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Restricting and Sorting Data

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Objectives

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

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

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Objectives

When retrieving data from the database, you may need to do the following:

- Restrict the rows of data that are displayed
- Specify the order in which the rows are displayed

This lesson explains the SQL statements that you use to perform the actions listed above.

Lesson Agenda

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

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Limiting Rows Using a Selection

EMPLOYEES

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

...

**“retrieve all
employees in
department 90”**



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

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Limiting Rows Using a Selection

In the example in the slide, assume that you want to display all the employees in department 90. The rows with a value of 90 in the `DEPARTMENT_ID` column are the only ones that are returned. This method of restriction is the basis of the `WHERE` clause in SQL.

Limiting the Rows that Are Selected

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

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

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

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Limiting the Rows that Are Selected

You can restrict the rows that are returned from the query by using the `WHERE` clause. A `WHERE` clause contains a condition that must be met and it directly follows the `FROM` clause. If the condition is true, the row meeting the condition is returned.

In the syntax:

`WHERE` restricts the query to rows that meet a condition

`condition` is composed of column names, expressions, constants, and a comparison operator. A condition specifies a combination of one or more expressions and logical (Boolean) operators, and returns a value of `TRUE`, `FALSE`, or `UNKNOWN`.

The `WHERE` clause can compare values in columns, literal, arithmetic expressions, or functions. It consists of three elements:

- Column name
- Comparison condition
- Column name, constant, or list of values

Using the WHERE Clause

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

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

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Using the WHERE Clause

In the example, the `SELECT` statement retrieves the employee ID, last name, job ID, and department number of all employees who are in department 90.

Note: You cannot use column alias in the `WHERE` clause.

Character Strings and Dates

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

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

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

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Character Strings and Dates

Character strings and dates in the WHERE clause must be enclosed with single quotation marks (' '). Number constants, however, should not be enclosed with single quotation marks.

All character searches are case-sensitive. In the following example, no rows are returned because the EMPLOYEES table stores all the last names in mixed case:

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

Oracle databases store dates in an internal numeric format, representing the century, year, month, day, hours, minutes, and seconds. The default date display is in the DD-MON-RR format.

Note: For details about the RR format and about changing the default date format, see the lesson titled “Using Single-Row Functions to Customize Output.” Also, you learn about the use of single-row functions such as UPPER and LOWER to override the case sensitivity in the same lesson.

Comparison Operators

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

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Comparison Operators

Comparison operators are used in conditions that compare one expression to another value or expression. They are used in the `WHERE` clause in the following format:

Syntax

```
... WHERE expr operator value
```

Example

```
... WHERE hire_date = '01-JAN-95'  
... WHERE salary >= 6000  
... WHERE last_name = 'Smith'
```

An alias cannot be used in the `WHERE` clause.

Note: The symbols `!=` and `^=` can also represent the *not equal to* condition.

Using Comparison Operators

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

	LAST_NAME	SALARY
1	Matos	2600
2	Vargas	2500

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Using Comparison Operators

In the example, the `SELECT` statement retrieves the last name and salary from the `EMPLOYEES` table for any employee whose salary is less than or equal to \$3,000. Note that there is an explicit value supplied to the `WHERE` clause. The explicit value of 3000 is compared to the salary value in the `SALARY` column of the `EMPLOYEES` table.

Range Conditions Using the BETWEEN Operator

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

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

Lower limit

Upper limit

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

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Range Conditions Using the BETWEEN Operator

You can display rows based on a range of values using the `BETWEEN` operator. The range that you specify contains a lower limit and an upper limit.

The `SELECT` statement in the slide returns rows from the `EMPLOYEES` table for any employee whose salary is between \$2,500 and \$3,500.

Values that are specified with the `BETWEEN` operator are inclusive. However, you must specify the lower limit first.

You can also use the `BETWEEN` operator on character values:

```
SELECT last_name
FROM   employees
WHERE  last_name BETWEEN 'King' AND 'Smith';
```

	LAST_NAME
1	King
2	Kochhar
3	Lorentz
4	Matos
5	Mourgos
6	Rajs

Membership Condition Using the IN Operator

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

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

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

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Membership Condition Using the IN Operator

To test for values in a specified set of values, use the `IN` operator. The condition defined using the `IN` operator is also known as the *membership condition*.

