CS4.301 Data & Applications

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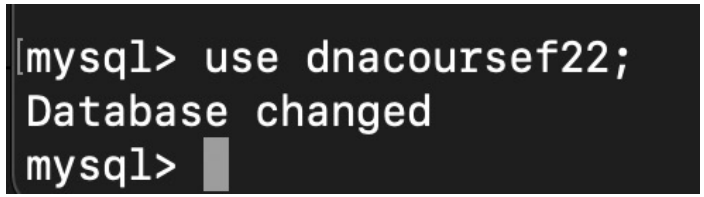
Hands-on for some basics

mysql> show tables;

```
mysql> show tables;
+------------------------+
| Tables_in_dnacoursef22 |
+------------------------+
| DEPARTMENT             |
| DEPENDENT              |
| DEPT_LOCATIONS         |
| EMPLOYEE               |
| PROJECT                |
| WORKS_ON               |
+------------------------+
6 rows in set (0.01 sec)
```

Hands-on for some basics

mysql> use dnacoursef22;



SELECT Pnumber, Dnum, Lname, Address, Bdate
FROM EMPLOYEE, DEPARTMENT, PROJECT
WHERE DNUM=DNUMBER AND Mgr_ssn=Ssn AND
Plocation = 'Stafford';

```
mysql> SELECT Pnumber, Dnum, Lname, Address, Bdate
    -> FROM EMPLOYEE, DEPARTMENT, PROJECT
    -> WHERE DNUM=DNUMBER AND Mgr_ssn=Ssn AND
    -> Plocation = 'Stafford';
+---------+------+---------+-----------------------+------------+
| Pnumber | Dnum | Lname   | Address               | Bdate      |
+---------+------+---------+-----------------------+------------+
|      10 |    4 | Wallace | 291 Berry, Bellaire TX | 1941-06-20 |
|      30 |    4 | Wallace | 291 Berry, Bellaire TX | 1941-06-20 |
+---------+------+---------+-----------------------+------------+
2 rows in set (0.00 sec)
```

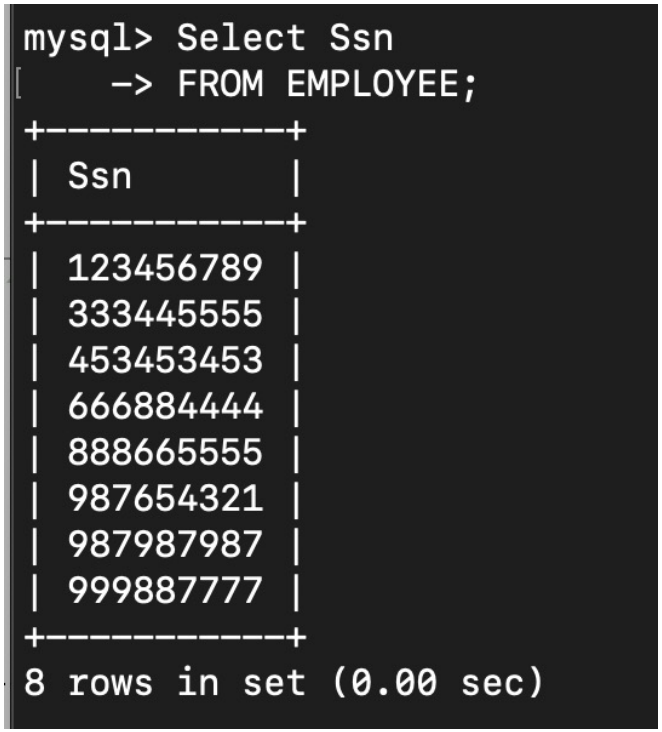
```
SELECT Pnumber, Dnum, Lname, Address, Bdate
FROM PROJECT, DEPARTMENT, EMPLOYEE
WHERE DNUM=DNUMBER AND Mgr_ssn=Ssn AND
Plocation = 'Stafford';
```

```
mysql> SELECT Pnumber, Dnum, Lname, Address, Bdate
    -> FROM PROJECT, DEPARTMENT, EMPLOYEE
    -> WHERE DNUM=DNUMBER AND Mgr_ssn=Ssn AND
    -> Plocation = 'Stafford';
+---------+------+---------+-----------------------+------------+
| Pnumber | Dnum | Lname   | Address               | Bdate      |
+---------+------+---------+-----------------------+------------+
|      10 |    4 | Wallace | 291 Berry, Bellaire TX | 1941-06-20 |
|      30 |    4 | Wallace | 291 Berry, Bellaire TX | 1941-06-20 |
+---------+------+---------+-----------------------+------------+
2 rows in set (0.00 sec)
```

