Introduction to Oracle9*i*: SQL Basics

Electronic Presentation

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Introduction

Objectives

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

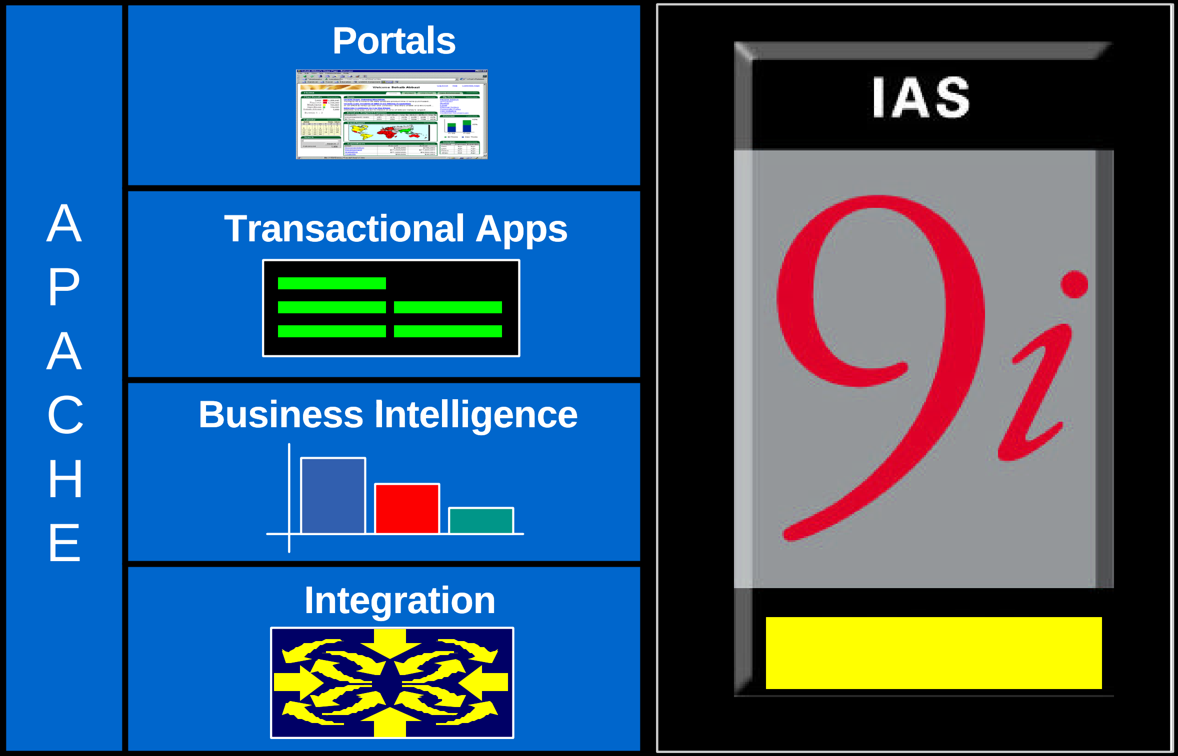
- **List the features of Oracle9*i***
- **Discuss the theoretical and physical aspects of a relational database**
- **Describe the Oracle implementation of the RDBMS and ORDBMS**

Oracle9*i*

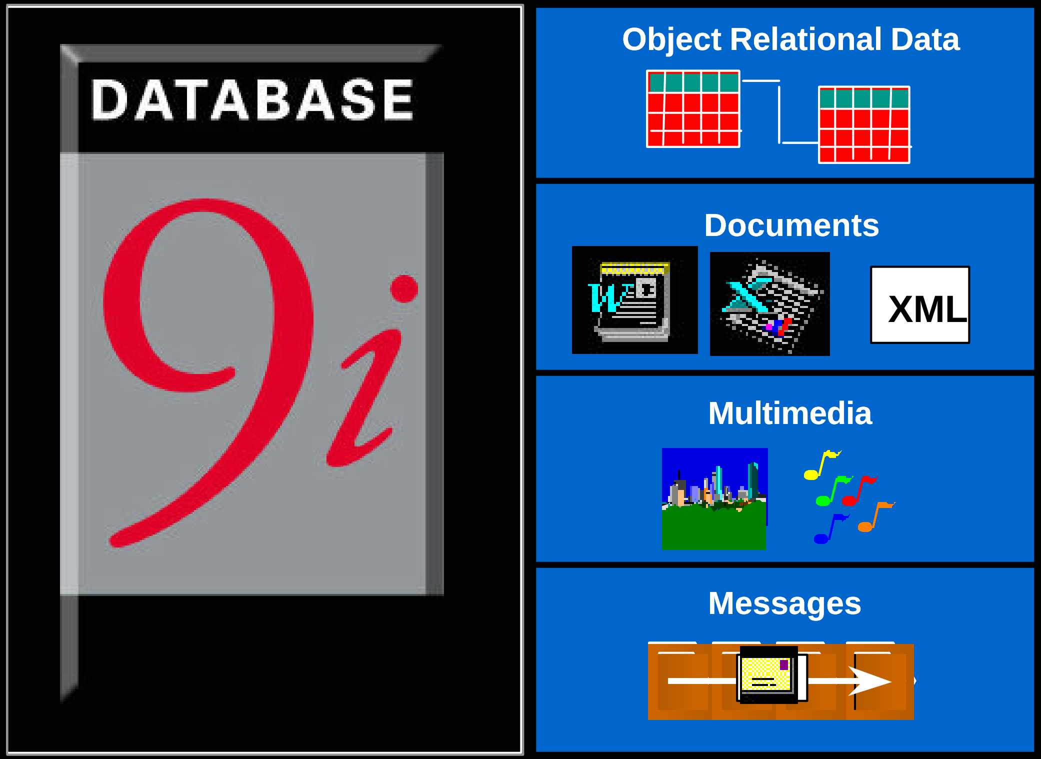
- Scalability
- Reliability
- Single development model
- Common skill sets
- One management interface
- One vendor

Oracle9*i*

Oracle9*i* Application Server



Oracle9*i* Database



Relational and Object Relational Database Management System

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

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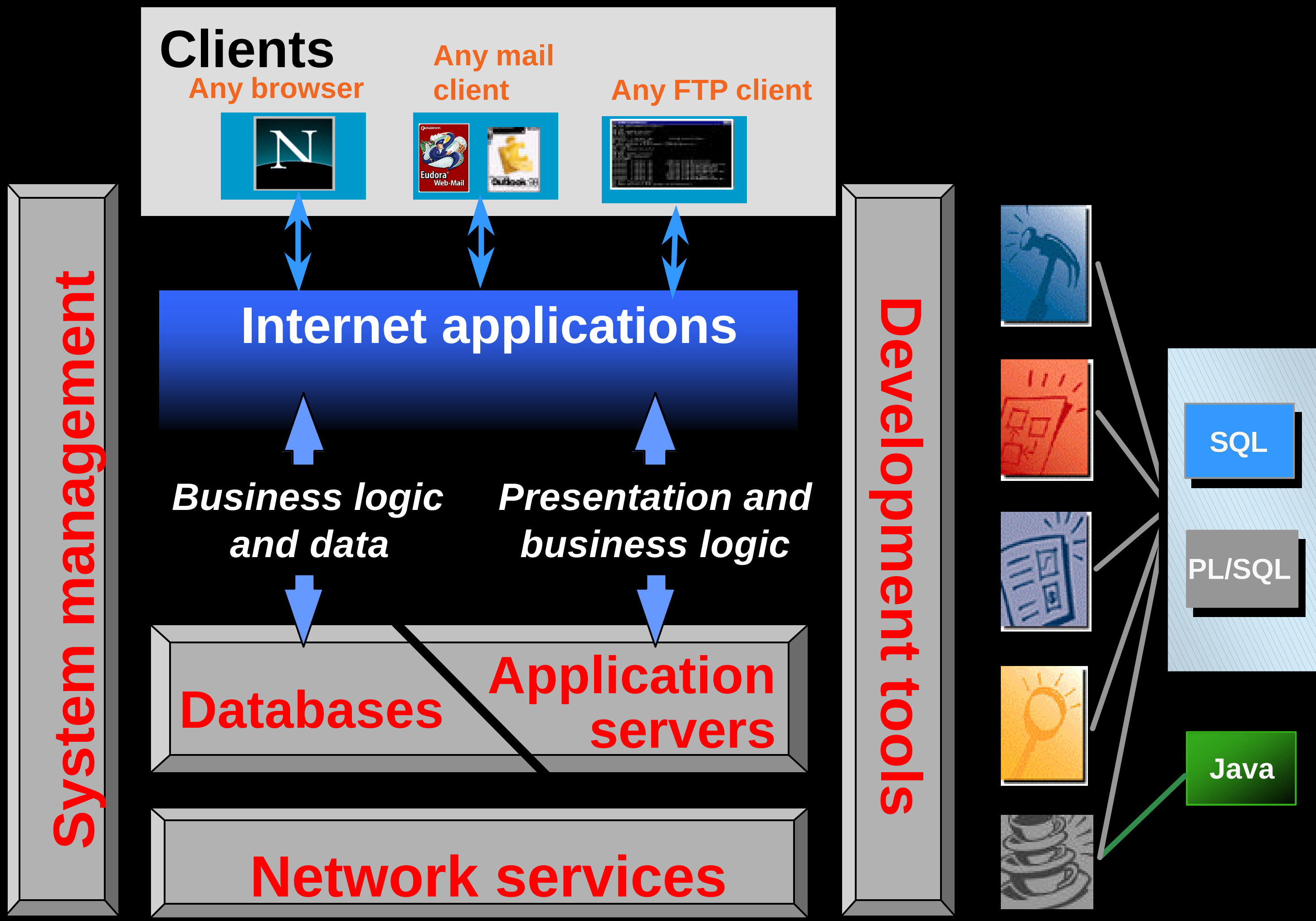
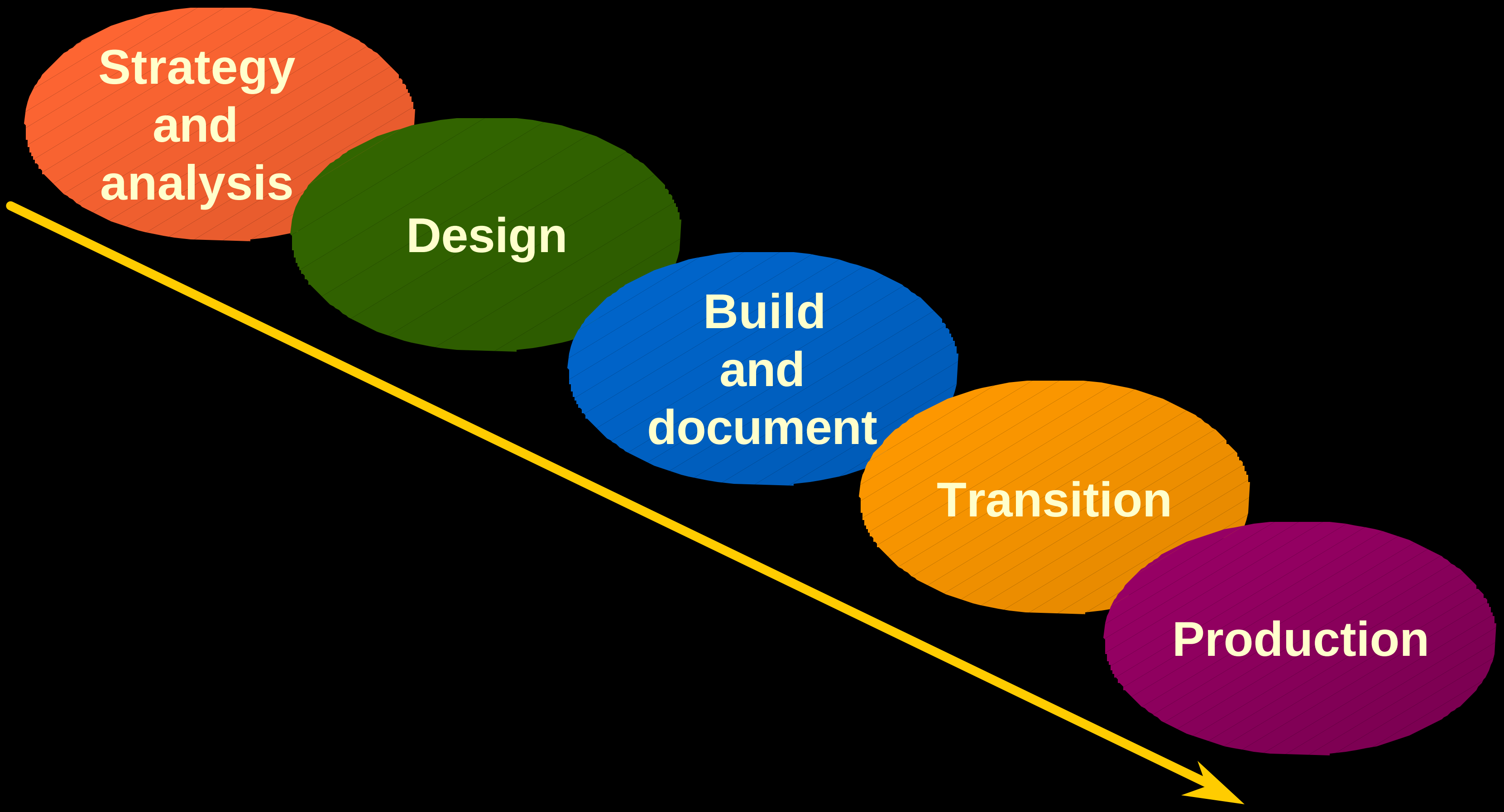
Oracle Internet Platform



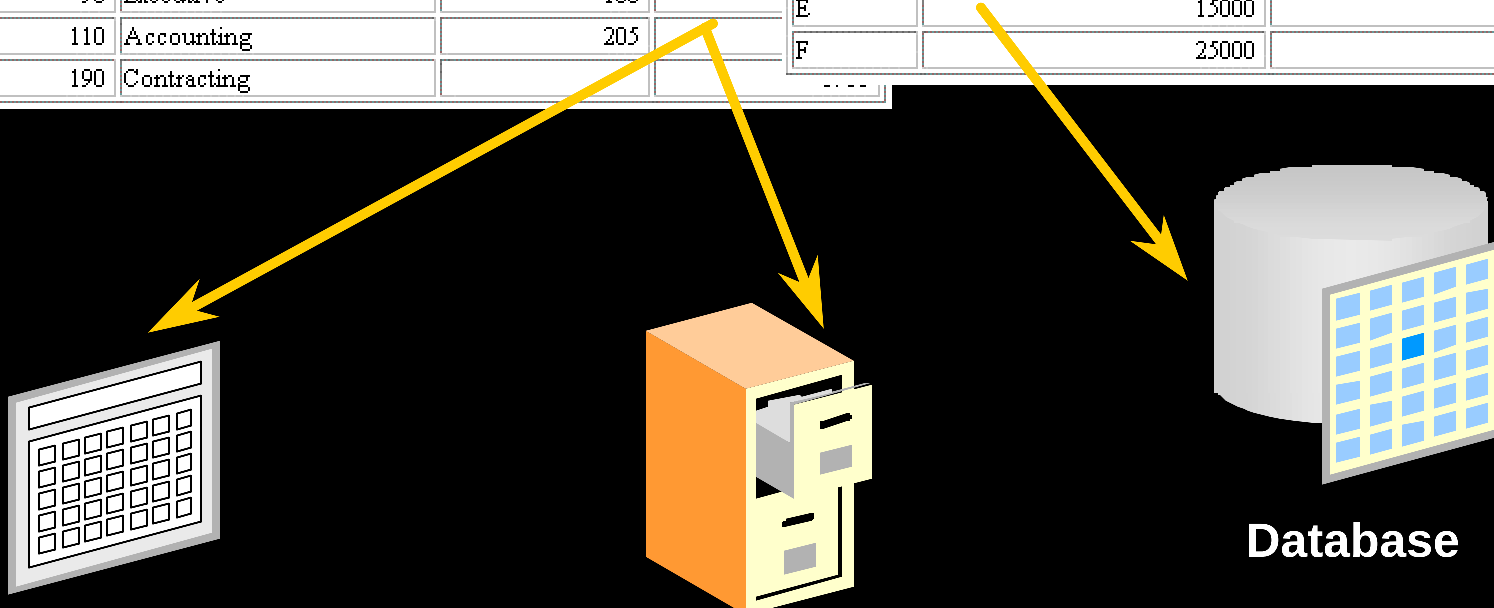
System Development Life Cycle



Data Storage on Different Media

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	
20	Marketing	201	
50	Shipping	124	
60	IT	103	
80	Sales	149	
90	Executive	100	
110	Accounting	205	
190	Contracting		

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



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

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Definition of a Relational Database

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

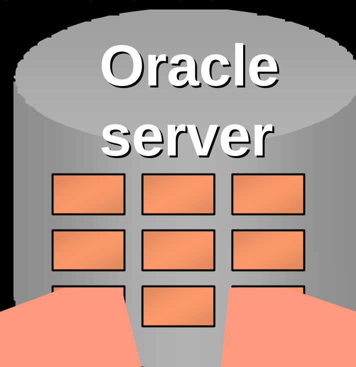

Table Name: **EMPLOYEES**

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PI
100	Steven	King	SKING	51
101	Neena	Kochhar	NKOCHHAR	51
102	Lex	De Haan	LDEHAAN	51

…

Table Name: **DEPARTMENTS**

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

…

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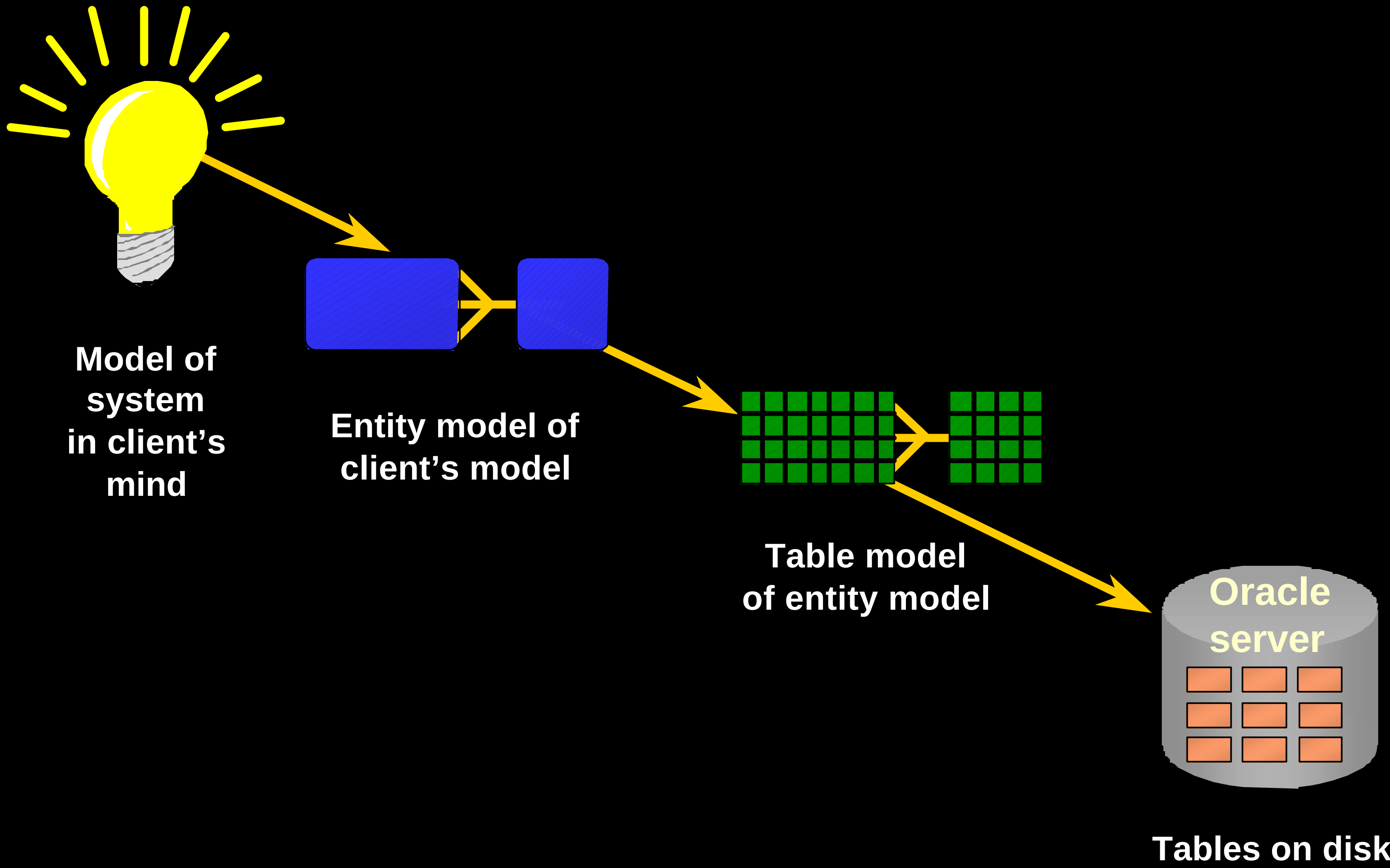
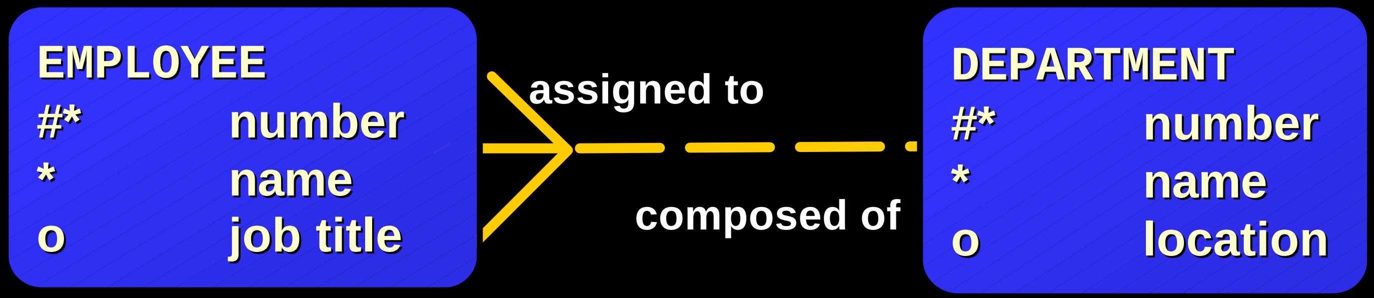
Data Models


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

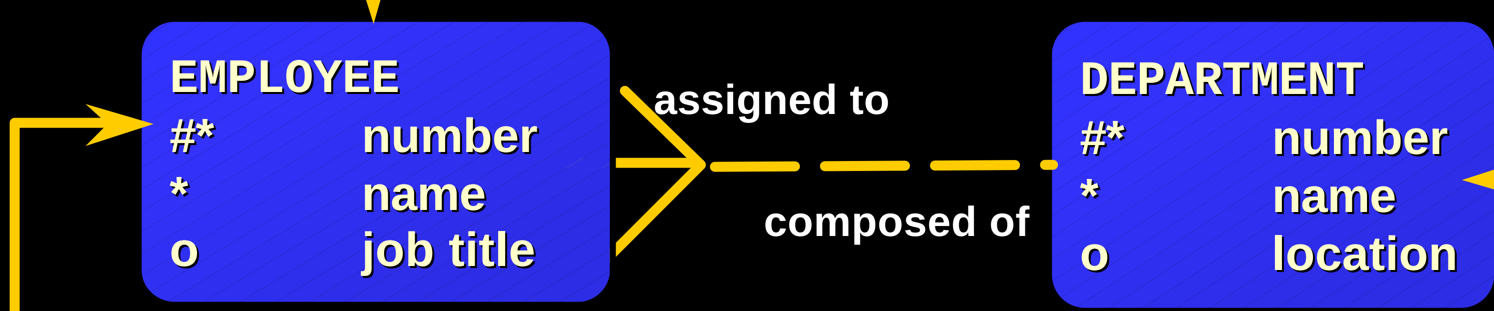


- Scenario
  - "... Assign one or more employees to a department ..."
  - "... Some departments do not yet have assigned employees ..."

Entity Relationship Modeling Conventions

Entity
Soft box
Singular, unique name
Uppercase
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 (PK).
- You can logically relate data from multiple tables using foreign keys (FK).