The slide example displays employee numbers, last names, salaries, and managers' employee numbers for all the employees whose manager's employee number is 100, 101, or 201.

The `IN` operator can be used with any data type. The following example returns a row from the `EMPLOYEES` table, for any employee whose last name is included in the list of names in the `WHERE` clause:

```
SELECT employee_id, manager_id, department_id
FROM   employees
WHERE  last_name IN ('Hartstein', 'Vargas');
```

If characters or dates are used in the list, they must be enclosed with single quotation marks (' ').

Note: The `IN` operator is internally evaluated by the Oracle server as a set of `OR` conditions, such as `a=value1 or a=value2 or a=value3`. Therefore, using the `IN` operator has no performance benefits and is used only for logical simplicity.

Pattern Matching Using the LIKE Operator

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

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

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Pattern Matching Using the LIKE Operator

You may not always know the exact value to search for. You can select rows that match a character pattern by using the `LIKE` operator. The character pattern-matching operation is referred to as a *wildcard* search. Two symbols can be used to construct the search string.

Symbol	Description
<code>%</code>	Represents any sequence of zero or more characters
<code>_</code>	Represents any single character

The `SELECT` statement in the slide returns the first name from the `EMPLOYEES` table for any employee whose first name begins with the letter “S.” Note the uppercase “S.” Consequently, names beginning with a lowercase “s” are not returned.

The `LIKE` operator can be used as a shortcut for some `BETWEEN` comparisons. The following example displays the last names and hire dates of all employees who joined between January, 1995 and December, 1995:

```
SELECT last_name, hire_date
FROM employees
WHERE hire_date LIKE '%95';
```

Combining Wildcard Characters

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

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

	LAST_NAME
1	Kochhar
2	Lorentz
3	Mourgos

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

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Combining Wildcard Characters

The % and _ symbols can be used in any combination with literal characters. The example in the slide displays the names of all employees whose last names have the letter “o” as the second character.

ESCAPE Identifier

When you need to have an exact match for the actual % and _ characters, use the `ESCAPE` identifier. This option specifies what the escape character is. If you want to search for strings that contain `SA_`, you can use the following SQL statement:

```
SELECT employee_id, last_name, job_id  
FROM employees WHERE job_id LIKE '%SA\_%' ESCAPE '\\';
```

	EMPLOYEE_ID	LAST_NAME	JOB_ID
1	149	Zlotkey	SA_MAN
2	174	Abel	SA_REP
3	176	Taylor	SA_REP
4	178	Grant	SA_REP

The `ESCAPE` identifier identifies the backslash (\) as the escape character. In the SQL statement, the escape character precedes the underscore (_). This causes the Oracle server to interpret the underscore literally.

Using the NULL Conditions

Test for nulls with the `IS NULL` operator.

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

	LAST_NAME	MANAGER_ID
1	King	(null)

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Using the NULL Conditions

The NULL conditions include the `IS NULL` condition and the `IS NOT NULL` condition.

The `IS NULL` condition tests for nulls. A null value means that the value is unavailable, unassigned, unknown, or inapplicable. Therefore, you cannot test with `=`, because a null cannot be equal or unequal to any value. The slide example retrieves the last names and managers of all employees who do not have a manager.

Here is another example: To display the last name, job ID, and commission for all employees who are *not* entitled to receive a commission, use the following SQL statement:

```
SELECT last_name, job_id, commission_pct
FROM   employees
WHERE  commission_pct IS NULL;
```

	LAST_NAME	JOB_ID	COMMISSION_PCT
1	King	AD_PRES	(null)
2	Kochhar	AD_VP	(null)
...			
15	Higgins	AC_MGR	(null)
16	Gietz	AC_ACCOUNT	(null)

Defining Conditions Using the Logical Operators

Operator	Meaning
AND	Returns TRUE if <i>both</i> component conditions are true
OR	Returns TRUE if <i>either</i> component condition is true
NOT	Returns TRUE if the condition is false

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Defining Conditions Using the Logical Operators

A logical condition combines the result of two component conditions to produce a single result based on those conditions or it inverts the result of a single condition. A row is returned only if the overall result of the condition is true.

Three logical operators are available in SQL:

- AND
- OR
- NOT

All the examples so far have specified only one condition in the WHERE clause. You can use several conditions in a single WHERE clause using the AND and OR operators.