Unspecified WHERE Clause and Use of the Asterisk

Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;



Select Ssn
FROM EMPLOYEE;

SELECT SSN, DNAME
FROM EMPLOYEE, DEPARTMENT;

```
mysql> SELECT SSN, DNAME
    -> FROM EMPLOYEE, DEPARTMENT;
+-----------+----------------+
| SSN       | DNAME          |
+-----------+----------------+
| 123456789 | Research       |
| 123456789 | Headquarters   |
| 123456789 | Administration |
| 333445555 | Research       |
| 333445555 | Headquarters   |
| 333445555 | Administration |
| 453453453 | Research       |
| 453453453 | Headquarters   |
| 453453453 | Administration |
| 666884444 | Research       |
| 666884444 | Headquarters   |
| 666884444 | Administration |
| 888665555 | Research       |
| 888665555 | Headquarters   |
| 888665555 | Administration |
| 987654321 | Research       |
| 987654321 | Headquarters   |
| 987654321 | Administration |
| 987987987 | Research       |
| 987987987 | Headquarters   |
| 987987987 | Administration |
| 999887777 | Research       |
| 999887777 | Headquarters   |
| 999887777 | Administration |
+-----------+----------------+
24 rows in set (0.00 sec)
```

Unspecified WHERE Clause and Use of the Asterisk (cont'd.)

Specify an asterisk (*)

Retrieve all the attribute values of the selected tuples

The * can be prefixed by the relation name; e.g., EMPLOYEE.*

```
SELECT *
FROM EMPLOYEE
WHERE Dno = 5;
```

```
mysql> SELECT *
    -> FROM EMPLOYEE
    -> WHERE Dno = 5;
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+
| Fname    | Minit | Lname   | Ssn       | Bdate      | Address                 | Sex  | Salary | Super_ssn | Dno |
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+
| John     | B     | Smith   | 123456789 | 1965-01-09 | 731 Fondren, Houston TX | M    |  30000 | 333445555 |   5 |
| Franklin | T     | Wong    | 333445555 | 1965-12-08 | 638 Voss, Houston TX    | M    |  40000 | 888665555 |   5 |
| Joyce    | A     | English | 453453453 | 1972-07-31 | 5631 Rice, Houston TX   | F    |  25000 | 333445555 |   5 |
| Ramesh   | K     | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble TX | M    |  38000 | 333445555 |   5 |
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+
4 rows in set (0.00 sec)
```

SELECT *
FROM EMPLOYEE, DEPARTMENT
WHERE Dname='Research' AND Dno=Dnumber;

Attributes from both tables

```
mysql> SELECT *
    -> FROM EMPLOYEE, DEPARTMENT
    -> WHERE Dname='Research' AND Dno=Dnumber;
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+----------+---------+-----------+----------------+
| Fname    | Minit | Lname   | Ssn       | Bdate      | Address                 | Sex  | Salary | Super_ssn | Dno | Dname    | Dnumber | Mgr_ssn   | Mgr_start_date |
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+----------+---------+-----------+----------------+
| John     | B     | Smith   | 123456789 | 1965-01-09 | 731 Fondren, Houston TX | M    |  30000 | 333445555 |   5 | Research |       5 | 333445555 | 1988-05-22     |
| Franklin | T     | Wong    | 333445555 | 1965-12-08 | 638 Voss, Houston TX    | M    |  40000 | 888665555 |   5 | Research |       5 | 333445555 | 1988-05-22     |
| Joyce    | A     | English | 453453453 | 1972-07-31 | 5631 Rice, Houston TX   | F    |  25000 | 333445555 |   5 | Research |       5 | 333445555 | 1988-05-22     |
| Ramesh   | K     | Narayan | 666884444 | 1962-09-15 | 975 Fire Oak, Humble TX | M    |  38000 | 333445555 |   5 | Research |       5 | 333445555 | 1988-05-22     |
+----------+-------+---------+-----------+------------+-------------------------+------+--------+-----------+-----+----------+---------+-----------+----------------+
4 rows in set (0.00 sec)
```

