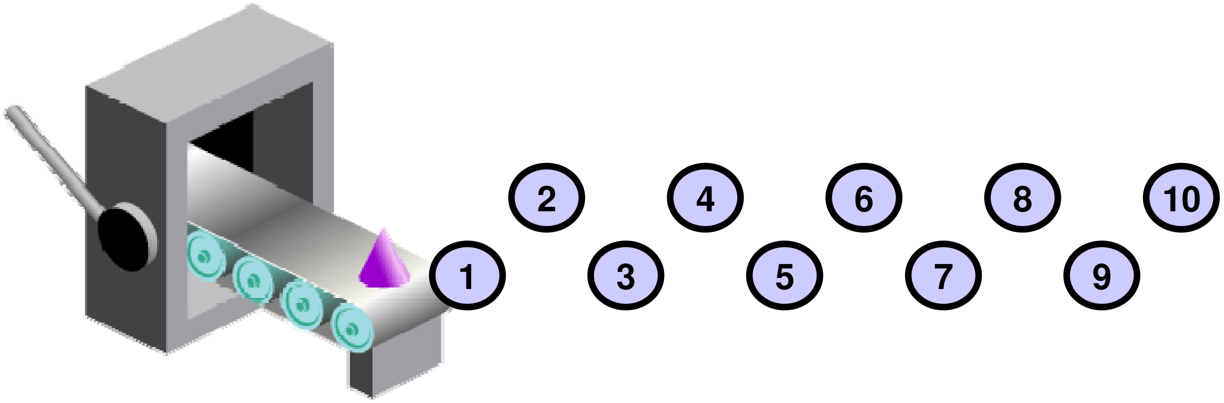
Sequences

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative names to objects

Sequences

A sequence:

- Can automatically generate unique numbers
- Is a shareable object
- Can be used to create a primary key value
- Replaces application code
- Speeds up the efficiency of accessing sequence values when cached in memory



`CREATE SEQUENCE` Statement: Syntax

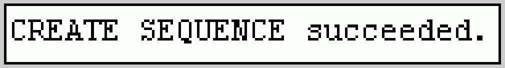
Define a sequence to generate sequential numbers automatically:

```
CREATE SEQUENCE sequence
       [INCREMENT BY n]
       [START WITH n]
       [{MAXVALUE n | NOMAXVALUE}]
       [{MINVALUE n | NOMINVALUE}]
       [{CYCLE | NOCYCLE}]
       [{CACHE n | NOCACHE}];
```

Creating a Sequence

- Create a sequence named `DEPT_DEPTID_SEQ` to be used for the primary key of the `DEPARTMENTS` table.
- Do not use the `CYCLE` option.

```
CREATE SEQUENCE dept_deptid_seq
                INCREMENT BY 10
                START WITH 120
                MAXVALUE 9999
                NOCACHE
                NOCYCLE;
```



```
CREATE SEQUENCE succeeded.
```

`NEXTVAL` and `CURRVAL` Pseudocolumns

- `NEXTVAL` returns the next available sequence value. It returns a unique value every time it is referenced, even for different users.
- `CURRVAL` obtains the current sequence value.
- `NEXTVAL` must be issued for that sequence before `CURRVAL` contains a value.

Using a Sequence

- Insert a new department named “Support” in location ID 2500:

```
INSERT INTO departments(department_id,
                department_name, location_id)
VALUES          (dept_deptid_seq.NEXTVAL,
                'Support', 2500);
```

```
1 rows inserted
```

- View the current value for the `DEPT_DEPTID_SEQ` sequence:

```
SELECT   dept_deptid_seq.CURRVAL
FROM     dual;
```

Caching Sequence Values

- Caching sequence values in memory gives faster access to those values.
- Gaps in sequence values can occur when:
  - A rollback occurs
  - The system crashes
  - A sequence is used in another table

Modifying a Sequence

Change the increment value, maximum value, minimum value, cycle option, or cache option:

```
ALTER SEQUENCE dept_deptid_seq
               INCREMENT BY 20
               MAXVALUE 999999
               NOCACHE
               NOCYCLE;
```

```
ALTER SEQUENCE dept_deptid_seq succeeded.
```

Guidelines for Modifying a Sequence

- You must be the owner or have the `ALTER` privilege for the sequence.
- Only future sequence numbers are affected.
- The sequence must be dropped and re-created to restart the sequence at a different number.
- Some validation is performed.
- To remove a sequence, use the `DROP` statement:

```
DROP SEQUENCE dept_deptid_seq;
```

```
DROP SEQUENCE dept_deptid_seq succeeded.
```

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

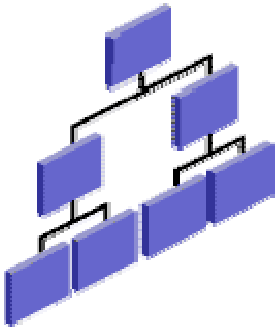
Indexes

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative names to objects

Indexes

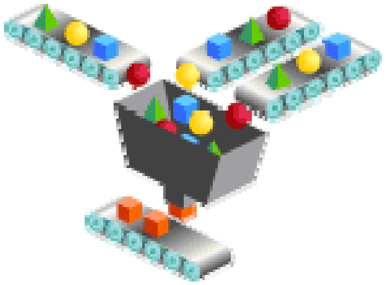
An index:

- Is a schema object
- May be used by the Oracle server to speed up the retrieval of rows by using a pointer
- Can reduce disk input/output (I/O) by using a rapid path access method to locate data quickly
- Is independent of the table that it indexes
- Is used and maintained automatically by the Oracle server

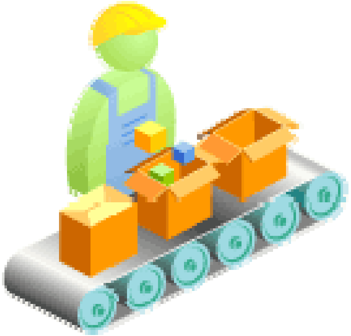


How Are Indexes Created?

- Automatically: A unique index is created automatically when you define a `PRIMARY KEY` or `UNIQUE` constraint in a table definition.



- Manually: Users can create nonunique indexes on columns to speed up access to the rows.



Creating an Index

- Create an index on one or more columns:

```
CREATE  [UNIQUE][BITMAP]INDEX index
ON table (column[, column]...);
```

- Improve the speed of query access to the `LAST_NAME` column in the `EMPLOYEES` table:

```
CREATE INDEX  emp_last_name_idx
ON            employees(last_name);
```

```
CREATE INDEX succeeded.
```

Index Creation Guidelines

Create an index when:	
✓	A column contains a wide range of values
✓	A column contains a large number of null values
✓	One or more columns are frequently used together in a `WHERE` clause or a join condition
✓	The table is large and most queries are expected to retrieve less than 2% to 4% of the rows in the table
Do not create an index when:	
✗	The columns are not often used as a condition in the query
✗	The table is small or most queries are expected to retrieve more than 2% to 4% of the rows in the table
✗	The table is updated frequently
✗	The indexed columns are referenced as part of an expression

Removing an Index

- Remove an index from the data dictionary by using the `DROP INDEX` command:

```
DROP INDEX index;
```

- Remove the `emp_last_name_idx` index from the data dictionary:

```
DROP INDEX emp_last_name_idx;
```

```
DROP INDEX emp_last_name_idx succeeded.
```

- To drop an index, you must be the owner of the index or have the `DROP ANY INDEX` privilege.

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

Synonyms

Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative names to objects

Creating a Synonym for an Object

Simplify access to objects by creating a synonym (another name for an object). With synonyms, you can:

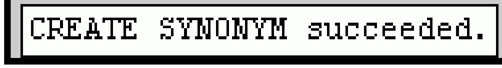
- Create an easier reference to a table that is owned by another user
- Shorten lengthy object names

```
CREATE [PUBLIC] SYNONYM synonym
FOR    object;
```

Creating and Removing Synonyms

- Create a shortened name for the `DEPT_SUM_VU` view:

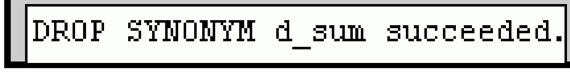
```
CREATE SYNONYM  d_sum
FOR  dept_sum_vu;
```



```
CREATE SYNONYM succeeded.
```

- Drop a synonym:

```
DROP SYNONYM d_sum;
```



```
DROP SYNONYM d_sum succeeded.
```

Quiz

Indexes must be created manually and serve to speed up access to rows in a table.

1. True
2. False

Summary

In this lesson, you should have learned how to:

- Create, use, and remove views
- Automatically generate sequence numbers by using a sequence generator
- Create indexes to improve speed of query retrieval
- Use synonyms to provide alternative names for objects

Practice 11: Overview of Part 2

This practice covers the following topics:

- Creating sequences
- Using sequences
- Creating nonunique indexes
- Creating synonyms

C

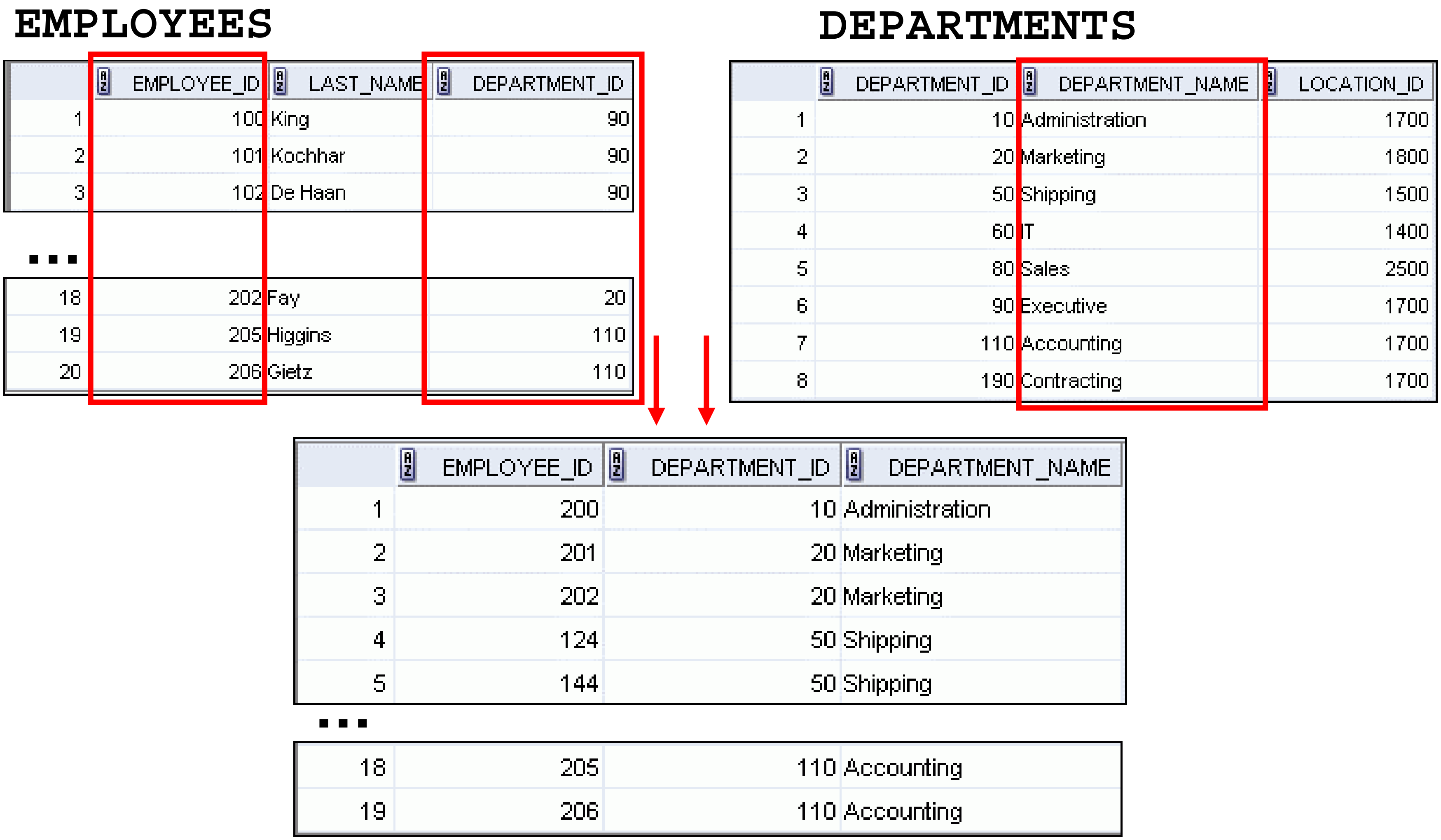
Oracle Join Syntax

Objectives

After completing this appendix, you should be able to do the following:

- Write `SELECT` statements to access data from more than one table using equijoins and nonequijoins
- Join a table to itself by using a self-join
- View data that generally does not meet a join condition by using outer joins
- Generate a Cartesian product of all rows from two or more tables

Obtaining Data from Multiple Tables



EMPLOYEES

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90

…

18	202	Fay	20
19	205	Higgins	110
20	206	Gietz	110

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

	EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
1	200	10	Administration
2	201	20	Marketing
3	202	20	Marketing
4	124	50	Shipping
5	144	50	Shipping

…

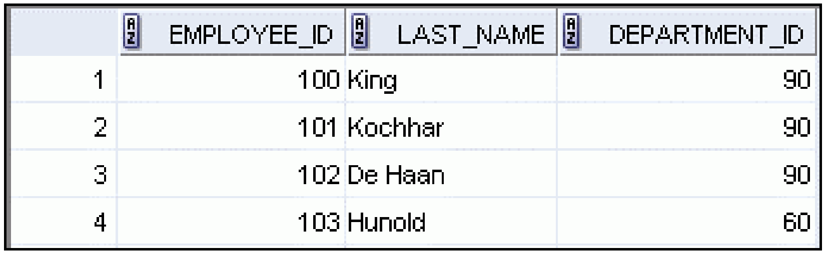
18	205	110	Accounting
19	206	110	Accounting

Cartesian Products

- A Cartesian product is formed when:
  - A join condition is omitted
  - A join condition is invalid
  - All rows in the first table are joined to all rows in the second table
- To avoid a Cartesian product, always include a valid join condition in a `WHERE` clause.

Generating a Cartesian Product

EMPLOYEES (20 rows)

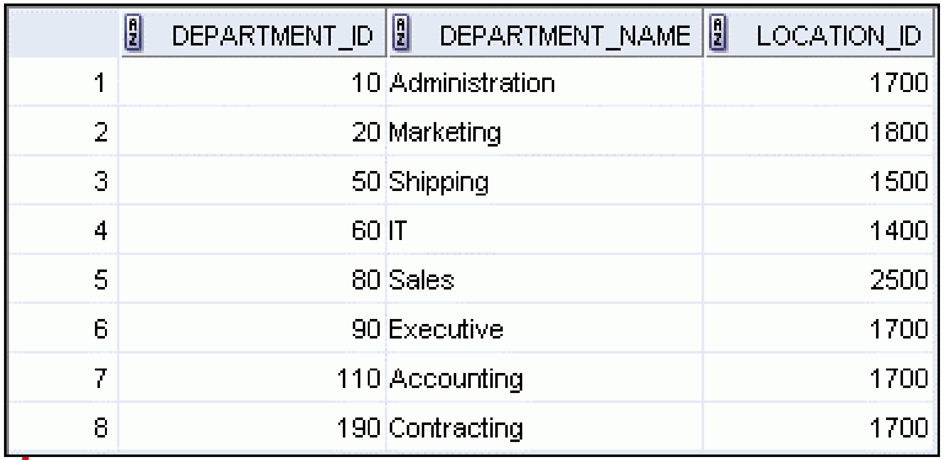


	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60

…

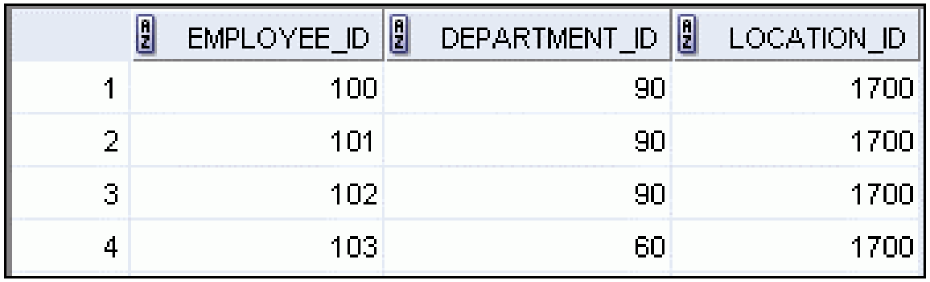
19	205	Higgins	110
20	206	Gietz	110

DEPARTMENTS (8 rows)



	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

Cartesian product:
20 x 8 = 160 rows



	EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
1	100	90	1700
2	101	90	1700
3	102	90	1700
4	103	60	1700

…

159	205	110	1700
160	206	110	1700

Types of Oracle-Proprietary Joins

- Equijoin
- Nonequijoin
- Outer join
- Self-join

Joining Tables Using Oracle Syntax

Use a join to query data from more than one table:

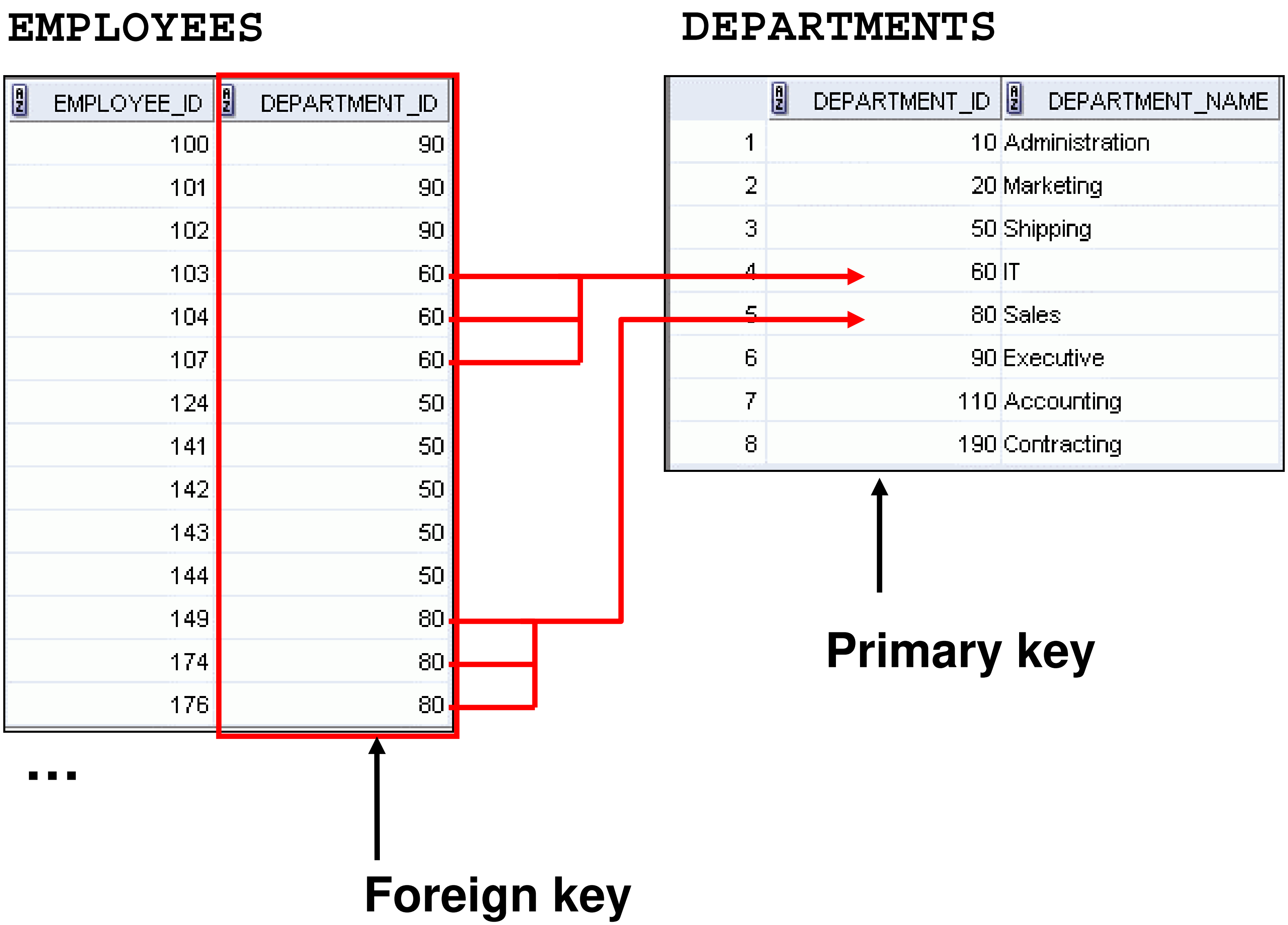
```
SELECT    table1.column, table2.column
FROM      table1, table2
WHERE     table1.column1 = table2.column2;
```

- Write the join condition in the `WHERE` clause.
- Prefix the column name with the table name when the same column name appears in more than one table.