Using the AND Operator

AND requires both the component conditions to be true:

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

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

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Using the AND Operator

In the example, both the component conditions must be true for any record to be selected. Therefore, only those employees who have a job title that contains the string 'MAN' *and* earn \$10,000 or more are selected.

All character searches are case-sensitive, that is no rows are returned if 'MAN' is not uppercase. Further, character strings must be enclosed with quotation marks.

AND Truth Table

The following table shows the results of combining two expressions with AND:

AND	TRUE	FALSE	NULL
TRUE	TRUE	FALSE	NULL
FALSE	FALSE	FALSE	FALSE
NULL	NULL	FALSE	NULL

Using the OR Operator

OR requires either component condition to be true:

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

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

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Using the OR Operator

In the example, either component condition can be true for any record to be selected. Therefore, any employee who has a job ID that contains the string 'MAN' *or* earns \$10,000 or more is selected.

OR Truth Table

The following table shows the results of combining two expressions with OR:

OR	TRUE	FALSE	NULL
TRUE	TRUE	TRUE	TRUE
FALSE	TRUE	FALSE	NULL
NULL	TRUE	NULL	NULL

Using the NOT Operator

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

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

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Using the NOT Operator

The slide example displays the last name and job ID of all employees whose job ID *is not* IT_PROG, ST_CLERK, or SA_REP.

NOT Truth Table

The following table shows the result of applying the NOT operator to a condition:

NOT	TRUE	FALSE	NULL
	FALSE	TRUE	NULL

Note: The NOT operator can also be used with other SQL operators, such as BETWEEN, LIKE, and NULL.

```
... WHERE job_id    NOT IN ('AC_ACCOUNT', 'AD_VP')
... WHERE salary    NOT BETWEEN 10000 AND 15000
... WHERE last_name NOT LIKE '%A%'
... WHERE commission_pct IS NOT NULL
```

Lesson Agenda

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

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Rules of Precedence

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

You can use parentheses to override rules of precedence.

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Rules of Precedence

The rules of precedence determine the order in which expressions are evaluated and calculated. The table in the slide lists the default order of precedence. However, you can override the default order by using parentheses around the expressions that you want to calculate first.

Rules of Precedence

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

1

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

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

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	LAST_NAME	JOB_ID	SALARY
1	King	AD_PRES	24000

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Rules of Precedence (continued)

1. Precedence of the AND Operator: Example

In this example, there are two conditions:

- The first condition is that the job ID is AD_PRES *and* the salary is greater than \$15,000.
- The second condition is that the job ID is SA_REP.

Therefore, the SELECT statement reads as follows:

“Select the row if an employee is a president *and* earns more than \$15,000, *or* if the employee is a sales representative.”

2. Using Parentheses: Example

In this example, there are two conditions:

- The first condition is that the job ID is AD_PRES *or* SA_REP.
- The second condition is that the salary is greater than \$15,000.

Therefore, the SELECT statement reads as follows:

“Select the row if an employee is a president *or* a sales representative, *and* if the employee earns more than \$15,000.”

Lesson Agenda

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

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Using the ORDER BY Clause

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

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

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

...

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Using the ORDER BY Clause

The order of rows that are returned in a query result is undefined. The ORDER BY clause can be used to sort the rows. However, if you use the ORDER BY clause, it must be the last clause of the SQL statement. Further, you can specify an expression, an alias, or a column position as the sort condition.

Syntax

```
SELECT          expr
FROM            table
[WHERE          condition(s)]
[ORDER BY {column, expr, numeric_position} [ASC|DESC]];
```

In the syntax:

ORDER BY	specifies the order in which the retrieved rows are displayed
ASC	orders the rows in ascending order (this is the default order)
DESC	orders the rows in descending order

If the ORDER BY clause is not used, the sort order is undefined, and the Oracle server may not fetch rows in the same order for the same query twice. Use the ORDER BY clause to display the rows in a specific order.

Note: Use the keywords NULLS FIRST or NULLS LAST to specify whether returned rows containing null values should appear first or last in the ordering sequence.

