

2020-2021

# 5COSC002W DATABASE SYSTEMS

## Lecture 06

### DATABASE QUERYING

### SQL: Retrieving, restricting and sorting data

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- *Capabilities of SQL SELECT statements.*
- *Execute a basic SELECT statement.*
- *Limit the rows that are retrieved by a query.*
- *Sort the rows that are retrieved by a query.*

# SQL Statements

SELECT INSERT UPDATE DELETE MERGE	Data Manipulation Language ( <b>DML</b> )
CREATE ALTER DROP RENAME TRUNCATE COMMENT	Data Definition Language ( <b>DDL</b> )
GRANT REVOKE	Data control Language (DCL)
COMMIT ROLLBACK SAVEPOINT	Transaction Control

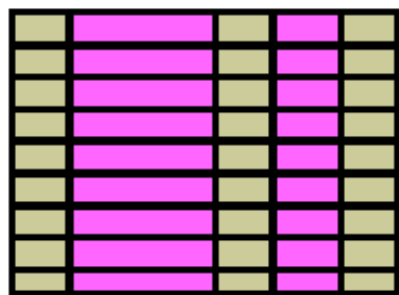
# Displaying Table Structure

```
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)

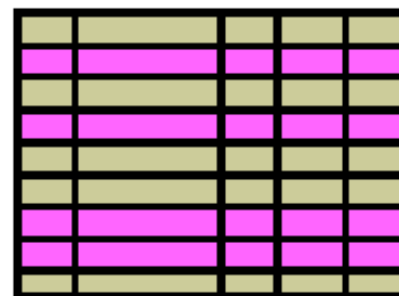
# Capabilities of SQL `SELECT` Statements

**Projection**

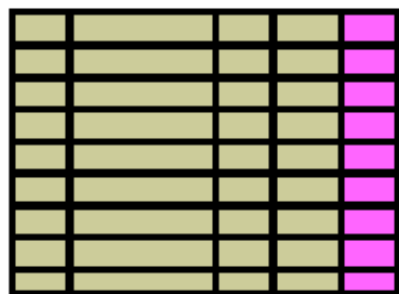



**Table 1**

**Selection**

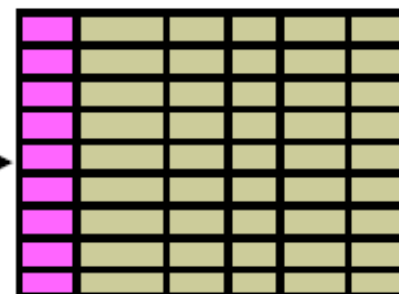



**Table 1**




**Table 1**

Join




**Table 2**

# 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.

# 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

...

20 rows selected.

# Operator Precedence

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

1

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

...  
20 rows selected.

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

2

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

...  
20 rows selected.

## Defining a Null Value

- A null is a value that is unavailable, unassigned, unknown, or inapplicable.
- A null is not the same as a 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.

# 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 if it is case-sensitive

# 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:

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

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

Employees
KingAD_PRES
KochharAD_VP
De HaanAD_VP
...

20 rows selected.

## Literal Character Strings

- A literal is a character, a number, or a date that is included in the `SELECT` statement.
- Date and character literal values must be enclosed by 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.

# MySQL: Concatenation

- **Concatenate columns: use CONCAT function**

```
SELECT CONCAT (fName, lName)  
FROM Emp;
```

- **Concatenate columns and rename new column**

```
SELECT CONCAT (fName, lName) AS "Full Name"  
FROM Emp
```

- **Concatenate columns and introduce a string**

```
SELECT CONCAT (fName, ' - ', lName)  
AS "Full Name"  
FROM Emp
```

# Duplicate Rows

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

```
SELECT department_id  
FROM employees;
```

1

DEPARTMENT_ID	
	90
	90
	90

...

20 rows selected.

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

2

DEPARTMENT_ID	
	10
	20
	50

...

8 rows selected.

# 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

# 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 by 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' ;
```

# Comparison Conditions

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

## Using Comparison Conditions

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

LAST_NAME	SALARY
Matos	2600
Vargas	2500



## 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	3600
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.

# 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 <i>both</i> component conditions are true
OR	Returns TRUE if <i>either</i> 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

# 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

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

You can use parentheses to override rules of precedence.

# Rules of Precedence

```
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
King	AD_PRES	24000
Abel	SA_REP	11000
Taylor	SA_REP	8600
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;
```

2

LAST_NAME	JOB_ID	SALARY
King	AD_PRES	24000

# 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
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

- **Sorting in descending order:**

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

1

- **Sorting by column alias:**

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

2

- **Sorting by multiple columns:**

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

3