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Use table prefixes to improve performance.
- Instead of full table name prefixes, use table aliases.
- Table aliases give a table a shorter name.
  - Keeps SQL code smaller, uses less memory
- Use column aliases to distinguish columns that have identical names, but reside in different tables.

Equijoins



EMPLOYEES

EMPLOYEE_ID	DEPARTMENT_ID
100	90
101	90
102	90
103	60
104	60
107	60
124	50
141	50
142	50
143	50
144	50
149	80
174	80
176	80

…

DEPARTMENTS

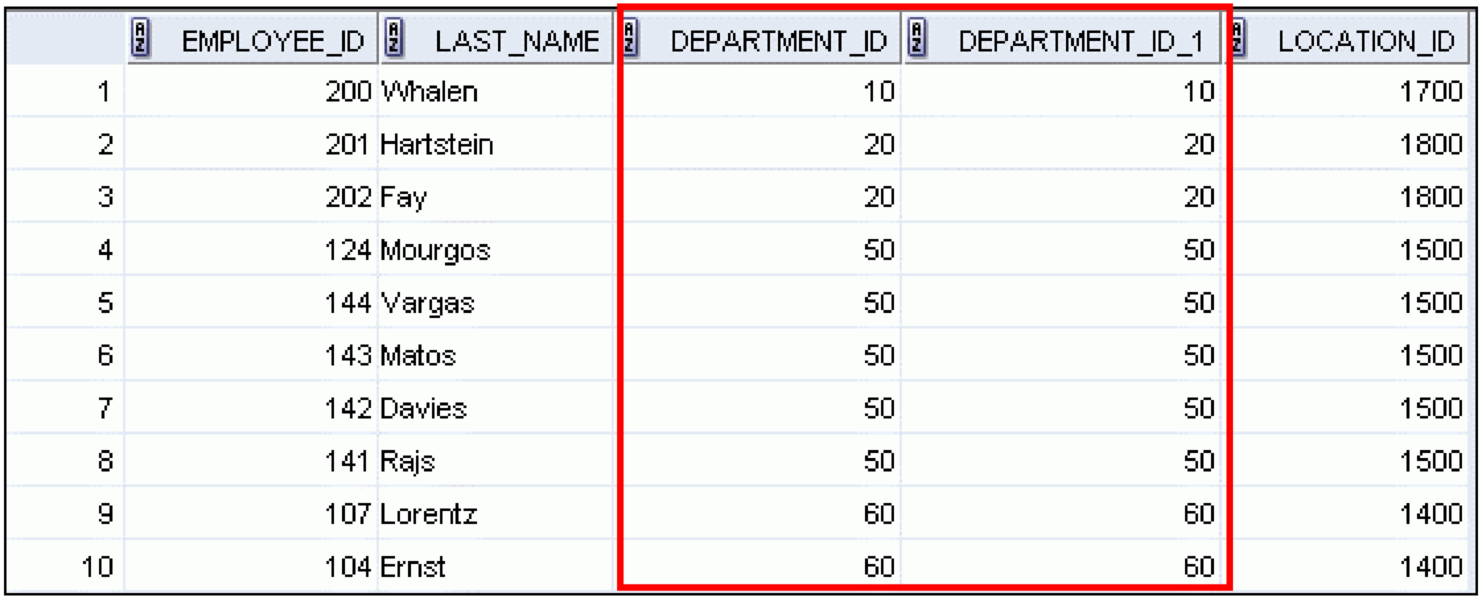
	DEPARTMENT_ID	DEPARTMENT_NAME
1	10	Administration
2	20	Marketing
3	50	Shipping
4	60	IT
5	80	Sales
6	90	Executive
7	110	Accounting
8	190	Contracting

Primary key

Foreign key

Retrieving Records with Equijoins

```
SELECT e.employee_id, e.last_name, e.department_id,
       d.department_id, d.location_id
FROM   employees e, departments d
WHERE  e.department_id = d.department_id;
```

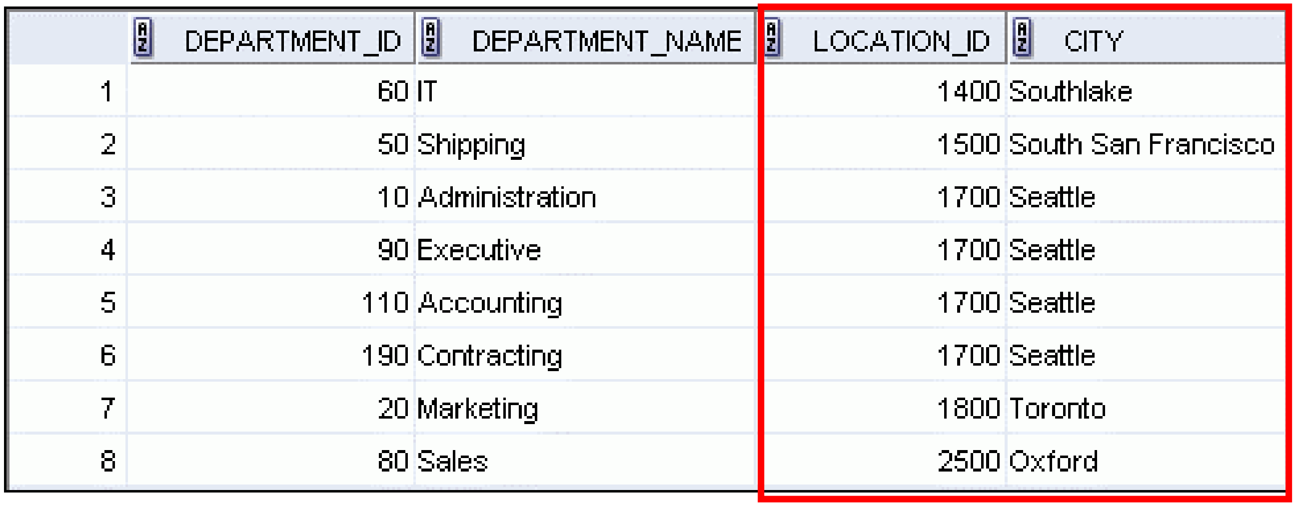


	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID_1	LOCATION_ID
1	200	Whalen	10	10	1700
2	201	Hartstein	20	20	1800
3	202	Fay	20	20	1800
4	124	Mourgos	50	50	1500
5	144	Vargas	50	50	1500
6	143	Matos	50	50	1500
7	142	Davies	50	50	1500
8	141	Rajs	50	50	1500
9	107	Lorentz	60	60	1400
10	104	Ernst	60	60	1400

…

Retrieving Records with Equijoins: Example

```
SELECT d.department_id, d.department_name,
       d.location_id, l.city
FROM   departments d, locations l
WHERE  d.location_id = l.location_id;
```



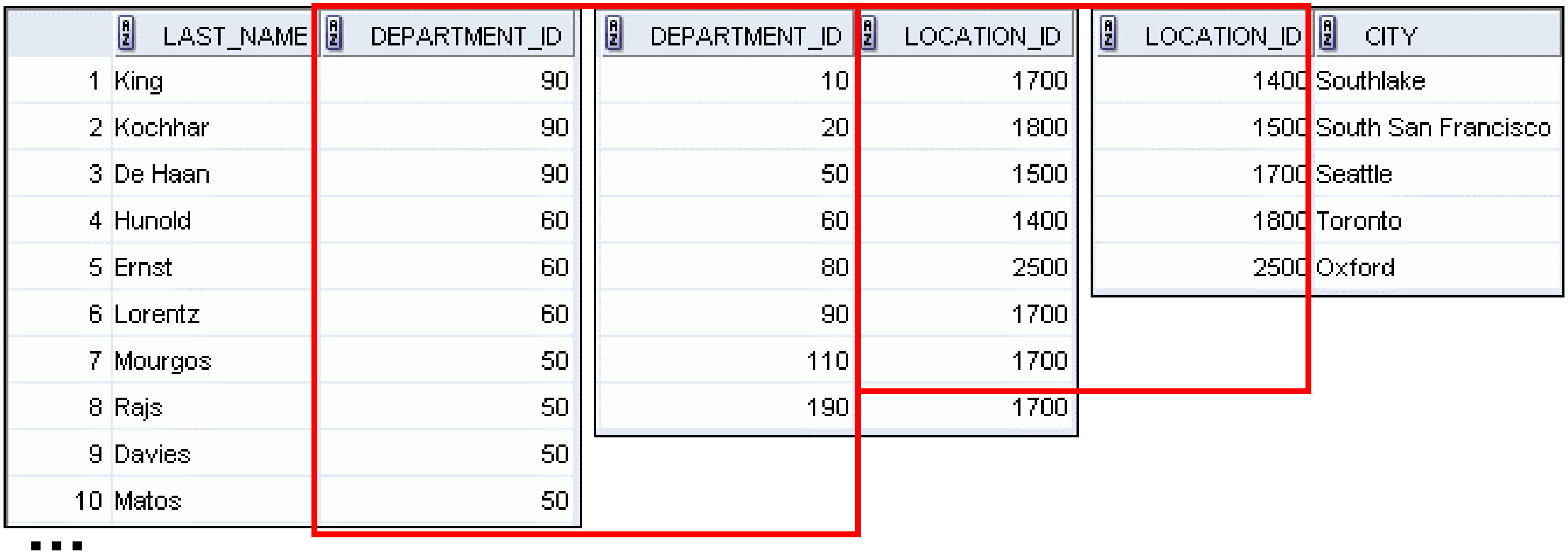
	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
1	60	IT	1400	Southlake
2	50	Shipping	1500	South San Francisco
3	10	Administration	1700	Seattle
4	90	Executive	1700	Seattle
5	110	Accounting	1700	Seattle
6	190	Contracting	1700	Seattle
7	20	Marketing	1800	Toronto
8	80	Sales	2500	Oxford

Additional Search Conditions Using the `AND` Operator

```
SELECT  d.department_id, d.department_name, l.city
FROM    departments d, locations l
WHERE   d.location_id = l.location_id
AND d.department id IN (20, 50);
```

	DEPARTMENT_ID	DEPARTMENT_NAME	CITY
1	20	Marketing	Toronto
2	50	Shipping	South San Francisco

Joining More than Two Tables



EMPLOYEES

	LAST_NAME	DEPARTMENT_ID
1	King	90
2	Kochhar	90
3	De Haan	90
4	Hunold	60
5	Ernst	60
6	Lorentz	60
7	Mourgos	50
8	Rajs	50
9	Davies	50
10	Matos	50

…

DEPARTMENTS

DEPARTMENT_ID	LOCATION_ID
10	1700
20	1800
50	1500
60	1400
80	2500
90	1700
110	1700
190	1700

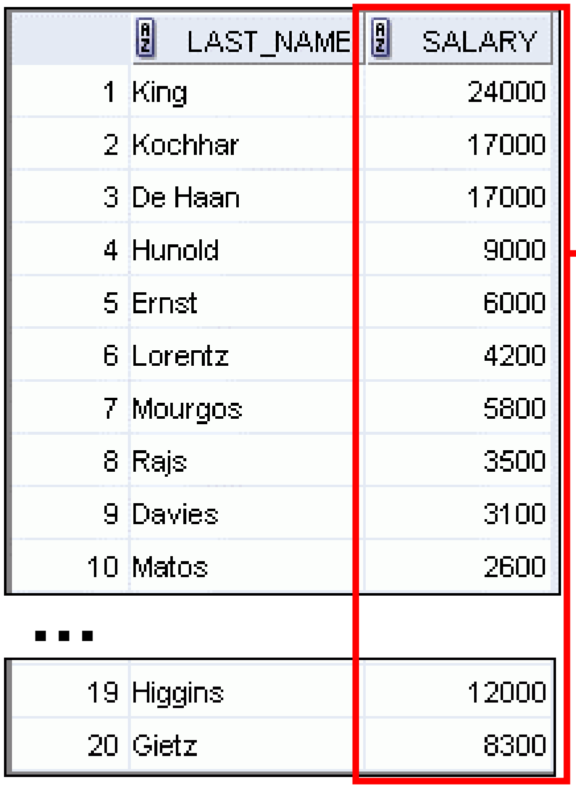
LOCATIONS

LOCATION_ID	CITY
1400	Southlake
1500	South San Francisco
1700	Seattle
1800	Toronto
2500	Oxford

To join *n* tables together, you need a minimum of n–1 join conditions. For example, to join three tables, a minimum of two joins is required.

Nonequijoins

EMPLOYEES

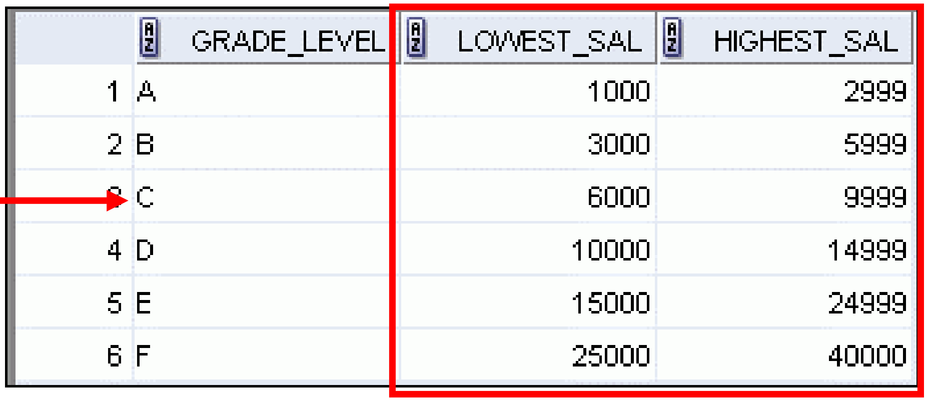


	LAST_NAME	SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Hunold	9000
5	Ernst	6000
6	Lorentz	4200
7	Mourgos	5800
8	Rajs	3500
9	Davies	3100
10	Matos	2600

…

	LAST_NAME	SALARY
19	Higgins	12000
20	Gietz	8300

JOB_GRADES

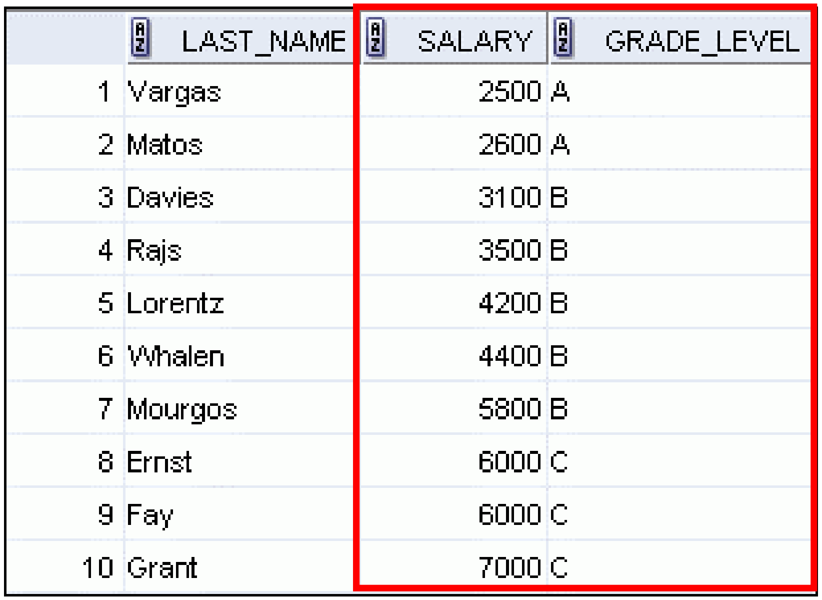


	GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
1	A	1000	2999
2	B	3000	5999
3	C	6000	9999
4	D	10000	14999
5	E	15000	24999
6	F	25000	40000

`JOB_GRADES` table defines `LOWEST_SAL` and `HIGHEST_SAL` range of values for each `GRADE_LEVEL`. Hence, the `GRADE_LEVEL` column can be used to assign grades to each employee.

Retrieving Records with Nonequijoins

```
SELECT  e.last_name, e.salary, j.grade_level
FROM    employees e, job_grades j
WHERE   e.salary
        BETWEEN j.lowest_sal AND j.highest_sal;
```

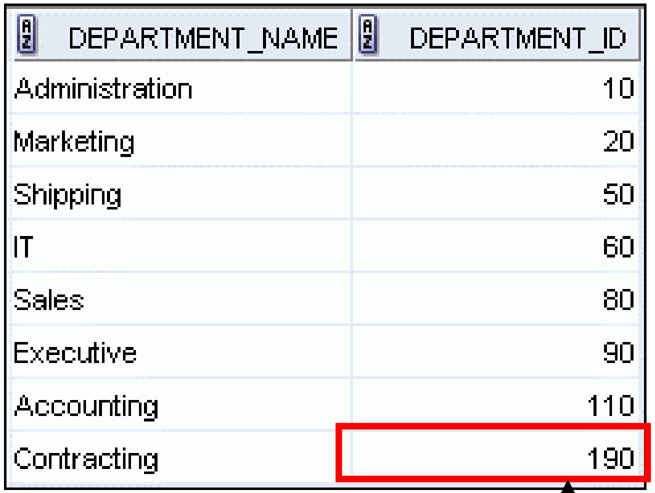


	LAST_NAME	SALARY	GRADE_LEVEL
1	Vargas	2500	A
2	Matos	2600	A
3	Davies	3100	B
4	Rajs	3500	B
5	Lorentz	4200	B
6	Whalen	4400	B
7	Mourgos	5800	B
8	Ernst	6000	C
9	Fay	6000	C
10	Grant	7000	C

…

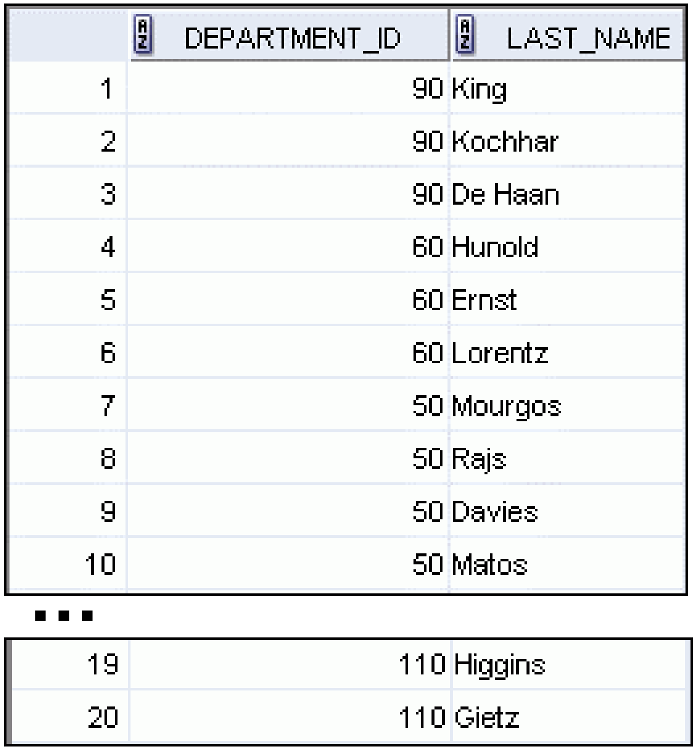
Returning Records with No Direct Match with Outer Joins

DEPARTMENTS



DEPARTMENT_NAME	DEPARTMENT_ID
Administration	10
Marketing	20
Shipping	50
IT	60
Sales	80
Executive	90
Accounting	110
Contracting	190

EMPLOYEES



	DEPARTMENT_ID	LAST_NAME
1	90	King
2	90	Kochhar
3	90	De Haan
4	60	Hunold
5	60	Ernst
6	60	Lorentz
7	50	Mourgos
8	50	Rajs
9	50	Davies
10	50	Matos
...		
19	110	Higgins
20	110	Gietz

There are no employees in department 190.