SELECT ALL Salary
FROM EMPLOYEE;

```
mysql> SELECT ALL Salary
    -> FROM EMPLOYEE;
+--------+
| Salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
|  55000 |
|  43000 |
|  25000 |
|  25000 |
+--------+
8 rows in set (0.01 sec)
```

SELECT DISTINCT Salary
FROM EMPLOYEE;

```
mysql> SELECT DISTINCT Salary
    -> FROM EMPLOYEE;
+--------+
| Salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
|  55000 |
|  43000 |
+--------+
6 rows in set (0.01 sec)
```

Tables as Sets in SQL (cont'd.)

Set operations

- **`UNION`**, **`EXCEPT`** (difference), **`INTERSECT`**
- Corresponding multiset operations: `UNION ALL`, `EXCEPT ALL`, `INTERSECT ALL`
- Type compatibility is needed for these operations to be valid

Query 4. Make a list of all project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project.

```
Q4A:  (SELECT    DISTINCT Pnumber
       FROM      PROJECT, DEPARTMENT, EMPLOYEE
       WHERE     Dnum=Dnumber AND Mgr_ssn=Ssn
                 AND Lname='Smith' )
       UNION
      ( SELECT   DISTINCT Pnumber
       FROM      PROJECT, WORKS_ON, EMPLOYEE
       WHERE     Pnumber=Pno AND Essn=Ssn
                 AND Lname='Smith' );
```

Tables as Sets in SQL (cont'd.)

Set operations

- **`UNION`**, **`EXCEPT`** (difference), **`INTERSECT`**
- Corresponding multiset operations: `UNION ALL`, `EXCEPT ALL`, `INTERSECT ALL`
- Type compatibility is needed for these operations to be valid

Query 4. Make a list of all project numbers for projects that involve an employee whose last name is 'Smith', either as a worker or as a manager of the department that controls the project.

```
Q4A:  ( SELECT    DISTINCT Pnumber
        FROM      PROJECT, DEPARTMENT, EMPLOYEE
        WHERE     Dnum=Dnumber AND Mgr_ssn=Ssn
                  AND Lname='Smith' )
        UNION
      ( SELECT    DISTINCT Pnumber
        FROM      PROJECT, WORKS_ON, EMPLOYEE
        WHERE     Pnumber=Pno AND Essn=Ssn
                  AND Lname='Smith' );
```

'Smith' as Manager

'Smith' as Employee

Tables as Sets in SQL (cont'd.) [Kabir]

```
(SELECT DISTINCT Pnumber
FROM PROJECT, DEPARTMENT, EMPLOYEE
WHERE Dnum=Dnumber AND Mgr_ssn=Ssn
      AND Lname='Smith')
UNION
(SELECT DISTINCT Pnumber
FROM PROJECT, WORKS_ON, EMPLOYEE
WHERE Pnumber=Pno AND Essn=Ssn
      AND Lname='Smith');
```

```
mysql> (SELECT DISTINCT Pnumber
    -> FROM PROJECT, DEPARTMENT, EMPLOYEE
    -> WHERE Dnum=Dnumber AND Mgr_ssn=Ssn
    -> AND Lname='Smith')
    -> UNION
    -> (SELECT DISTINCT Pnumber
    -> FROM PROJECT, WORKS_ON, EMPLOYEE
    -> WHERE Pnumber=Pno AND Essn=Ssn
    -> AND Lname='Smith');
+---------+
| Pnumber |
+---------+
|       1 |
|       2 |
+---------+
2 rows in set (0.00 sec)
```