Table Name: **EMPLOYEES**

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	DEPARTMENT_ID
174	Ellen	Abel	80
142	Curtis	Davies	50
102	Lex	De Haan	90
104	Bruce	Ernst	60
202	Pat	Fay	20
206	William	Gietz	110

...

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		1700

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

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Relational Database Terminology

EMPLOYEE_ID	LAST_NAME	FIRST_NAME	SALARY	COMMISSION_PCT	DEPARTMENT_ID
100	King	Steven	24000		90
101	Kochhar	Neena	17000		90
102	De Haan	Lex	17000		90
103	Hunold	Alexander	9000		60
104	Ernst	Bruce	6000		60
107	Lorentz	Diana	4200		60
124	Mourgos	Kevin	5800		50
141	Rajs	Trenna	3500		50
142	Davies	Curtis	3100		50
143	Matos	Randall	2600		50
144	Vargas	Peter	2500		50
149	Zlotkey	Eleni	10500	.2	80
174	Abel	Ellen	11000	.3	80
176	Taylor	Jonathon	8600	.2	80
178	Grant	Kimberely	7000	.15	
200	Whalen	Jennifer	4400		10
201	Hartstein	Michael	13000		20
202	Fay	Pat	6000		20
205	Higgins	Shelley	12000		110
206	Gietz	William	8300		110

Relational Database Properties

A relational database:

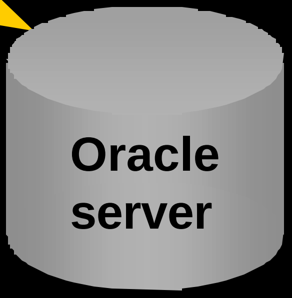
- Can be accessed and modified by executing structured query language (SQL) statements
- Contains a collection of tables with no physical pointers
- Uses a set of operators

Communicating with a RDBMS Using SQL

SQL statement is entered.

```
SELECT department_name
FROM   departments;
```

Statement is sent to Oracle Server.



DEPARTMENT_NAME
Administration
Marketing
Shipping
IT
Sales
Executive
Accounting
Contracting

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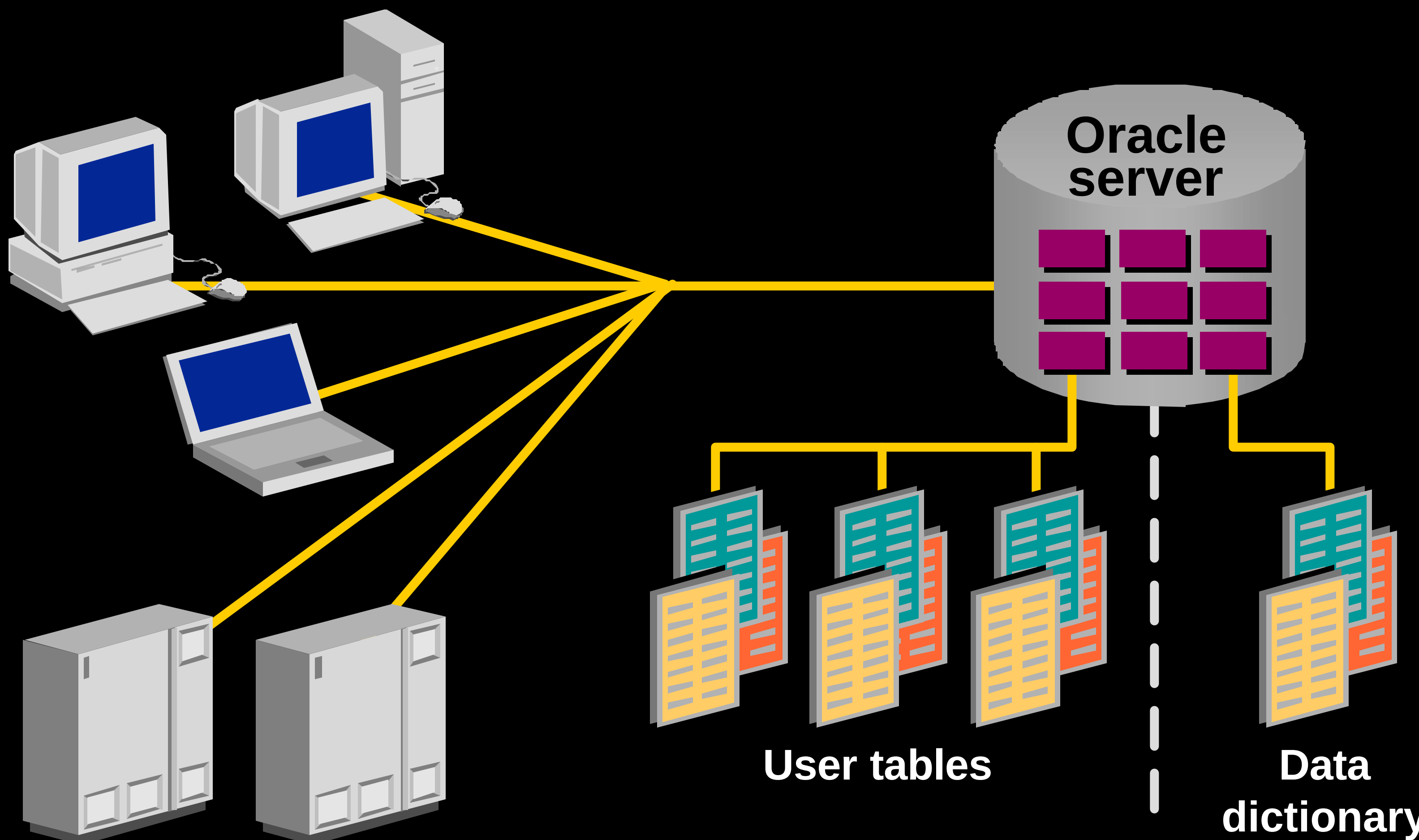
Relational Database Management System



SQL Statements

SELECT	Data retrieval
INSERT UPDATE DELETE MERGE	Data manipulation language (DML)
CREATE ALTER DROP RENAME TRUNCATE	Data definition language (DDL)
COMMIT ROLLBACK SAVEPOINT	Transaction control
GRANT REVOKE	Data control language (DCL)

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Tables Used in the Course

EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALA
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	240
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	170
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	170
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	90
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	42
124	Kevin	Mourgos	KMOURGOS	650.123.5234	16-NOV-99	ST_MAN	58
141	Trenna	Rajs	TRAJS	650.121.8009	17-OCT-95	ST_CLERK	35
142	Curtis	Davies	CDAVIES	650.121.2994	29-JAN-97	ST_CLERK	31
143	Randall	Matos	RMATOS	650.121.2874	15-MAR-98	ST_CLERK	26
[illegible]	[illegible]	[illegible]	[illegible]	0.121.2004	09-JUL-98	ST_CLERK	25
[illegible]	[illegible]	[illegible]	[illegible]	1.44.1344.429018	29-JAN-00	SA_MAN	105
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.44.16[illegible]	[illegible]	[illegible]	[illegible]

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		1700

DEPARTMENTS

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

JOB_GRADES

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Summary

- The Oracle9*i* Server is the database for Internet computing.
- Oracle9*i* is based on the object relational database management system.
- 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 the SQL language and PL/SQL engine.

1

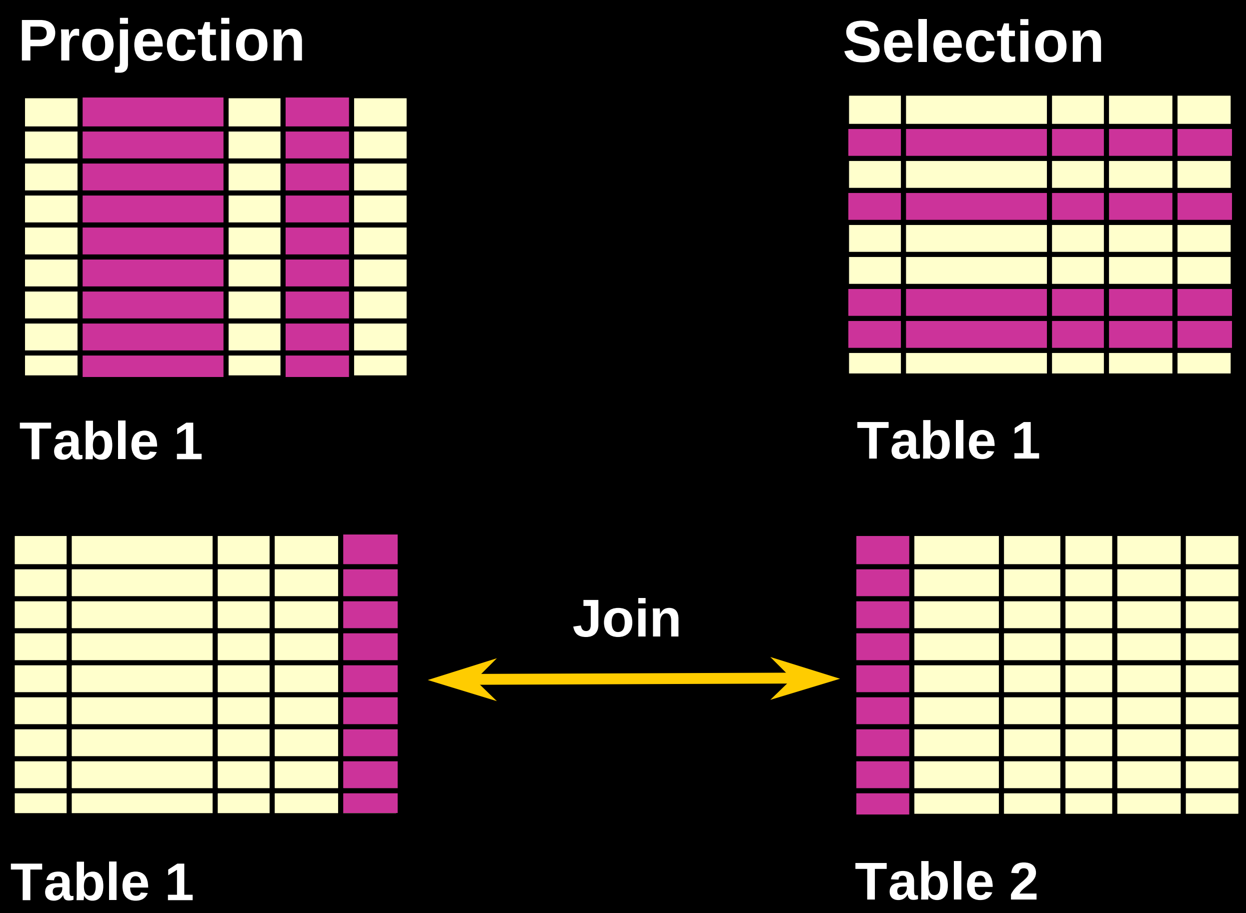
Writing Basic SQL SELECT Statements

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
- Differentiate between SQL statements and *i*SQL*Plus commands

Capabilities of SQL SELECT Statements



Basic SELECT Statement

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

- **SELECT identifies *what* columns**
- **FROM identifies *which* table**

Selecting All Columns

```
SELECT *
FROM   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		1700

8 rows selected.

Selecting Specific Columns

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

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

8 rows selected.

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Writing SQL Statements

- SQL statements are not case sensitive.
- SQL statements can be 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.

Column Heading Defaults

- *i*SQL*Plus:
  - Default heading justification: Center
  - Default heading display: Uppercase
- SQL*Plus:
  - Character and Date column headings are left-justified
  - Number column headings are right-justified
  - Default heading display: Uppercase

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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
King	24000	24300
Kochhar	17000	17300
De Haan	17000	17300
Hunold	9000	9300
Ernst	6000	6300
...		
Hartstein	13000	13300
Fay	6000	6300
Higgins	12000	12300
Gietz	8300	8600

20 rows selected.

Operator Precedence

- Multiplication and division take priority over addition and subtraction.
- Operators of the same priority are evaluated from left to right.
- Parentheses are used to force prioritized evaluation and to clarify statements.

Operator Precedence

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

LAST_NAME	SALARY	12*SALARY+100
King	24000	288100
Kochhar	17000	204100
De Haan	17000	204100
Hunold	9000	108100
Ernst	6000	72100
...		
Hartstein	13000	156100
Fay	6000	72100
Higgins	12000	144100
Gietz	8300	99700

20 rows selected.

Using Parentheses

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

LAST_NAME	SALARY	12*(SALARY+100)
King	24000	289200
Kochhar	17000	205200
De Haan	17000	205200
Hunold	9000	109200
Ernst	6000	73200
...		
Hartstein	13000	157200
Fay	6000	73200
Higgins	12000	145200
Gietz	8300	100800

20 rows selected.

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Defining a Null Value

- A null is a value that is unavailable, unassigned, unknown, or inapplicable.
- A 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
King	AD_PRES	24000	
Kochhar	AD_VP	17000	
...			
Zlotkey	SA_MAN	10500	.2
Abel	SA_REP	11000	.3
Taylor	SA_REP	8600	.2
...			
Gietz	AC_ACCOUNT	8300	

20 rows selected.

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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
King	
Kochhar	
...	
Zlotkey	25200
Abel	39600
Taylor	20640
...	
Gietz	

20 rows selected.

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 is case sensitive

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Using Column Aliases

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

NAME	COMM
King	
Kochhar	
De Haan	

...

20 rows selected.

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

Name	Annual Salary
King	288000
Kochhar	204000
De Haan	204000

...

20 rows selected.

Concatenation Operator

A concatenation operator:

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

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Using the Concatenation Operator

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

Employees
KingAD_PRES
KochharAD_VP
De HaanAD_VP
HunoldIT_PROG
ErnstIT_PROG
LorentzIT_PROG
MourgosST_MAN
RajsST_CLERK

...

20 rows selected.

Literal Character Strings

- A literal is a character, a number, or a date included in the SELECT list.
- 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
King is a AD_PRES
Kochhar is a AD_VP
De Haan is a AD_VP
Hunold is a IT_PROG
Ernst is a IT_PROG
Lorentz is a IT_PROG
Mourgos is a ST_MAN
Rajs is a ST_CLERK

...

20 rows selected.

Duplicate Rows

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