Outer Joins: Syntax

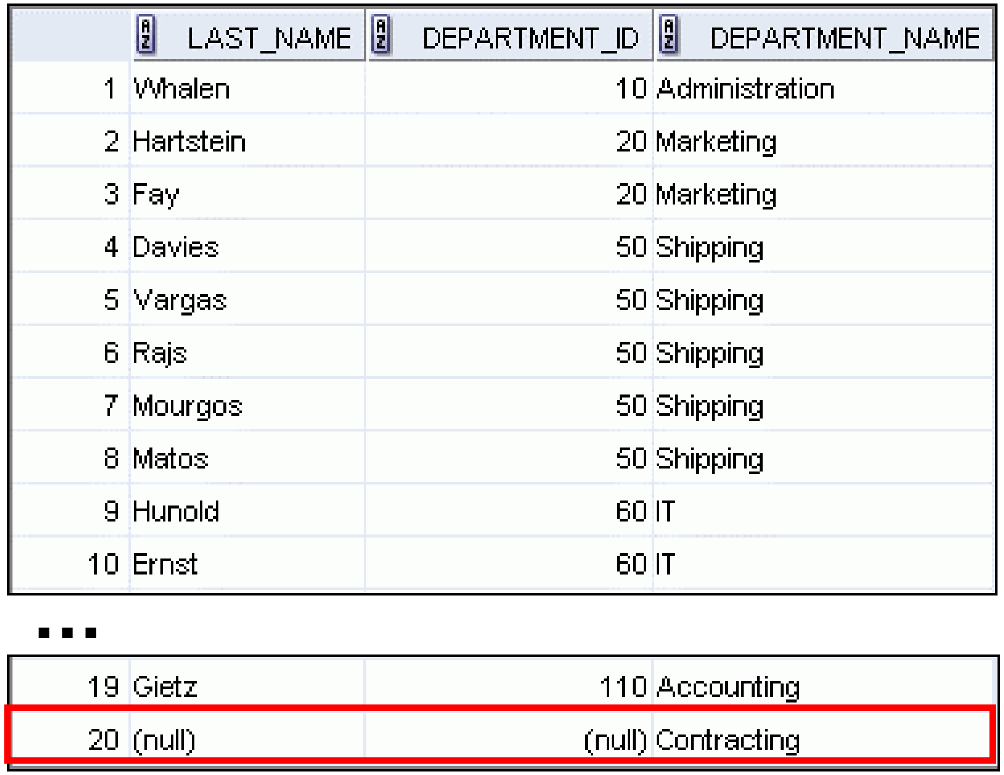
- You use an outer join to see rows that do not meet the join condition.
- The outer join operator is the plus sign (+).

```
SELECT table1.column, table2.column
FROM   table1, table2
WHERE  table1.column(+) = table2.column;
```

```
SELECT table1.column, table2.column
FROM   table1, table2
WHERE  table1.column = table2.column(+);
```

Using Outer Joins

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  e.department_id(+) = d.department_id ;
```



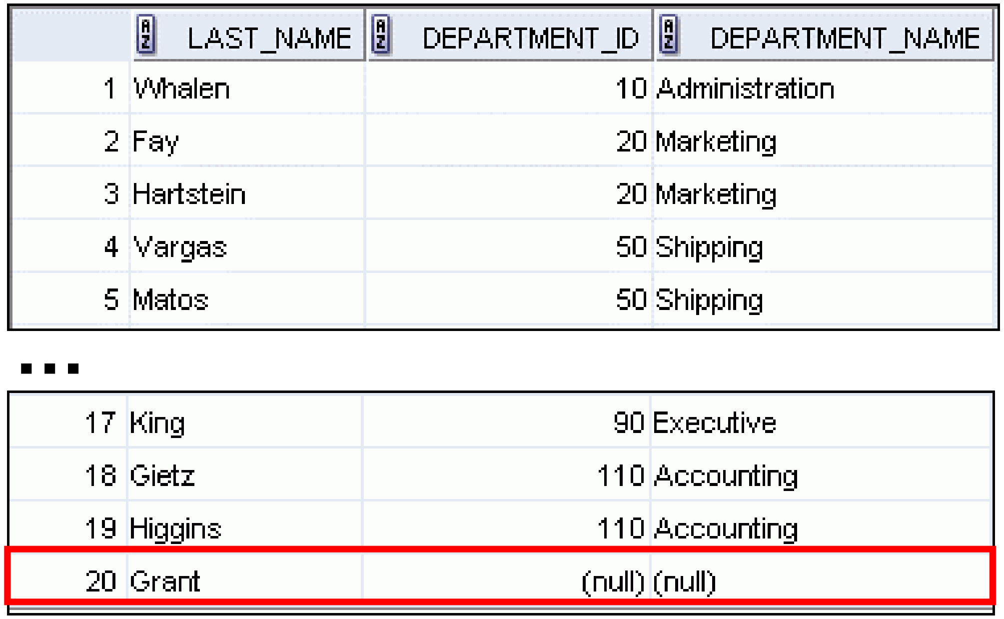
	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Davies	50	Shipping
5	Vargas	50	Shipping
6	Rajs	50	Shipping
7	Mourgos	50	Shipping
8	Matos	50	Shipping
9	Hunold	60	IT
10	Ernst	60	IT

...

19	Gietz	110	Accounting
20	(null)	(null)	Contracting

Outer Join: Another Example

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  e.department_id = d.department_id(+) ;
```



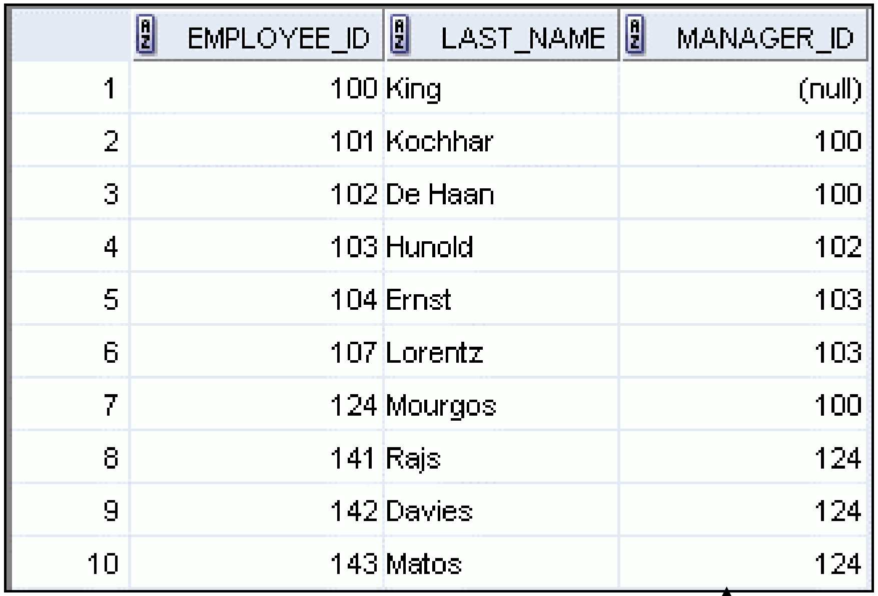
	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Fay	20	Marketing
3	Hartstein	20	Marketing
4	Vargas	50	Shipping
5	Matos	50	Shipping

…

17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

Joining a Table to Itself

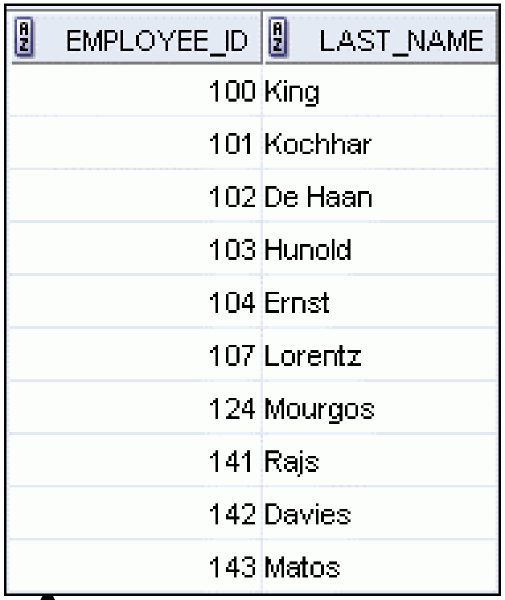
`EMPLOYEES (WORKER)`



	EMPLOYEE_ID	LAST_NAME	MANAGER_ID
1	100	King	(null)
2	101	Kochhar	100
3	102	De Haan	100
4	103	Hunold	102
5	104	Ernst	103
6	107	Lorentz	103
7	124	Mourgos	100
8	141	Rajs	124
9	142	Davies	124
10	143	Matos	124

…

`EMPLOYEES (MANAGER)`



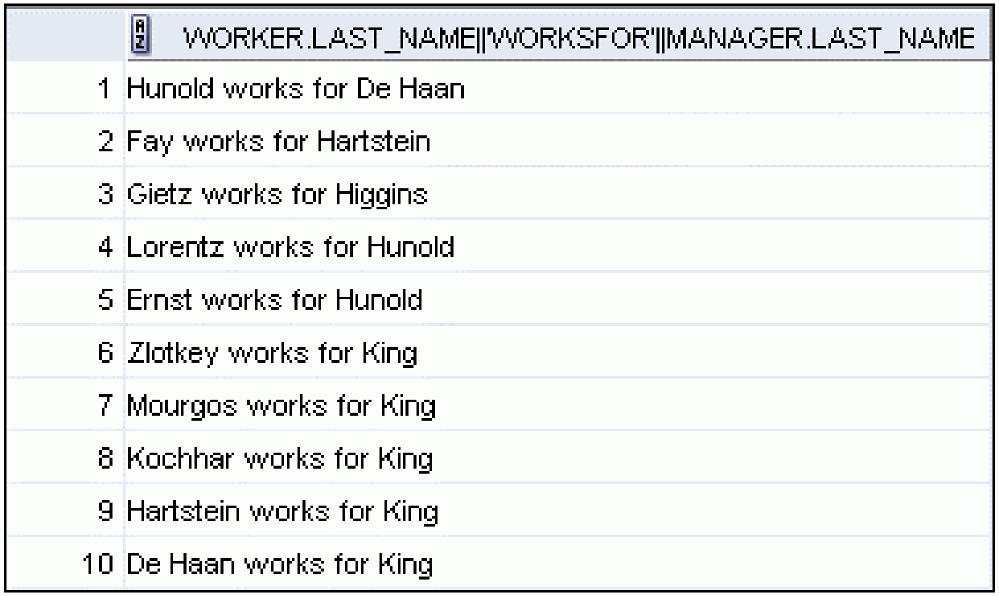
EMPLOYEE_ID	LAST_NAME
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst
107	Lorentz
124	Mourgos
141	Rajs
142	Davies
143	Matos

…

`MANAGER_ID` in the `WORKER` table is equal to `EMPLOYEE_ID` in the `MANAGER` table.

Self-Join: Example

```
SELECT worker.last_name || ' works for '
       || manager.last_name
FROM   employees worker, employees manager
WHERE  worker.manager_id = manager.employee_id ;
```



	WORKER.LAST_NAME||'WORKSFOR'||MANAGER.LAST_NAME
1	Hunold works for De Haan
2	Fay works for Hartstein
3	Gietz works for Higgins
4	Lorentz works for Hunold
5	Ernst works for Hunold
6	Zlotkey works for King
7	Mourgos works for King
8	Kochhar works for King
9	Hartstein works for King
10	De Haan works for King

…

Summary

In this appendix, you should have learned how to use joins to display data from multiple tables by using Oracle-proprietary syntax.

Practice C: Overview

This practice covers the following topics:

- Joining tables by using an equijoin
- Performing outer and self-joins
- Adding conditions

D

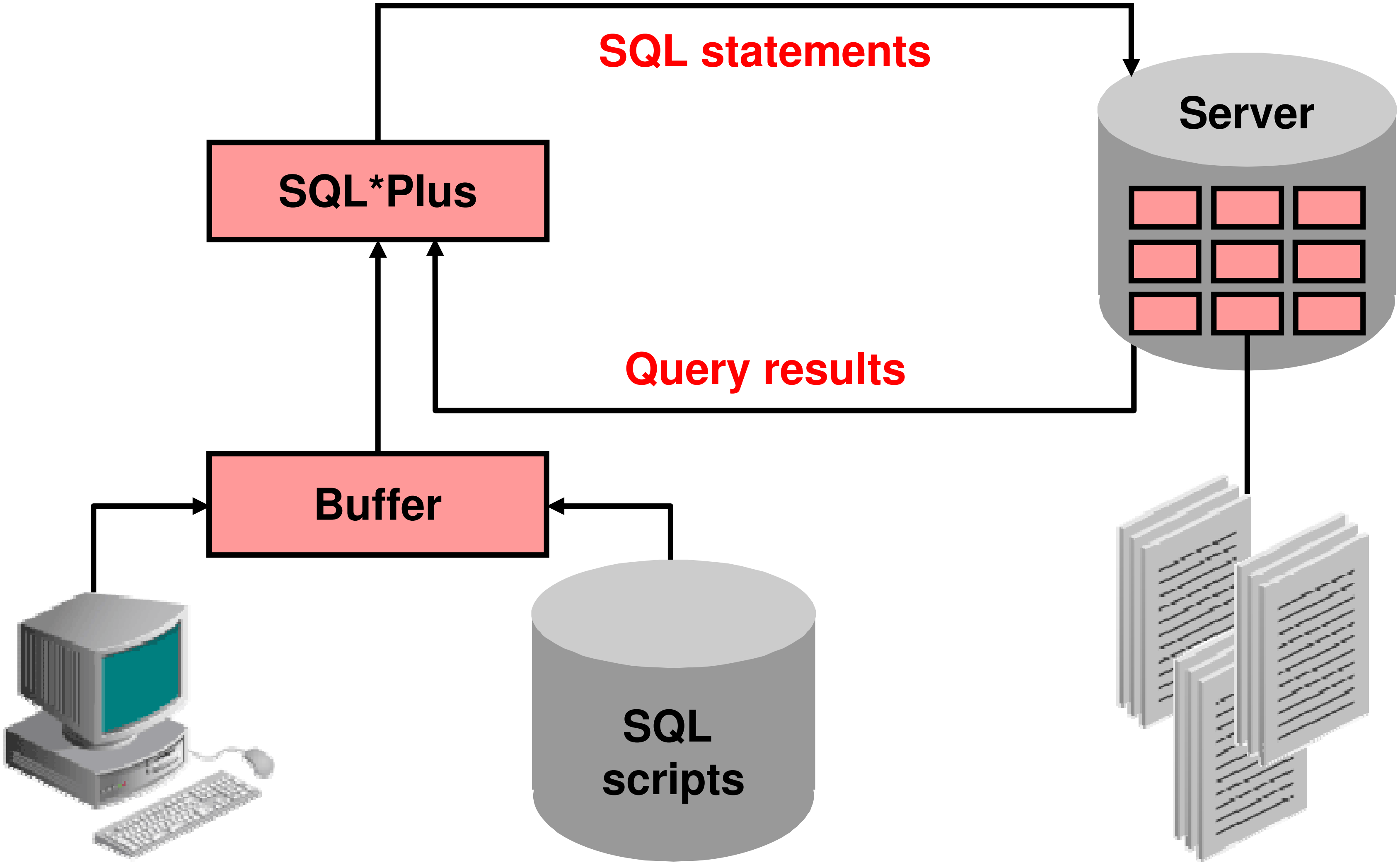
Using SQL*Plus

Objectives

After completing this appendix, you should be able to do the following:

- Log in to SQL*Plus
- Edit SQL commands
- Format output using SQL*Plus commands
- Interact with script files

SQL and SQL*Plus Interaction



SQL statements

Server

SQL*Plus

Query results

Buffer

SQL scripts

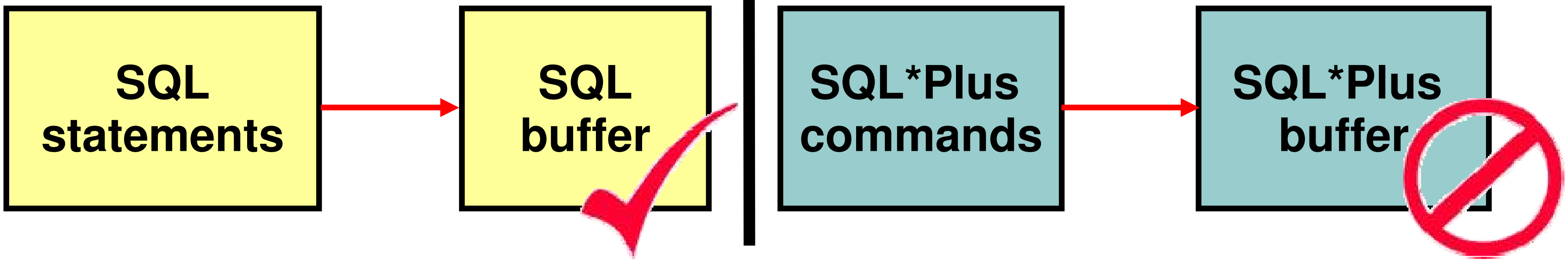
SQL Statements Versus SQL*Plus Commands

SQL

- A language
- ANSI-standard
- Keywords cannot be abbreviated
- Statements manipulate data and table definitions in the database

SQL*Plus

- An environment
- Oracle-proprietary
- Keywords can be abbreviated
- Commands do not allow manipulation of values in the database



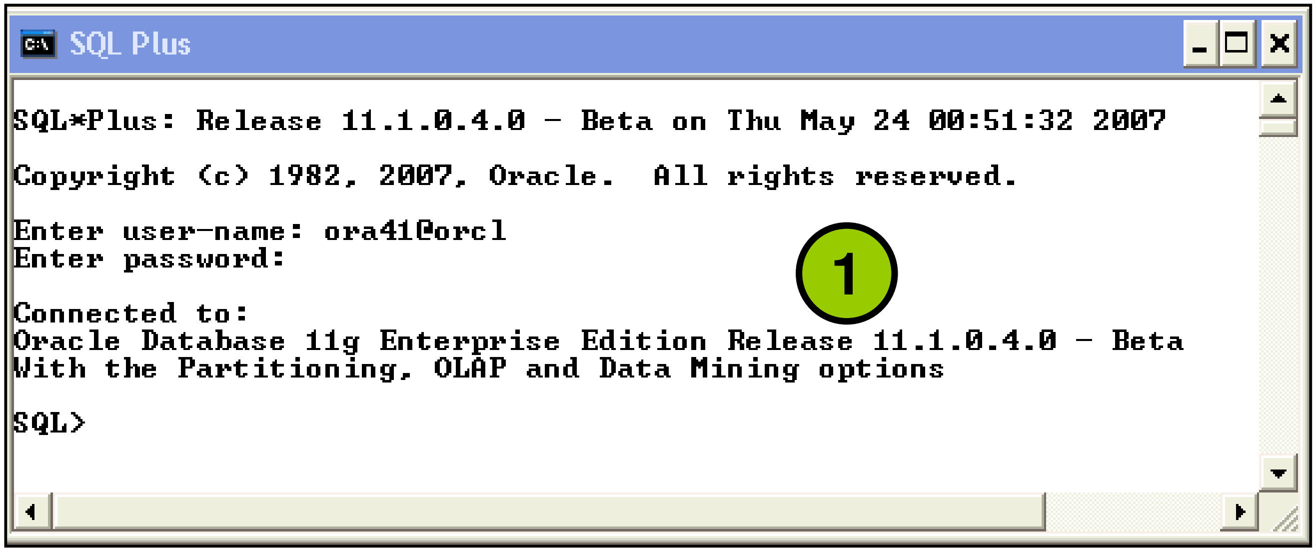
SQL statements → **SQL buffer** ✓

SQL*Plus commands → **SQL*Plus buffer** 🚫

Overview of SQL*Plus

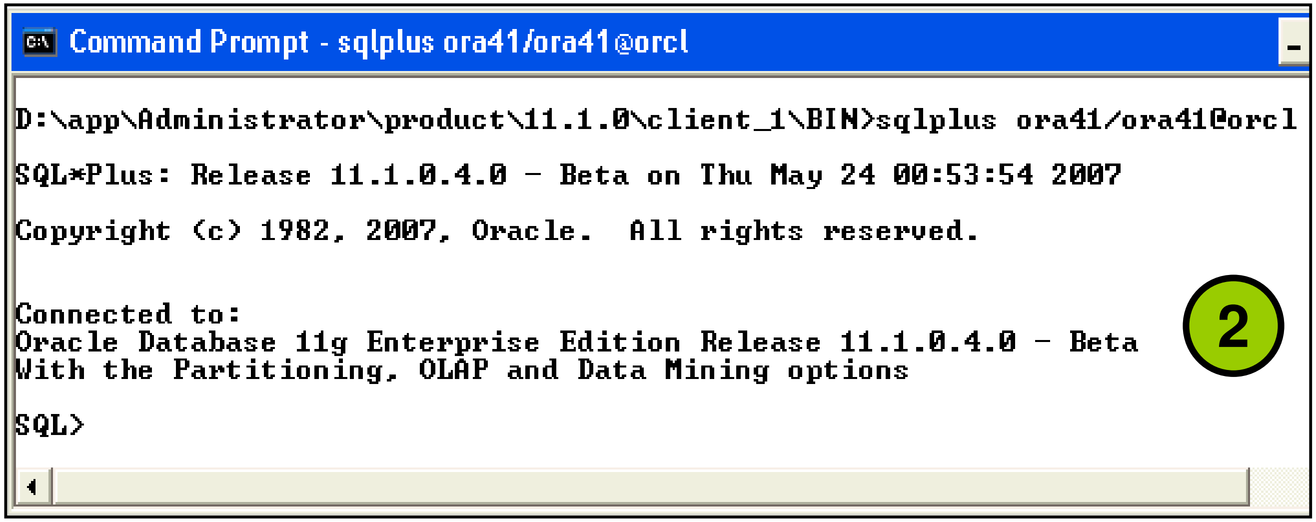
- Log in to SQL*Plus.
- Describe the table structure.
- Edit your SQL statement.
- Execute SQL from SQL*Plus.
- Save SQL statements to files and append SQL statements to files.
- Execute saved files.
- Load commands from file to buffer to edit.