Sorting

- Sorting in descending order:

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

1

- Sorting by column alias:

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

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Sorting

The default sort order is ascending:

- Numeric values are displayed with the lowest values first (for example, 1 to 999).
- Date values are displayed with the earliest value first (for example, 01-JAN-92 before 01-JAN-95).
- Character values are displayed in the alphabetical order (for example, “A” first and “Z” last).
- Null values are displayed last for ascending sequences and first for descending sequences.
- You can also sort by a column that is not in the SELECT list.

Examples:

1. To reverse the order in which the rows are displayed, specify the DESC keyword after the column name in the ORDER BY clause. The slide example sorts the result by the most recently hired employee.
2. You can also use a column alias in the ORDER BY clause. The slide example sorts the data by annual salary.

Sorting

- Sorting by using the column's numeric position:

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

3

- Sorting by multiple columns:

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

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Sorting (continued)

Examples:

3. You can sort query results by specifying the numeric position of the column in the `SELECT` clause. The slide example sorts the result by the `department_id` as this column is at the third position in the `SELECT` clause.
4. You can sort query results by more than one column. The sort limit is the number of columns in the given table. In the `ORDER BY` clause, specify the columns and separate the column names using commas. If you want to reverse the order of a column, specify `DESC` after its name.

Lesson Agenda

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

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Substitution Variables



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Substitution Variables

So far, all the SQL statements were executed with predetermined columns, conditions and their values. Suppose that you want a query that lists the employees with various jobs and not just those whose `job_ID` is `SA_REP`. You can edit the `WHERE` clause to provide a different value each time you run the command, but there is also an easier way.

By using a substitution variable in place of the exact values in the `WHERE` clause, you can run the same query for different values.

You can create reports that prompt users to supply their own values to restrict the range of data returned, by using substitution variables. You can embed *substitution variables* in a command file or in a single SQL statement. A variable can be thought of as a container in which values are temporarily stored. When the statement is run, the stored value is substituted.

Substitution Variables

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

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Substitution Variables (continued)

You can use single-ampersand (&) substitution variables to temporarily store values.

You can also predefine variables by using the `DEFINE` command. `DEFINE` creates and assigns a value to a variable.

Restricted Ranges of Data: Examples

- Reporting figures only for the current quarter or specified date range
- Reporting on data relevant only to the user requesting the report
- Displaying personnel only within a given department

Other Interactive Effects

Interactive effects are not restricted to direct user interaction with the `WHERE` clause. The same principles can also be used to achieve other goals, such as:

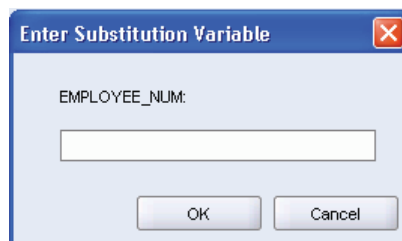
- Obtaining input values from a file rather than from a person
- Passing values from one SQL statement to another

Note: Both SQL Developer and SQL* Plus support the substitution variables and the `DEFINE`/`UNDEFINE` commands. Though SQL Developer or SQL* Plus does not support validation checks (except for data type) on user input.

Using the Single-Ampersand Substitution Variable

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

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



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Using the Single-Ampersand Substitution Variable

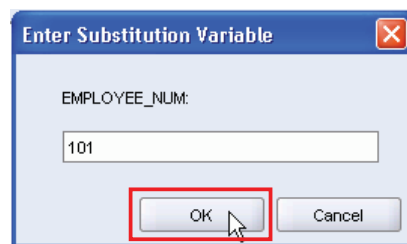
When running a report, users often want to restrict the data that is returned dynamically. SQL*Plus or SQL Developer provides this flexibility with user variables. Use an ampersand (&) to identify each variable in your SQL statement. However, you do not need to define the value of each variable.

Notation	Description
<i>&user_variable</i>	Indicates a variable in a SQL statement; if the variable does not exist, SQL*Plus or SQL Developer prompts the user for a value (the new variable is discarded after it is used.)

The example in the slide creates a SQL Developer substitution variable for an employee number. When the statement is executed, SQL Developer prompts the user for an employee number and then displays the employee number, last name, salary, and department number for that employee.

With the single ampersand, the user is prompted every time the command is executed if the variable does not exist.