```
SELECT department_id
FROM   employees;
```

DEPARTMENT_ID
90
90
90
60
60
60
50
50
50

...

20 rows selected.

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Eliminating Duplicate Rows

Eliminate duplicate rows by using the `DISTINCT` keyword in the `SELECT` clause.

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

DEPARTMENT_ID
10
20
50
60
80
90
110

8 rows selected.

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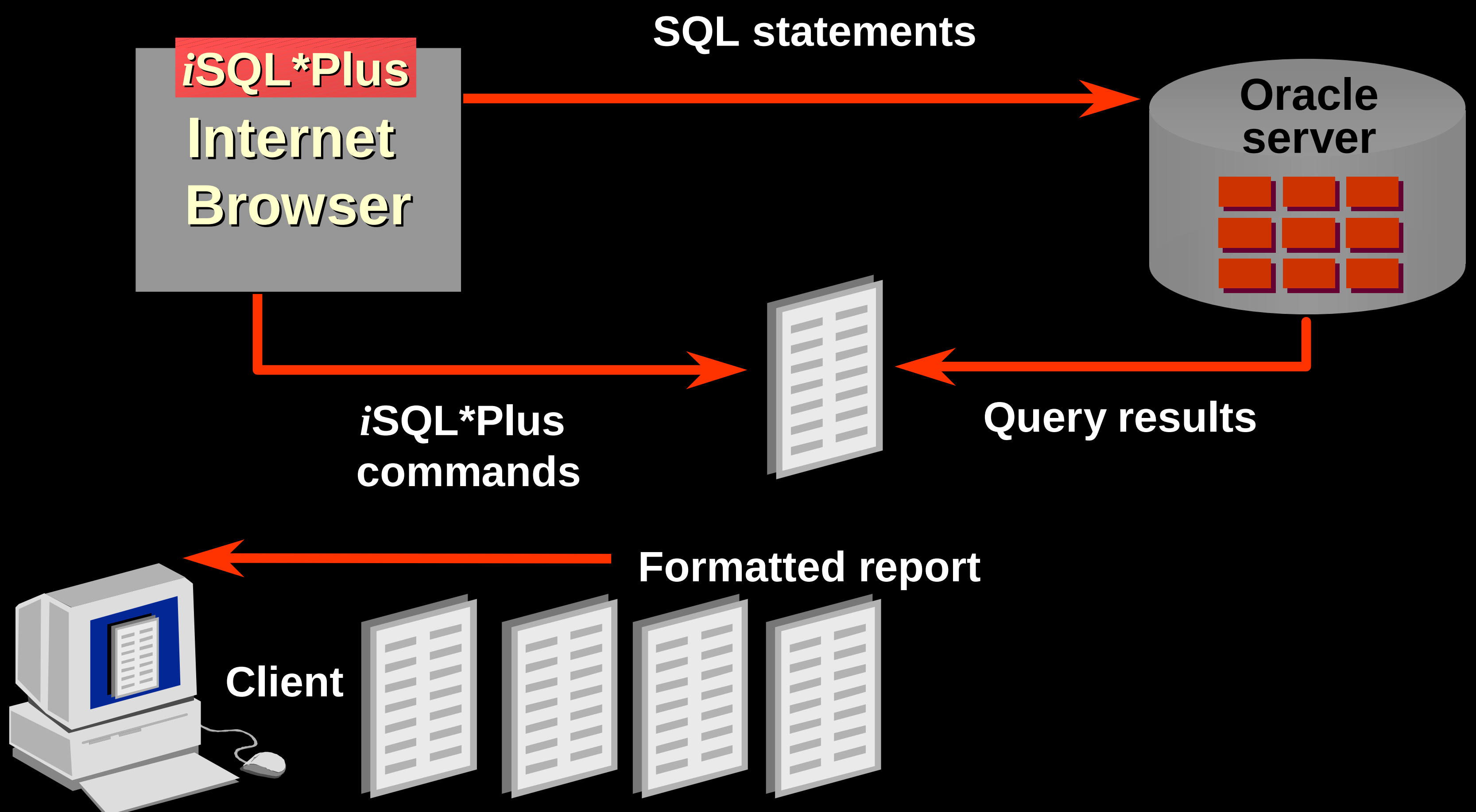
SQL and *i*SQL*Plus Interaction



SQL Statements Versus *i*SQL*Plus Commands

SQL	*i*SQL*Plus
• A language	• An environment
• ANSI standard	• Oracle proprietary
• Keyword cannot be abbreviated	• Keywords can be abbreviated
• Statements manipulate data and table definitions in the database	• Commands do not allow manipulation of values in the database
	• Runs on a browser
	• Centrally loaded, does not have to be implemented on each machine
SQL statements	*i*SQL*Plus commands

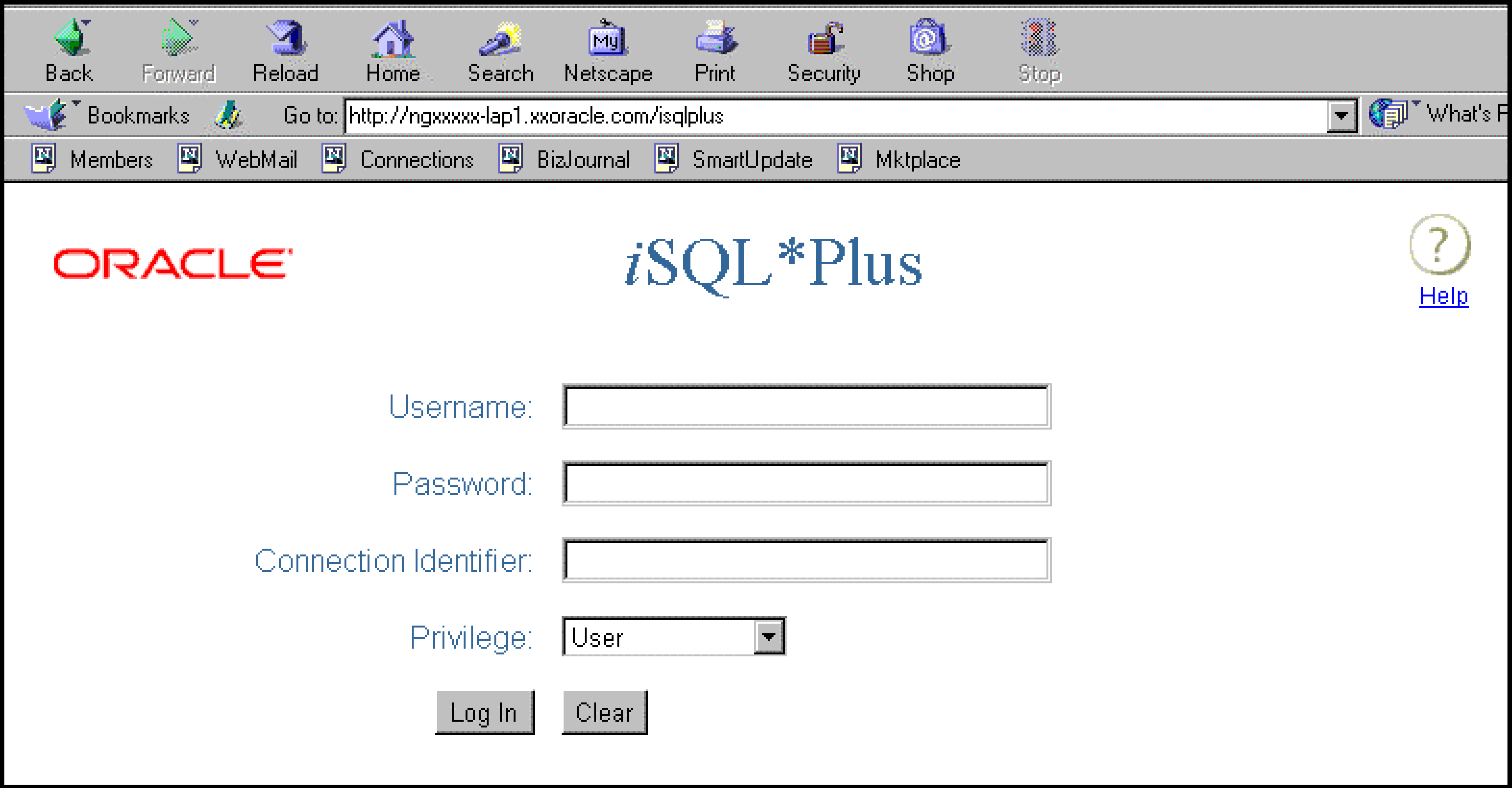
Overview of *i*SQL*Plus

After you log into *i*SQL*Plus, you can:

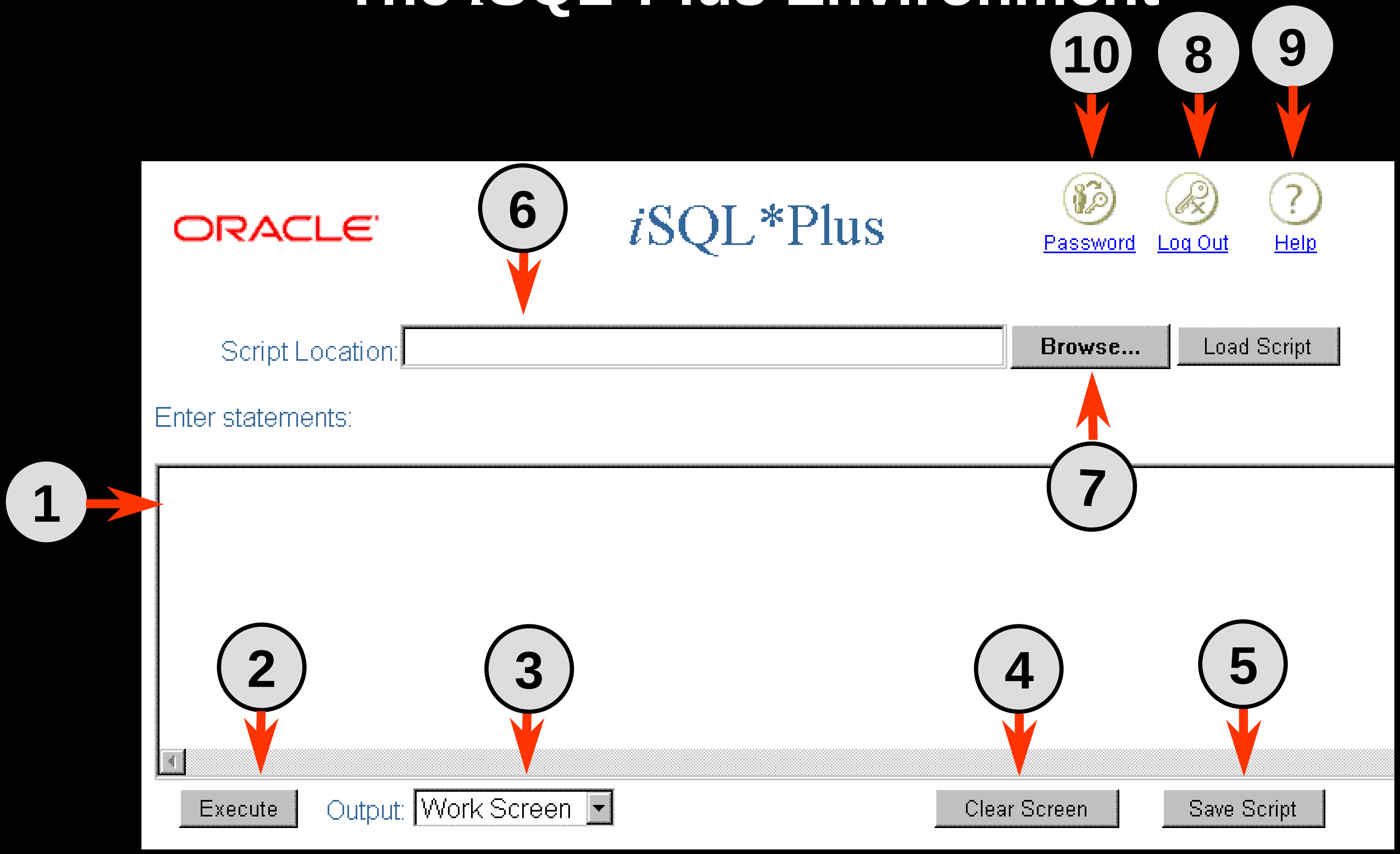
- Describe the table structure
- Edit your SQL statement
- Execute SQL from *i*SQL*Plus
- Save SQL statements to files and append SQL statements to files
- Execute statements stored in saved files
- Load commands from a text file into the *i*SQL*Plus Edit window

Logging In to *i*SQL*Plus

From your Windows browser environment:



The *i*SQL*Plus Environment



Displaying Table Structure

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

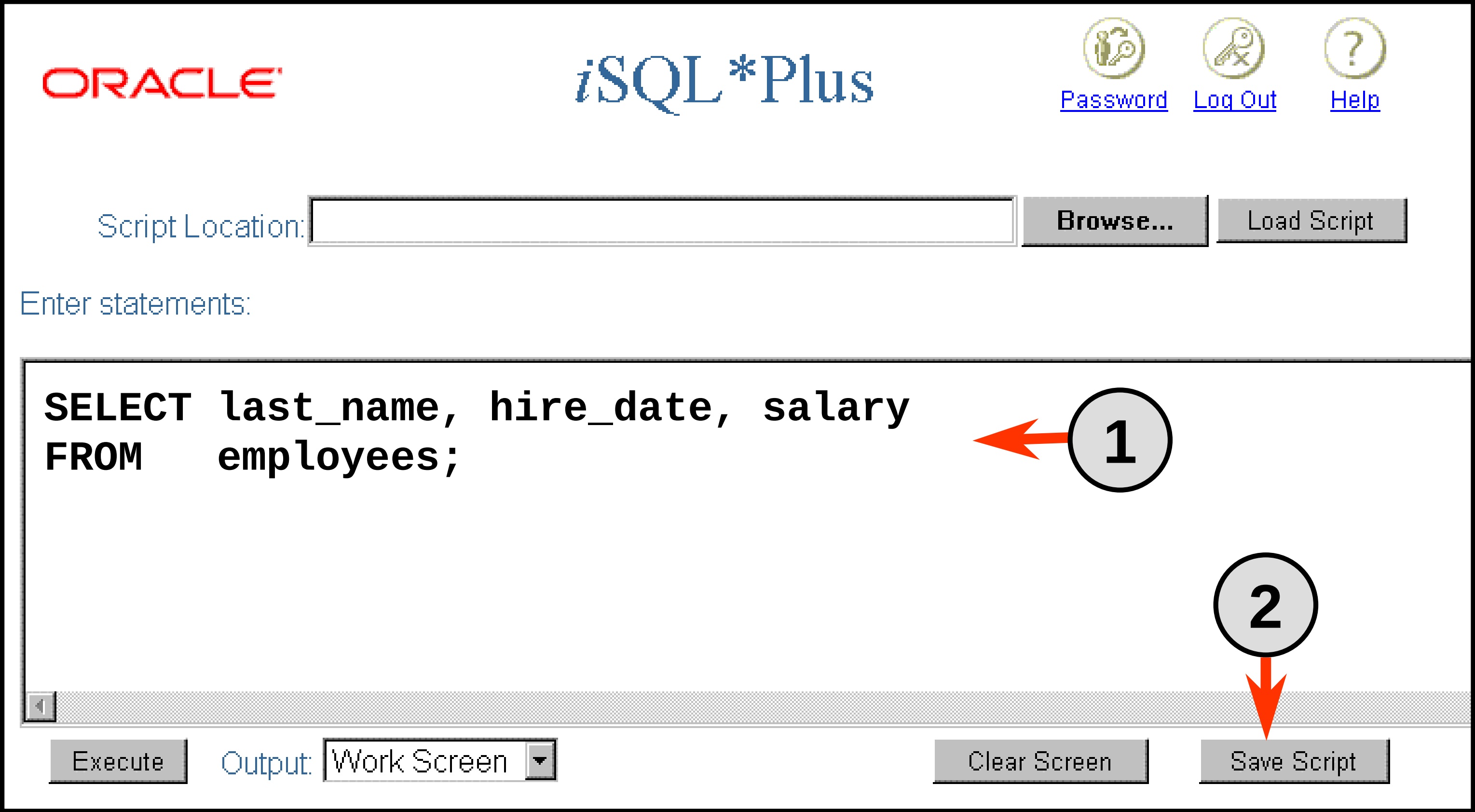
```
DESC[RIBE] tablename
```

Displaying Table Structure

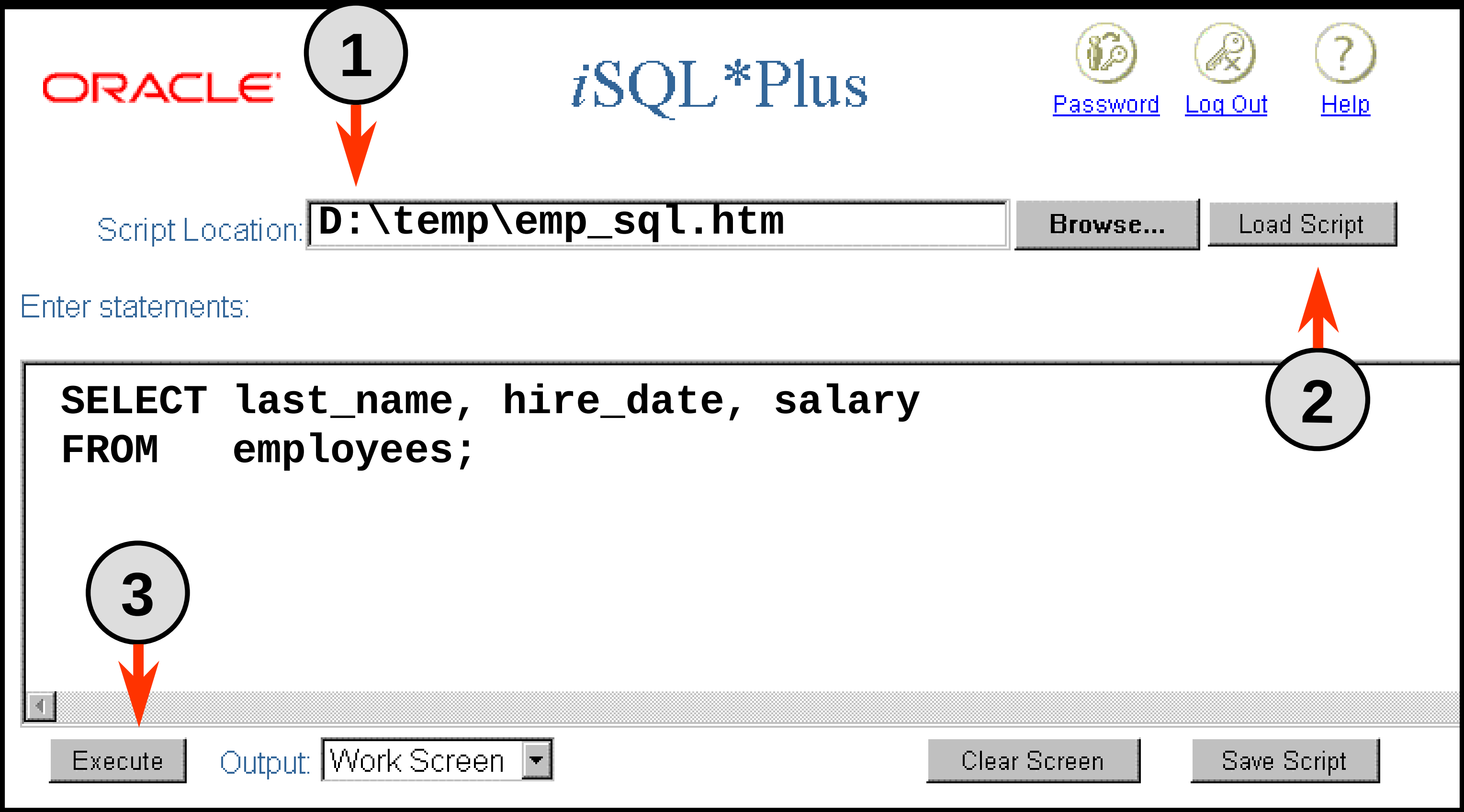
```
DESCRIBE employees
```

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)

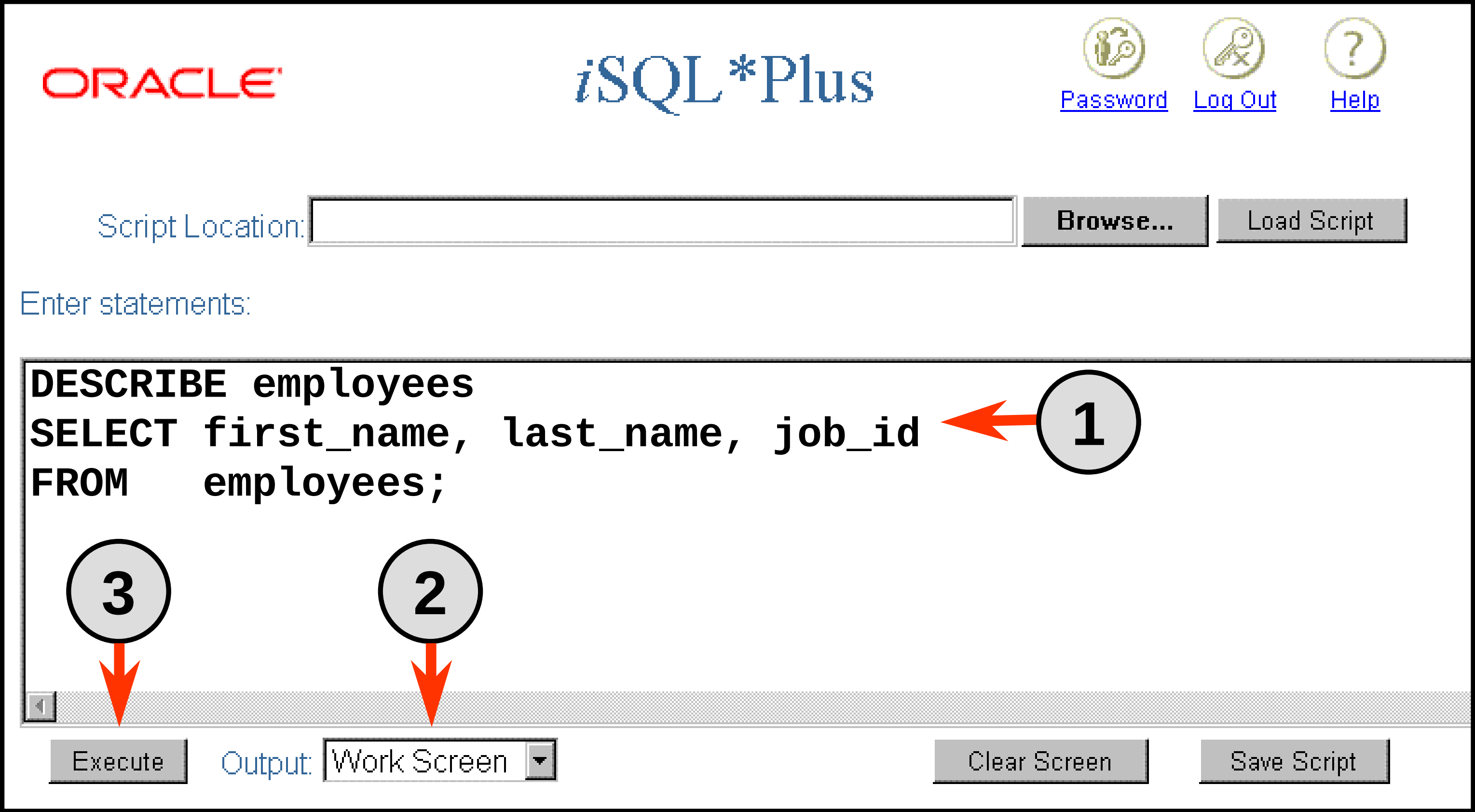
Interacting with Script Files



Interacting with Script Files



Interacting with Script Files



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 give descriptive column headings
- Use the *i*SQL*Plus environment to write, save, and execute SQL statements and *i*SQL*Plus commands.

```
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
- Using *i*SQL*Plus

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2

Restricting and Sorting Data

Objectives

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

- Limit the rows retrieved by a query
- Sort the rows retrieved by a query

Limiting Rows Using a Selection

EMPLOYEES

EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
100	King	AD_PRES	90
101	Kochhar	AD_VP	90
102	De Haan	AD_VP	90
103	Hunold	IT_PROG	60
104	Ernst	IT_PROG	60
107	Lorentz	IT_PROG	60
124	Mourgos	ST_MAN	50

…

20 rows selected.

“retrieve all employees in department 90”

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

Limiting the Rows Selected

- Restrict the rows 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
100	King	AD_PRES	90
101	Kochhar	AD_VP	90
102	De Haan	AD_VP	90

Character Strings and Dates

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

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

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Comparison Conditions

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

Using Comparison Conditions

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

LAST_NAME	SALARY
Matos	2600
Vargas	2500

Other Comparison Conditions

Operator	Meaning
`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

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Using the BETWEEN Condition

Use the BETWEEN condition 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
Rajs	3500
Davies	3100
Matos	2600
Vargas	2500

Using the IN Condition

Use the `IN` membership condition 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
202	Fay	6000	201
200	Whalen	4400	101
205	Higgins	12000	101
101	Kochhar	17000	100
102	De Haan	17000	100
124	Mourgos	5800	100
149	Zlotkey	10500	100
201	Hartstein	13000	100

8 rows selected.

Using the LIKE Condition

- Use the LIKE condition 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%';
```

Using the LIKE Condition

- You can combine pattern-matching characters.

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

LAST_NAME
Kochhar
Lorentz
Mourgos

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

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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
King	

Logical Conditions

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 following condition is false

Using the AND Operator

AND requires both 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
149	Zlotkey	SA_MAN	10500
201	Hartstein	MK_MAN	13000

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Using the OR Operator

OR requires either 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
100	King	AD_PRES	24000
101	Kochhar	AD_VP	17000
102	De Haan	AD_VP	17000
124	Mourgos	ST_MAN	5800
149	Zlotkey	SA_MAN	10500
174	Abel	SA_REP	11000
201	Hartstein	MK_MAN	13000
205	Higgins	AC_MGR	12000

8 rows selected.

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
King	AD_PRES
Kochhar	AD_VP
De Haan	AD_VP
Mourgos	ST_MAN
Zlotkey	SA_MAN
Whalen	AD_ASST
Hartstein	MK_MAN
Fay	MK_REP
Higgins	AC_MGR
Gietz	AC_ACCOUNT

10 rows selected.

Rules of Precedence

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

Override rules of precedence by using parentheses.

Rules of Precedence

```
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
King	AD_PRES	24000
Abel	SA_REP	11000
Taylor	SA_REP	8600
Grant	SA_REP	7000

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Rules of Precedence

Use parentheses to force priority.

```
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
King	AD_PRES	24000

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ORDER BY Clause

- Sort 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
King	AD_PRES	90	17-JUN-87
Whalen	AD_ASST	10	17-SEP-87
Kochhar	AD_VP	90	21-SEP-89
Hunold	IT_PROG	60	03-JAN-90
Ernst	IT_PROG	60	21-MAY-91

...

20 rows selected.

Sorting in Descending Order

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

LAST_NAME	JOB_ID	DEPARTMENT_ID	HIRE_DATE
Zlotkey	SA_MAN	80	29-JAN-00
Mourgos	ST_MAN	50	16-NOV-99
Grant	SA_REP		24-MAY-99
Lorentz	IT_PROG	60	07-FEB-99
Vargas	ST_CLERK	50	09-JUL-98
Taylor	SA_REP	80	24-MAR-98
Matos	ST_CLERK	50	15-MAR-98
Fay	MK_REP	20	17-AUG-97
Davies	ST_CLERK	50	29-JAN-97

...

20 rows selected.

Sorting by Column Alias

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

EMPLOYEE_ID	LAST_NAME	ANNSAL
144	Vargas	30000
143	Matos	31200
142	Davies	37200
141	Rajs	42000
107	Lorentz	50400
200	Whalen	52800
124	Mourgos	69600
104	Ernst	72000
202	Fay	72000
178	Grant	84000

...

20 rows selected.

Sorting by Multiple Columns

- The order of ORDER BY list is the order of sort.

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

LAST_NAME	DEPARTMENT_ID	SALARY
Whalen	10	4400
Hartstein	20	13000
Fay	20	6000
Mourgos	50	5800
Rajs	50	3500
Davies	50	3100
Matos	50	2600
Vargas	50	2500

...

20 rows selected.

- You can sort by a column that is not in the SELECT list.

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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` conditions
  - 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]];
```

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Practice 2 Overview

This practice covers the following topics:

- Selecting data and changing the order of rows displayed
- Restricting rows by using the `WHERE` clause
- Sorting rows by using the `ORDER BY` clause

3

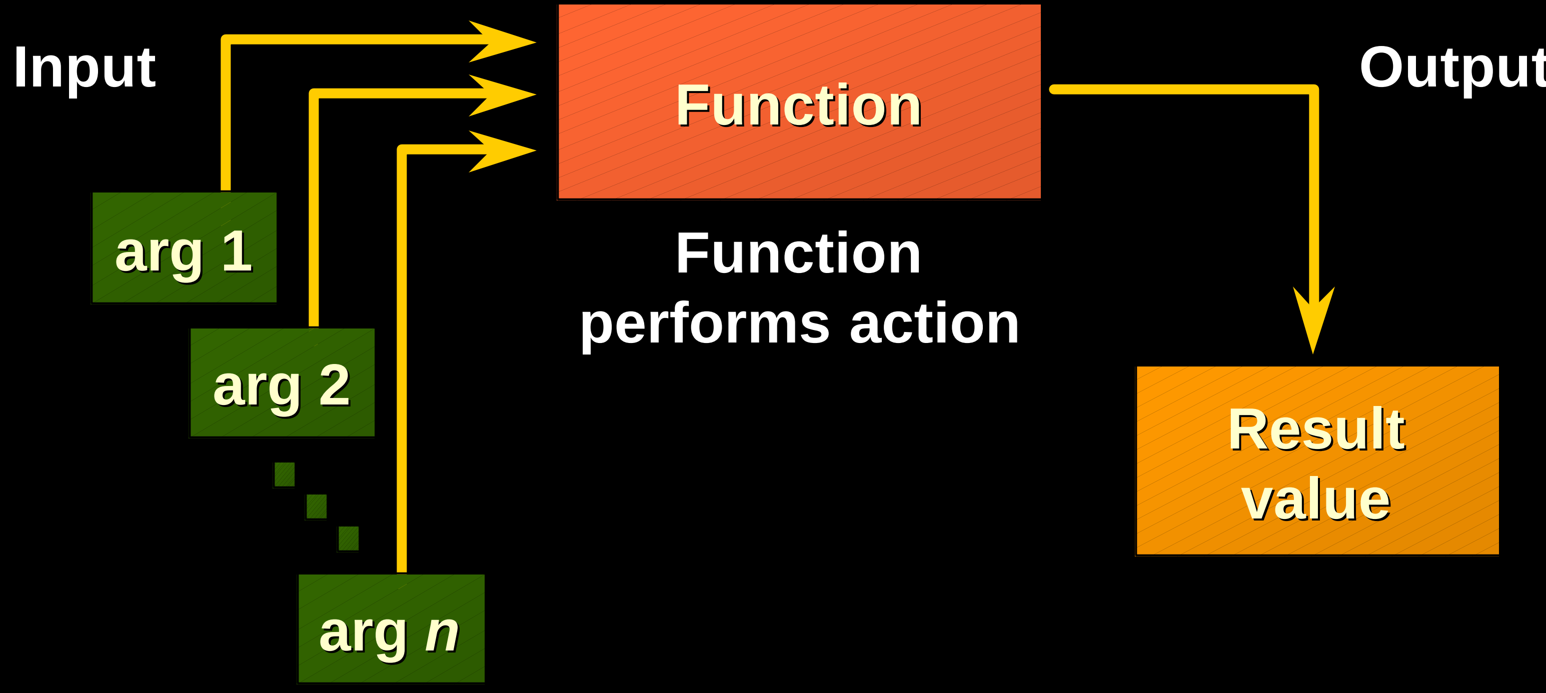
Single-Row Functions

Objectives

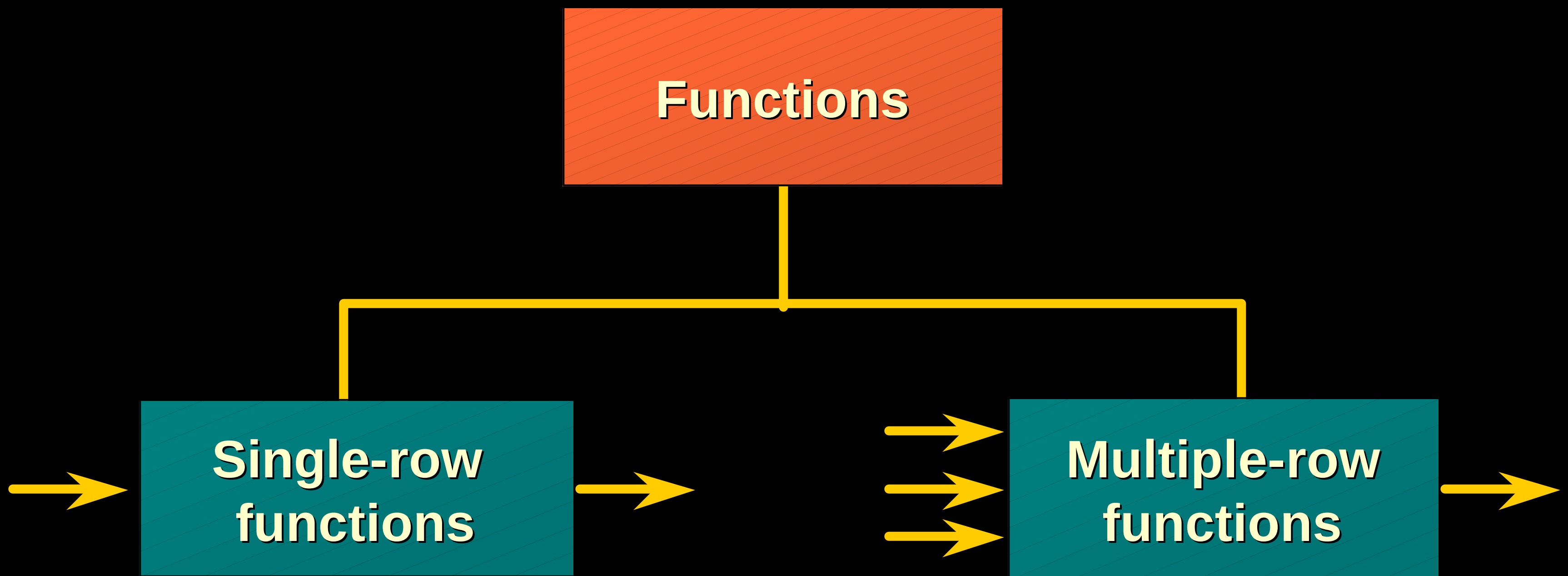
After completing this lesson, you should be able to do the following:

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

SQL Functions



Two Types of SQL Functions



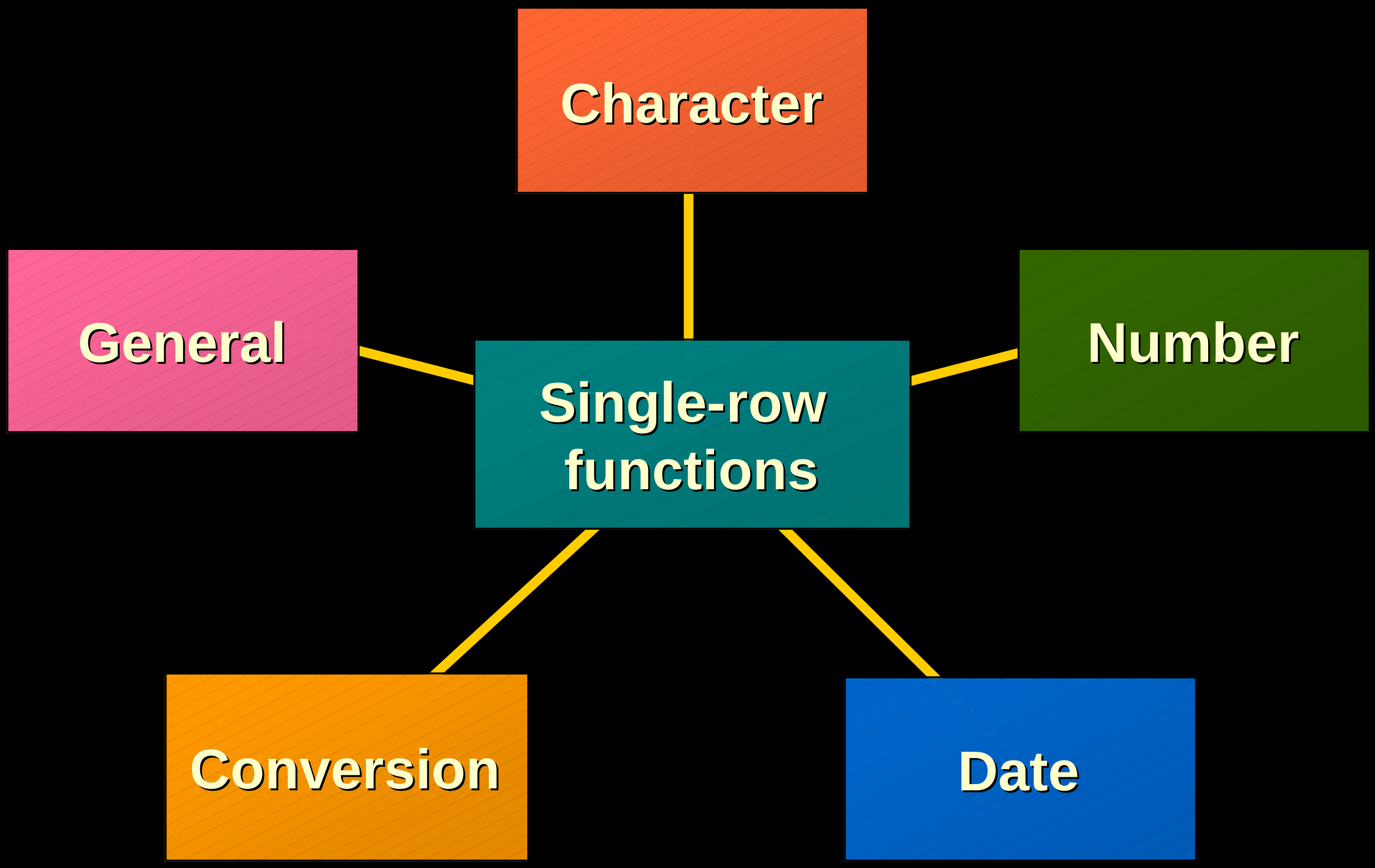
Single-Row Functions

Single row functions:

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

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

Single-Row Functions



Character Functions

- **Character functions**
  - **Case-manipulation functions**
    - `LOWER`
    - `UPPER`
    - `INITCAP`
  - **Character-manipulation functions**
    - `CONCAT`
    - `SUBSTR`
    - `LENGTH`
    - `INSTR`
    - `LPAD | RPAD`
    - `TRIM`
    - `REPLACE`

Case Manipulation Functions

These functions convert case for character strings.

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

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Using Case Manipulation 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';
no rows selected
```

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

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
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*****`
`TRIM('H' FROM 'HelloWorld')`	`elloWorld`

Using the Character-Manipulation Functions

1

```
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';
```

2

3

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

1 2 3

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Number Functions

- **`ROUND`: Rounds value to specified decimal**

  `ROUND(45.926, 2)` → `45.93`

- **`TRUNC`: Truncates value to specified decimal**

  `TRUNC(45.926, 2)` → `45.92`

- **`MOD`: Returns remainder of division**

  `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)
45.92	46	50

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

Using the TRUNC Function

1 2

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

3

TRUNC(45.923,2)	TRUNC(45.923)	TRUNC(45.923,-2)
45.92	45	0

1 2 3

Using the MOD Function

Calculate the remainder of a salary after it is divided by 5000 for all employees whose job title is sales representative.

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

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

Working with Dates

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

```
SELECT last_name, hire_date
FROM   employees
WHERE  last_name like 'G%';
```

LAST_NAME	HIRE_DATE
Gietz	07-JUN-94
Grant	24-MAY-99

Working with Dates

SYSDATE is a function that returns:

- **Date**
- **Time**

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
King	744.245395
Kochhar	626.102538
De Haan	453.245395

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Date Functions

Function	Description
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

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Using Date Functions

- MONTHS_BETWEEN ('01-SEP-95','11-JAN-94')
  → 19.6774194
- ADD_MONTHS ('11-JAN-94',6) → '11-JUL-94'
- NEXT_DAY ('01-SEP-95','FRIDAY')
  → '08-SEP-95'
- LAST_DAY('01-FEB-95') → '28-FEB-95'

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Using Date Functions

Assume SYSDATE = '25-JUL-95':

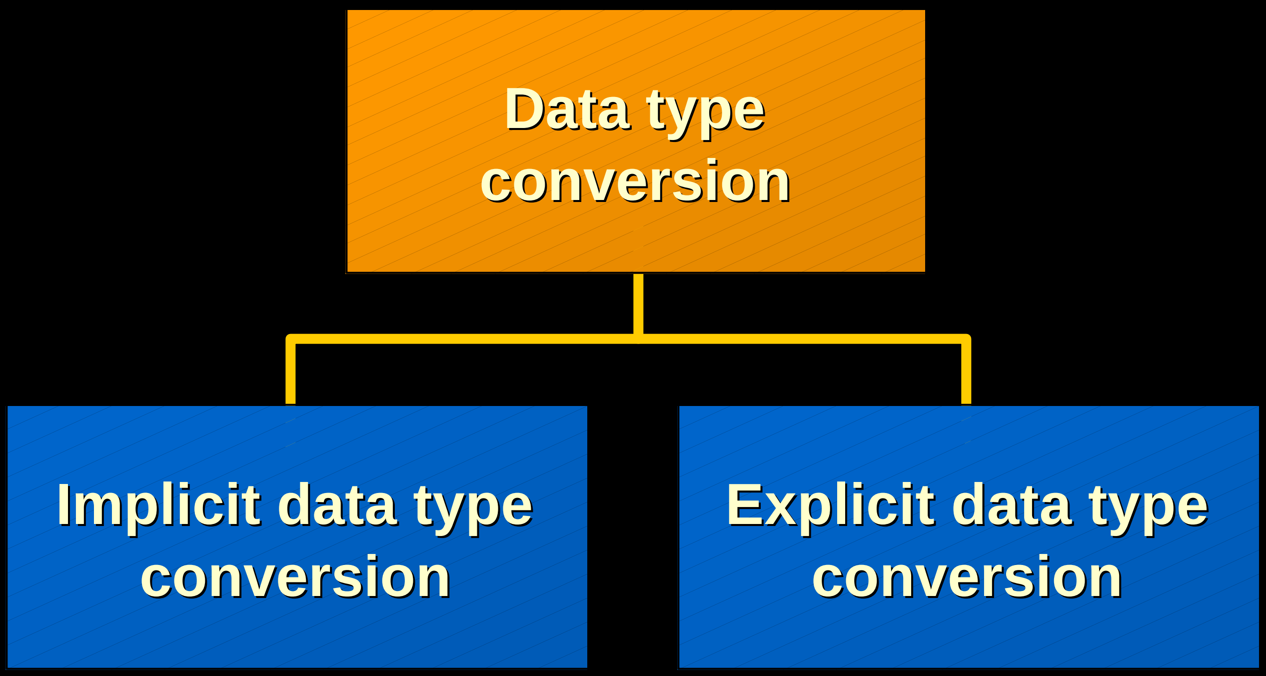
- **ROUND(SYSDATE,'MONTH')** → **01-AUG-95**
- **ROUND(SYSDATE ,'YEAR')** → **01-JAN-96**
- **TRUNC(SYSDATE ,'MONTH')** → **01-JUL-95**
- **TRUNC(SYSDATE ,'YEAR')** → **01-JAN-95**

Practice 3, Part One: 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

Conversion Functions



Implicit Data Type Conversion

For assignments, the Oracle server can automatically convert the following:

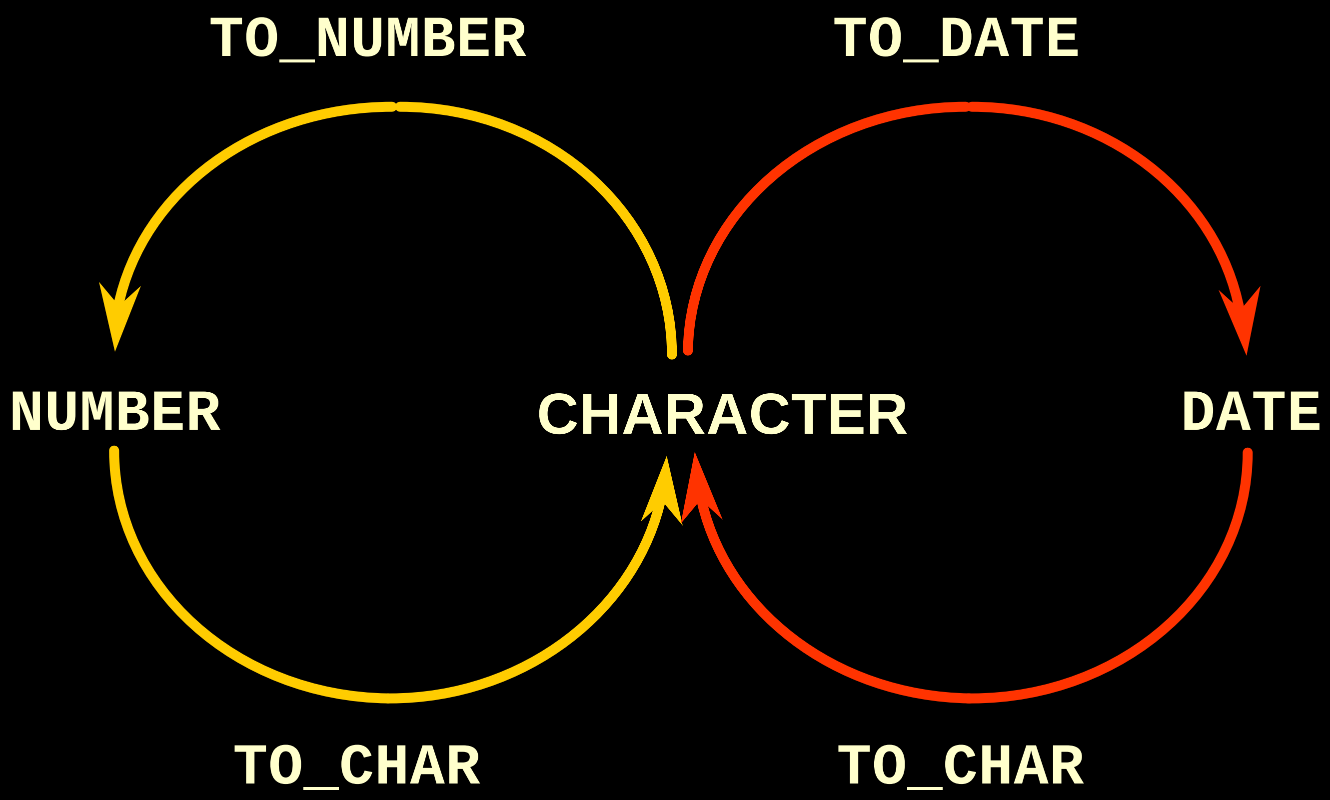
From	To
`VARCHAR2 or CHAR`	`NUMBER`
`VARCHAR2 or CHAR`	`DATE`
`NUMBER`	`VARCHAR2`
`DATE`	`VARCHAR2`

Implicit Data Type Conversion

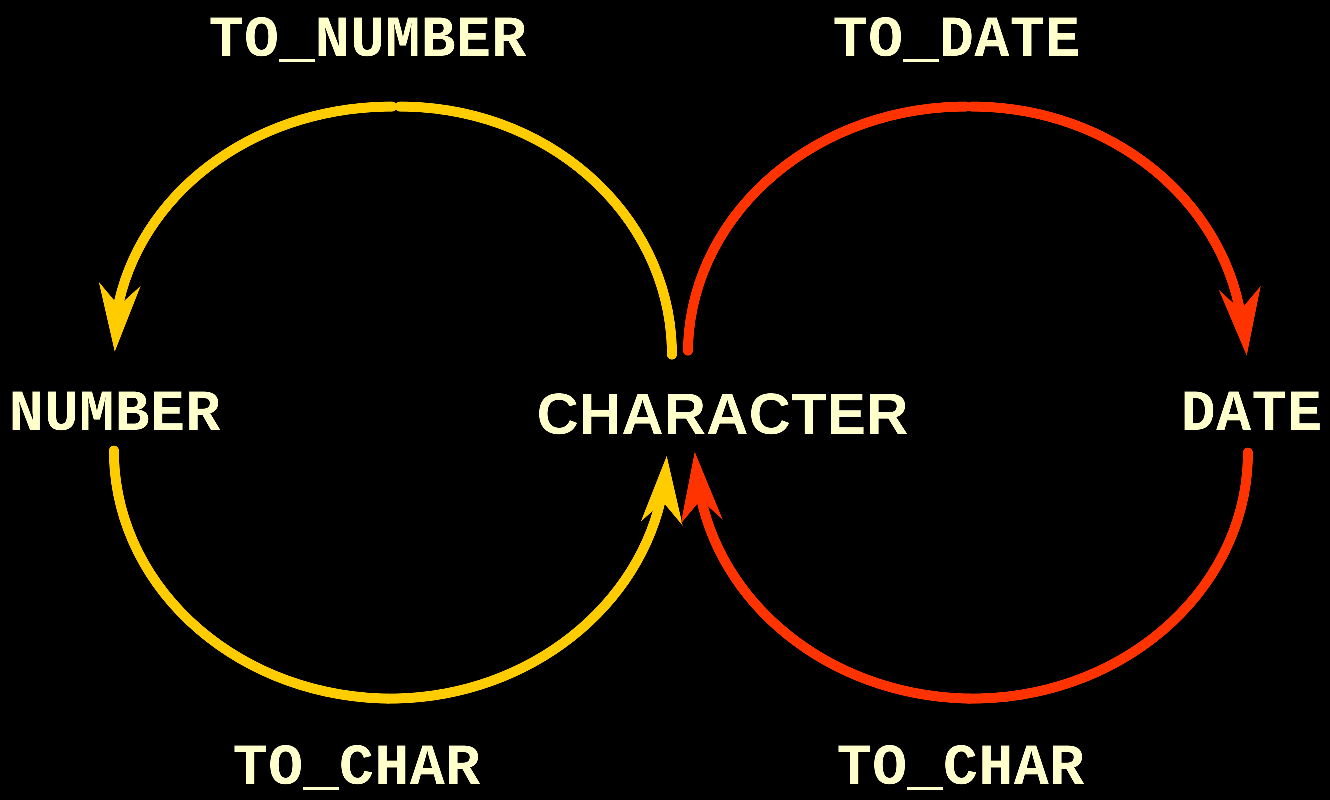
For expression evaluation, the Oracle Server can automatically convert the following:

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

Explicit Data Type Conversion



Explicit Data Type Conversion



Using the TO_CHAR Function with Dates

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

The format model:

- Must be enclosed in single quotation marks and 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

YYYY	Full year in numbers
YEAR	Year spelled out
MM	Two-digit value for 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

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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 in double quotation marks.**

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

- **Number suffixes spell out numbers.**

`ddspth`	`fourteenth`

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Using the TO_CHAR Function with Dates

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

LAST_NAME	HIREDATE
King	17 June 1987
Kochhar	21 September 1989
De Haan	13 January 1993
Hunold	3 January 1990
Ernst	21 May 1991
Lorentz	7 February 1999
Mourgos	16 November 1999

...

20 rows selected.

Using the TO_CHAR Function with Numbers

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

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

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 thousand indicator

Using the TO_CHAR Function with Numbers

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

SALARY
$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 matching for the character argument and date format model of a TO_DATE function

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 matching for the character argument and date format model of a TO_DATE function

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

		If the specified two-digit year is:	
		0–49	50–99
If two digits of the current year are:	0–49	The return date is in the current century	The return date is in the century before the current one
	50–99	The return date is in the century after the current one	The return date is in the current century

Example of RR Date Format

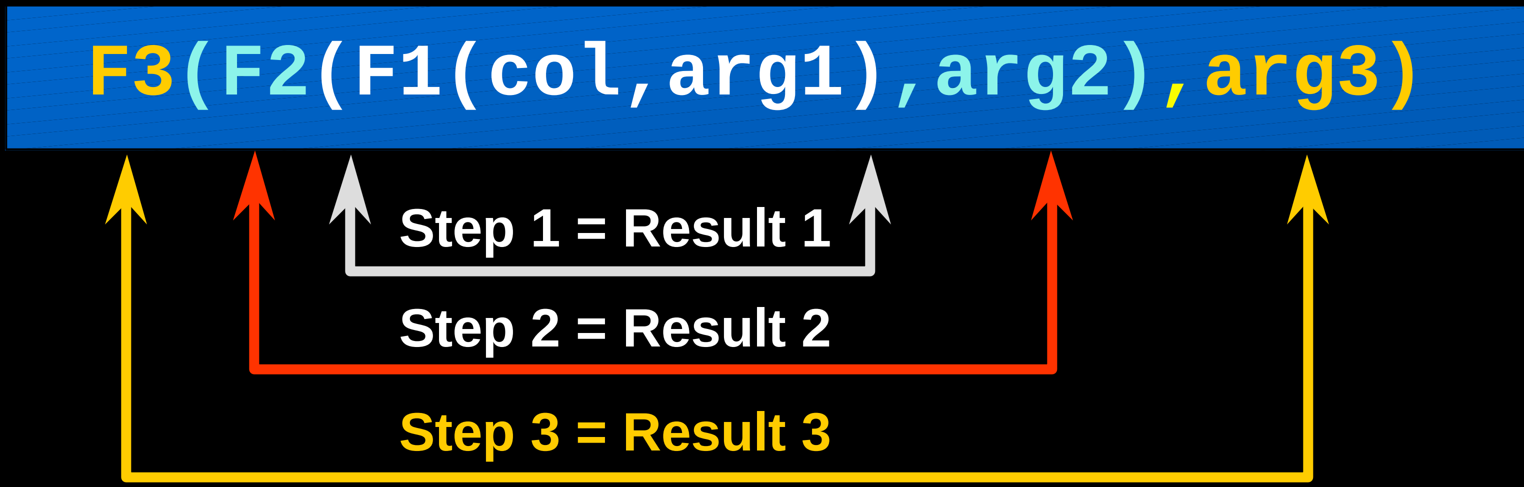
To find employees hired prior to 1990, use the RR format, which produces the same results whether the command is run in 1999 or now:

```
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(HIR
King	17-Jun-1987
Kochhar	21-Sep-1989
Whalen	17-Sep-1987

Nesting Functions

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



Nesting Functions

```
SELECT last_name,
       NVL(TO_CHAR(manager_id), 'No Manager')
FROM   employees
WHERE  manager_id IS NULL;
```

LAST_NAME	NVL(TO_CHAR(MANAGER_ID),'NOMANAGER')
King	No Manager

General Functions

These 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 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;
```

1

2

LAST_NAME	SALARY	NVL(COMMISSION_PCT,0)	AN_SAL
King	24000	0	288000
Kochhar	17000	0	204000
De Haan	17000	0	204000
Hunold	9000	0	108000
Ernst	6000	0	72000
Lorentz	4200	0	50400
Mourgos	5800	0	69600
Rajs	3500	0	42000

...

20 rows selected.

1

2

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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
Zlotkey	10500	.2	SAL+COMM
Abel	11000	.3	SAL+COMM
Taylor	8600	.2	SAL+COMM
Mourgos	5800		SAL
Rajs	3500		SAL
Davies	3100		SAL
Matos	2600		SAL
Vargas	2500		SAL

8 rows selected.

1 2

Using the NULLIF Function

1

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

2

3

FIRST_NAME	expr1	LAST_NAME	expr2	RESULT
Steven	6	King	4	6
Neena	5	Kochhar	7	5
Lex	3	De Haan	7	3
Alexander	9	Hunold	6	9
Bruce	5	Ernst	5	
Diana	5	Lorentz	7	5
Kevin	5	Mourgos	7	5
Trenna	6	Rajs	4	6
Curtis	6	Davies	6	

...

20 rows selected.

1 2 3

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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, it returns that expression; otherwise, it does a `COALESCE` of the remaining expressions.

Using the COALESCE Function

```
SELECT   last_name,
         COALESCE(commission_pct, salary, 10) comm
FROM     employees
ORDER BY commission_pct;
```

LAST_NAME	COMM
Grant	.15
Zlotkey	.2
Taylor	.2
Abel	.3
King	24000
Kochhar	17000
De Haan	17000
Hunold	9000

...

20 rows selected.

Conditional Expressions

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

The 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
...			
Lorentz	IT_PROG	4200	4620
Mourgos	ST_MAN	5800	5800
Rajs	ST_CLERK	3500	4025
...			
Gietz	AC_ACCOUNT	8300	8300

20 rows selected.

The DECODE Function

Facilitates conditional inquiries by doing the work of a CASE or 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
...			
Lorentz	IT_PROG	4200	4620
Mourgos	ST_MAN	5800	5800
Rajs	ST_CLERK	3500	4025
...			
Gietz	AC_ACCOUNT	8300	8300

20 rows selected.

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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;
```

Summary

In this lesson, you should have learned how to:

- Perform calculations on data using functions
- Modify individual data items using functions
- Manipulate output for groups of rows using functions
- Alter date formats for display using functions
- Convert column data types using functions
- Use NVL functions
- Use IF-THEN-ELSE logic

Practice 3, Part Two: Overview

This practice covers the following topics:

- Creating queries that require the use of numeric, character, and date functions
- Using concatenation with functions
- Writing case-insensitive queries to test the usefulness of character functions
- Performing calculations of years and months of service for an employee
- Determining the review date for an employee

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4

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 equality and nonequality joins
- View data that generally does not meet a join condition by using outer joins
- Join a table to itself by using a self join

Obtaining Data from Multiple Tables

EMPLOYEES

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
100	King	90
101	Kochhar	90
...		
202	Fay	20
205	Higgins	110
206	Gietz	110

DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
10	Administration	1700
20	Marketing	1800
50	Shipping	1500
60	IT	1400
80	Sales	2500
90	Executive	1700
110	Accounting	1700
190	Contracting	1700

EMPLOYEE_ID	DEPARTMENT_ID	DEPARTMENT_NAME
200	10	Administration
201	20	Marketing
202	20	Marketing
...		
102	90	Executive
205	110	Accounting
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
100	King	90
101	Kochhar	90
...		
202	Fay	20
205	Higgins	110
206	Gietz	110

20 rows selected.