Logging In to SQL*Plus



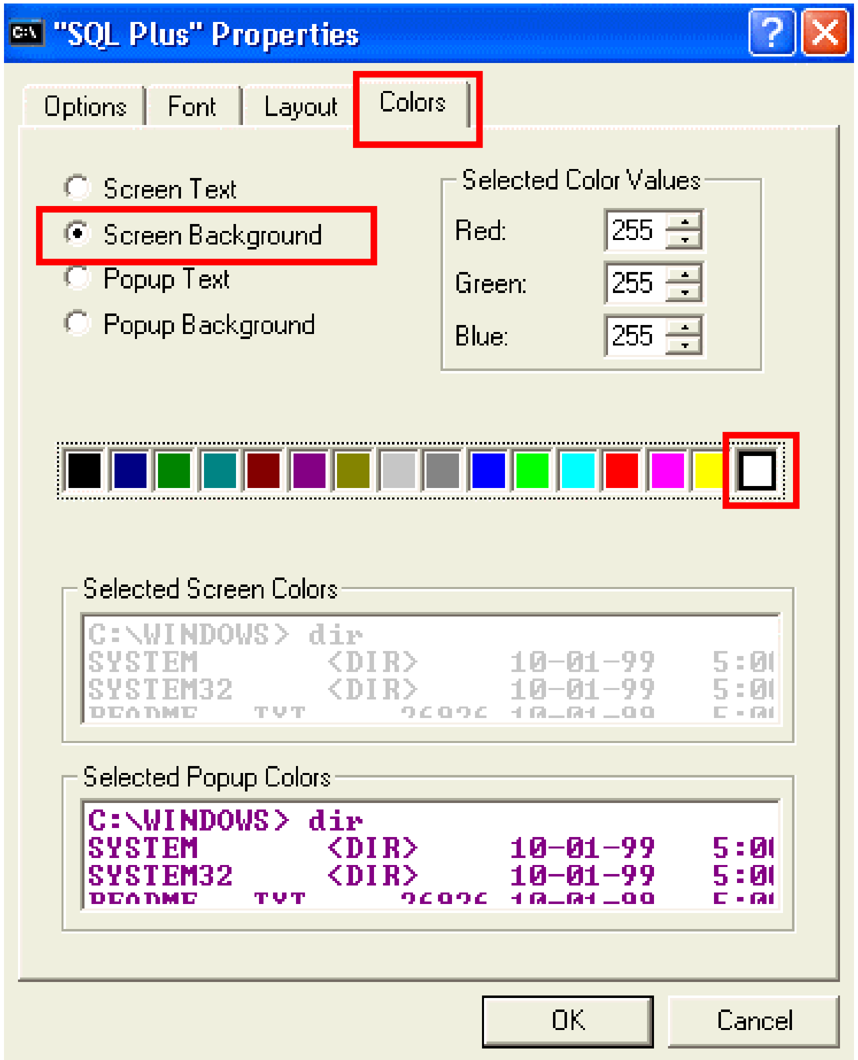
```
SQL*Plus: Release 11.1.0.4.0 - Beta on Thu May 24 00:51:32 2007

Copyright (c) 1982, 2007, Oracle.  All rights reserved.

Enter user-name: ora41@orcl
Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.1.0.4.0 - Beta
With the Partitioning, OLAP and Data Mining options

SQL>
```

```
sqlplus [username[/password[@database]]]
```



```
D:\app\Administrator\product\11.1.0\client_1\BIN>sqlplus ora41/ora41@orcl

SQL*Plus: Release 11.1.0.4.0 - Beta on Thu May 24 00:53:54 2007

Copyright (c) 1982, 2007, Oracle.  All rights reserved.


Connected to:
Oracle Database 11g Enterprise Edition Release 11.1.0.4.0 - Beta
With the Partitioning, OLAP and Data Mining options

SQL>
```

Changing the Settings of SQL*Plus Environment



○ Screen Text
● Screen Background
○ Popup Text
○ Popup Background

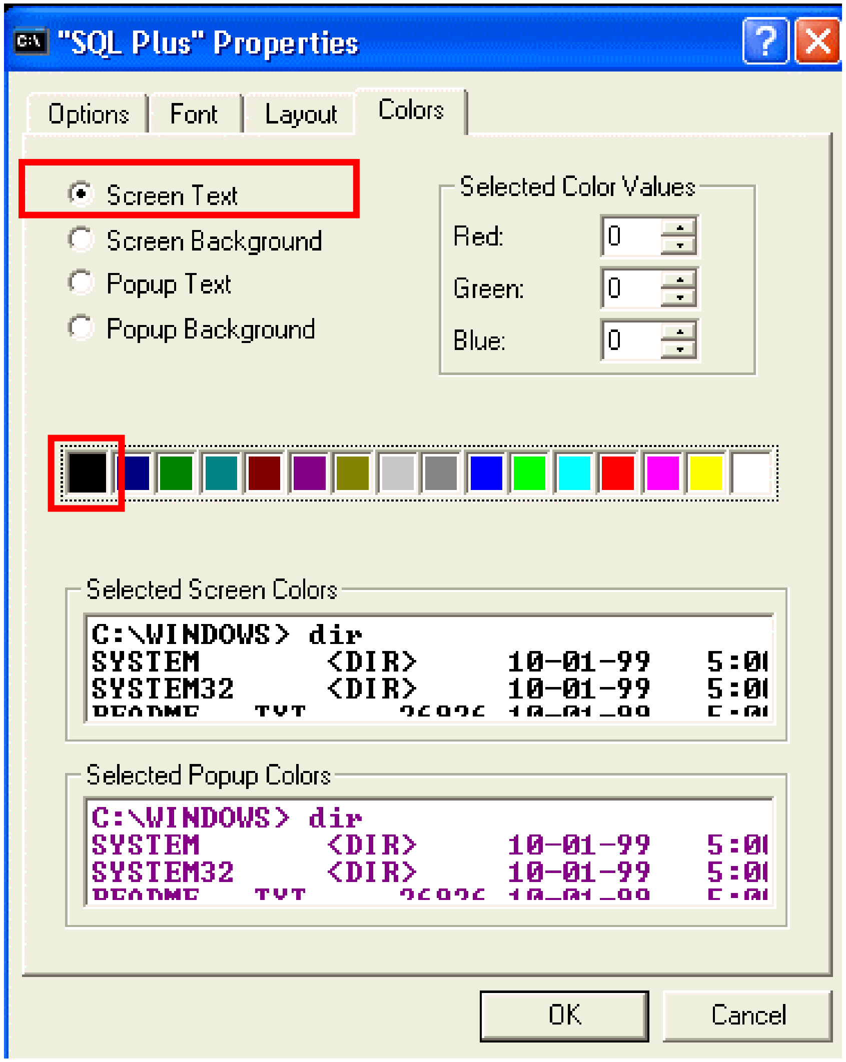
Selected Color Values
Red: 255
Green: 255
Blue: 255

Selected Screen Colors

```
C:\WINDOWS> dir
SYSTEM          <DIR>         10-01-99     5:0
SYSTEM32        <DIR>         10-01-99     5:0
```

Selected Popup Colors

```
C:\WINDOWS> dir
SYSTEM          <DIR>         10-01-99     5:0
SYSTEM32        <DIR>         10-01-99     5:0
```



● Screen Text
○ Screen Background
○ Popup Text
○ Popup Background

Selected Color Values
Red: 0
Green: 0
Blue: 0

Selected Screen Colors

```
C:\WINDOWS> dir
SYSTEM          <DIR>         10-01-99     5:0
SYSTEM32        <DIR>         10-01-99     5:0
```

Selected Popup Colors

```
C:\WINDOWS> dir
SYSTEM          <DIR>         10-01-99     5:0
SYSTEM32        <DIR>         10-01-99     5:0
```

Displaying Table Structure

Use the SQL*Plus `DESCRIBE` command to display the structure of a table:

```
DESC[RIBE]  tablename
```

Displaying Table Structure

```
DESCRIBE departments
```

```
Name                    Null?    Type
----------------------- -------- ------------
DEPARTMENT_ID           NOT NULL NUMBER(4)
DEPARTMENT_NAME         NOT NULL VARCHAR2(30)
MANAGER_ID              NUMBER(6)
LOCATION_ID             NUMBER(4)
```

SQL*Plus Editing Commands

- `A[PPEND]` *`text`*
- `C[HANGE] /` *`old`* `/` *`new`*
- `C[HANGE] /` *`text`* `/`
- `CL[EAR] BUFF[ER]`
- `DEL`
- `DEL` *`n`*
- `DEL` *`m n`*

SQL*Plus Editing Commands

- `I[NPUT]`
- `I[NPUT]` *`text`*
- `L[IST]`
- `L[IST]` *`n`*
- `L[IST]` *`m n`*
- `R[UN]`
- *`n`*
- *`n text`*
- `0` *`text`*

Using `LIST`, `n`, and `APPEND`

```
LIST
  1   SELECT last_name
  2*  FROM   employees
```

```
1
  1*  SELECT last_name
```

```
A , job_id
  1*  SELECT last_name, job_id
```

```
LIST
  1   SELECT last_name, job_id
  2*  FROM   employees
```

Using the `CHANGE` Command

```
LIST
  1* SELECT * from employees
```

```
c/employees/departments
  1* SELECT * from departments
```

```
LIST

  1* SELECT * from departments
```

SQL*Plus File Commands

- `SAVE` *`filename`*
- `GET` *`filename`*
- `START` *`filename`*
- `@` *`filename`*
- `EDIT` *`filename`*
- `SPOOL` *`filename`*
- `EXIT`

Using the `SAVE`, `START`, and `EDIT` Commands

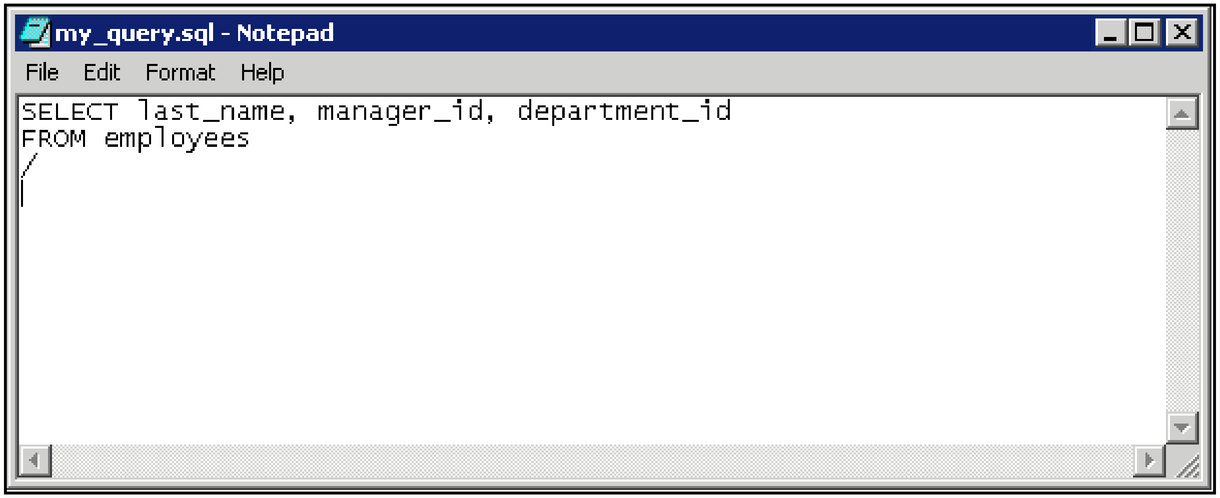
```
LIST
  1  SELECT last_name, manager_id, department_id
  2* FROM employees
```

```
SAVE my_query
  Created file my_query
```

```
START my_query

LAST_NAME                 MANAGER_ID DEPARTMENT_ID
------------------------- ---------- -------------
King                                            90
Kochhar                          100            90
...
107 rows selected.
```

Using the `SAVE`, `START`, and `EDIT` Commands

```
EDIT my_query
```



```
SELECT last_name, manager_id, department_id
FROM employees
/
```

`SERVEROUTPUT` Command

- Use the `SET SERVEROUT[PUT]` command to control whether to display the output of stored procedures or PL/SQL blocks in SQL*Plus.
- The `DBMS_OUTPUT` line length limit is increased from 255 bytes to 32767 bytes.
- The default size is now unlimited.
- Resources are not preallocated when `SERVEROUTPUT` is set.
- Because there is no performance penalty, use `UNLIMITED` unless you want to conserve physical memory.

```
SET SERVEROUT[PUT] {ON | OFF} [SIZE {n | UNL[IMITED]}]
    [FOR[MAT] {WRA[PPED] | WOR[D_WRAPPED] | TRU[NCATED]}]
```

Using the SQL*Plus `SPOOL` Command

```
SPO[OL] [file_name[.ext] [CRE[ATE] | REP[LACE] |
    APP[END]] | OFF | OUT]
```

Option	Description
`file_name[.ext]`	Spools output to the specified file name
`CRE[ATE]`	Creates a new file with the name specified
`REP[LACE]`	Replaces the contents of an existing file. If the file does not exist, `REPLACE` creates the file.
`APP[END]`	Adds the contents of the buffer to the end of the file you specify
`OFF`	Stops spooling
`OUT`	Stops spooling and sends the file to your computer's standard (default) printer

Using the `AUTOTRACE` Command

- Displays a report after the successful execution of SQL DML statements such as `SELECT`, `INSERT`, `UPDATE`, or `DELETE`
- May optionally include the query execution path and execution statistics

```
SET AUTOT[RACE] {ON | OFF | TRACE[ONLY]} [EXP[LAIN]]
    [STAT[ISTICS]]
```

```
SET AUTOTRACE ON
-- The AUTOTRACE report includes both the optimizer
-- execution path and the SQL statement execution
-- statistics
```

Summary

In this appendix, you should have learned how to use SQL*Plus as an environment to do the following:

- Execute SQL statements
- Edit SQL statements
- Format output
- Interact with script files

E

Using SQL Developer

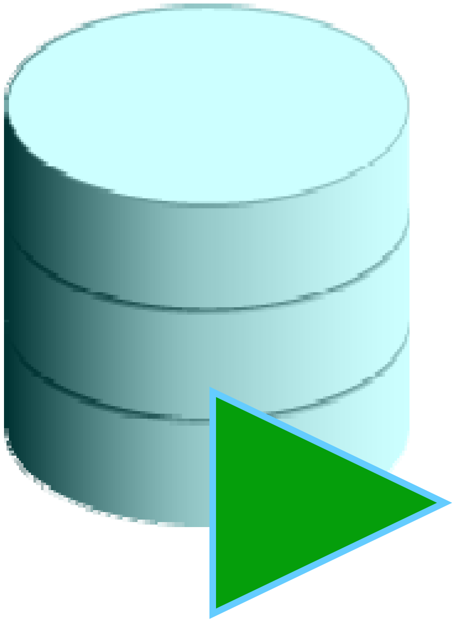
Objectives

After completing this appendix, you should be able to do the following:

- List the key features of Oracle SQL Developer
- Install Oracle SQL Developer 1.2.1
- Identify menu items of Oracle SQL Developer
- Create a database connection
- Manage database objects
- Use SQL Worksheet
- Save and Run SQL scripts
- Create and save reports
- Install and use Oracle SQL Developer 1.5.3

What Is Oracle SQL Developer?

- Oracle SQL Developer is a graphical tool that enhances productivity and simplifies database development tasks.
- You can connect to any target Oracle database schema by using standard Oracle database authentication.



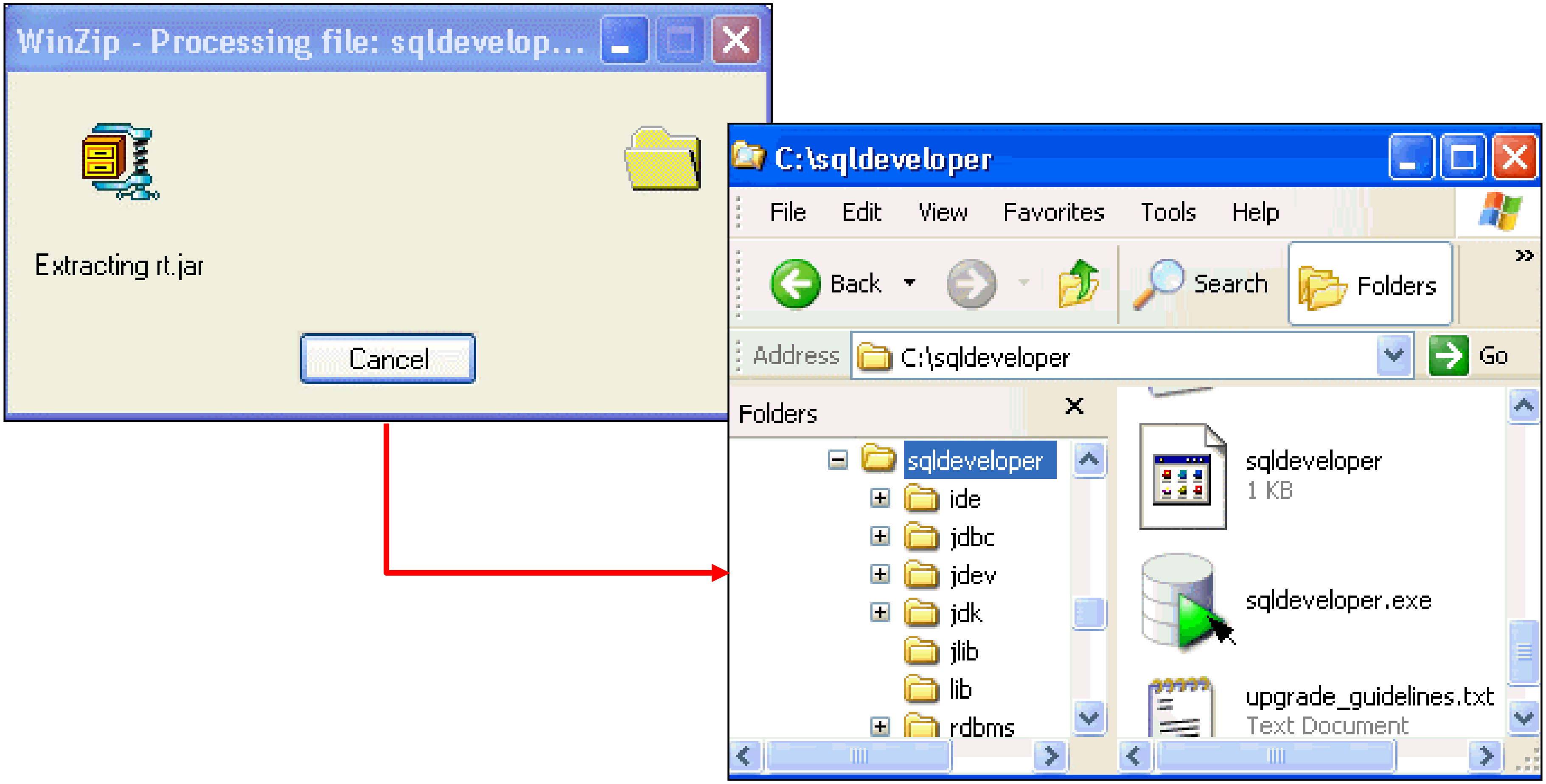
SQL Developer

Specifications of SQL Developer

- Developed in Java
- Supports Windows, Linux, and Mac OS X platforms
- Default connectivity by using the JDBC Thin driver
- Does not require an installer
  - Unzip the downloaded SQL Developer kit and double-click `sqldeveloper.exe` to start SQL Developer.
- Connects to Oracle Database version 9.2.0.1 and later
- Freely downloadable from the following link:
  - http://www.oracle.com/technology/products/database/sql_developer/index.html
- Needs JDK 1.5 installed on your system that can be downloaded from the following link:
  - http://java.sun.com/javase/downloads/index_jdk5.jsp

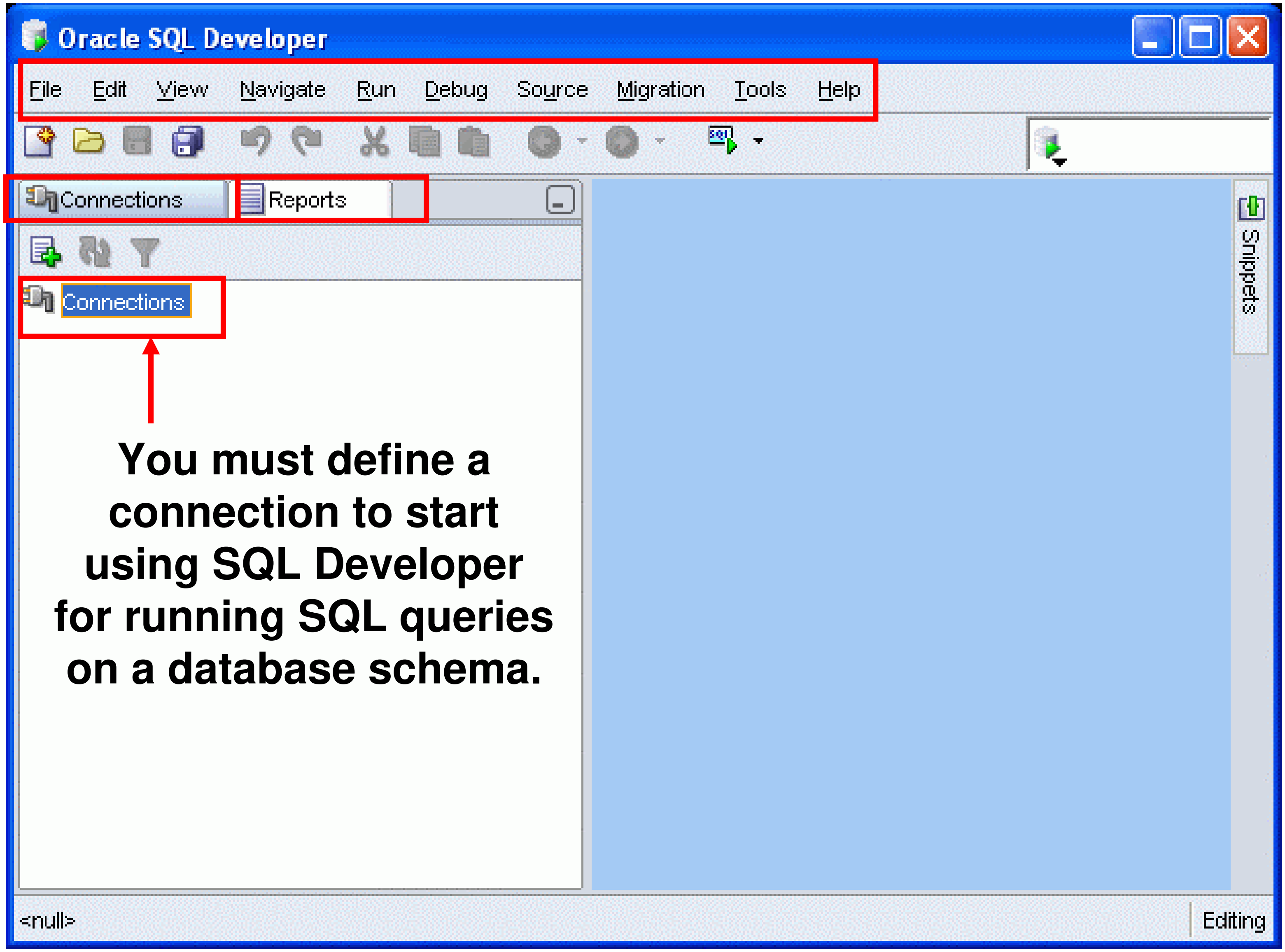
Installing SQL Developer

Download the Oracle SQL Developer kit and unzip into any directory on your machine.