Substring Pattern Matching and Arithmetic Operators

LIKE comparison operator

Used for string **pattern matching**

% replaces an arbitrary number of zero or more characters

underscore (_) replaces a single character

Examples: **WHERE** Address **LIKE** '%Houston,TX%';

WHERE Ssn **LIKE** '_ _ 1_ _ 8901';

BETWEEN comparison operator [ka_ _ _ ka%]

E.g., in Q14 :

WHERE(Salary **BETWEEN** 30000 **AND** 40000)

AND Dno = 5;

Arithmetic Operations

Standard arithmetic operators:

Addition (+), subtraction (–), multiplication (*), and division (/) may be included as a part of **SELECT**

Query 13. Show the resulting salaries if every employee working on the 'ProductX' project is given a 10 percent raise.

```
SELECT  E.Fname, E.Lname, 1.1 * E.Salary AS Increased_sal
FROM  EMPLOYEE AS E, WORKS_ON AS W, PROJECT AS P
WHERE  E.Ssn=W.Essn AND W.Pno=P.Pnumber AND P.Pname='ProductX';
```

Ordering of Query Results

Use **`ORDER BY`** clause

- Keyword **`DESC`** to see result in a descending order of values
- Keyword **`ASC`** to specify ascending order explicitly
- Typically placed at the end of the query

```
ORDER BY D.Dname DESC, E.Lname ASC, E.Fname ASC
```

The INSERT Command

Specify the relation name and a list of values for the tuple. All values including nulls are supplied.

```
U1:   INSERT INTO   EMPLOYEE
      VALUES        ( 'Richard', 'K', 'Marini', '653298653', '1962-12-30', '98
                      Oak Forest, Katy, TX', 'M', 37000, '653298653', 4 );
```

The variation below inserts multiple tuples where a new table is loaded values from the result of a query.

```
U3B:  INSERT INTO   WORKS_ON_INFO ( Emp_name, Proj_name,
                    Hours_per_week )
      SELECT        E.Lname, P.Pname, W.Hours
      FROM          PROJECT P, WORKS_ON W, EMPLOYEE E
      WHERE         P.Pnumber=W.Pno AND W.Essn=E.Ssn;
```

The DELETE Command

Removes tuples from a relation

Includes a `WHERE` clause to select the tuples to be deleted. The number of tuples deleted will vary.

```
U4A:  DELETE FROM   EMPLOYEE
      WHERE         Lname='Brown';

U4B:  DELETE FROM   EMPLOYEE
      WHERE         Ssn='123456789';

U4C:  DELETE FROM   EMPLOYEE
      WHERE         Dno=5;

U4D:  DELETE FROM   EMPLOYEE;
```

UPDATE (contd.)

Example: Change the location and controlling department number of project number 10 to 'Bellaire' and 5, respectively

```
U5: UPDATE      PROJECT
    SET         PLOCATION = 'Bellaire', DNUM = 5
    WHERE       PNUMBER=10
```

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

UPDATE (contd.)

Example: Give all employees in the 'Research' department a 10% raise in salary.

```
U6: UPDATE          EMPLOYEE
    SET             SALARY = SALARY *1.1
    WHERE DNO  IN (SELECT          DNUMBER
                     FROM          DEPARTMENT
                     WHERE         DNAME='Research')
```

In this request, the modified SALARY value depends on the original SALARY value in each tuple

- The reference to the SALARY attribute on the right of = refers to the old SALARY value before modification
- The reference to the SALARY attribute on the left of = refers to the new SALARY value after modification