DEPARTMENTS (8 rows)

DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
10	Administration	1700
20	Marketing	1800
50	Shipping	1500
60	IT	1400
80	Sales	2500
90	Executive	1700
110	Accounting	1700
190	Contracting	1700

8 rows selected.

Cartesian product: 20x8=160 rows

EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
100	90	1700
101	90	1700
102	90	1700
103	60	1700
104	60	1700
107	60	1700
...		

160 rows selected.

Types of Joins

Oracle Proprietary Joins (8*i* and prior):

- Equijoin
- Non-equijoin
- Outer join
- Self join

SQL: 1999 Compliant Joins:

- Cross joins
- Natural joins
- Using clause
- Full or two sided outer joins
- Arbitrary join conditions for outer joins

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.

What is an Equijoin?

EMPLOYEES

EMPLOYEE_ID	DEPARTMENT_ID
200	10
201	20
202	20
124	50
141	50
142	50
143	50
144	50
103	60
104	60
107	60
149	80
174	80
176	80

...

DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME
10	Administration
20	Marketing
20	Marketing
50	Shipping
50	Shipping
50	Shipping
50	Shipping
50	Shipping
60	IT
60	IT
60	IT
80	Sales
80	Sales
80	Sales

...

Foreign key **Primary key**

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Retrieving Records with Equijoins

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

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID	LOCATION_ID
200	Whalen	10	10	1700
201	Hartstein	20	20	1800
202	Fay	20	20	1800
124	Mourgos	50	50	1500
141	Rajs	50	50	1500
142	Davies	50	50	1500
143	Matos	50	50	1500
144	Vargas	50	50	1500

...

19 rows selected.

Additional Search Conditions Using the AND Operator

EMPLOYEES

LAST_NAME	DEPARTMENT_ID
Whalen	10
Hartstein	20
Fay	20
Mourgos	50
Rajs	50
Davies	50
Matos	50
Vargas	50
Hunold	60
Ernst	60

...

DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME
10	Administration
20	Marketing
20	Marketing
50	Shipping
50	Shipping
50	Shipping
50	Shipping
50	Shipping
60	IT
60	IT

...

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Improve performance by using table prefixes.
- Distinguish columns that have identical names but reside in different tables by using column aliases.

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Using Table Aliases

- Simplify queries by using table aliases.
- Improve performance by using table prefixes.

```
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;
```

Joining More than Two Tables

EMPLOYEES

LAST_NAME	DEPARTMENT_ID
King	90
Kochhar	90
De Haan	90
Hunold	60
Ernst	60
Lorentz	60
Mourgos	50
Rajs	50
Davies	50
Matos	50
Vargas	50
Zlotkey	80
Abel	80
Taylor	80

...

20 rows selected.

DEPARTMENTS

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

8 rows selected.

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.

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Non-Equijoins

EMPLOYEES

LAST_NAME	SALARY
King	24000
Kochhar	17000
De Haan	17000
Hunold	9000
Ernst	6000
Lorentz	4200
Mourgos	5800
Rajs	3500
Davies	3100
Matos	2600
Vargas	2500
Zlotkey	10500
Abel	11000
Taylor	8600

...

20 rows selected.

JOB_GRADES

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

Salary in the `EMPLOYEES` table must be between lowest salary and highest salary in the `JOB_GRADES` table.

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Retrieving Records with Non-Equijoins

```
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	GRA
Matos	2600	A
Vargas	2500	A
Lorentz	4200	B
Mourgos	5800	B
Rajs	3500	B
Davies	3100	B
Whalen	4400	B
Hunold	9000	C
Ernst	6000	C

...

20 rows selected.

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Outer Joins

DEPARTMENTS

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

8 rows selected.

EMPLOYEES

DEPARTMENT_ID	LAST_NAME
90	King
90	Kochhar
90	De Haan
60	Hunold
60	Ernst
60	Lorentz
50	Mourgos
50	Rajs
50	Davies
50	Matos
50	Vargas
80	Zlotkey

...

20 rows selected.

There are no employees in department 190.

Outer Joins Syntax

- You use an outer join to also 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(+);
```

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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
Whalen	10	Administration
Hartstein	20	Marketing
Fay	20	Marketing
Mourgos	50	Shipping
Rajs	50	Shipping
Davies	50	Shipping
Matos	50	Shipping

...

Gietz	110	Accounting
		Contracting

20 rows selected.

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Self Joins

EMPLOYEES (WORKER)

EMPLOYEE_ID	LAST_NAME	MANAGER_ID
100	King	
101	Kochhar	100
102	De Haan	100
103	Hunold	102
104	Ernst	103
107	Lorentz	103
124	Mourgos	100

…

EMPLOYEES (MANAGER)

EMPLOYEE_ID	LAST_NAME
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst
107	Lorentz
124	Mourgos

…

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

Joining a Table to Itself

```
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
Kochhar works for King
De Haan works for King
Mourgos works for King
Zlotkey works for King
Hartstein works for King
Whalen works for Kochhar
Higgins works for Kochhar
Hunold works for De Haan
Ernst works for Hunold

...

19 rows selected.

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Practice 4, Part One: Overview

This practice covers writing queries to join tables together using Oracle syntax.

Joining Tables Using SQL: 1999 Syntax

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

```
SELECT   table1.column, table2.column
FROM     table1
[CROSS JOIN table2] |
[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)];
```

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Creating Cross Joins

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

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

LAST_NAME	DEPARTMENT_NAME
King	Administration
Kochhar	Administration
De Haan	Administration
Hunold	Administration

...

160 rows selected.

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
60	IT	1400	Southlake
50	Shipping	1500	South San Francisco
10	Administration	1700	Seattle
90	Executive	1700	Seattle
110	Accounting	1700	Seattle
190	Contracting	1700	Seattle
20	Marketing	1800	Toronto
80	Sales	2500	Oxford

8 rows selected.

Creating Joins with the `USING` Clause

- If several columns have the same names but the data types do not match, the `NATURAL JOIN` clause can be modified with the `USING` clause to specify the columns that should be used for an equijoin.
- Use the `USING` clause to match only one column when more than one column matches.
- Do not use a table name or alias in the referenced columns.
- The `NATURAL JOIN` and `USING` clauses are mutually exclusive.

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Retrieving Records with the USING Clause

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

EMPLOYEE_ID	LAST_NAME	LOCATION_ID
200	Whalen	1700
201	Hartstein	1800
202	Fay	1800
124	Mourgos	1500
141	Rajs	1500
142	Davies	1500
143	Matos	1500
144	Vargas	1500
103	Hunold	1400

...

19 rows selected.

Creating Joins with the `ON` Clause

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

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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	LOCATION_ID
200	Whalen	10	10	1700
201	Hartstein	20	20	1800
202	Fay	20	20	1800
124	Mourgos	50	50	1500
141	Rajs	50	50	1500
142	Davies	50	50	1500
143	Matos	50	50	1500

...

19 rows selected.

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
103	Southlake	IT
104	Southlake	IT
107	Southlake	IT
124	South San Francisco	Shipping
141	South San Francisco	Shipping
142	South San Francisco	Shipping
143	South San Francisco	Shipping
144	South San Francisco	Shipping

...

19 rows selected.

INNER Versus OUTER Joins

- In SQL: 1999, the join of two tables returning only matched rows is an inner join.
- A join between two tables that returns the results of the inner join as well as unmatched rows left (or right) tables is 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
Whalen	10	Administration
Fay	20	Marketing
Hartstein	20	Marketing

...

De Haan	90	Executive
Kochhar	90	Executive
King	90	Executive
Gietz	110	Accounting
Higgins	110	Accounting
Grant		

20 rows selected.

RIGHT OUTER JOIN

```
SELECT e.last_name, e.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
King	90	Executive
Kochhar	90	Executive
...		
Whalen	10	Administration
Hartstein	20	Marketing
Fay	20	Marketing
Higgins	110	Accounting
Gietz	110	Accounting
		Contracting

20 rows selected.

FULL OUTER JOIN

```
SELECT e.last_name, e.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
Whalen	10	Administration
Fay	20	Marketing

...

LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
De Haan	90	Executive
Kochhar	90	Executive
King	90	Executive
Gietz	110	Accounting
Higgins	110	Accounting
Grant		
		Contracting

21 rows selected.

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 ;
```

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID	LOCATION_ID
174	Abel	80	80	2500
176	Taylor	80	80	2500

Summary

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

- Oracle proprietary syntax for versions 8*i* and earlier
- SQL: 1999 compliant syntax for version 9*i*

Practice 4, Part Two: Overview

This practice covers the following topics:

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

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5

Aggregating Data
Using Group Functions

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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 using the `GROUP BY` clause
- Include or exclude grouped rows by using the `HAVING` clause

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What Are Group Functions?

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

EMPLOYEES

DEPARTMENT_ID	SALARY
90	24000
90	17000
90	17000
60	9000
60	6000
60	4200
50	5800
50	3500
50	3100
50	2600
50	2500
80	10500
80	11000
80	8600
	7000
10	4400

...

20 rows selected.

MAX(SALARY)
24000

Types of Group Functions

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

Group Functions Syntax

```
SELECT        [column,] group_function(column), ...
FROM          table
[WHERE        condition]
[GROUP BY     column]
[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)
8150	11000	6000	32600

Using the MIN and MAX Functions

You can use MIN and MAX for any data type.

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

MIN(HIRE_	MAX(HIRE_
17-JUN-87	29-JAN-00

Using the COUNT Function

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

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

COUNT(*)
5

Using the COUNT Function

- `COUNT(`*`expr`*`)` returns the number of rows with non-null values for the *expr*.
- Display the number of department values in the `EMPLOYEES` table, excluding the null values.

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

COUNT(COMMISSION_PCT)
3

Using the `DISTINCT` Keyword

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

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

COUNT(DISTINCTDEPARTMENT_ID)
7

Group Functions and Null Values

Group functions ignore null values in the column.

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

AVG(COMMISSION_PCT)
.2125

Using the NVL Function with Group Functions

The NVL function forces group functions to include null values.

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

AVG(NVL(COMMISSION_PCT,0))
.0425

Creating Groups of Data

EMPLOYEES

DEPARTMENT_ID	SALARY
10	4400
20	13000
20	6000
50	5800
50	3500
50	3100
50	2500
50	2600
60	9000
60	6000
60	4200
80	10500
80	8600
80	11000
90	24000
90	17000

...

20 rows selected.

4400

9500

3500

6400

10033

The average salary in EMPLOYEES table for each department.

DEPARTMENT_ID	AVG(SALARY)
10	4400
20	9500
50	3500
60	6400
80	10033.3333
90	19333.3333
110	10150
	7000

Creating Groups of Data: The `GROUP BY` Clause Syntax

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

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)
10	4400
20	9500
50	3500
60	6400
80	10033.3333
90	19333.3333
110	10150
	7000

8 rows selected.

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)
4400
9500
3500
6400
10033.3333
19333.3333
10150
7000

Grouping by More Than One Column

EMPLOYEES

DEPARTMENT_ID	JOB_ID	SALARY
90	AD_PRES	24000
90	AD_VP	17000
90	AD_VP	17000
60	IT_PROG	9000
60	IT_PROG	6000
60	IT_PROG	4200
50	ST_MAN	5800
50	ST_CLERK	3500
50	ST_CLERK	3100
50	ST_CLERK	2600
50	ST_CLERK	2500
80	SA_MAN	10500
80	SA_REP	11000
80	SA_REP	8600
...		
20	MK_REP	6000
110	AC_MGR	12000
110	AC_ACCOUNT	8300

20 rows selected.

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

DEPARTMENT_ID	JOB_ID	SUM(SALARY)
10	AD_ASST	4400
20	MK_MAN	13000
20	MK_REP	6000
50	ST_CLERK	11700
50	ST_MAN	5800
60	IT_PROG	19200
80	SA_MAN	10500
80	SA_REP	19600
90	AD_PRES	24000
90	AD_VP	34000
110	AC_ACCOUNT	8300
110	AC_MGR	12000
	SA_REP	7000

13 rows selected.

Using the GROUP BY Clause on Multiple Columns

```
SELECT   department_id dept_id, job_id, SUM(salary)
FROM     employees
GROUP BY department_id, job_id ;
```

DEPT_ID	JOB_ID	SUM(SALARY)
10	AD_ASST	4400
20	MK_MAN	13000
20	MK_REP	6000
50	ST_CLERK	11700
50	ST_MAN	5800
60	IT_PROG	19200
80	SA_MAN	10500
80	SA_REP	19600
90	AD_PRES	24000
90	AD_VP	34000
110	AC_ACCOUNT	8300
110	AC_MGR	12000
	SA_REP	7000

13 rows selected.

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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;
```

```
SELECT department_id, COUNT(last_name)
       *
ERROR at line 1:
ORA-00937: not a single-group group function
```

Column missing in the GROUP BY clause

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;
```

```
WHERE  AVG(salary) > 8000
       *
ERROR at line 3:
ORA-00934: group function is not allowed here
```

Cannot use the `WHERE` clause to restrict groups

Excluding Group Results

EMPLOYEES

DEPARTMENT_ID	SALARY
90	24000
90	17000
90	17000
60	9000
60	6000
60	4200
50	5800
50	3500
50	3100
50	2600
50	2500
80	10500
80	11000
80	8600

...

DEPARTMENT_ID	SALARY
20	6000
110	12000
110	8300

20 rows selected.

DEPARTMENT_ID	MAX(SALARY)
20	13000
80	11000
90	24000
110	12000

Excluding Group Results: The `HAVING` Clause

Use the `HAVING` clause to restrict groups:

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];
```

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Using the `HAVING` Clause

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

DEPARTMENT_ID	MAX(SALARY)
20	13000
80	11000
90	24000
110	12000

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
IT_PROG	19200
AD_PRES	24000
AD_VP	34000

Nesting Group Functions

Display the maximum average salary.

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

MAX(AVG(SALARY))
19333.3333

Summary

In this lesson, you should have learned how to:

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

```
SELECT        column, group_function(column)
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
- Excluding groups by using the `HAVING` clause

6

Subqueries

Objectives

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

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

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

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Using a Subquery

```
SELECT last_name
FROM   employees 11000
WHERE  salary >
               (SELECT salary
                FROM   employees
                WHERE  last_name = 'Abel');
```

LAST_NAME
King
Kochhar
De Haan
Hartstein
Higgins

Guidelines for Using Subqueries

- **Enclose subqueries in parentheses.**
- **Place subqueries on the right side of the comparison condition.**
- **The `ORDER BY` clause in the subquery is not needed unless you are performing Top-N analysis.**
- **Use single-row operators with single-row subqueries and use multiple-row operators with multiple-row subqueries.**

Types of Subqueries

- Single-row subquery

- Multiple-row 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  employee_id = 141)
AND    salary >
                (SELECT salary
                 FROM   employees
                 WHERE  employee_id = 143);
```

ST_CLERK

2600

LAST_NAME	JOB_ID	SALARY
Rajs	ST_CLERK	3500
Davies	ST_CLERK	3100

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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
Vargas	ST_CLERK	2500

The HAVING Clause with Subqueries

- The Oracle server executes 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

What is Wrong with this Statement?

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

```
ERROR at line 4:
ORA-01427: single-row subquery returns more than
one row
```

Single-row operator with multiple-row subquery

Will this Statement Return Rows?

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

```
no rows selected
```

Subquery returns no values

Multiple-Row Subqueries

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

Operator	Meaning
`IN`	Equal to any member in the list
`ANY`	Compare value to each value returned by the subquery
`ALL`	Compare value to every value returned by the subquery

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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
124	Mourgos	ST_MAN	5800
141	Rajs	ST_CLERK	3500
142	Davies	ST_CLERK	3100
143	Matos	ST_CLERK	2600
144	Vargas	ST_CLERK	2500

...

10 rows selected.

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
141	Rajs	ST_CLERK	3500
142	Davies	ST_CLERK	3100
143	Matos	ST_CLERK	2600
144	Vargas	ST_CLERK	2500

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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);

no rows selected
```

Summary

In this lesson, you should have learned how to:

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

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

Practice 6 Overview

This practice covers the following topics:

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

7

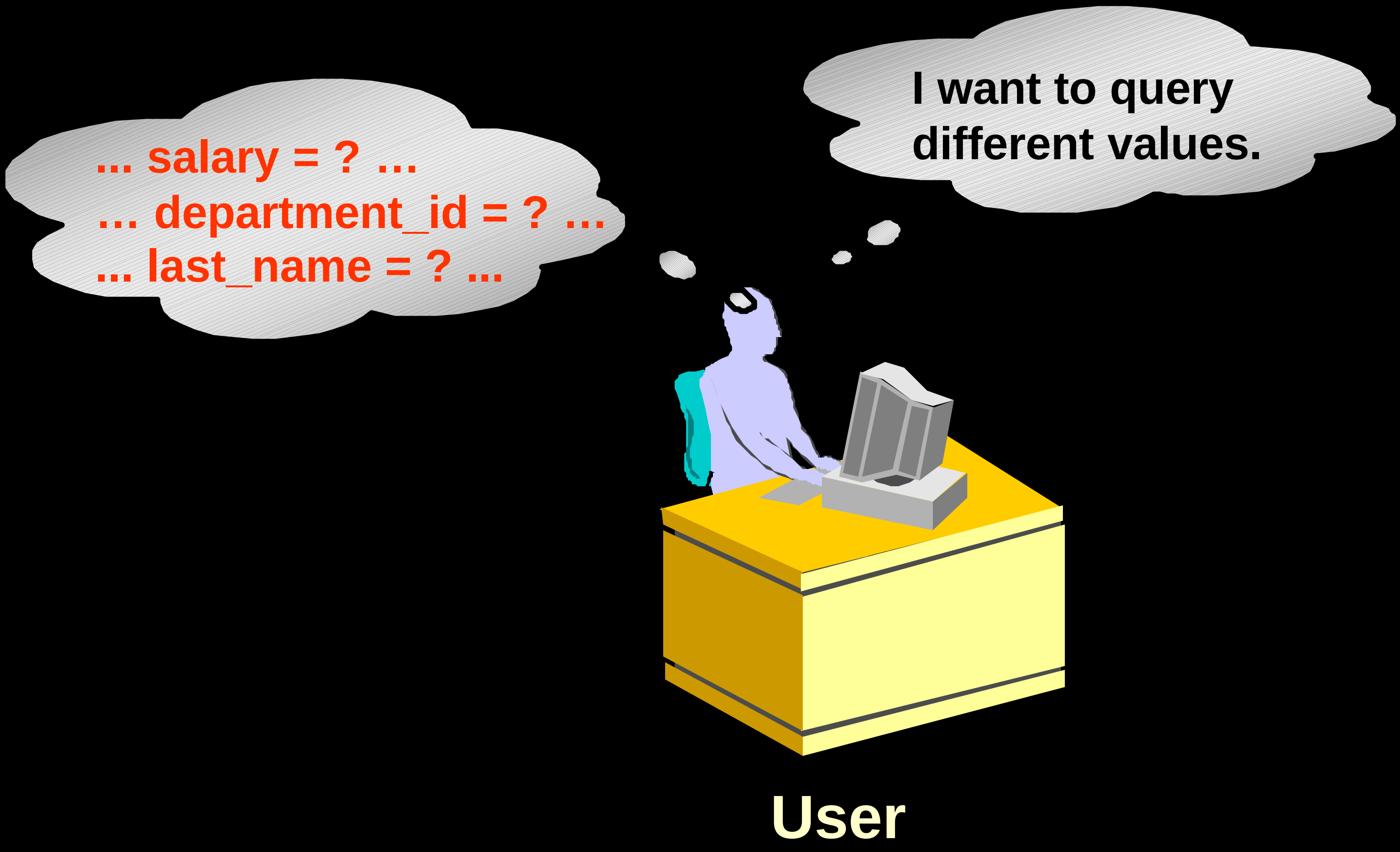
Producing Readable Output with *i*SQL*Plus

Objectives

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

- Produce queries that require a substitution variable
- Customize the *i*SQL*Plus environment
- Produce more readable output
- Create and execute script files

Substitution Variables



Substitution Variables

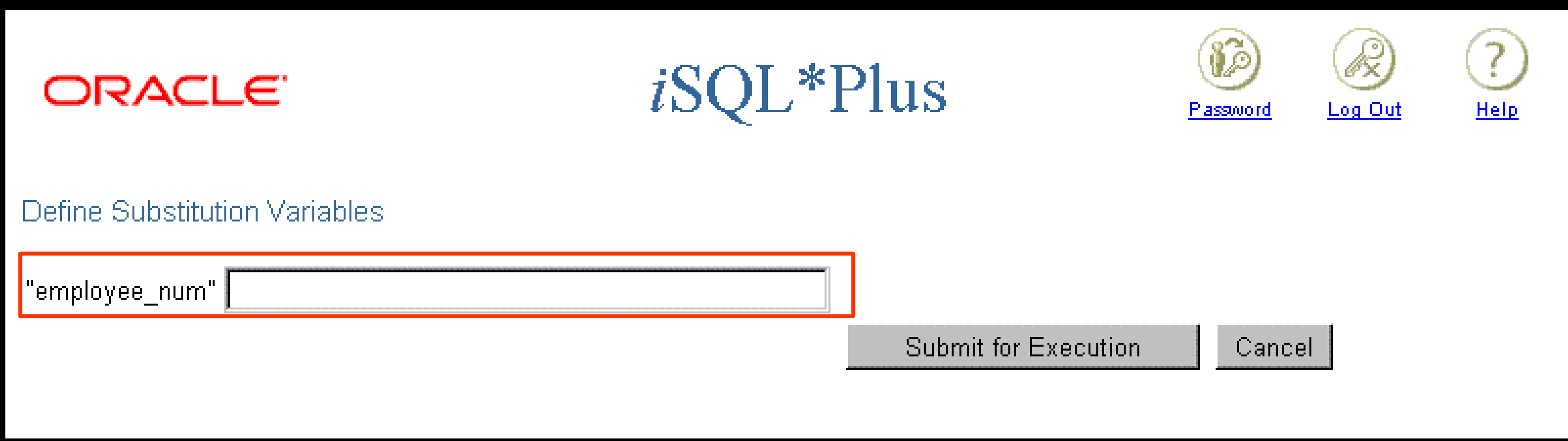
Use *i*SQL*Plus substitution variables to:

- Temporarily store values
  - Single ampersand (&)
  - Double ampersand (&&)
  - `DEFINE` command
- Pass variable values between SQL statements
- Dynamically alter headers and footers

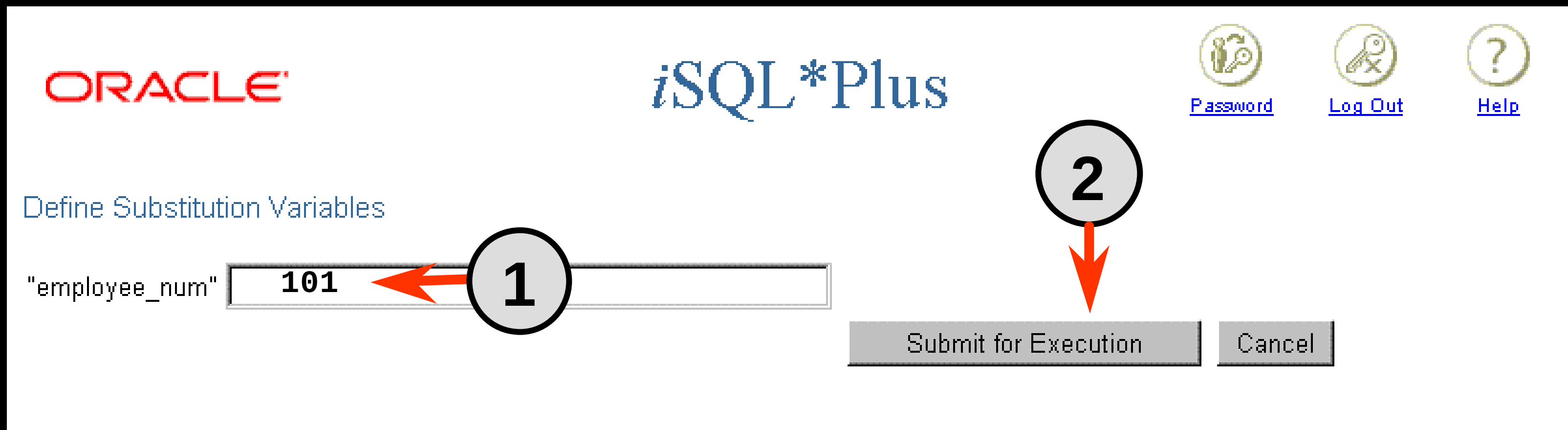
Using the & Substitution Variable

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 & Substitution Variable



old 3: WHERE employee_id = &employee_num
new 3: WHERE employee_id = 101

EMPLOYEE_ID	LAST_NAME	SALARY	DEPARTMENT_ID
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' ;
```

Define Substitution Variables

"job_title" IT_PROG

Submit for Execution | Cancel

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

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Specifying Column Names, Expressions, and Text

Use substitution variables to supplement the following:

- `WHERE` **conditions**
- `ORDER BY` **clauses**
- **Column expressions**
- **Table names**
- **Entire** `SELECT` **statements**

Specifying Column Names, Expressions, and Text

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

Define Substitution Variables

"column_name"	salary
"condition"	salary > 15000
"order_column"	last_name

Submit for Execution | Cancel

EMPLOYEE_ID	LAST_NAME	JOB_ID	SALARY
102	De Haan	AD_VP	17000
100	King	AD_PRES	24000
101	Kochhar	AD_VP	17000

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Defining Substitution Variables

- You can predefine variables using the *i*SQL*Plus `DEFINE` command.