Extracting rt.jar

SQL Developer 1.2 Interface

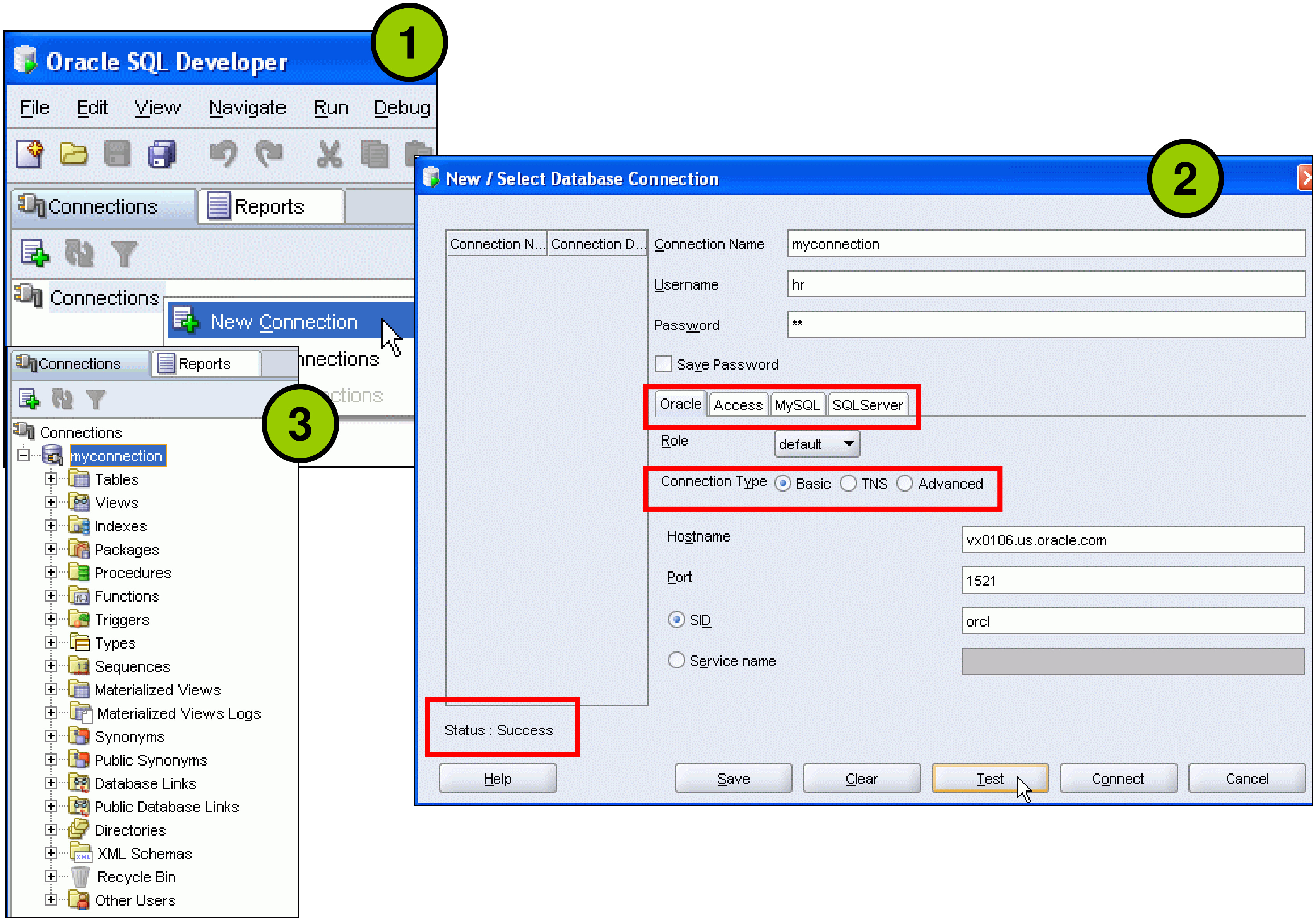


You must define a connection to start using SQL Developer for running SQL queries on a database schema.

Creating a Database Connection

- You must have at least one database connection to use SQL Developer.
- You can create and test connections for:
  - Multiple databases
  - Multiple schemas
- SQL Developer automatically imports any connections defined in the `tnsnames.ora` file on your system.
- You can export connections to an Extensible Markup Language (XML) file.
- Each additional database connection created is listed in the Connections Navigator hierarchy.

Creating a Database Connection



Connection Name: myconnection

Username: hr

Password: **

☐ Save Password

Role: default

Connection Type: ● Basic ○ TNS ○ Advanced

Hostname: vx0106.us.oracle.com

Port: 1521

● SID: orcl

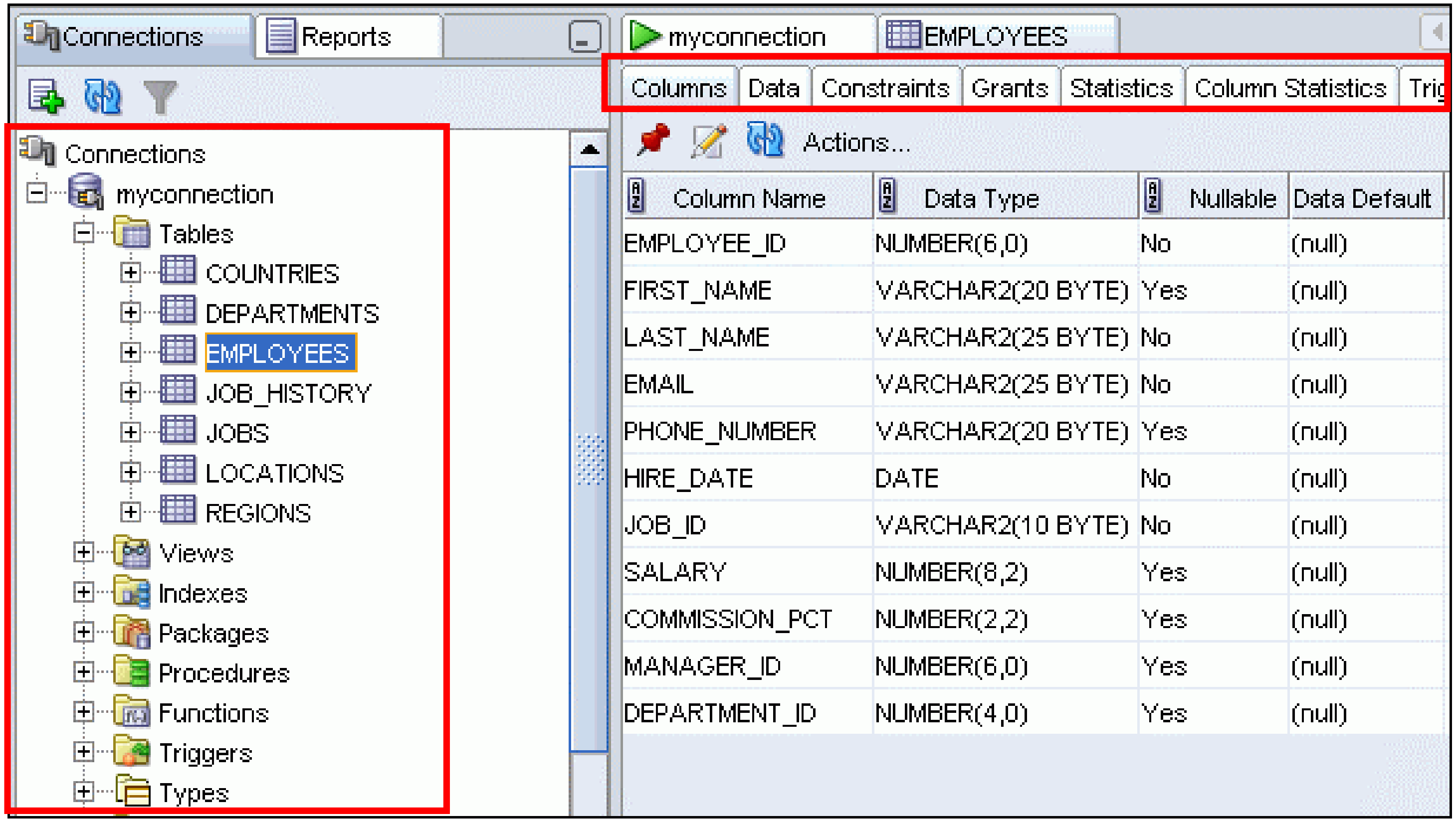
○ Service name:

Status : Success

Browsing Database Objects

Use the Connections Navigator to:

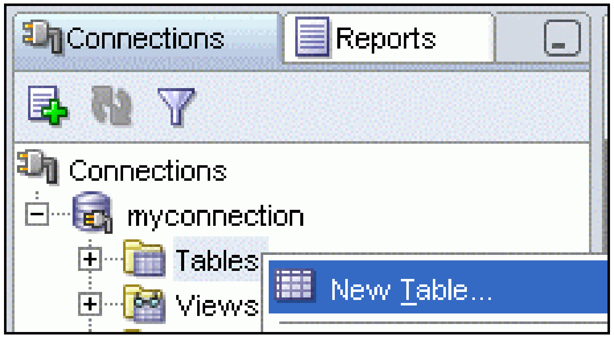
- Browse through many objects in a database schema
- Review the definitions of objects at a glance



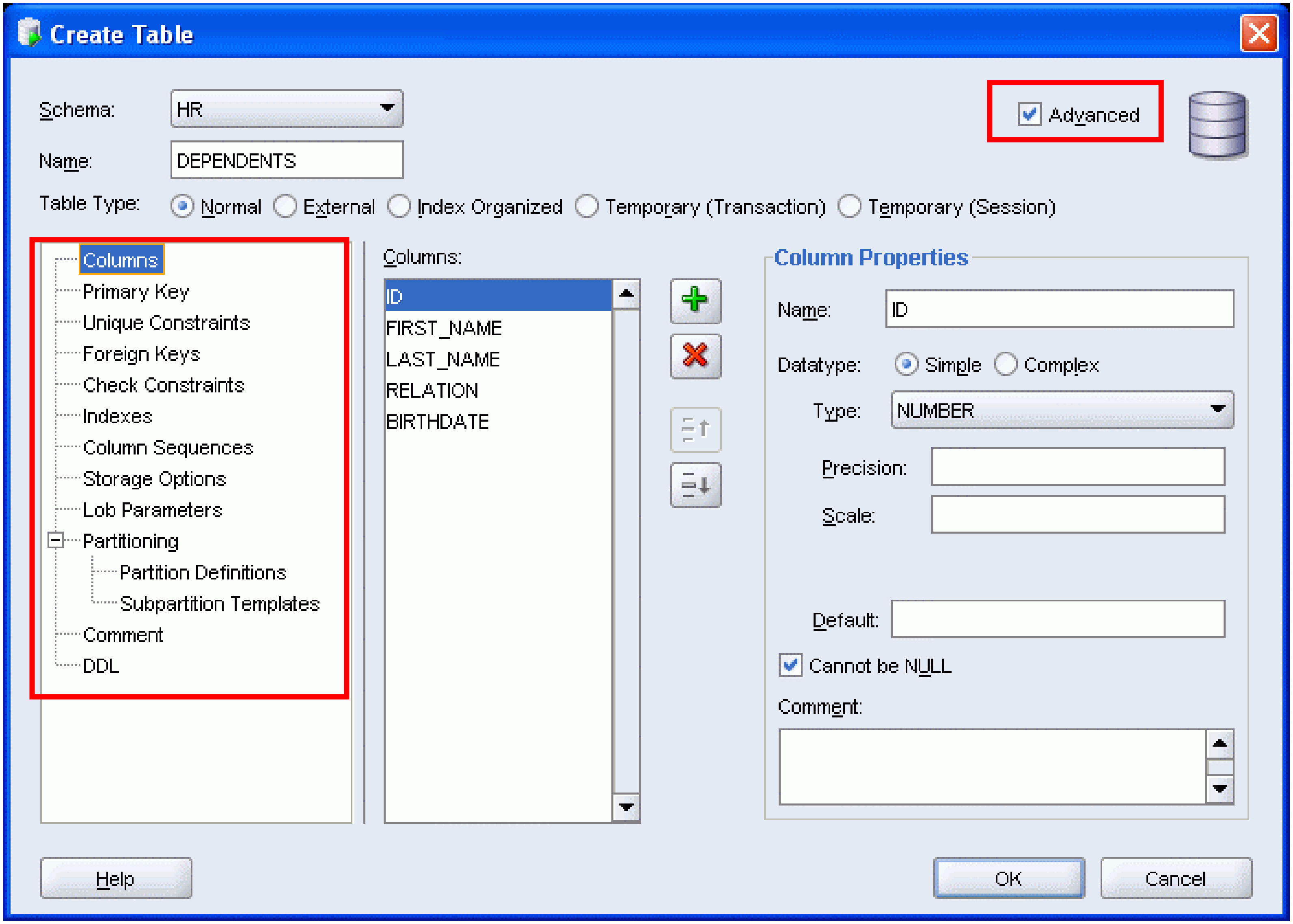
Column Name	Data Type	Nullable	Data Default
EMPLOYEE_ID	NUMBER(6,0)	No	(null)
FIRST_NAME	VARCHAR2(20 BYTE)	Yes	(null)
LAST_NAME	VARCHAR2(25 BYTE)	No	(null)
EMAIL	VARCHAR2(25 BYTE)	No	(null)
PHONE_NUMBER	VARCHAR2(20 BYTE)	Yes	(null)
HIRE_DATE	DATE	No	(null)
JOB_ID	VARCHAR2(10 BYTE)	No	(null)
SALARY	NUMBER(8,2)	Yes	(null)
COMMISSION_PCT	NUMBER(2,2)	Yes	(null)
MANAGER_ID	NUMBER(6,0)	Yes	(null)
DEPARTMENT_ID	NUMBER(4,0)	Yes	(null)

Creating a Schema Object

- SQL Developer supports the creation of any schema object by:
  - Executing a SQL statement in SQL Worksheet
  - Using the context menu
- Edit the objects by using an edit dialog or one of the many context-sensitive menus.
- View the data definition language (DDL) for adjustments such as creating a new object or editing an existing schema object.



Creating a New Table: Example



Create Table

Schema: HR

Name: DEPENDENTS

Table Type: ● Normal ○ External ○ Index Organized ○ Temporary (Transaction) ○ Temporary (Session)

☑ Advanced

Columns:

- ID
- FIRST_NAME
- LAST_NAME
- RELATION
- BIRTHDATE

Column Properties

Name: ID

Datatype: ● Simple ○ Complex

Type: NUMBER

Precision:

Scale:

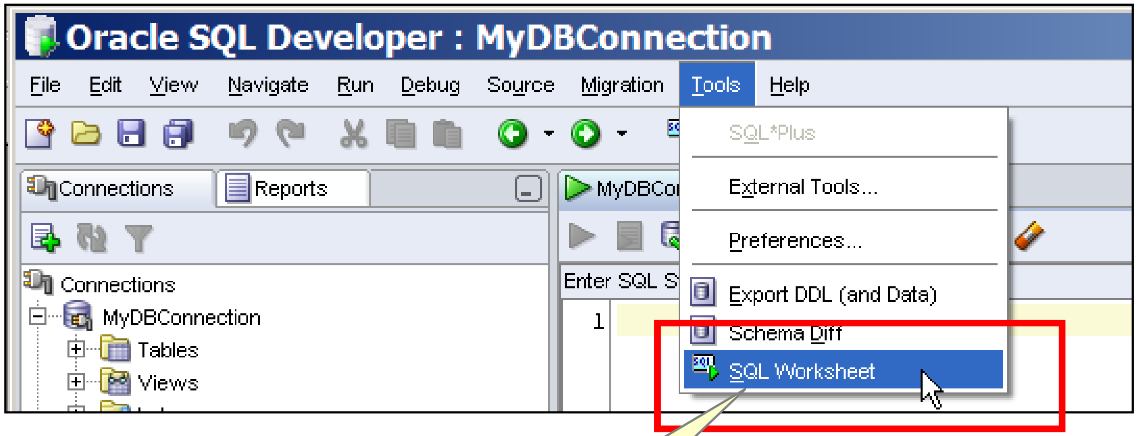
Default:

☑ Cannot be NULL

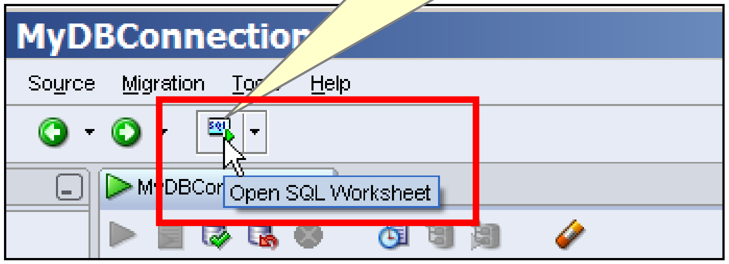
Comment:

Using the SQL Worksheet

- Use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL *Plus statements.
- Specify any actions that can be processed by the database connection associated with the worksheet.