Comparisons Involving NULL

SQL allows queries that check whether an attribute value is `NULL`

`IS` or `IS NOT NULL`

Query 18. Retrieve the names of all employees who do not have supervisors.

```
Q18:  SELECT  Fname, Lname
      FROM    EMPLOYEE
      WHERE   Super_ssn IS NULL;
```

```
mysql> Select fname, lname from employee where super_ssn IS null;
+-------+-------+
| fname | lname |
+-------+-------+
| James | Borg  |
+-------+-------+
1 row in set (0.00 sec)
```

IS & IS NOT

```
Select fname, lname from employee where super_ssn
IS NOT null;
```

```
mysql> Select fname, lname from employee where super_ssn IS NOT null;
+----------+---------+
| fname    | lname   |
+----------+---------+
| John     | Smith   |
| Franklin | Wong    |
| Joyce    | English |
| Ramesh   | Narayan |
| Jennifer | Wallace |
| Ahmad    | Jabbar  |
| Alicia   | Zelaya  |
+----------+---------+
7 rows in set (0.00 sec)

mysql>
```

This Lecture

Nested Queries, Tuples, and Set/Multiset Comparisons

Nested queries

- Complete select-from-where blocks within WHERE clause of another query
- **Outer query and nested subqueries**

Comparison operator `IN`

- Compares value *v* with a set (or multiset) of values *V*
- Evaluates to `TRUE` if *v* is one of the elements in *V*

Nested Queries (cont'd.)

```
SELECT   DISTINCT Pnumber
FROM     PROJECT
WHERE    Pnumber IN
         (SELECT   Pnumber
         FROM      PROJECT, DEPARTMENT, EMPLOYEE
         WHERE     Dnum = Dnumber AND
         Mgr_ssn = Ssn and Lname = 'Smith')
         OR
         Pnumber IN
         (SELECT   Pno
         FROM      WORKS_ON, EMPLOYEE
         WHERE     Essn = Ssn AND Lname = 'Smith');
```

```
+---------+
| Pnumber |
+---------+
|       1 |
|       2 |
+---------+
2 rows in set (0.01 sec)
```

Nested Queries (cont'd.)

Use tuples of values in comparisons

Place them within parentheses

```
Select distinct essn
From works_on
Where (pno, hours) IN
(Select pno, hours from
works_on where essn =
'123456789');
```

```
mysql> Select pno, hours from works_on where essn = '123456789';
+-----+-------+
| pno | hours |
+-----+-------+
|   1 |  32.5 |
|   2 |   7.5 |
+-----+-------+
2 rows in set (0.04 sec)
```

```
mysql> Select distinct essn
    -> From works_on
    -> Where (pno, hours) IN (Select pno, hours from works_on where essn = '123456789');
+-----------+
| essn      |
+-----------+
| 123456789 |
+-----------+
1 row in set (0.01 sec)
```

Nested Queries (cont'd.)

Use other comparison operators to compare a single value *v*

= ANY (or = SOME) operator

Returns TRUE if the value *v* is equal to some value in the set *V* and is hence equivalent to IN

Other operators that can be combined with ANY (or SOME): >, >=, <, <=, and <>

ALL: value must exceed all values from nested query

```
mysql> select salary from employee where dno = 5;
+--------+
| salary |
+--------+
|  30000 |
|  40000 |
|  25000 |
|  38000 |
+--------+
4 rows in set (0.00 sec)
```

Select lname, fname, salary from employee where salary > all (select salary from employee where dno = 5);

```
mysql> Select lname, fname, salary from employee w
here salary > all (select salary from employee whe
re dno = 5);
+---------+----------+--------+
| lname   | fname    | salary |
+---------+----------+--------+
| Borg    | James    |  55000 |
| Wallace | Jennifer |  43000 |
+---------+----------+--------+
2 rows in set (0.00 sec)
```

```
mysql> Select lname, fname, salary from employee wh
ere salary > any (select salary from employee where
 dno = 5);
+---------+----------+--------+
| lname   | fname    | salary |
+---------+----------+--------+
| Smith   | John     |  30000 |
| Wong    | Franklin |  40000 |
| Narayan | Ramesh   |  38000 |
| Borg    | James    |  55000 |
| Wallace | Jennifer |  43000 |
+---------+----------+--------+
5 rows in set (0.00 sec)

mysql> Select lname, fname, salary from employee wh
ere salary > some (select salary from employee wher
e dno = 5);
+---------+----------+--------+
| lname   | fname    | salary |
+---------+----------+--------+
| Smith   | John     |  30000 |
| Wong    | Franklin |  40000 |
| Narayan | Ramesh   |  38000 |
| Borg    | James    |  55000 |
| Wallace | Jennifer |  43000 |
+---------+----------+--------+
5 rows in set (0.00 sec)
```

Nested Queries (cont'd.)