  `DEFINE variable = value` creates a user variable with the CHAR data type.

- If you need to predefine a variable that includes spaces, you must enclose the value within single quotation marks when using the `DEFINE` command.
- A defined variable is available for the session

DEFINE and UNDEFINE Commands

- A variable remains defined until you either:
  – Use the UNDEFINE command to clear it
  – Exit *i*SQL*Plus
- You can verify your changes with the DEFINE command.

```
DEFINE job_title = IT_PROG
DEFINE job_title
DEFINE JOB_TITLE       = "IT_PROG" (CHAR)
```

```
UNDEFINE job_title
DEFINE job_title
SP2-0135: symbol job_title is UNDEFINED
```

Using the DEFINE Command with & Substitution Variable

- Create the substitution variable using the DEFINE command.

```
DEFINE employee_num = 200
```

- Use a variable prefixed with an ampersand (&) to substitute the value in the SQL statement.

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

EMPLOYEE_ID	LAST_NAME	SALARY	DEPARTMENT_ID
200	Whalen	4400	10

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Using the && Substitution Variable

Use the 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;
```

Define Substitution Variables

"column_name" department_id

Submit for Execution | Cancel

EMPLOYEE_ID	LAST_NAME	JOB_ID	DEPARTMENT_ID
200	Whalen	AD_ASST	10
201	Hartstein	MK_MAN	20

...

20 rows selected.

Using the VERIFY Command

Use the VERIFY command to toggle the display of the substitution variable, before and after *i*SQL*Plus replaces substitution variables with values.

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

"employee_num" 200

```
old   3: WHERE  employee_id = &employee_num
new   3: WHERE  employee_id = 200
```

Customizing the *i*SQL*Plus Environment

- Use SET commands to control current session.

```
SET system_variable value
```

- Verify what you have set by using the SHOW command.

```
SET ECHO ON
```

```
SHOW ECHO
echo ON
```

SET Command Variables

- **ARRAYSIZE {<u>20</u> | *n*}**
- **FEEDBACK {<u>6</u> | *n* |OFF | ON}**
- **HEADING {OFF | <u>ON</u>}**
- **LONG {<u>80</u> | *n*}| ON | *text*}**

```
SET HEADING OFF
```

```
SHOW HEADING
HEADING OFF
```

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*i*SQL*Plus Format Commands

- `COLUMN [`*`column option`*`]`
- `TTITLE [`*`text`*` | OFF | ON]`
- `BTITLE [`*`text`*` | OFF | ON]`
- `BREAK  [ON `*`report_element`*`]`

The COLUMN Command

Controls display of a column:

```
COL[UMN] [{column|alias} [option]]
```

- **CLE[AR]: Clears any column formats**
- **HEA[DING] *text*: Sets the column heading**
- **FOR[MAT] *format*: Changes the display of the column using a format model**
- **NOPRINT | PRINT**
- **NULL**

Using the COLUMN Command

- Create column headings.

```
COLUMN last_name HEADING 'Employee|Name'
COLUMN salary JUSTIFY LEFT FORMAT $99,990.00
COLUMN manager FORMAT 999999999 NULL 'No manager'
```

- Display the current setting for the LAST_NAME column.

```
COLUMN last_name
```

- Clear settings for the LAST_NAME column.

```
COLUMN last_name CLEAR
```

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`COLUMN` Format Models

Element	Description	Example	Result
9	Single zero-suppression digit	999999	1234
0	Enforces leading zero	099999	001234
$	Floating dollar sign	$9999	$1234
L	Local currency	L9999	L1234
.	Position of decimal point	9999.99	1234.00
,	Thousand separator	9,999	1,234

Using the BREAK Command

Use the BREAK command to suppress duplicates.

```
BREAK ON job_id
```

Using the TTITLE and BTITLE Commands

- Display headers and footers.

```
TTI[TLE] [text|OFF|ON]
```

- Set the report header.

```
TTITLE 'Salary|Report'
```

- Set the report footer.

```
BTITLE 'Confidential'
```

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Using the TTITLE and BTITLE Commands

- Display headers and footers.

```
TTI[TLE] [text|OFF|ON]
```

- Set the report header.

```
TTITLE 'Salary|Report'
```

- Set the report footer.

```
BTITLE 'Confidential'
```

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Creating a Script File to Run a Report

1. Create and test the SQL `SELECT` statement.
2. Save the `SELECT` statement into a script file.
3. Load the script file into an editor.
4. Add formatting commands before the `SELECT` statement.
5. Verify that the termination character follows the `SELECT` statement.

Creating a Script File to Run a Report

6. Clear formatting commands after the SELECT statement.
7. Save the script file.
8. Load the script file into the *i*SQL*Plus text window, and click the Execute button.

Sample Report

Fri Sep 28 | Employee Report | page 1

Job Category	Employee	Salary
AC_ACCOUNT	Gietz	$8,300.00
AC_MGR	Higgins	$12,000.00
AD_ASST	Whalen	$4,400.00
IT_PROG	Ernst	$6,000.00
	Hunold	$9,000.00
	Lorentz	$4,200.00
MK_MAN	Hartstein	$13,000.00
MK_REP	Fay	$6,000.00
SA_MAN	Zlotkey	$10,500.00
SA_REP	Abel	$11,000.00
	Grant	$7,000.00
	Taylor	$8,600.00

Confidential

...

Sample Report

Fri Sep 28	Employee Report	page 1

Job Category	Employee	Salary
AC_ACCOUNT	Gietz	$8,300.00
AC_MGR	Higgins	$12,000.00
AD_ASST	Whalen	$4,400.00
IT_PROG	Ernst	$6,000.00
	Hunold	$9,000.00
	Lorentz	$4,200.00
MK_MAN	Hartstein	$13,000.00
MK_REP	Fay	$6,000.00
SA_MAN	Zlotkey	$10,500.00
SA_REP	Abel	$11,000.00
	Grant	$7,000.00
	Taylor	$8,600.00

Confidential

...

Summary

In this lesson, you should have learned how to:

- Use *i*SQL*Plus substitution variables to store values temporarily
- Use `SET` commands to control the current *i*SQL*Plus environment
- Use the `COLUMN` command to control the display of a column
- Use the `BREAK` command to suppress duplicates and divide rows into sections
- Use the `TTITLE` and `BTITLE` commands to display headers and footers

Practice 7 Overview

This practice covers the following topics:

- Creating a query to display values using substitution variables
- Starting a command file containing variables

8

Manipulating Data

Objectives

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

- Describe each DML statement
- Insert rows into a table
- Update rows in a table
- Delete rows from a table
- Merge rows in a table
- Control transactions

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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

New row

70	Public Relations	100	1700

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		1700

…insert a new row into the DEPARMENTS table…

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		1700
70	Public Relations	100	1700

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The `INSERT` Statement Syntax

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

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

- Only one row is inserted at a time with this syntax.

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 row created.
```

- Enclose character and date values within single quotation marks.

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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 row created.
```

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

```
INSERT INTO   departments
VALUES        (100, 'Finance', NULL, NULL);
1 row created.
```

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, 100);
1 row created.
```

Inserting Specific Date Values

- Add a new employee.

```
INSERT INTO employees
VALUES      (114,
             'Den', 'Raphealy',
             'DRAPHEAL', '515.127.4561',
             TO_DATE('FEB 3, 1999', 'MON DD, YYYY'),
             'AC_ACCOUNT', 11000, NULL, 100, 30);
1 row created.
```

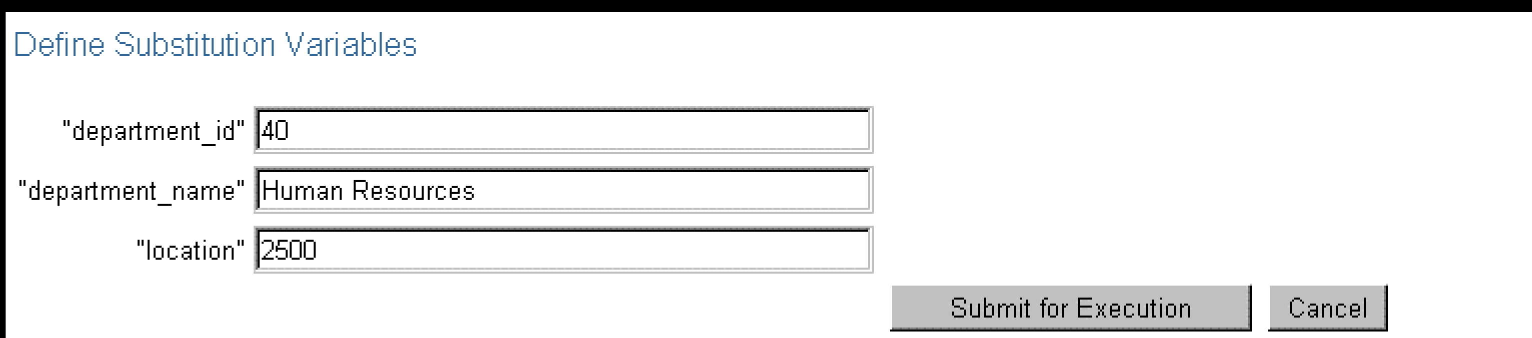
- Verify your addition.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_P
114	Den	Raphealy	DRAPHEAL	515.127.4561	03-FEB-99	AC_ACCOUNT	11000	

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);
```




```
1 row created.
```

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 created.
```

- Do not use the `VALUES` clause.
- Match the number of columns in the `INSERT` clause to those in the subquery.

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Changing Data in a Table

EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	HIRE_DATE	JOB_ID	SALARY	DEPARTMENT_ID	COMMISSION_P
100	Steven	King	SKING	17-JUN-87	AD_PRES	24000	90	
101	Neena	Kochhar	NKOCHHAR	21-SEP-89	AD_VP	17000	90	
102	Lex	De Haan	LDEHAAN	13-JAN-93	AD_VP	17000	90	
103	Alexander	Hunold	AHUNOLD	03-JAN-90	IT_PROG	9000	60	
104	Bruce	Ernst	BERNST	21-MAY-91	IT_PROG	6000	60	
107	Diana	Lorentz	DLORENTZ	07-FEB-99	IT_PROG	4200	60	
124	Kevin	Mourgos	KMOURGOS	16-NOV-99	ST_MAN	5800	50	

Update rows in the EMPLOYEES table.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	HIRE_DATE	JOB_ID	SALARY	DEPARTMENT_ID	COMMISSIO
100	Steven	King	SKING	17-JUN-87	AD_PRES	24000	90	
101	Neena	Kochhar	NKOCHHAR	21-SEP-89	AD_VP	17000	90	
102	Lex	De Haan	LDEHAAN	13-JAN-93	AD_VP	17000	90	
103	Alexander	Hunold	AHUNOLD	03-JAN-90	IT_PROG	9000	30	
104	Bruce	Ernst	BERNST	21-MAY-91	IT_PROG	6000	30	
107	Diana	Lorentz	DLORENTZ	07-FEB-99	IT_PROG	4200	30	
124	Kevin	Mourgos	KMOURGOS	16-NOV-99	ST_MAN	5800	50	

The UPDATE Statement Syntax

- Modify existing rows with the UPDATE statement.

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

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

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Updating Rows in a Table

- Specific row or rows are modified if you specify the `WHERE` clause.

```
UPDATE employees
SET    department_id = 70
WHERE  employee_id = 113;
1 row updated.
```

- All rows in the table are modified if you omit the `WHERE` clause.

```
UPDATE   copy_emp
SET      department_id = 110;
22 rows updated.
```

Updating Two Columns with a Subquery

Update employee 114's job and salary to match that 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    =  114;
1 row updated.
```

Updating Rows Based on Another Table

Use subqueries in `UPDATE` statements to update rows 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 row updated.
```

Updating Rows: Integrity Constraint Error

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

```
UPDATE employees
       *
ERROR at line 1:
ORA-02291: integrity constraint (HR.EMP_DEPT_FK)
violated - parent key not found
```

Department number 55 does not exist

Removing a Row from a Table

DEPARTMENTS

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
30	Purchasing		
100	Finance		
50	Shipping	124	1500
60	IT	103	1400

Delete a row from the DEPARTMENTS table.

DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
10	Administration	200	1700
20	Marketing	201	1800
30	Purchasing		
50	Shipping	124	1500
60	IT	103	1400

The 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 row 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 subqueries in 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 row deleted.
```

Deleting Rows: Integrity Constraint Error

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

```
DELETE FROM departments
            *
ERROR at line 1:
ORA-02292: integrity constraint (HR.EMP_DEPT_FK)
violated - child record found
```

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

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Using a Subquery in an INSERT Statement

```
INSERT INTO
        (SELECT employee_id, last_name,
                email, hire_date, job_id, salary,
                department_id
         FROM   employees
         WHERE  department_id = 50)
VALUES (99999, 'Taylor', 'DTAYLOR',
        TO_DATE('07-JUN-99', 'DD-MON-RR'),
        'ST_CLERK', 5000, 50);

1 row created.
```

Using a Subquery in an INSERT Statement

```
SELECT employee_id, last_name, email, hire_date,
       job_id, salary, department_id
FROM   employees
WHERE  department_id = 50;
```

EMPLOYEE_ID	LAST_NAME	EMAIL	HIRE_DATE	JOB_ID	SALARY	DEPARTMENT_ID
124	Mourgos	KMOURGOS	16-NOV-99	ST_MAN	5800	50
141	Rajs	TRAJS	17-OCT-95	ST_CLERK	3500	50
142	Davies	CDAVIES	29-JAN-97	ST_CLERK	3100	50
143	Matos	RMATOS	15-MAR-98	ST_CLERK	2600	50
144	Vargas	PVARGAS	09-JUL-98	ST_CLERK	2500	50
99999	Taylor	DTAYLOR	07-JUN-99	ST_CLERK	5000	50

6 rows selected.

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Using the `WITH CHECK OPTION` Keyword on DML Statements

- A subquery is used to identify the table and columns of the DML statement.
- The `WITH CHECK OPTION` keyword prohibits you from changing rows that are not in the subquery.

```
INSERT INTO  (SELECT employee_id, last_name, email,
                     hire_date, job_id, salary
              FROM   employees
              WHERE  department_id = 50 WITH CHECK OPTION)
VALUES (99998, 'Smith', 'JSMITH',
        TO_DATE('07-JUN-99', 'DD-MON-RR'),
        'ST_CLERK', 5000);
INSERT INTO
         *
ERROR at line 1:
ORA-01402: view WITH CHECK OPTION where-clause violation
```

Overview of the Explicit Default Feature

- With the explicit default feature, you can use the `DEFAULT` keyword as a column value where the column default is desired.
- The addition of this feature is for compliance with the SQL: 1999 Standard.
- This allows the user to control where and when the default value should be applied to data.
- Explicit defaults can be used in `INSERT` and `UPDATE` statements.

Using Explicit Default Values

- **`DEFAULT` with `INSERT`:**

```
INSERT INTO departments
  (department_id, department_name, manager_id)
VALUES (300, 'Engineering', DEFAULT);
```

- **`DEFAULT` with `UPDATE`:**

```
UPDATE departments
SET manager_id = DEFAULT WHERE department_id = 10;
```

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The `MERGE` Statement

- Provides the ability to conditionally update or insert data into a database table
- Performs an `UPDATE` if the row exists, and an `INSERT` if it is a new row:
  - Avoids separate updates
  - Increases performance and ease of use
  - Is useful in data warehousing applications

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The MERGE Statement Syntax

You can conditionally insert or update rows in a table by using the `MERGE` statement.

```
MERGE INTO table_name table_alias
  USING (table|view|sub_query) alias
  ON (join condition)
  WHEN MATCHED THEN
    UPDATE SET
    col1 = col_val1,
    col2 = col2_val
  WHEN NOT MATCHED THEN
    INSERT (column_list)
    VALUES (column_values);
```

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Merging Rows

Insert or update rows in the COPY_EMP table to match the EMPLOYEES table.

```
MERGE INTO copy_emp  c
  USING employees e
  ON (c.employee_id = e.employee_id)
WHEN MATCHED THEN
  UPDATE SET
     c.first_name     = e.first_name,
     c.last_name      = e.last_name,
     ...
     c.department_id  = e.department_id
WHEN NOT MATCHED THEN
 INSERT VALUES(e.employee_id, e.first_name, e.last_name,
          e.email, e.phone_number, e.hire_date, e.job_id,
          e.salary, e.commission_pct, e.manager_id,
          e.department_id);
```

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Merging Rows

```
SELECT *
FROM COPY_EMP;

no rows selected
```

```
MERGE INTO copy_emp c
  USING employees e
  ON (c.employee_id = e.employee_id)
WHEN MATCHED THEN
  UPDATE SET
     ...
WHEN NOT MATCHED THEN
 INSERT VALUES...;
```

```
SELECT *
FROM COPY_EMP;

20 rows selected.
```

Database Transactions

A database transaction consists of one of the following:

- DML statements which constitute one consistent change to the data
- One DDL statement
- One DCL statement

Database Transactions

- 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 *i*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

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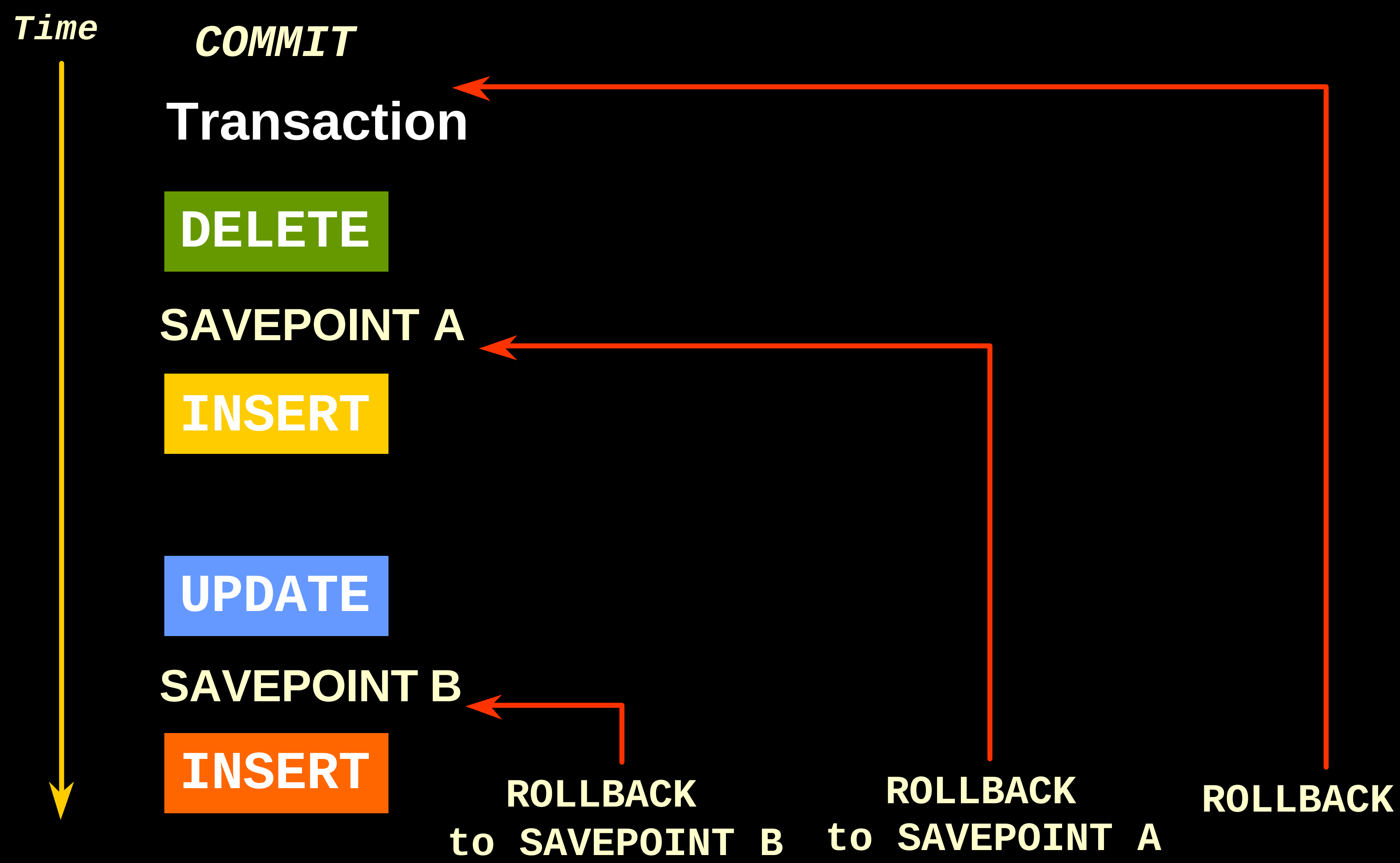
Controlling Transactions



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Rolling Back Changes to a Marker

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

```
UPDATE...
SAVEPOINT update_done;
Savepoint created.
INSERT...
ROLLBACK TO update_done;
Rollback complete.
```

Implicit Transaction Processing

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

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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 by the current user.**
- **The affected rows are *locked*; other users cannot change the data within the affected rows.**

State of the Data after `COMMIT`

- Data changes are made permanent in the database.
- The previous state of the data is permanently lost.
- 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 row deleted.

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

- Commit the changes.

```
COMMIT;
Commit complete.
```

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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;
22 rows deleted.
ROLLBACK;
Rollback complete.
```

Statement-Level Rollback

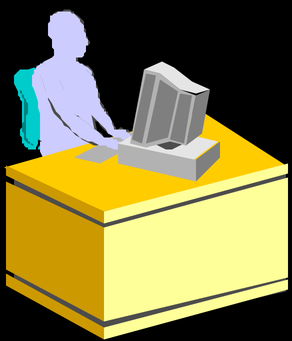
- If a single DML statement fails during execution, only that statement is rolled back.
- The Oracle server implements an implicit savepoint.
- All other changes are retained.
- The user should terminate transactions explicitly by executing a `COMMIT` or `ROLLBACK` statement.

Read Consistency

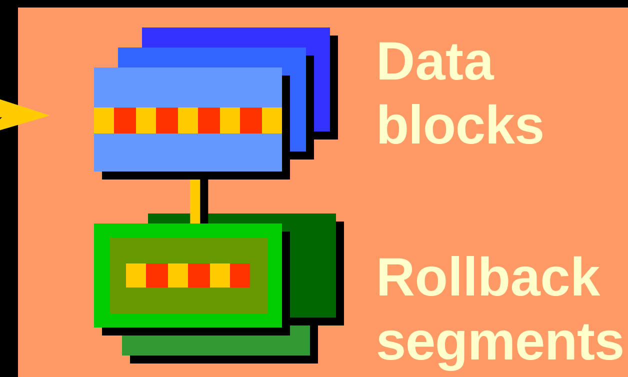
- Read consistency guarantees a consistent view of the data at all times.
- Changes made by one user do not conflict with changes made by another user.
- Read consistency ensures that on the same data:
  - Readers do not wait for writers.
  - Writers do not wait for readers.