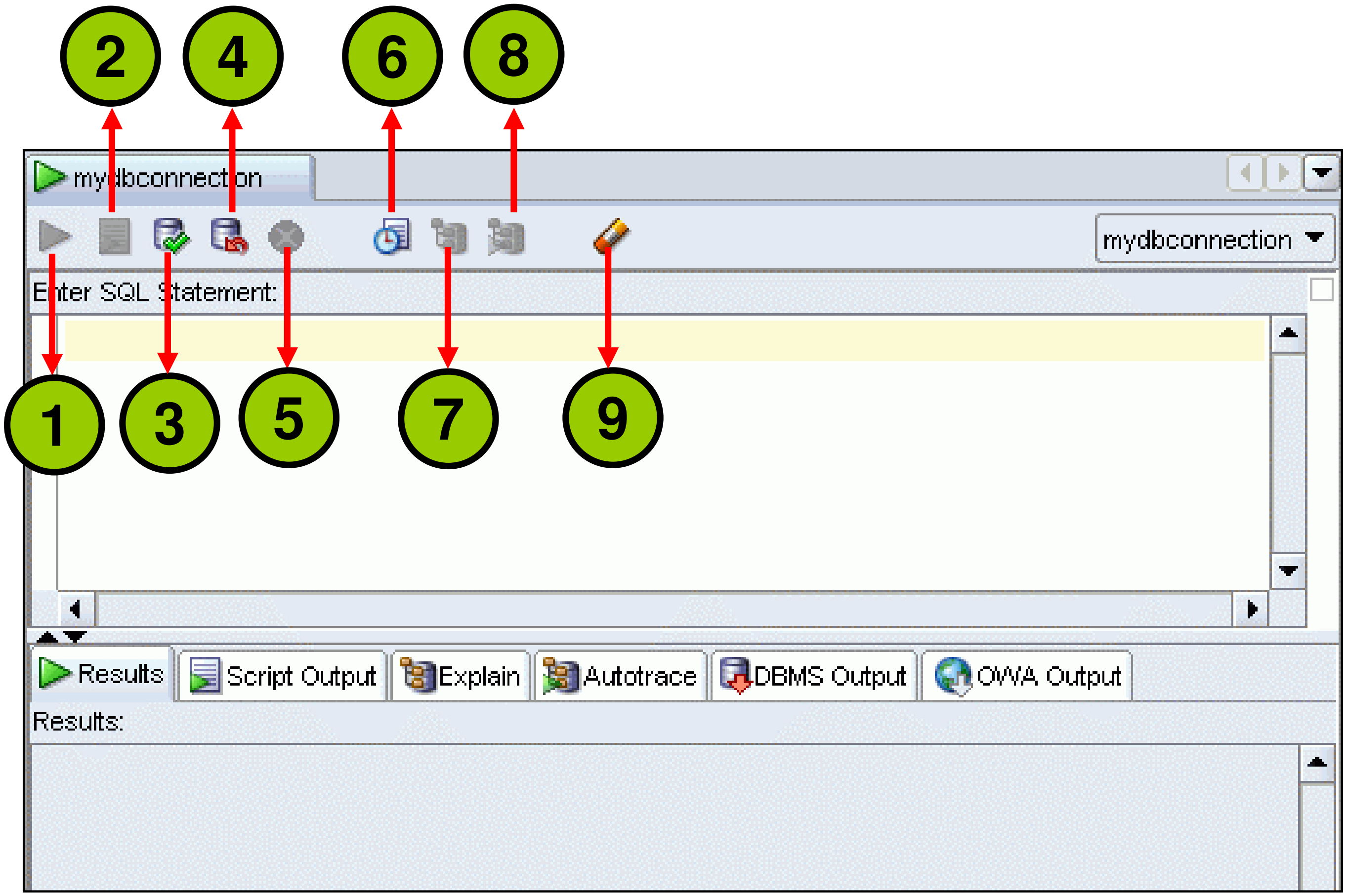


Select SQL Worksheet from the Tools menu, or



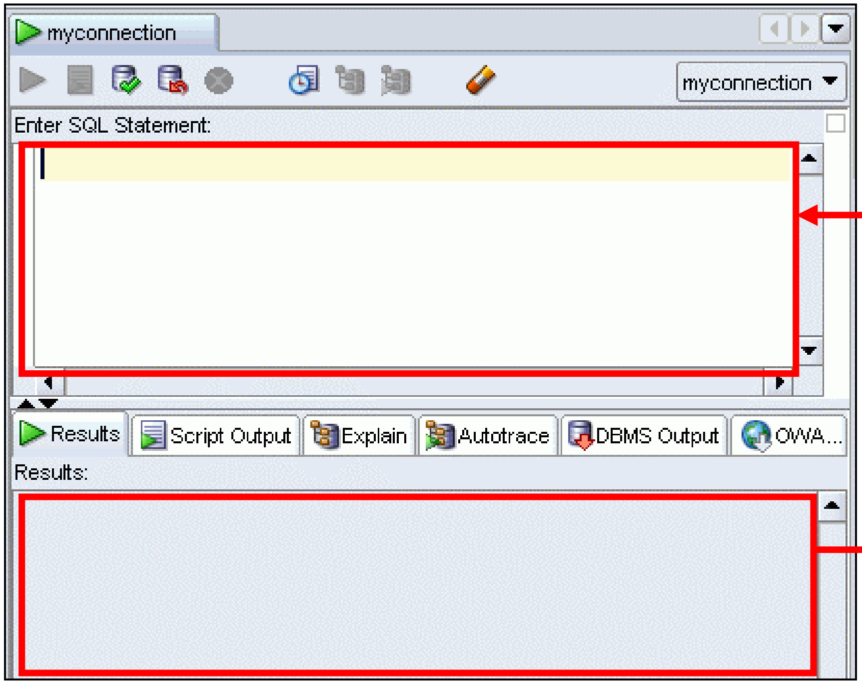
Click the Open SQL Worksheet icon.

Using the SQL Worksheet



Using the SQL Worksheet

- Use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL*Plus statements.
- Specify any actions that can be processed by the database connection associated with the worksheet.



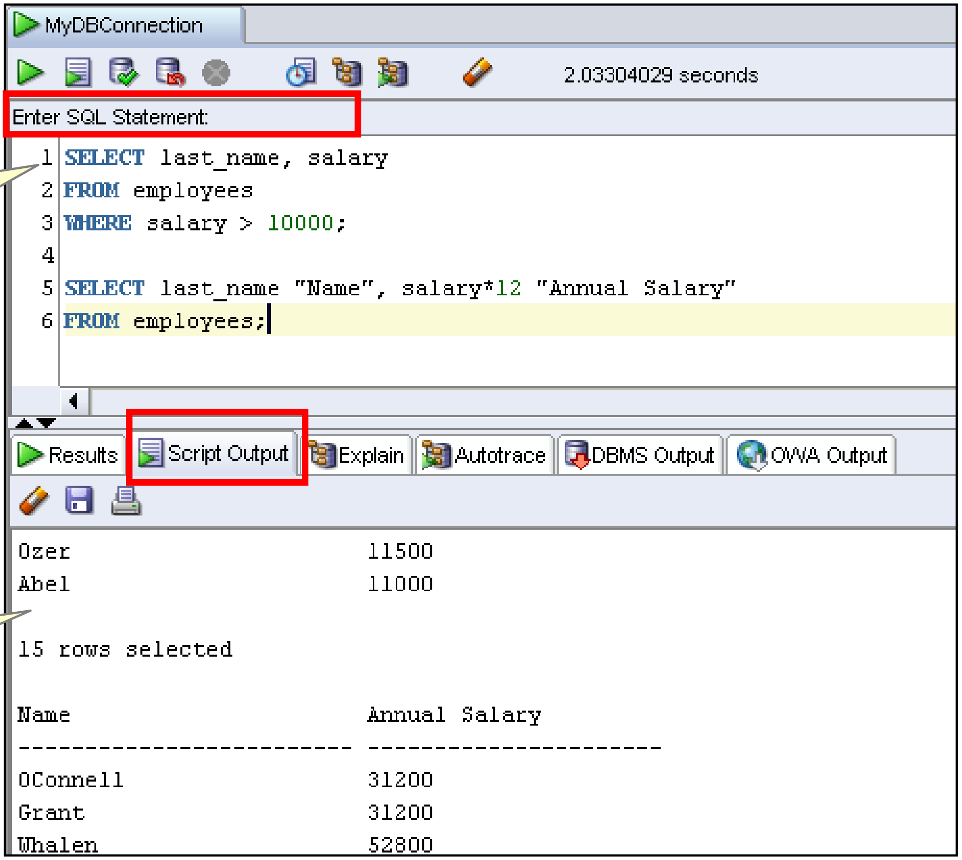
Enter SQL statements.

Results are shown here.

Executing SQL Statements

Use the Enter SQL Statement box to enter single or multiple SQL statements.

Use the Enter SQL Statement box to enter single or multiple SQL statements.



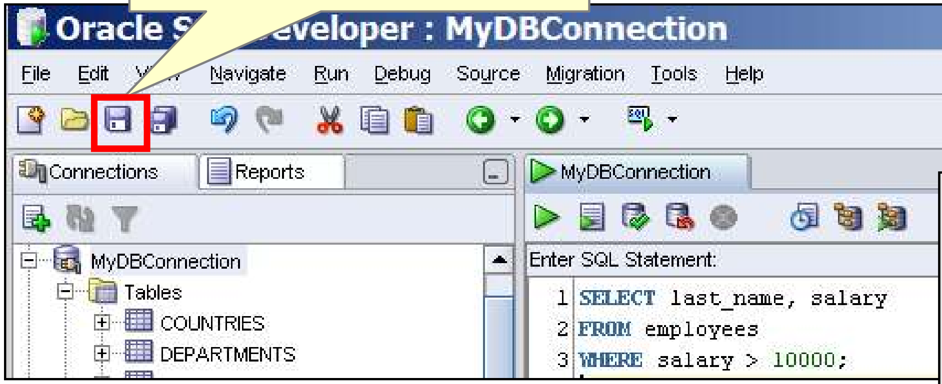
```
SELECT last_name, salary
FROM employees
WHERE salary > 10000;

SELECT last_name "Name", salary*12 "Annual Salary"
FROM employees;
```

```
Ozer                      11500
Abel                      11000

15 rows selected

Name                      Annual Salary
------------------------- ----------------------
OConnell                  31200
Grant                     31200
Whalen                    52800
```

View the results on the Script Output tabbed page.

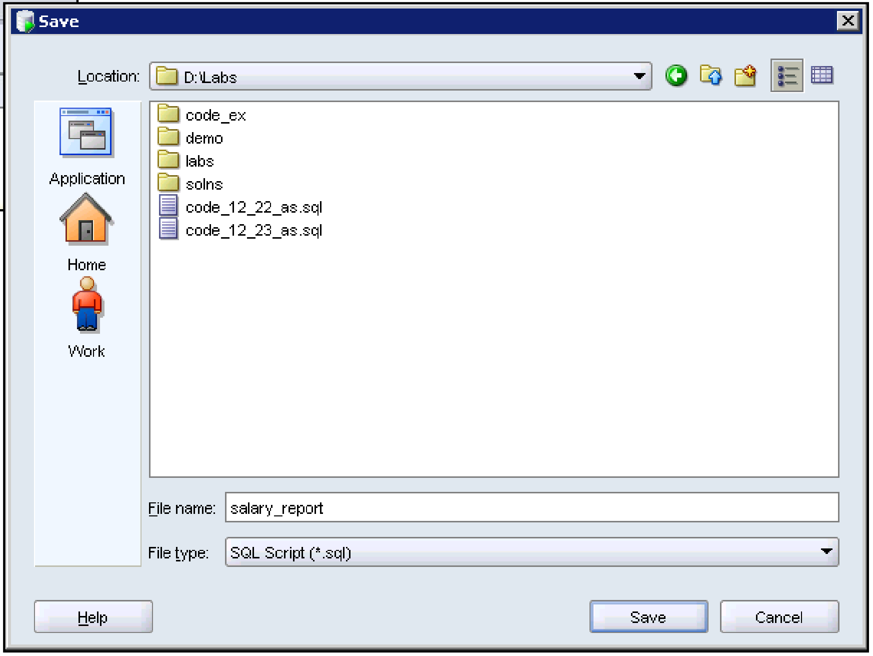
Saving SQL Scripts

Click the Save icon to save your SQL statement to a file.



```
SELECT last_name, salary
FROM employees
WHERE salary > 10000;
```

Enter a file name and identify a location to save the file, and click Save.



Location: D:\Labs

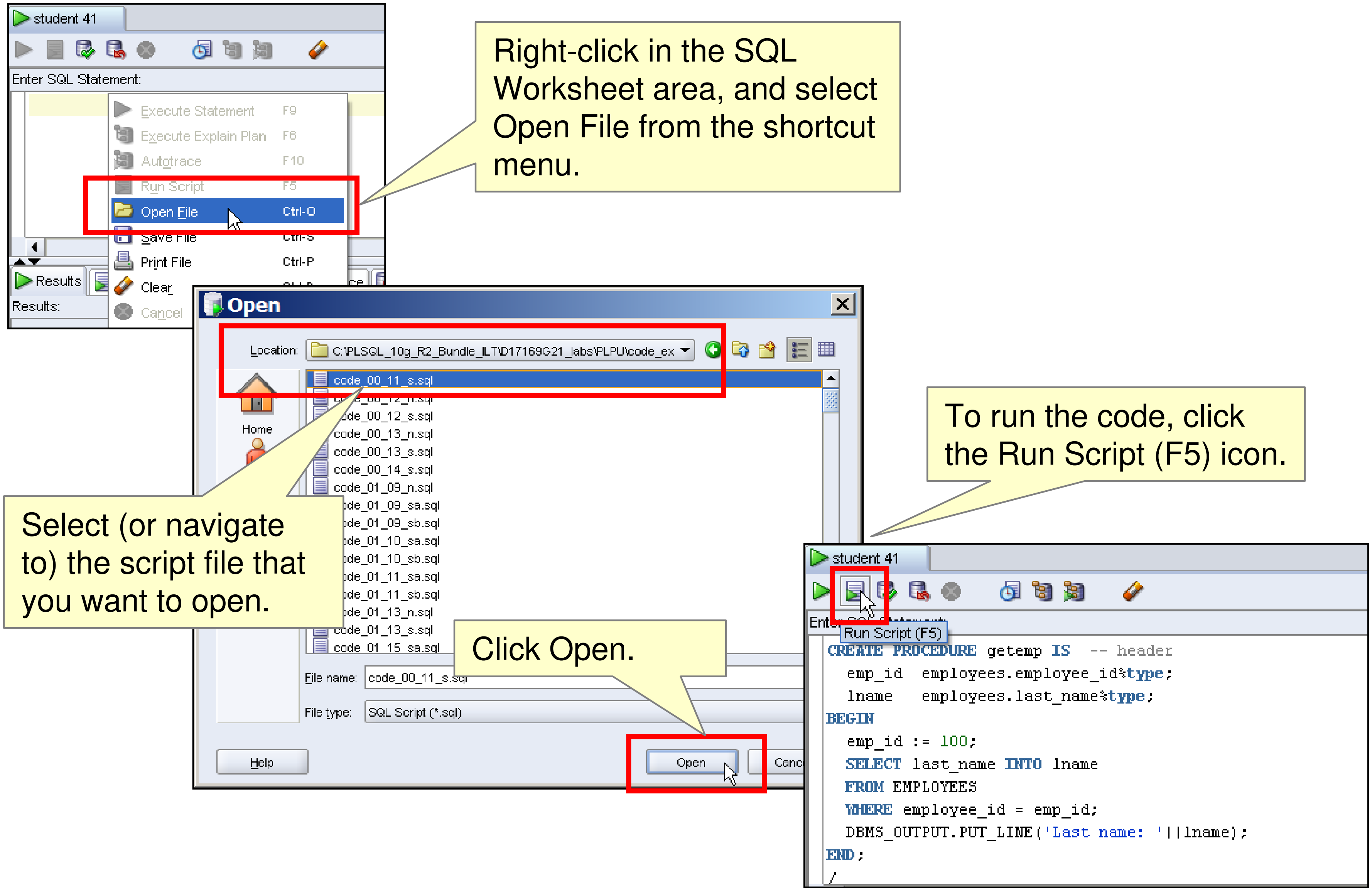
File name: salary_report

File type: SQL Script (*.sql)

The contents of the saved file are visible and editable in your SQL Worksheet window.

```
SELECT last_name, salary
FROM employees
WHERE salary > 10000;
```

Executing Saved Script Files: Method 1



Location: C:\PLSQL_10g_R2_Bundle_ILT\D17169G21_labs\PLPU\code_ex

File name: code_00_11_s.sql

File type: SQL Script (*.sql)

Right-click in the SQL Worksheet area, and select Open File from the shortcut menu.

Select (or navigate to) the script file that you want to open.

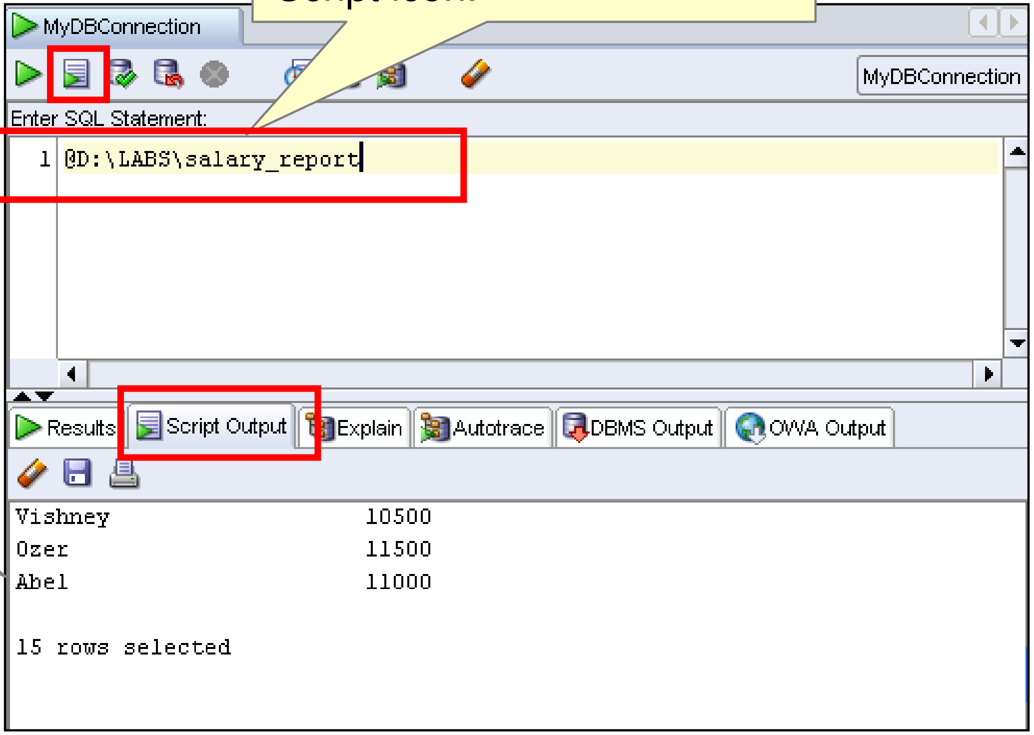
Click Open.

To run the code, click the Run Script (F5) icon.

```
CREATE PROCEDURE getemp IS   -- header
  emp_id  employees.employee_id%type;
  lname   employees.last_name%type;
BEGIN
  emp_id := 100;
  SELECT last_name INTO lname
  FROM EMPLOYEES
  WHERE employee_id = emp_id;
  DBMS_OUTPUT.PUT_LINE('Last name: '||lname);
END;
/
```

Executing Saved Script Files: Method 2

Use the @ command followed by the location and name of the file you want to execute, and click the Run Script icon.



Enter SQL Statement:

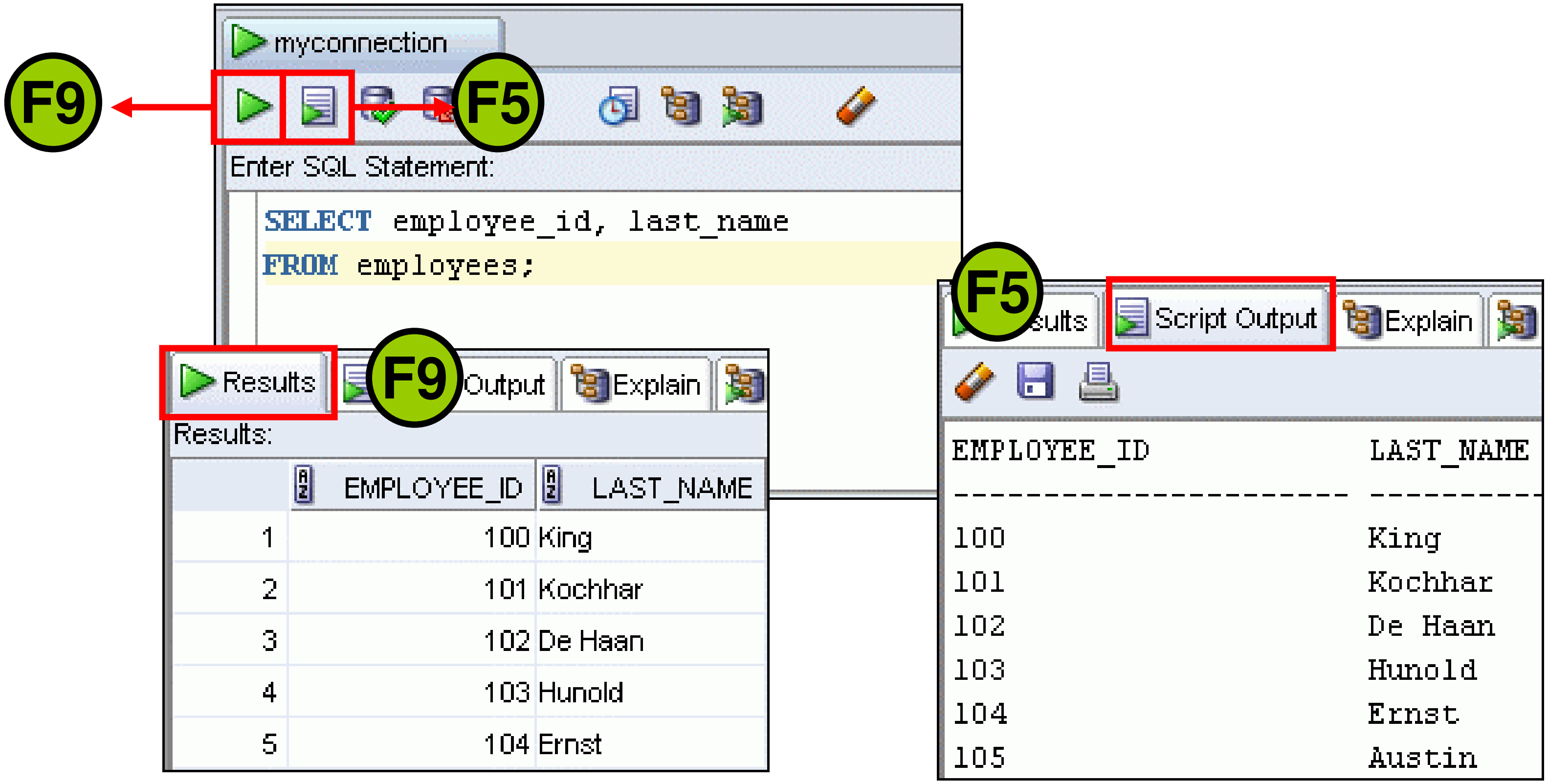
```
@D:\LABS\salary_report
```

```
Vishney                    10500
Ozer                       11500
Abel                       11000

15 rows selected
```

The output from the script is displayed on the Script Output tabbed page.