Using the Single-Ampersand Substitution Variable



	EMPLOYEE_ID	LAST_NAME	SALARY	DEPARTMENT_ID
1	101	Kochhar	17000	90

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Using the Single-Ampersand Substitution Variable (continued)

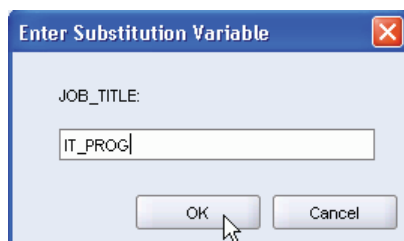
When SQL Developer detects that the SQL statement contains an ampersand, you are prompted to enter a value for the substitution variable that is named in the SQL statement.

After you enter a value and click the OK button, the results are displayed in the Results tab of your SQL Developer session.

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' ;
```

A dialog box titled "Enter Substitution Variable" with a close button (X) in the top right corner. It contains a label "JOB_TITLE:" followed by a text input field. The input field contains the text "IT_PROG". Below the input field are two buttons: "OK" and "Cancel".

Enter Substitution Variable

JOB_TITLE:

IT_PROG

OK Cancel

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

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Character and Date Values with Substitution Variables

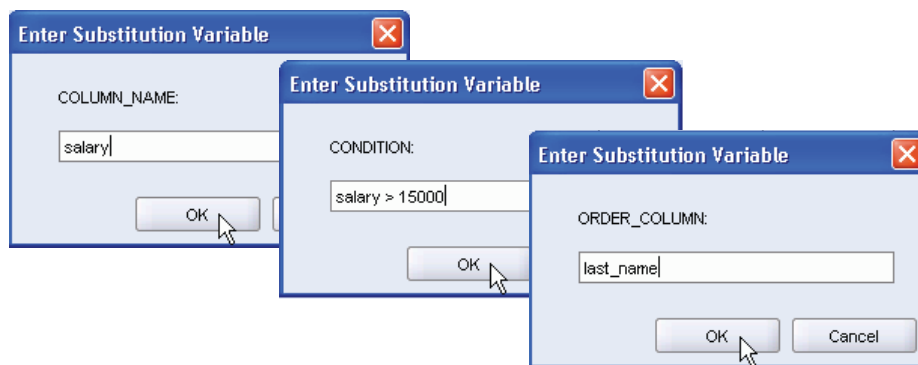
In a `WHERE` clause, date and character values must be enclosed with single quotation marks. The same rule applies to the substitution variables.

Enclose the variable with single quotation marks within the SQL statement itself.

The slide shows a query to retrieve the employee names, department numbers, and annual salaries of all employees based on the job title value of the SQL Developer substitution variable.

Specifying Column Names, Expressions, and Text

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



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Specifying Column Names, Expressions, and Text

You can use the substitution variables not only in the `WHERE` clause of a SQL statement, but also as substitution for column names, expressions, or text.

Example:

The slide example displays the employee number, last name, job title, and any other column that is specified by the user at run time, from the `EMPLOYEES` table. For each substitution variable in the `SELECT` statement, you are prompted to enter a value, and then click `OK` to proceed.

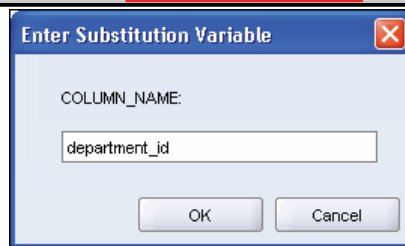
If you do not enter a value for the substitution variable, you get an error when you execute the preceding statement.

Note: A substitution variable can be used anywhere in the `SELECT` statement, except as the first word entered at the command prompt.

Using the Double-Ampersand Substitution Variable

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

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



A dialog box titled "Enter Substitution Variable" with a close button (X) in the top right corner. It contains a label "COLUMN_NAME:" followed by a text input field containing the value "department_id". At the bottom are "OK" and "Cancel" buttons.

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

...

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Using the Double-Ampersand Substitution Variable

You can use the double-ampersand (&&) substitution variable if you want to reuse the variable value without prompting the user each time. The user sees the prompt for the value only once. In the example in the slide, the user is asked to give the value for the variable, `column_name`, only once. The value that is supplied by the user (`department_id`) is used for both display and ordering of data. If you run the query again, you will not be prompted for the value of the variable.

SQL Developer stores the value that is supplied by using the `DEFINE` command; it uses it again whenever you reference the variable name. After a user variable is in place, you need to use the `UNDEFINE` command to delete it:

```
UNDEFINE column_name
```

Lesson Agenda

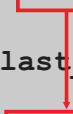
- Limiting rows with:
 - The `WHERE` clause
 - The comparison conditions using `=`, `<=`, `BETWEEN`, `IN`, `LIKE`, and `NULL` operators
 - Logical conditions using `AND`, `OR`, and `NOT` operators
- Rules of precedence for operators in an expression
- Sorting rows using the `ORDER BY` clause
- Substitution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

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Using the DEFINE Command

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

```
DEFINE employee_num = 200  
  
SELECT employee_id, last_name, salary, department_id  
FROM employees  
WHERE employee_id = &employee_num ;  
  
UNDEFINE employee_num
```

A red arrow points from the value '200' in the `DEFINE` statement to the `&employee_num` placeholder in the `WHERE` clause of the `SELECT` statement, illustrating how the variable's value is substituted.

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Using the DEFINE Command

The example shown creates a substitution variable for an employee number by using the `DEFINE` command. At run time, this displays the employee number, name, salary, and department number for that employee.

Because the variable is created using the SQL Developer `DEFINE` command, the user is not prompted to enter a value for the employee number. Instead, the defined variable value is automatically substituted in the `SELECT` statement.

The `EMPLOYEE_NUM` substitution variable is present in the session until the user undefines it or exits the SQL Developer session.

Using the VERIFY Command

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

The screenshot shows the SQL Developer interface. At the top, a code editor contains the following SQL statement:

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

Below the code editor, an "Enter Substitution Variable" dialog box is open, showing the variable `EMPLOYEE_NUM` with the value `200` entered. To the right, the "Script Output" tab is active, displaying the SQL statement after substitution:

```
SELECT employee_id, last_name, salary
FROM employees
WHERE employee_id = 200
```

Below the SQL statement, a table shows the query results:

EMPLOYEE_ID	LAST_NAME	SALARY
200	Whalen	4400

At the bottom of the output, it says "1 rows selected".

Using the VERIFY Command

To confirm the changes in the SQL statement, use the `VERIFY` command. Setting `SET VERIFY ON` forces SQL Developer to display the text of a command after it replaces substitution variables with values. To see the `VERIFY` output, you should use the Run Script (F5) icon in the SQL Worksheet. SQL Developer displays the text of a command after it replaces substitution variables with values, in the Script Output tab as shown in the slide.

The example in the slide displays the new value of the `EMPLOYEE_ID` column in the SQL statement followed by the output.

SQL*Plus System Variables

SQL*Plus uses various system variables that control the working environment. One of the variables is `VERIFY`. To obtain a complete list of all the system variables, you can issue the `SHOW ALL` command on the SQL*Plus command prompt.

Summary

In this lesson, you should have learned how to:

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

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

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

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Summary

In this lesson, you should have learned about restricting and sorting rows that are returned by the `SELECT` statement. You should also have learned how to implement various operators and conditions.

By using the substitution variables, you can add flexibility to your SQL statements. This enables the queries to prompt for the filter condition for the rows during run time.

Practice 2: Overview

This practice covers the following topics:

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

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Practice 2: Overview

In this practice, you build more reports, including statements that use the `WHERE` clause and the `ORDER BY` clause. You make the SQL statements more reusable and generic by including the ampersand substitution.

Practice 2

The HR department needs your assistance in creating some queries.

1. Because of budget issues, the HR department needs a report that displays the last name and salary of employees who earn more than \$12,000. Save your SQL statement as a file named `lab_02_01.sql`. Run your query.

	A Z LAST_NAME	A Z SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Hartstein	13000

2. Open a new SQL Worksheet. Create a report that displays the last name and department number for employee number 176. Run the query.



	A Z LAST_NAME	A Z DEPARTMENT_ID
1	Taylor	80

3. The HR department needs to find high-salary and low-salary employees. Modify `lab_02_01.sql` to display the last name and salary for any employee whose salary is not in the range of \$5,000 to \$12,000. Save your SQL statement as `lab_02_03.sql`.



	A Z LAST_NAME	A Z SALARY
1	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Lorentz	4200
5	Rajs	3500
6	Davies	3100
7	Matos	2600
8	Vargas	2500
9	Whalen	4400
10	Hartstein	13000

Practice 2 (continued)

4. Create a report to display the last name, job ID, and start date for the employees with the last names of Matos and Taylor. Order the query in ascending order by the start date.

	 LAST_NAME	 JOB_ID	HIRE_DATE
1	Matos	ST_CLERK	15-MAR-98
2	Taylor	SA_REP	24-MAR-98

5. Display the last name and department number of all employees in departments 20 or 50 in ascending alphabetical order by name.


	 LAST_NAME	 DEPARTMENT_ID
1	Davies	50
2	Fay	20
3	Hartstein	20
4	Matos	50
5	Mourgos	50
6	Rajs	50
7	Vargas	50

6. Modify lab_02_03.sql to display the last name and salary of employees who earn between \$5,000 and \$12,000, and are in department 20 or 50. Label the columns Employee and Monthly Salary, respectively. Resave lab_02_03.sql as lab_02_06.sql. Run the statement in lab_02_06.sql.



	 Employee	 Monthly Salary
1	Fay	6000
2	Mourgos	5800

Practice 2 (continued)




7. The HR department needs a report that displays the last name and hire date for all employees who were hired in 1994.

	 LAST_NAME	HIRE_DATE
1	Higgins	07-JUN-94
2	Gietz	07-JUN-94



8. Create a report to display the last name and job title of all employees who do not have a manager.

	 LAST_NAME	 JOB_ID
1	King	AD_PRES

9. Create a report to display the last name, salary, and commission of all employees who earn commissions. Sort data in descending order of salary and commissions. Use the column's numeric position in the ORDER BY clause.

	 LAST_NAME	 SALARY	 COMMISSION_PCT
1	Abel	11000	0.3
2	Zlotkey	10500	0.2
3	Taylor	8600	0.2
4	Grant	7000	0.15





10. Members of the HR department want to have more flexibility with the queries that you are writing. They would like a report that displays the last name and salary of employees who earn more than an amount that the user specifies after a prompt. Save this query to a file named `lab_02_10.sql`. If you enter 12000 when prompted, the report displays the following results:

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




Practice 2 (continued)

11. The HR department wants to run reports based on a manager. Create a query that prompts the user for a manager ID and generates the employee ID, last name, salary, and department for that manager's employees. The HR department wants the ability to sort the report on a selected column. You can test the data with the following values:

manager_id = 103, sorted by last_name:

	 EMPLOYEE_ID	 LAST_NAME	 SALARY	 DEPARTMENT_ID
1	104	Ernst	6000	60
2	107	Lorentz	4200	60

manager_id = 201, sorted by salary:

	 EMPLOYEE_ID	 LAST_NAME	 SALARY	 DEPARTMENT_ID
1	202	Fay	6000	20

manager_id = 124, sorted by employee_id:

	 EMPLOYEE_ID	 LAST_NAME	 SALARY	 DEPARTMENT_ID
1	141	Rajs	3500	50
2	142	Davies	3100	50
3	143	Matos	2600	50
4	144	Vargas	2500	50

Practice 2 (continued)

If you have time, complete the following exercises:

12. Display all employee last names in which the third letter of the name is “a.”

	A Z	LAST_NAME
1		Grant
2		Whalen

13. Display the last names of all employees who have both an “a” and an “e” in their last name.

	A Z	LAST_NAME
1		Davies
2		De Haan
3		Hartstein
4		Whalen

If you want an extra challenge, complete the following exercises:

14. Display the last name, job, and salary for all employees whose jobs are either those of a sales representative or of a stock clerk, and whose salaries are not equal to \$2,500, \$3,500, or \$7,000.

	A Z	LAST_NAME	A Z	JOB_ID	A Z	SALARY
1		Abel		SA_REP		11000
2		Taylor		SA_REP		8600
3		Davies		ST_CLERK		3100
4		Matos		ST_CLERK		2600

15. Modify lab_02_06.sql to display the last name, salary, and commission for all employees whose commission is 20%. Resave lab_02_06.sql as lab_02_15.sql. Rerun the statement in lab_02_15.sql.

	A Z	Employee	A Z	Monthly Salary	A Z	COMMISSION_PCT
1		Zlotkey		10500		0.2
2		Taylor		8600		0.2