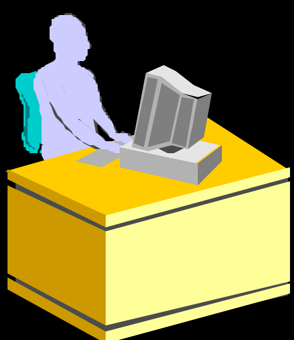
Implementation of Read Consistency

User A



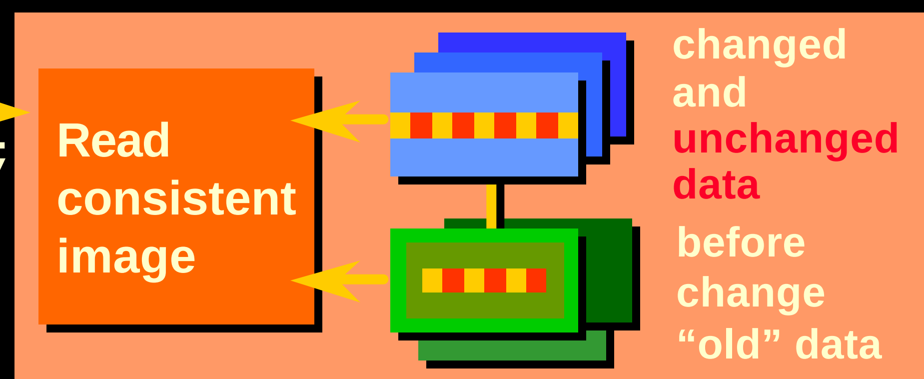
```
UPDATE employees
SET    salary = 7000
WHERE  last_name = 'Goyal';
```





User B

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



Locking

In an Oracle database, locks:

- Prevent destructive interaction between concurrent transactions
- Require no user action
- Automatically use the lowest level of restrictiveness
- Are held for the duration of the transaction
- Are of two types: explicit locking and implicit locking

Implicit Locking

- Two lock modes:
  - Exclusive: Locks out other users
  - Share: Allows other users to access
- High level of data concurrency:
  - DML: Table share, row exclusive
  - Queries: No locks required
  - DDL: Protects object definitions
- Locks held until commit or rollback

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Summary

In this lesson, you should have learned how to use DML statements and control transactions.

Statement	Description
`INSERT`	Adds a new row to the table
`UPDATE`	Modifies existing rows in the table
`DELETE`	Removes existing rows from the table
`MERGE`	Conditionally inserts or updates data in a table
`COMMIT`	Makes all pending changes permanent
`SAVEPOINT`	Is used to rollback to the savepoint marker
`ROLLBACK`	Discards all pending data changes

Practice 8 Overview

This practice covers the following topics:

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

9

Creating and Managing Tables

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Objectives

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

- Describe the main database objects
- Create tables
- Describe the data types that can be used when specifying column definition
- Alter table definitions
- Drop, rename, and truncate tables

Database Objects

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

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**

The 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.**

The 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.

Creating Tables

- Create the table.

```
CREATE TABLE dept
            (deptno  NUMBER(2),
             dname   VARCHAR2(14),
             loc     VARCHAR2(13));
Table created.
```

- Confirm table creation.

```
DESCRIBE dept
```

Name	Null?	Type
DEPTNO		NUMBER(2)
DNAME		VARCHAR2(14)
LOC		VARCHAR2(13)

Tables in the Oracle Database

- **User Tables:**
  - **Are a collection of tables created and maintained by the user**
  - **Contain user information**
- **Data Dictionary:**
  - **Is a collection of tables created and maintained by the Oracle Server**
  - **Contain database information**

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Querying the Data Dictionary

- See the names of tables owned by the user.

```
SELECT table_name
FROM   user_tables ;
```

- View distinct object types owned by the user.

```
SELECT DISTINCT object_type
FROM   user_objects ;
```

- View tables, views, synonyms, and sequences owned by the user.

```
SELECT *
FROM   user_catalog ;
```

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 gigabytes
`CLOB`	Character data up to 4 gigabytes
`RAW` and `LONG RAW`	Raw binary data
`BLOB`	Binary data up to 4 gigabytes
`BFILE`	Binary data stored in an external file; up to 4 gigabytes
`ROWID`	A 64 base number system representing the unique address of a row in its table.

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DateTime Data Types

Datetime enhancements with Oracle9*i*:

- New Datetime data types have been introduced.
- New data type storage is available.
- Enhancements have been made to time zones and local time zone.

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 to hours minutes and seconds

DateTime Data Types

- The `TIMESTAMP` data type is an extension of the `DATE` data type.
- It stores the year, month, and day of the `DATE` data type, plus hour, minute, and second values as well as the fractional second value.
- The `TIMESTAMP` data type is specified as follows:

```
TIMESTAMP[(fractional_seconds_precision)]
```

TIMESTAMP WITH TIME ZONE Data Type

- `TIMESTAMP WITH TIME ZONE` is a variant of `TIMESTAMP` that includes a time zone displacement in its value.
- The time zone displacement is the difference, in hours and minutes, between local time and UTC.

```
TIMESTAMP[(fractional_seconds_precision)]
WITH TIME ZONE
```

TIMESTAMP WITH LOCAL TIME Data Type

- **TIMESTAMP WITH LOCAL TIME ZONE is another variant of TIMESTAMP that includes a time zone displacement in its value.**
- **Data stored in the database is normalized to the database time zone.**
- **The time zone displacement is not stored as part of the column data; Oracle returns the data in the users' local session time zone.**
- **TIMESTAMP WITH LOCAL TIME ZONE data type is specified as follows:**

```
TIMESTAMP[(fractional_seconds_precision)]
WITH LOCAL TIME ZONE
```

INTERVAL YEAR TO MONTH Data Type

- INTERVAL YEAR TO MONTH stores a period of time using the YEAR and MONTH datetime fields.

```
INTERVAL YEAR [(year_precision)] TO MONTH
```

```
INTERVAL '123-2' YEAR(3) TO MONTH
Indicates an interval of 123 years, 2 months.

INTERVAL '123' YEAR(3)
Indicates an interval of 123 years 0 months.

INTERVAL '300' MONTH(3)
Indicates an interval of 300 months.

INTERVAL '123' YEAR
Returns an error, because the default precision is 2,
and '123' has 3 digits.
```

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INTERVAL DAY TO SECOND Data Type

- `INTERVAL DAY TO SECOND` stores a period of time in terms of days, hours, minutes, and seconds.

```
INTERVAL DAY [(day_precision)]
   TO SECOND [(fractional_seconds_precision)]
```

```
INTERVAL '4 5:12:10.222' DAY TO SECOND(3)
Indicates 4 days, 5 hours, 12 minutes, 10 seconds,
and 222 thousandths of a second.INTERVAL '123' YEAR(3).

INTERVAL '7' DAY
Indicates 7 days.

INTERVAL '180' DAY(3)
Indicates 180 days.
```

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INTERVAL DAY TO SECOND Data Type

- **INTERVAL DAY TO SECOND stores a period of time in terms of days, hours, minutes, and seconds.**

```
INTERVAL '4 5:12:10.222' DAY TO SECOND(3)
Indicates 4 days, 5 hours, 12 minutes, 10 seconds,
and 222 thousandths of a second.

INTERVAL '4 5:12' DAY TO MINUTE
Indicates 4 days, 5 hours and 12 minutes.

INTERVAL '400 5' DAY(3) TO HOUR
Indicates 400 days 5 hours.

INTERVAL '11:12:10.2222222' HOUR TO SECOND(7)
indicates 11 hours, 12 minutes, and 10.2222222 seconds.
```

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Creating a Table by Using a Subquery Syntax

- 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 by Using a Subquery

```
CREATE TABLE  dept80
  AS
    SELECT  employee_id, last_name,
            salary*12 ANNSAL,
            hire_date
    FROM    employees
    WHERE   department_id = 80;
Table created.
```

```
DESCRIBE dept80
```

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

The ALTER TABLE Statement

Use the ALTER TABLE statement to:

- Add a new column
- Modify an existing column
- Define a default value for the new column
- Drop a column

The ALTER TABLE Statement

Use the ALTER TABLE statement to add, modify, or drop columns.

```
ALTER TABLE table
ADD         (column datatype [DEFAULT expr]
            [, column datatype]...);
```

```
ALTER TABLE table
MODIFY      (column datatype [DEFAULT expr]
            [, column datatype]...);
```

```
ALTER TABLE table
DROP        (column);
```

Adding a Column

New column

JOB_ID

DEPT80

EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE
149	Zlotkey	126000	29-JAN-00
174	Abel	132000	11-MAY-96
176	Taylor	103200	24-MAR-98

"Add a new column to the DEPT80 table."

DEPT80

EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE	JOB_ID
149	Zlotkey	126000	29-JAN-00	
174	Abel	132000	11-MAY-96	
176	Taylor	103200	24-MAR-98	

Adding a Column

- You use the ADD clause to add columns.

```
ALTER TABLE dept80
ADD         (job_id VARCHAR2(9));
Table altered.
```

- The new column becomes the last column.

EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE	JOB_ID
149	Zlotkey	126000	29-JAN-00	
174	Abel	132000	11-MAY-96	
176	Taylor	103200	24-MAR-98	

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Modifying a Column

- You can change a column's data type, size, and default value.

```
ALTER TABLE   dept80
MODIFY        (last_name VARCHAR2(30));
Table altered.
```

- A change to the default value affects only subsequent insertions to the table.

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Dropping a Column

Use the `DROP COLUMN` clause to drop columns you no longer need from the table.

```
ALTER TABLE  dept80
DROP COLUMN  job_id;
Table altered.
```

The SET UNUSED Option

- You use the `SET UNUSED` option to mark one or more columns as unused.
- You use the `DROP UNUSED COLUMNS` option to remove the columns that are marked as unused.

```
ALTER TABLE    table
SET   UNUSED  (column);
OR
ALTER TABLE  table
SET   UNUSED COLUMN column;
```

```
ALTER TABLE table
DROP  UNUSED COLUMNS;
```

Dropping a Table

- All data and structure in the table is deleted.
- Any pending transactions are committed.
- All indexes are dropped.
- You *cannot* roll back the `DROP TABLE` statement.

```
DROP TABLE dept80;
Table dropped.
```

Changing the Name of an Object

- To change the name of a table, view, sequence, or synonym, you execute the RENAME statement.

```
RENAME dept TO detail_dept;
Table renamed.
```

- You must be the owner of the object.

Truncating a Table

- The `TRUNCATE TABLE` statement:
  - Removes all rows from a table
  - Releases the storage space used by that table

```
TRUNCATE TABLE detail_dept;
Table truncated.
```

- You cannot roll back row removal when using `TRUNCATE`.
- Alternatively, you can remove rows by using the `DELETE` statement.

Adding Comments to a Table

- You can add comments to a table or column by using the COMMENT statement.

```
COMMENT ON TABLE employees
IS 'Employee Information';
Comment created.
```

- Comments can be viewed through the data dictionary views:
  - ALL_COL_COMMENTS
  - USER_COL_COMMENTS
  - ALL_TAB_COMMENTS
  - USER_TAB_COMMENTS

Summary

In this lesson, you should have learned how to use DDL statements to create, alter, drop, and rename tables.

Statement	Description
`CREATE TABLE`	Creates a table
`ALTER TABLE`	Modifies table structures
`DROP TABLE`	Removes the rows and table structure
`RENAME`	Changes the name of a table, view, sequence, or synonym
`TRUNCATE`	Removes all rows from a table and releases the storage space
`COMMENT`	Adds comments to a table or view

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Practice 9 Overview

This practice covers the following topics:

- Creating new tables
- Creating a new table by using the `CREATE TABLE AS` syntax
- Modifying column definitions
- Verifying that the tables exist
- Adding comments to tables
- Dropping tables
- Altering tables

10

Including Constraints

Objectives

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

- Describe constraints
- Create and maintain constraints

What Are 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

- Name a constraint or the Oracle server generates a name by using the `SYS_C`*n* format.
- Create a constraint either:
  - At the same time as the table is created, or
  - After the table has been created
- Define a constraint at the column or table level.
- View a constraint in the data dictionary.

Defining Constraints

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

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Defining Constraints

- **Column constraint level**

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

- **Table constraint level**

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

The NOT NULL Constraint

Ensures that null values are not permitted for the column:

EMPLOYEE_ID	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	DEPARTMENT_ID
100	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000	90
101	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000	90
102	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000	90
103	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000	60
104	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000	60
178	Grant	KGRANT	011.44.1644.429263	24-MAY-99	SA_REP	7000	
200	Whalen	JWHALEN	515.123.4444	17-SEP-87	AD_ASST	4400	10

...

20 rows selected.

NOT NULL constraint (No row can contain a null value for this column.)

NOT NULL constraint

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

The NOT NULL Constraint

Is defined at the column level:

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

System named

User named

The 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

...

INSERT INTO

208	Smith	JSMITH	Allowed
209	Smith	JSMITH	Not allowed: already exists

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The 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));
```

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The PRIMARY KEY Constraint

DEPARTMENTS

PRIMARY KEY

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

...

INSERT INTO

Not allowed (Null value)

	Public Accounting		1400
50	Finance	124	1500

Not allowed (50 already exists)

The PRIMARY KEY Constraint

Defined at either the table level or the column level:

```
CREATE TABLE   departments(
    department_id          NUMBER(4),
    department_name        VARCHAR2(30)
      CONSTRAINT dept_name_nn NOT NULL,
    manager_id             NUMBER(6),
    location_id            NUMBER(4),
      CONSTRAINT dept_id_pk PRIMARY KEY(department_id));
```

The FOREIGN KEY Constraint

DEPARTMENTS

PRIMARY KEY

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

...

EMPLOYEES

FOREIGN KEY

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
100	King	90
101	Kochhar	90
102	De Haan	90
103	Hunold	60
104	Ernst	60
107	Lorentz	60

...

INSERT INTO

200	Ford	9
201	Ford	60

Not allowed (9 does not exist)

Allowed

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The 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));
```

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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**

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The 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),...
```

Adding a Constraint Syntax

Use the `ALTER TABLE` statement to:

- Add or drop a constraint, but not modify its structure
- Enable or disable constraints
- Add a `NOT NULL` constraint by using the `MODIFY` clause

```
ALTER TABLE  table
ADD [CONSTRAINT constraint] type (column);
```

Adding a Constraint

Add a `FOREIGN KEY` constraint to the `EMPLOYEES` table indicating that a manager must already exist as a valid employee in the `EMPLOYEES` table.

```
ALTER TABLE     employees
ADD CONSTRAINT  emp_manager_fk
  FOREIGN KEY(manager_id)
  REFERENCES employees(employee_id);
Table altered.
```

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Dropping a Constraint

- Remove the manager constraint from the `EMPLOYEES` table.

```
ALTER TABLE      employees
DROP CONSTRAINT  emp_manager_fk;
Table altered.
```

- Remove the `PRIMARY KEY` constraint on the `DEPARTMENTS` table and drop the associated `FOREIGN KEY` constraint on the `EMPLOYEES.DEPARTMENT_ID` column.

```
ALTER TABLE   departments
DROP PRIMARY KEY CASCADE;
Table altered.
```

Disabling Constraints

- Execute the `DISABLE` clause of the `ALTER TABLE` statement to deactivate an integrity constraint.
- Apply the `CASCADE` option to disable dependent integrity constraints.

```
ALTER TABLE          employees
DISABLE CONSTRAINT   emp_emp_id_pk CASCADE;
Table altered.
```

Enabling Constraints

- Activate an integrity constraint currently disabled in the table definition by using the `ENABLE` clause.

```
ALTER TABLE          employees
ENABLE CONSTRAINT    emp_emp_id_pk;
Table altered.
```

- A `UNIQUE` or `PRIMARY KEY` index is automatically created if you enable a `UNIQUE` key or `PRIMARY KEY` constraint.

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Cascading Constraints

- The `CASCADE CONSTRAINTS` clause is used along with the `DROP COLUMN` clause.
- The `CASCADE CONSTRAINTS` clause drops all referential integrity constraints that refer to the primary and unique keys defined on the dropped columns.
- The `CASCADE CONSTRAINTS` clause also drops all multicolumn constraints defined on the dropped columns.

Cascading Constraints

Example:

```
ALTER TABLE test1
DROP (pk) CASCADE CONSTRAINTS;
Table altered.
```

```
ALTER TABLE test1
DROP (pk, fk, col1) CASCADE CONSTRAINTS;
Table altered.
```

Viewing Constraints

Query the **USER_CONSTRAINTS** table to view all constraint definitions and names.

```
SELECT   constraint_name, constraint_type,
         search_condition
FROM     user_constraints
WHERE    table_name = 'EMPLOYEES';
```

CONSTRAINT_NAME	C	SEARCH_CONDITION
EMP_LAST_NAME_NN	C	"LAST_NAME" IS NOT NULL
EMP_EMAIL_NN	C	"EMAIL" IS NOT NULL
EMP_HIRE_DATE_NN	C	"HIRE_DATE" IS NOT NULL
EMP_JOB_NN	C	"JOB_ID" IS NOT NULL
EMP_SALARY_MIN	C	salary > 0
EMP_EMAIL_UK	U	

...

Viewing the Columns Associated with Constraints

View the columns associated with the constraint names in the USER_CONS_COLUMNS view.

```
SELECT   constraint_name, column_name
FROM     user_cons_columns
WHERE    table_name = 'EMPLOYEES';
```

CONSTRAINT_NAME	COLUMN_NAME
EMP_DEPT_FK	DEPARTMENT_ID
EMP_EMAIL_NN	EMAIL
EMP_EMAIL_UK	EMAIL
EMP_EMP_ID_PK	EMPLOYEE_ID
EMP_HIRE_DATE_NN	HIRE_DATE
EMP_JOB_FK	JOB_ID
EMP_JOB_NN	JOB_ID

...

Summary

In this lesson, you should have learned how to create constraints.

- Types of constraints:
  - `NOT NULL`
  - `UNIQUE`
  - `PRIMARY KEY`
  - `FOREIGN KEY`
  - `CHECK`
- You can query the `USER_CONSTRAINTS` table to view all constraint definitions and names.

Practice 10 Overview

This practice covers the following topics:

- Adding constraints to existing tables
- Adding more columns to a table
- Displaying information in data dictionary views

11

Creating Views

Objectives

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

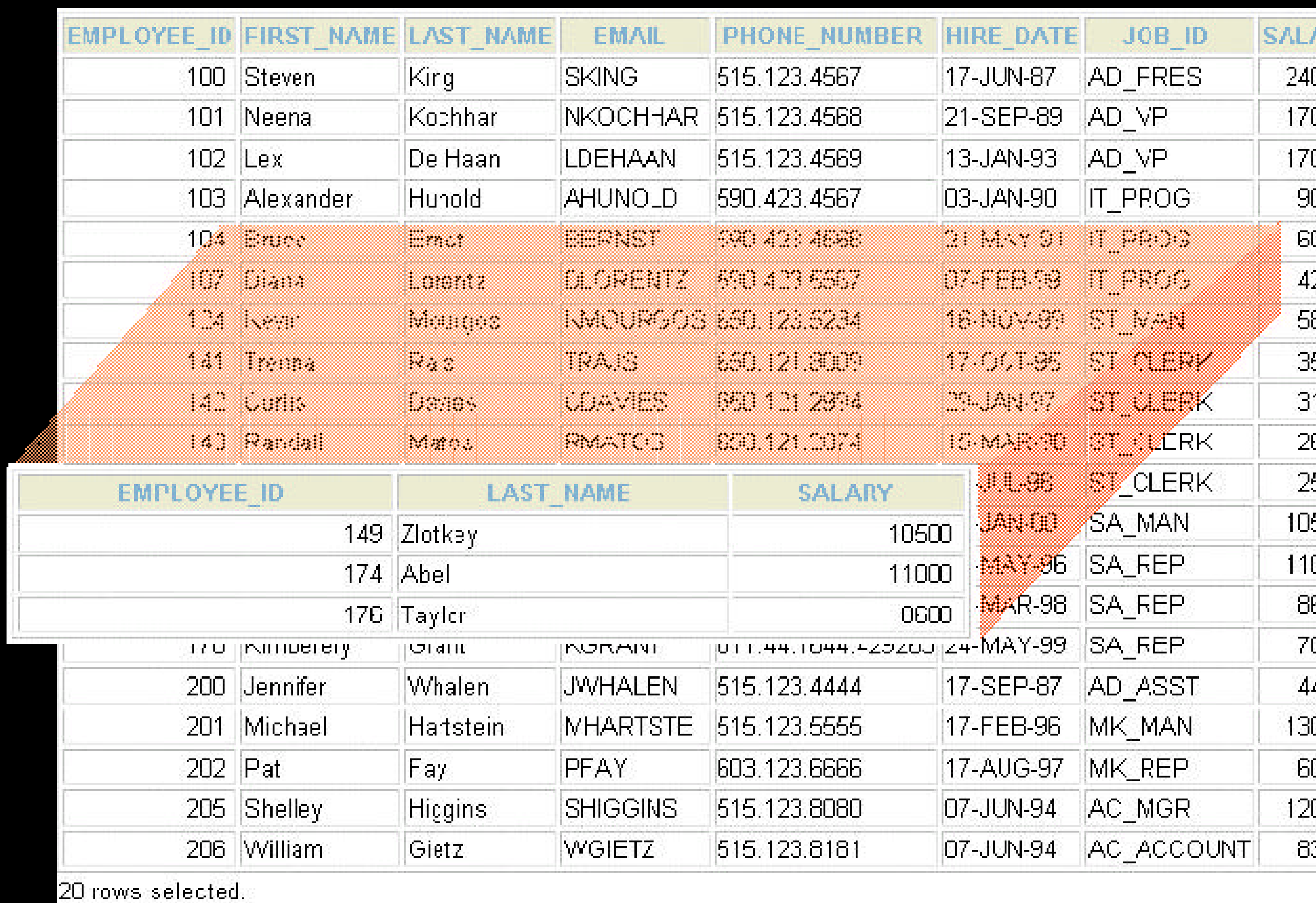
- Describe a view
- Create, alter the definition of, and drop a view
- Retrieve data through a view
- Insert, update, and delete data through a view
- Create and use an inline view
- Perform “Top-N” analysis

Database Objects

Object	Description
Table	Basic unit of storage; composed of rows and columns
View	Logically represents subsets of data from one or more tables
Sequence	Generates primary key values
Index	Improves the performance of some queries
Synonym	Alternative name for an object

What Is a View?

EMPLOYEES Table:



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALA
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	240
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	170
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	170
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	90
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	42
124	Kevin	Mourgos	KMOURGOS	650.123.5234	16-NOV-99	ST_MAN	58
141	Trenna	Rajs	TRAJS	650.121.8009	17-OCT-95	ST_CLERK	35
142	Curtis	Davies	CDAVIES	650.121.2994	29-JAN-97	ST_CLERK	31
143	Randall	Matos	RMATOS	650.121.2874	15-MAR-98	ST_CLERK	26
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	JUL-98	ST_CLERK	25
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	JAN-00	SA_MAN	105
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MAY-96	SA_REP	110
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MAR-98	SA_REP	86
178	Kimberely	Grant	KGRANT	011.44.1644.429263	24-MAY-99	SA_REP	70
200	Jennifer	Whalen	JWHALEN	515.123.4444	17-SEP-87	AD_ASST	44
201	Michael	Hartstein	MHARTSTE	515.123.5555	17-FEB-96	MK_MAN	130
202	Pat	Fay	PFAY	603.123.6666	17-AUG-97	MK_REP	60
205	Shelley	Higgins	SHIGGINS	515.123.8080	07-JUN-94	AC_MGR	120
206	William	Gietz	WGIETZ	515.123.8181	07-JUN-94	AC_ACCOUNT	83

20 rows selected.

EMPLOYEE_ID	LAST_NAME	SALARY
149	Zlotkey	10500
174	Abel	11000
176	Taylor	8600

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Why Use 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

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Creating a View

- You embed a subquery within 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 a view, **`EMPVU80`**, that contains details of employees in department 80.

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

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

```
DESCRIBE empvu80
```

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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;
View created.
```