Executing SQL Statements

Use the Enter SQL Statement box to enter single or multiple SQL statements.



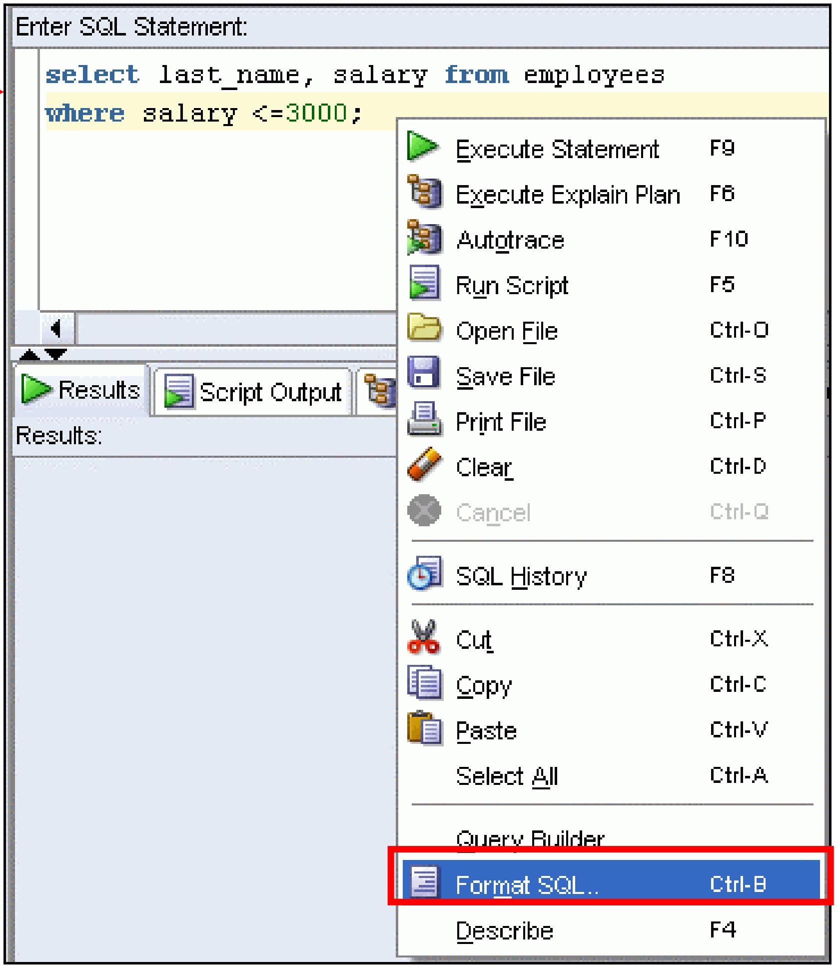
```
SELECT employee_id, last_name
FROM employees;
```

	EMPLOYEE_ID	LAST_NAME
1	100	King
2	101	Kochhar
3	102	De Haan
4	103	Hunold
5	104	Ernst

```
EMPLOYEE_ID            LAST_NAME
---------------------- ---------
100                    King
101                    Kochhar
102                    De Haan
103                    Hunold
104                    Ernst
105                    Austin
```

Formatting the SQL Code

Before formatting



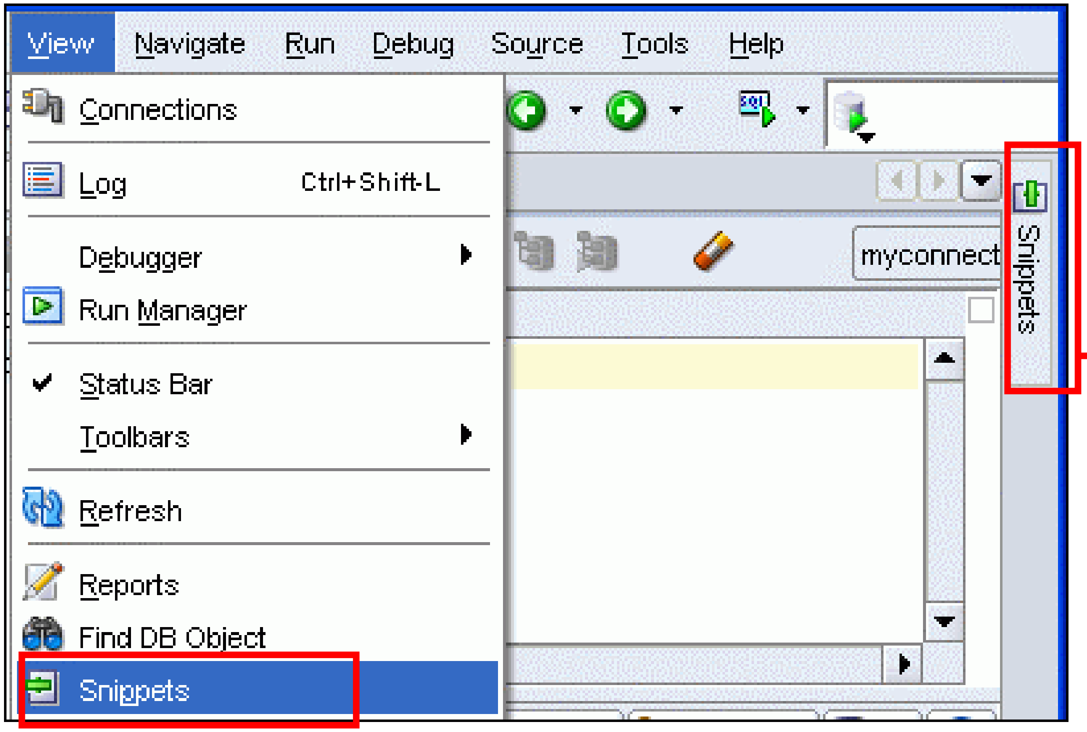
```
select last_name, salary from employees
where salary <=3000;
```

After formatting

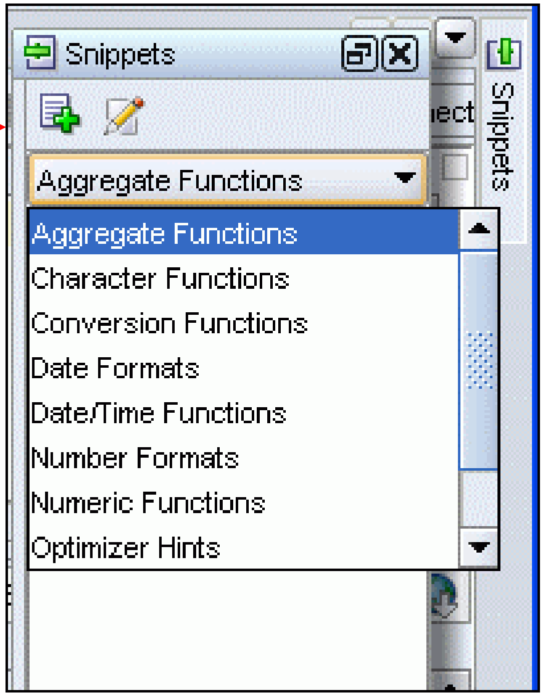
```
SELECT last_name,
  salary
FROM employees
WHERE salary <= 3000;
```

Using Snippets

Snippets are code fragments that may be just syntax or examples.

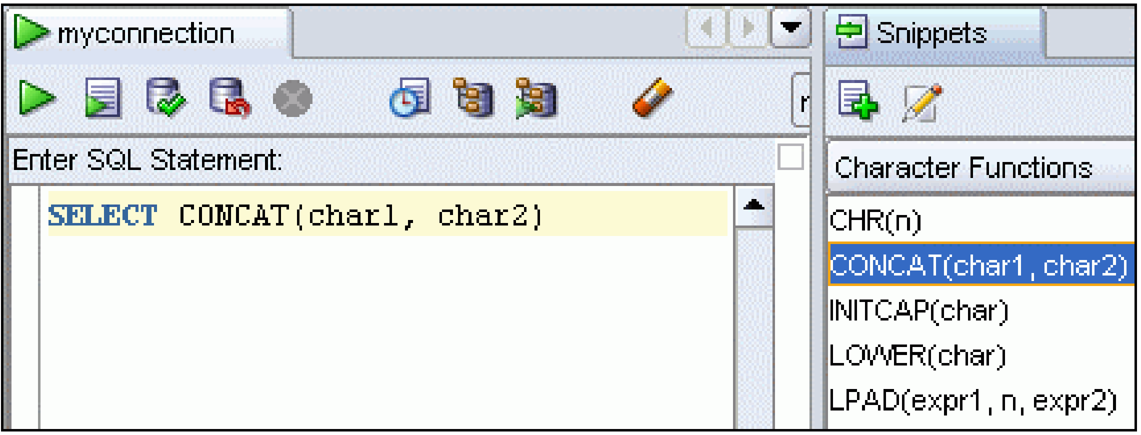


When you place your cursor here, it shows the Snippets window. From the drop-down list, you can select the functions category you want.



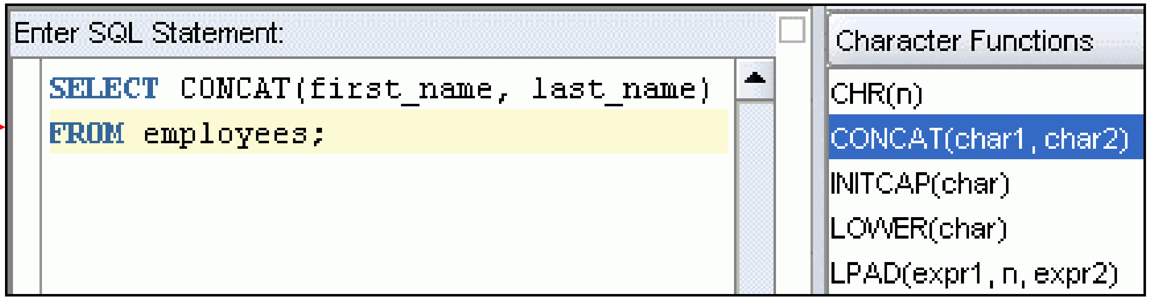
Using Snippets: Example

Inserting a snippet



```
SELECT CONCAT(char1, char2)
```

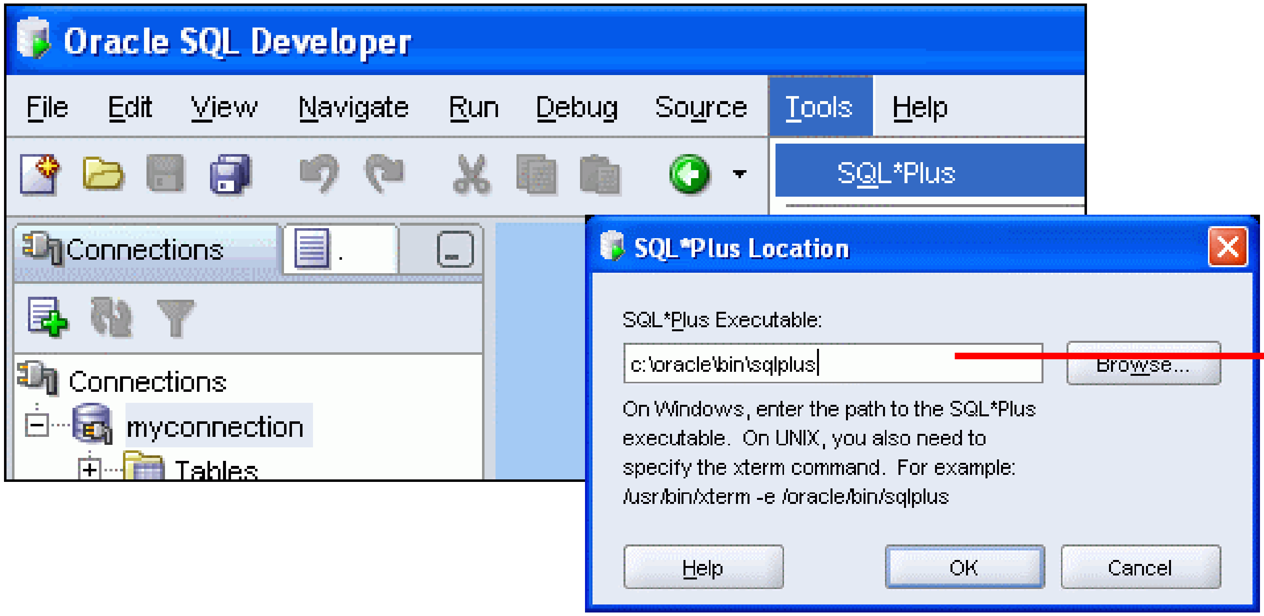
Editing the snippet



```
SELECT CONCAT(first_name, last_name)
FROM employees;
```

Using SQL*Plus

- You can invoke the SQL*Plus command-line interface from SQL Developer.
- Close all the SQL Worksheets to enable the SQL*Plus menu option.



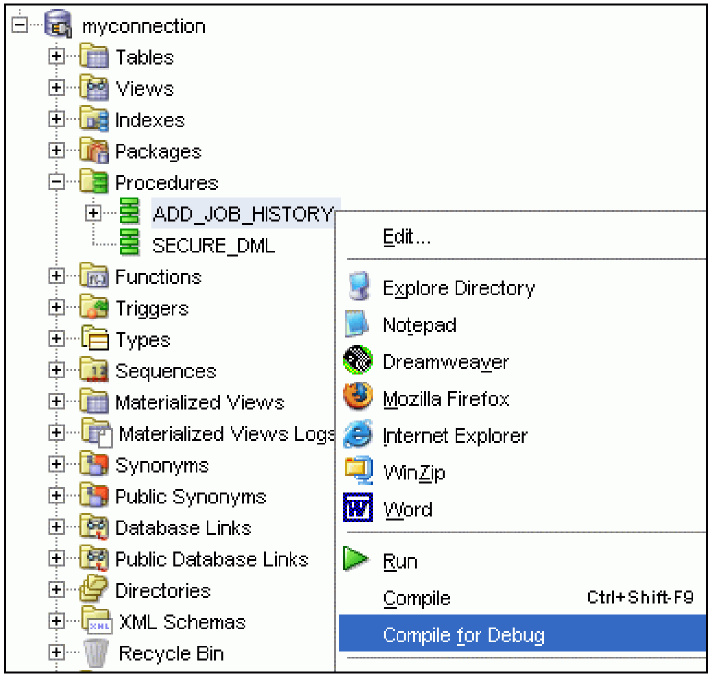
SQL*Plus Executable: c:\oracle\bin\sqlplus

On Windows, enter the path to the SQL*Plus executable. On UNIX, you also need to specify the xterm command. For example: /usr/bin/xterm -e /oracle/bin/sqlplus

Provide the location of the `sqlplus.exe` file only the first time you invoke SQL*Plus.

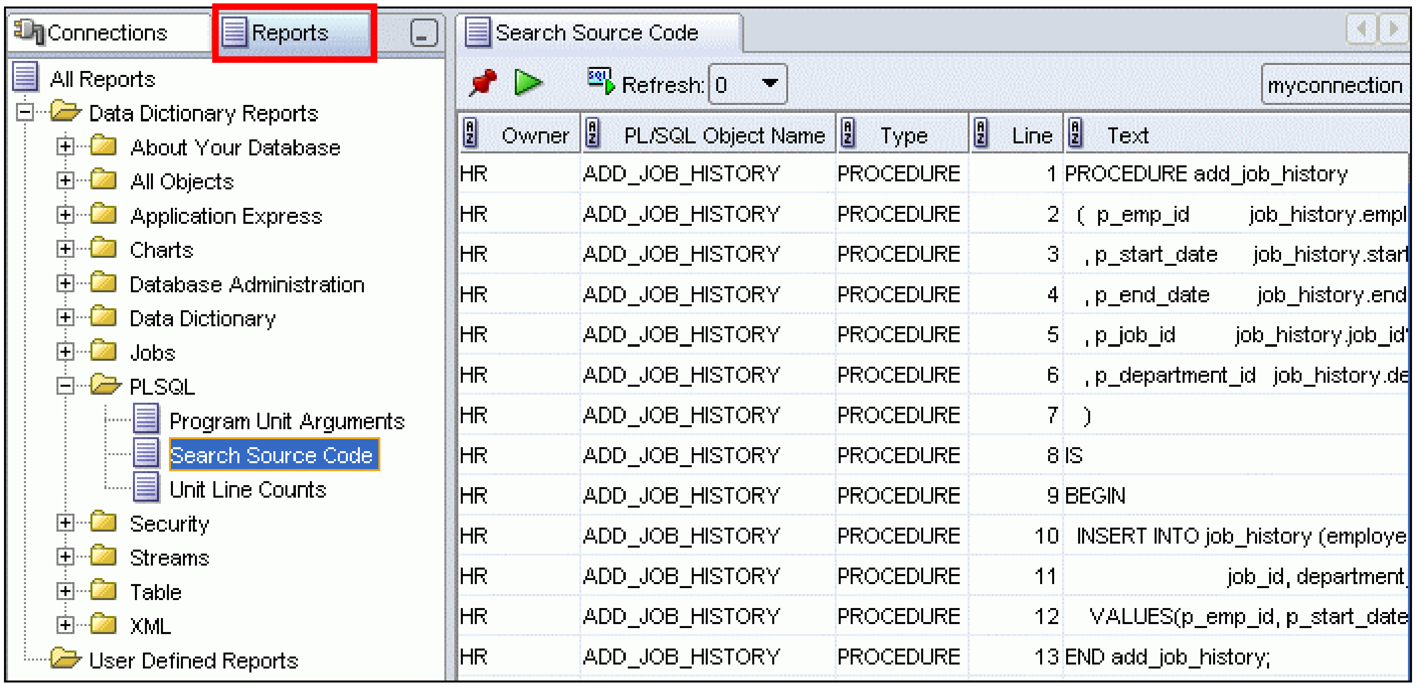
Debugging Procedures and Functions

- Use SQL Developer to debug PL/SQL functions and procedures.
- Use the Compile for Debug option to perform a PL/SQL compilation so that the procedure can be debugged.
- Use Debug menu options to set breakpoints, and to perform step into, step over tasks.



Database Reporting

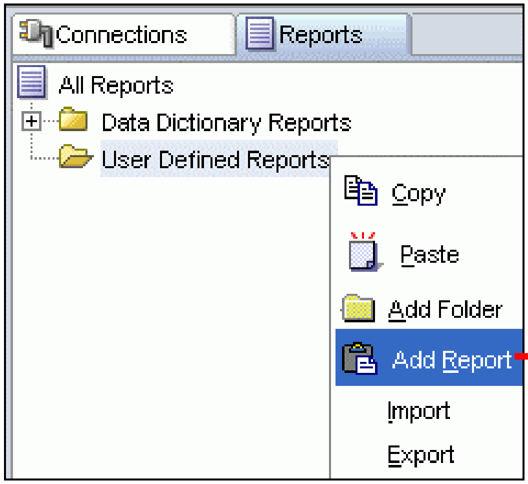
SQL Developer provides a number of predefined reports about the database and its objects.