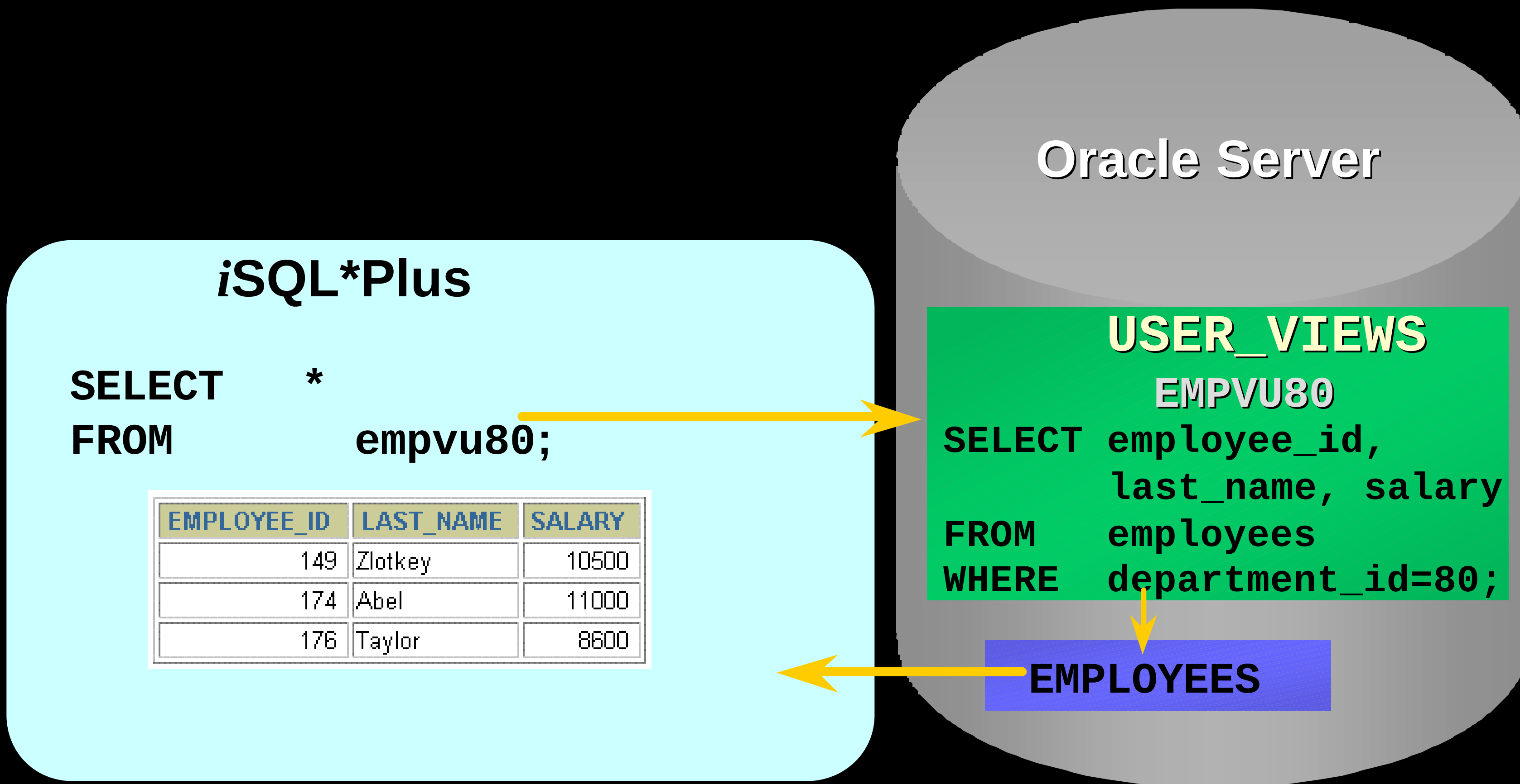
- **Select the columns from this view by the given alias names.**

Retrieving Data from a View

```
SELECT *
FROM  salvu50;
```

ID_NUMBER	NAME	ANN_SALARY
124	Mourgos	69600
141	Rajs	42000
142	Davies	37200
143	Matos	31200
144	Vargas	30000

Querying a View



Modifying a View

- Modify the EMPVU80 view by using `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;
View created.
```

- Column aliases in the `CREATE 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 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, departments d
   WHERE     e.department_id = d.department_id
   GROUP BY  d.department_name;
View created.
```

Rules for Performing DML Operations on a View

- **You can 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**

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Using the WITH CHECK OPTION Clause

- You can ensure that DML operations performed on the view stay within 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 ;
View created.
```

- Any attempt to change 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 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;
View created.
```

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;
View dropped.
```

Inline Views

- An inline view is a subquery with an alias (or correlation name) that you can use within a SQL statement.
- A named subquery in the `FROM` clause of the main query is an example of an inline view.
- An inline view is not a schema object.

Top-N Analysis

- Top-N queries ask for the *n* largest or smallest values of a column. For example:
  - What are the ten best selling products?
  - What are the ten worst selling products?
- Both largest values and smallest values sets are considered Top-N queries.

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Performing Top-N Analysis

The high-level structure of a Top-N analysis query is:

```
SELECT [column_list], ROWNUM
FROM   (SELECT [column_list]
        FROM table
        ORDER  BY Top-N_column)
WHERE  ROWNUM <=  N;
```

Example of Top-N Analysis

To display the top three earner names and salaries from the EMPLOYEES table:

```
SELECT ROWNUM as RANK, last_name, salary
FROM  (SELECT last_name,salary FROM employees
       ORDER BY salary DESC)
WHERE ROWNUM <= 3;
```

RANK	LAST_NAME	SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000

Summary

In this lesson, you should have learned that a view is derived from data in other tables or views and provides the following advantages:

- **Restricts database access**
- **Simplifies queries**
- **Provides data independence**
- **Provides multiple views of the same data**
- **Can be dropped without removing the underlying data**
- **An inline view is a subquery with an alias name.**
- **Top-N analysis can be done using subqueries and outer queries.**

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Practice 11 Overview

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
- Displaying view definitions
- Removing views

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12

Other Database Objects

Objectives

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

- Create, maintain, and use sequences
- Create and maintain indexes
- Create private and public synonyms

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Database Objects

Object	Description
Table	Basic unit of storage; composed of rows and columns
View	Logically represents subsets of data from one or more tables
Sequence	Generates primary key values
Index	Improves the performance of some queries
Synonym	Alternative name for an object

What Is a Sequence?

A sequence:

- Automatically generates unique numbers
- Is a sharable object
- Is typically used to create a primary key value
- Replaces application code
- Speeds up the efficiency of accessing sequence values when cached in memory

The 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;
Sequence created.
```

Confirming Sequences

- Verify your sequence values in the **USER_SEQUENCES** data dictionary table.

```
SELECT   sequence_name, min_value, max_value,
         increment_by, last_number
FROM     user_sequences;
```

- The **LAST_NUMBER** column displays the next available sequence number if **NOCACHE** is specified.

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 row created.
```

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

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

Using a Sequence

- 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
- If the sequence was created with `NOCACHE`, view the next available value, by querying the `USER_SEQUENCES` 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;
Sequence altered.
```

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.

Removing a Sequence

- Remove a sequence from the data dictionary by using the `DROP SEQUENCE` statement.
- Once removed, the sequence can no longer be referenced.

```
DROP SEQUENCE dept_deptid_seq;
Sequence dropped.
```

What Is an Index?

An index:

- Is a schema object
- Is used by the Oracle server to speed up the retrieval of rows by using a pointer
- Can reduce disk I/O by using a rapid path access method to locate data quickly
- Is independent of the table 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 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);
Index created.
```

When to Create an Index

You should create an index if:

- 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 percent of the rows

When Not to Create an Index

It is usually not worth creating an index if:

- The table is small
- The columns are not often used as a condition in the query
- Most queries are expected to retrieve more than 2 to 4 percent of the rows in the table
- The table is updated frequently
- The indexed columns are referenced as part of an expression

Confirming Indexes

- The USER_INDEXES data dictionary view contains the name of the index and its uniqueness.
- The USER_IND_COLUMNS view contains the index name, the table name, and the column name.

```
SELECT   ic.index_name, ic.column_name,
         ic.column_position col_pos,ix.uniqueness
FROM     user_indexes ix, user_ind_columns ic
WHERE    ic.index_name = ix.index_name
AND      ic.table_name = 'EMPLOYEES';
```

Function-Based Indexes

- A function-based index is an index based on expressions.
- The index expression is built from table columns, constants, SQL functions, and user-defined functions.

```
CREATE INDEX upper_dept_name_idx
ON departments(UPPER(department_name));

Index created.

SELECT *
FROM   departments
WHERE  UPPER(department_name) = 'SALES';
```

Removing an Index

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

```
DROP INDEX index;
```

- Remove the UPPER_LAST_NAME_IDX index from the data dictionary.

```
DROP INDEX upper_last_name_idx;
Index dropped.
```

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

Synonyms

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

- Ease referring to a table 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;
Synonym Created.
```

- Drop a synonym.

```
DROP SYNONYM d_sum;
Synonym dropped.
```

Summary

In this lesson, you should have learned how to:

- Automatically generate sequence numbers by using a sequence generator
- View sequence information in the `USER_SEQUENCES` data dictionary table
- Create indexes to improve query retrieval speed
- View index information in the `USER_INDEXES` dictionary table
- Use synonyms to provide alternative names for objects

Practice 12 Overview

This practice covers the following topics:

- Creating sequences
- Using sequences
- Creating nonunique indexes
- Displaying data dictionary information about sequences and indexes
- Dropping indexes

13

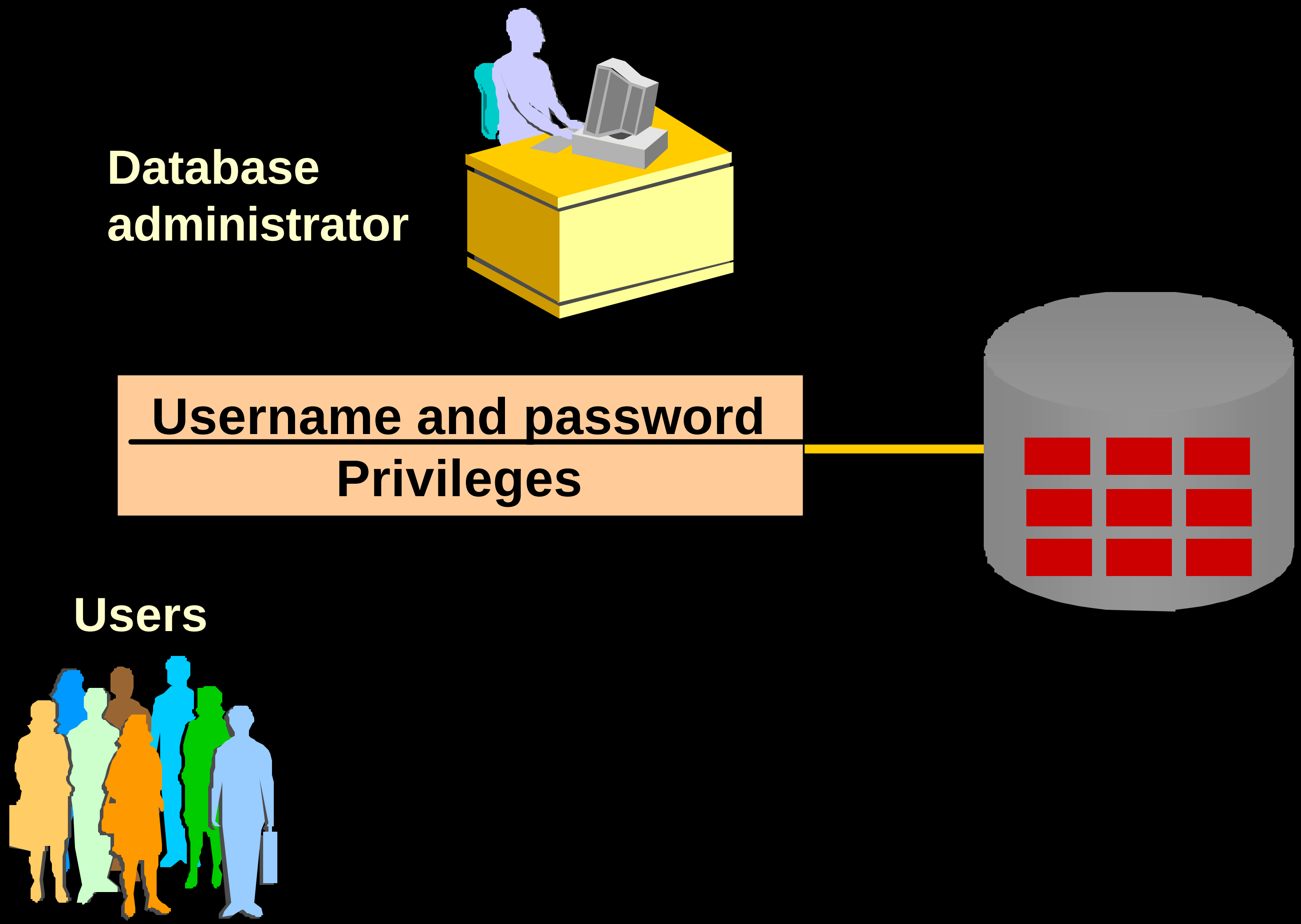
Controlling User Access

Objectives

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

- Create users
- Create roles to ease setup and maintenance of the security model
- Use the `GRANT` and `REVOKE` statements to grant and revoke object privileges
- Create and access database links

Controlling User Access



Privileges

- Database security:
  - System security
  - Data security
- System privileges: Gaining access to the database
- Object privileges: Manipulating the content of the database objects
- Schemas: Collections of objects, such as tables, views, and sequences

System Privileges

- More than 100 privileges are available.
- The database administrator has high-level system privileges for tasks such as:
  – Creating new users
  – Removing users
  – Removing tables
  – Backing up tables

Creating Users

The DBA creates users by using the `CREATE USER` statement.

```
CREATE USER user
IDENTIFIED BY   password;
```

```
CREATE USER  scott
IDENTIFIED BY   tiger;
User created.
```

User System Privileges

- Once a user is created, the DBA can grant specific system privileges to a user.

```
GRANT privilege [, privilege...]
TO user [, user| role, PUBLIC...];
```

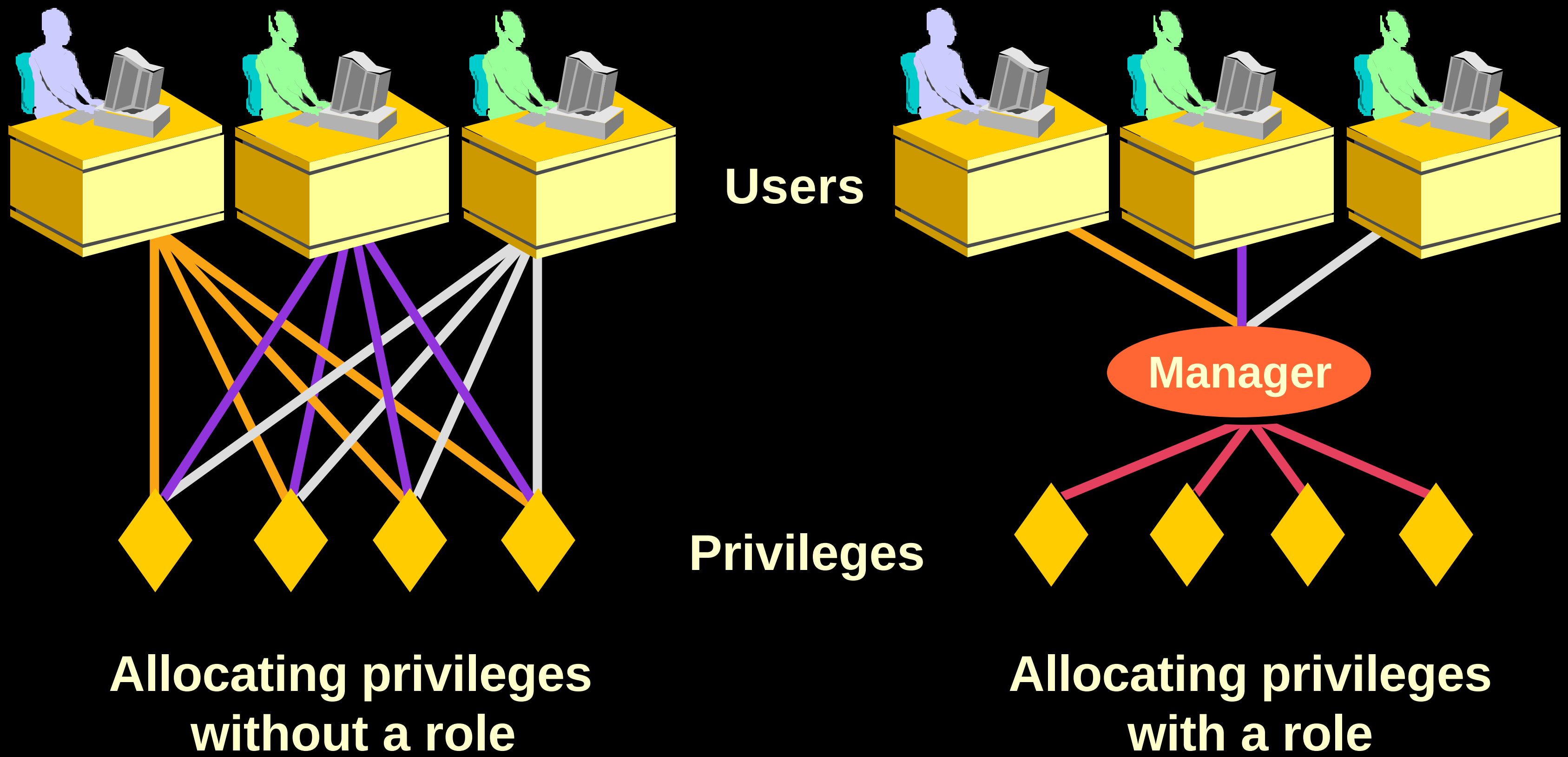
- An application developer, for example, may have the following system privileges:
  - `CREATE SESSION`
  - `CREATE TABLE`
  - `CREATE SEQUENCE`
  - `CREATE VIEW`
  - `CREATE PROCEDURE`

Granting System Privileges

The DBA can grant a user specific system privileges.

```
GRANT  create session, create table,
       create sequence, create view
TO     scott;
Grant succeeded.
```

What Is a Role?



Creating and Granting Privileges to a Role

- Create a role

```
CREATE ROLE manager;
Role created.
```

- Grant privileges to a role

```
GRANT create table, create view
TO manager;
Grant succeeded.
```

- Grant a role to users

```
GRANT manager TO DEHAAN, KOCHHAR;
Grant succeeded.
```

Changing Your Password

- The DBA creates your user account and initializes your password.
- You can change your password by using the `ALTER USER` statement.

```
ALTER USER scott
IDENTIFIED BY lion;
User altered.
```

Object Privileges

Object Privilege	Table	View	Sequence	Procedure
ALTER	Ö		Ö	
DELETE	Ö	Ö		
EXECUTE				Ö
INDEX	Ö			
INSERT	Ö	Ö		
REFERENCES	Ö	Ö		
SELECT	Ö	Ö	Ö	
UPDATE	Ö	Ö		

Object Privileges

- Object privileges vary from object to object.
- An owner has all the privileges on the object.
- An owner can give specific privileges on that owner's object.

```
GRANT          object_priv [(columns)]
ON             object
TO             {user|role|PUBLIC}
[WITH GRANT OPTION];
```

Granting Object Privileges

- Grant query privileges on the `EMPLOYEES` table.

```
GRANT  select
ON     employees
TO     sue, rich;
Grant succeeded.
```

- Grant privileges to update specific columns to users and roles.

```
GRANT  update (department_name, location_id)
ON     departments
TO     scott, manager;
Grant succeeded.
```

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Using the WITH GRANT OPTION and PUBLIC Keywords

- Give a user authority to pass along privileges.

```
GRANT  select, insert
ON     departments
TO     scott
WITH   GRANT OPTION;
Grant succeeded.
```

- Allow all users on the system to query data from Alice's DEPARTMENTS table.

```
GRANT  select
ON     alice.departments
TO     PUBLIC;
Grant succeeded.
```

Confirming Privileges Granted

Data Dictionary View	Description
`ROLE_SYS_PRIVS`	System privileges granted to roles
`ROLE_TAB_PRIVS`	Table privileges granted to roles
`USER_ROLE_PRIVS`	Roles accessible by the user
`USER_TAB_PRIVS_MADE`	Object privileges granted on the user's objects
`USER_TAB_PRIVS_RECD`	Object privileges granted to the user
`USER_COL_PRIVS_MADE`	Object privileges granted on the columns of the user's objects
`USER_COL_PRIVS_RECD`	Object privileges granted to the user on specific columns
`USER_SYS_PRIVS`	Lists system privileges granted to the user

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How to Revoke Object Privileges

- You use the `REVOKE` statement to revoke privileges granted to other users.
- Privileges granted to others through the `WITH GRANT OPTION` clause are also revoked.

```
REVOKE {privilege [, privilege...]|ALL}
ON     object
FROM   {user[, user...]|role|PUBLIC}
[CASCADE CONSTRAINTS];
```

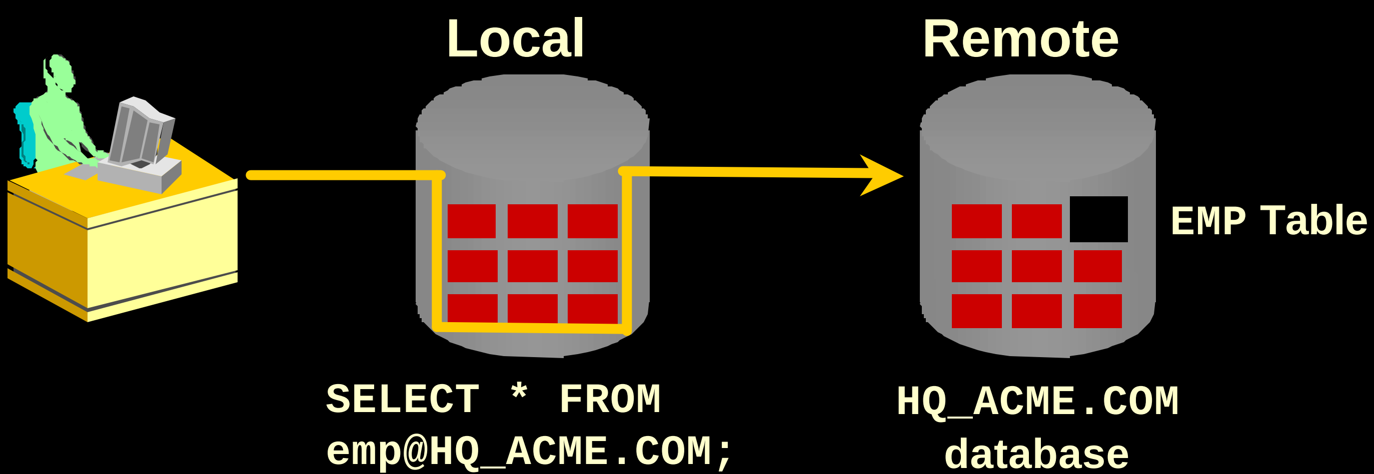
Revoking Object Privileges

As user Alice, revoke the `SELECT` and `INSERT` privileges given to user Scott on the `DEPARTMENTS` table.

```
REVOKE  select, insert
ON      departments
FROM    scott;
Revoke succeeded.
```

Database Links

A database link connection allows local users to access data on a remote database.



Database Links

- Create the database link.

```
CREATE PUBLIC DATABASE LINK hq.acme.com
USING 'sales';
Database link created.
```

- Write SQL statements that use the database link.

```
SELECT *
FROM emp@HQ.ACME.COM;
```

Summary

In this lesson, you should have learned about DCL statements that control access to the database and database objects.

Statement	Action
`CREATE USER`	Creates a user (usually performed by a DBA)
`GRANT`	Gives other users privileges to access the your objects
`CREATE ROLE`	Creates a collection of privileges (usually performed by a DBA)
`ALTER USER`	Changes a user’s password
`REVOKE`	Removes privileges on an object from users

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Practice 13 Overview

This practice covers the following topics:

- Granting other users privileges to your table
- Modifying another user's table through the privileges granted to you
- Creating a synonym
- Querying the data dictionary views related to privileges

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SQL Workshop

Workshop Overview

This workshop covers:

- Creating tables and sequences
- Modifying data in the tables
- Modifying table definitions
- Creating views
- Writing scripts containing SQL and *i*SQL*Plus commands
- Generating a simple report