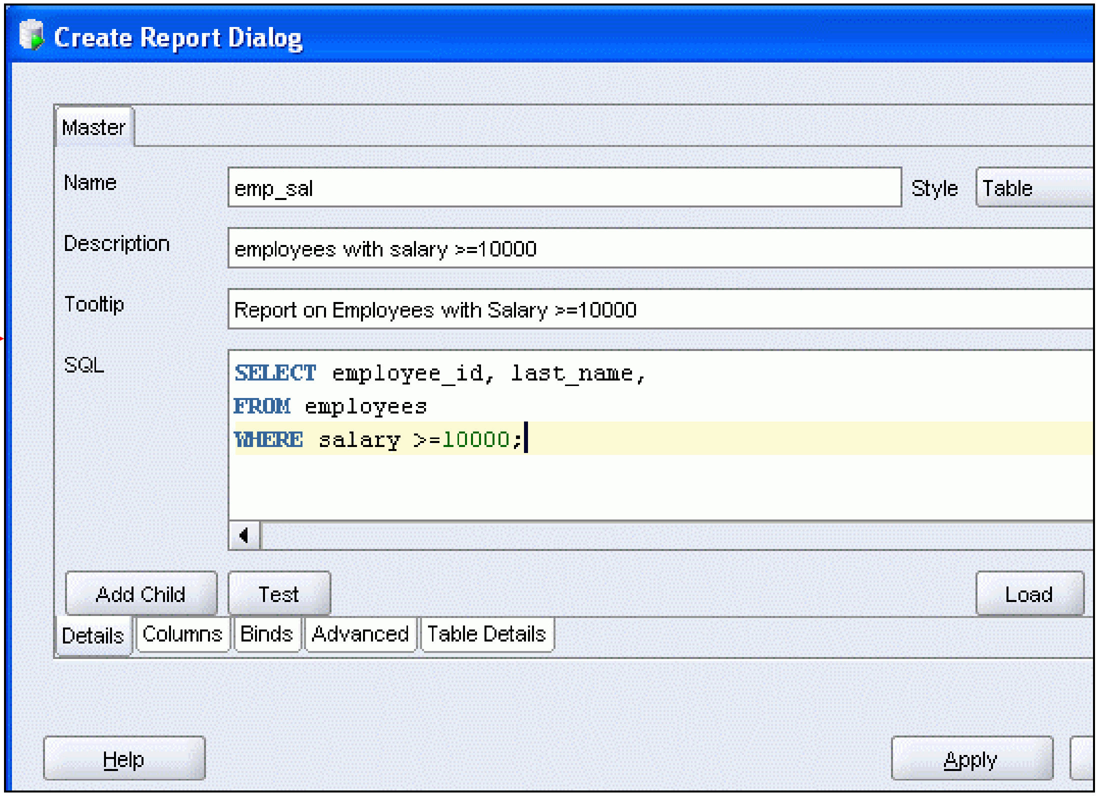


Owner	PL/SQL Object Name	Type	Line	Text
HR	ADD_JOB_HISTORY	PROCEDURE	1	PROCEDURE add_job_history
HR	ADD_JOB_HISTORY	PROCEDURE	2	(p_emp_id job_history.empl
HR	ADD_JOB_HISTORY	PROCEDURE	3	, p_start_date job_history.start
HR	ADD_JOB_HISTORY	PROCEDURE	4	, p_end_date job_history.end
HR	ADD_JOB_HISTORY	PROCEDURE	5	, p_job_id job_history.job_id
HR	ADD_JOB_HISTORY	PROCEDURE	6	, p_department_id job_history.de
HR	ADD_JOB_HISTORY	PROCEDURE	7	)
HR	ADD_JOB_HISTORY	PROCEDURE	8	IS
HR	ADD_JOB_HISTORY	PROCEDURE	9	BEGIN
HR	ADD_JOB_HISTORY	PROCEDURE	10	INSERT INTO job_history (employe
HR	ADD_JOB_HISTORY	PROCEDURE	11	job_id, department
HR	ADD_JOB_HISTORY	PROCEDURE	12	VALUES(p_emp_id, p_start_date
HR	ADD_JOB_HISTORY	PROCEDURE	13	END add_job_history;

Creating a User-Defined Report

Create and save user-defined reports for repeated use.





Name: emp_sal

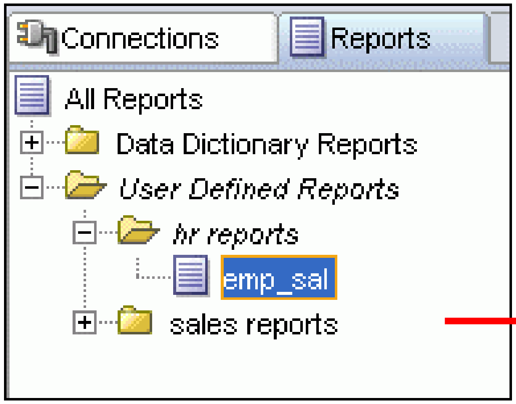
Style: Table

Description: employees with salary >=10000

Tooltip: Report on Employees with Salary >=10000

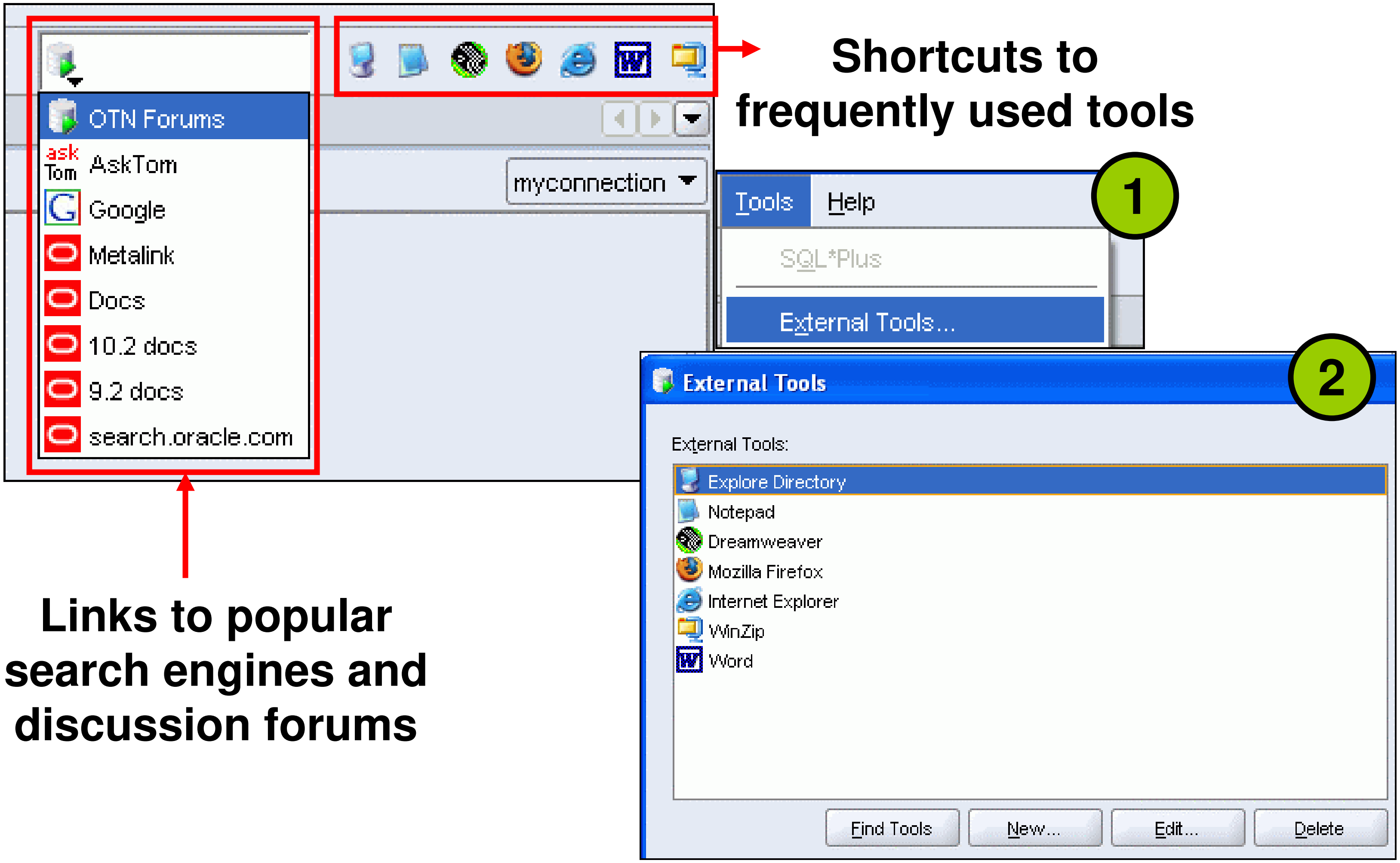
SQL:

```
SELECT employee_id, last_name,
FROM employees
WHERE salary >=10000;
```



Organize reports in folders.

Search Engines and External Tools

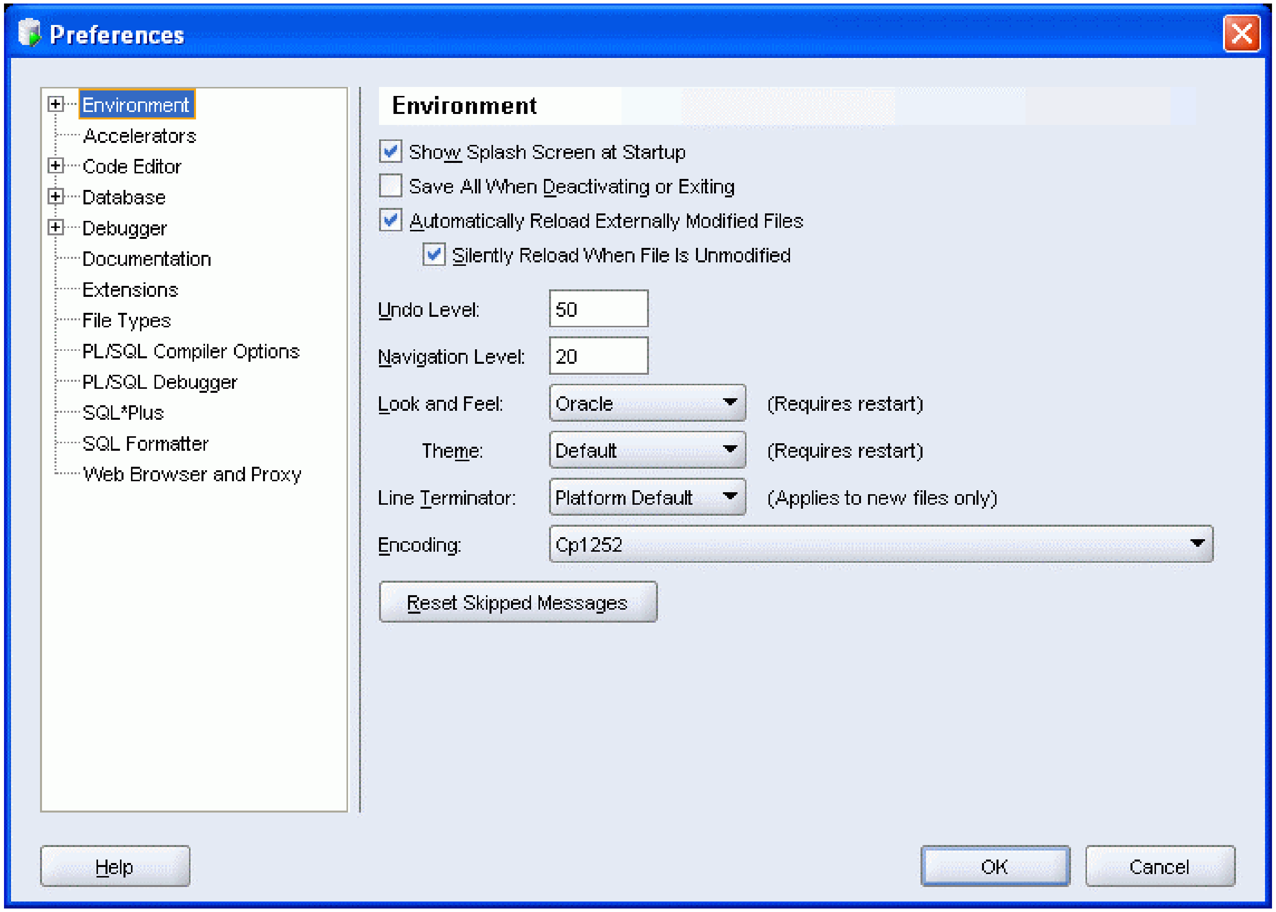


Shortcuts to frequently used tools

Links to popular search engines and discussion forums

Setting Preferences

- Customize the SQL Developer interface and environment.
- In the Tools menu, select Preferences.



Environment

☑ Show Splash Screen at Startup

☐ Save All When Deactivating or Exiting

☑ Automatically Reload Externally Modified Files

☑ Silently Reload When File Is Unmodified

Undo Level: 50

Navigation Level: 20

Look and Feel: Oracle (Requires restart)

Theme: Default (Requires restart)

Line Terminator: Platform Default (Applies to new files only)

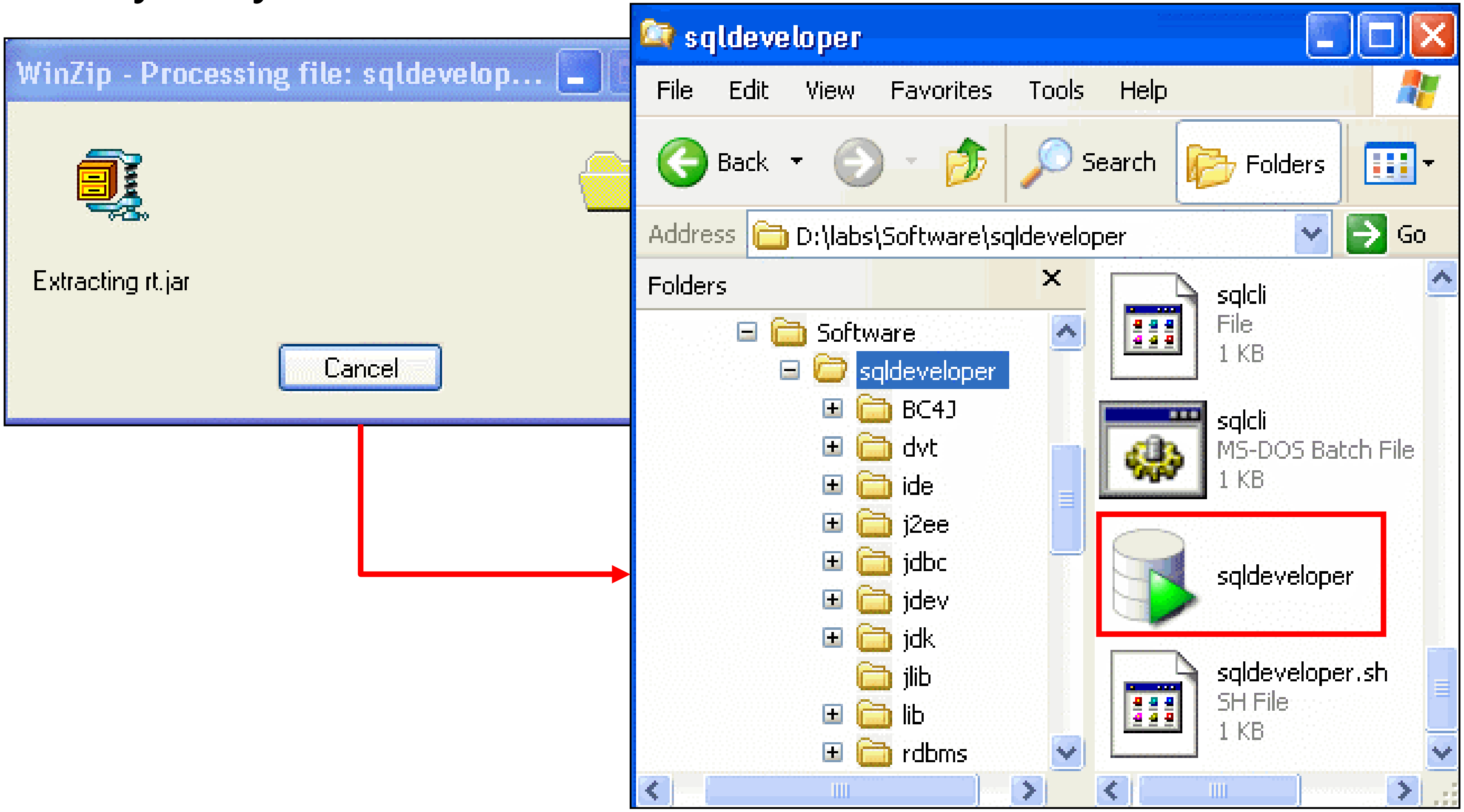
Encoding: Cp1252

Specifications of SQL Developer 1.5.3

- SQL Developer 1.5.3 is the first translation release, and is a patch to Oracle SQL Developer 1.5.
- New feature list is available at:
  - http://www.oracle.com/technology/products/database/sql_developer/files/newFeatures_v15.html
- Supports Windows, Linux, and Mac OS X platforms
- To install, unzip the downloaded SQL Developer kit, which includes the required minimum JDK (JDK1.5.0_06).
- To start, double-click `sqldeveloper.exe`
- Connects to Oracle Database version 9.2.0.1 and later
- Freely downloadable from the following link:
  - http://www.oracle.com/technology/products/database/sql_developer/index.html

Installing SQL Developer 1.5.3

Download the Oracle SQL Developer kit and unzip into any directory on your machine.

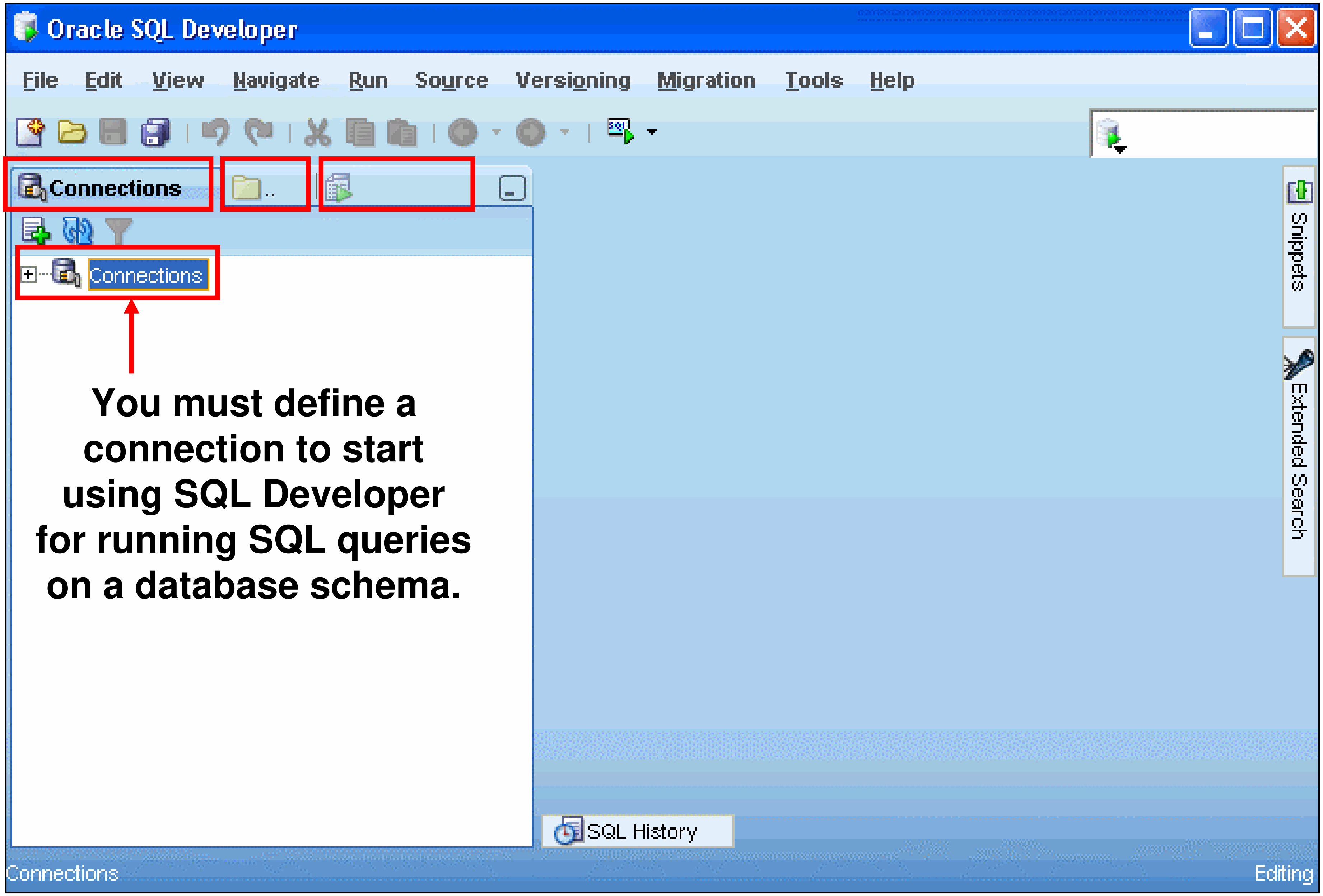


WinZip - Processing file: sqldevelop...

Extracting rt.jar

Address D:\labs\Software\sqldeveloper

SQL Developer 1.5.3 Interface



You must define a connection to start using SQL Developer for running SQL queries on a database schema.

Summary

In this appendix, you should have learned how to use SQL Developer to do the following:

- Browse, create, and edit database objects
- Execute SQL statements and scripts in SQL Worksheet
- Create and save custom reports