Avoid potential errors and ambiguities

Create tuple variables (aliases) for all tables referenced in SQL query

Query 16. Retrieve the name of each employee who has a dependent with the same first name and is the same sex as the employee.

Select e.fname, e.lname from employee as e where e.ssn in (select essn from dependent as d where e.fname=d.dependent_name and e.sex=d.sex);

```
mysql> Select e.fname, e.lname from employee as e w
here e.ssn in (select essn from dependent as d wher
e e.fname=d.dependent_name and e.sex=d.sex);
Empty set (0.00 sec)
```

Correlated Nested Queries

Queries that are nested using the = or IN comparison operator can be collapsed into one single block, last query can be changed like ???? Ideas?

```
Select e.fname, e.lname from
employee as e where e.ssn in
(select essn from dependent as
d where
e.fname=d.dependent_name
and e.sex=d.sex);
```

Correlated nested query

Evaluated once for each tuple in the outer query

Correlated Nested Queries

Queries that are nested using the = or IN comparison operator can be collapsed into one single block, last query can be changed like

```
Select e.fname, e.lname from
employee as e where e.ssn in
(select essn from dependent as
d where
e.fname=d.dependent_name
and e.sex=d.sex);
```

```
SELECT E.Fname, E.Lname
FROM EMPLOYEE AS E,
DEPENDENT AS D WHERE
E.Ssn=D.Essn AND E.Sex=D.Sex
AND
E.Fname=D.Dependent_name;
```

Correlated nested query

Evaluated once for each tuple in the outer query

Administrativia

In-class-closed-book-Quiz on Oct 31st

			24-Oct	M	23:59hrs				ER Model
4	7		24-Oct	M	0830 - 1000	Relational DB			
4	8		27-Oct	Th	0830 - 1000	Normalization			
5	9		31-Oct	M	0830 - 1000	Normalization		Quiz 2	
			03-Nov	Th	23:59hrs		HW3 submission		
5	10		03-Nov	Th	0830 - 1000	Normalization			
		5	05-Nov	S	1130 - 1300	Normalization			
			05-Nov	S	23:59hrs		HW4 publish		Relational Database design
6	11		07-Nov	M	0830 - 1000	SQL			
6	12		10-Nov	Th	0830 - 1000	SQL		Quiz 3	
		6	12-Nov	S	1130 - 1300	SQL			
			14-Nov	S	23:59hrs		HW4 submission		
7	13		14-Nov	M	0830 - 1000	SQL			
			15-Nov			All marks check			
			16-Nov			Final project demo			Application
			19 - 26 Nov			End Sem			
			02-Dec			End Sem paper check			
			05-Dec			Grades to be submitted			

Explicit Sets and Renaming of Attributes in SQL

Can use explicit set of values in WHERE clause

SELECT DISTINCT Essn FROM WORKS_ON WHERE Pno IN (1, 2, 3);

```
mysql> SELECT DISTINCT Essn FROM WORKS_ON WHERE Pno
 IN (1, 2, 3);
+-----------+
| Essn      |
+-----------+
| 123456789 |
| 453453453 |
| 333445555 |
| 666884444 |
+-----------+
4 rows in set (0.00 sec)
```

Explicit Sets and Renaming of Attributes in SQL

Use qualifier AS followed by desired new name

Rename any attribute that appears in the result of a query

Select e.lname as employee_name, s.lname as supervisor_name from employee as e, employee as s where e.super_ssn = s.ssn;

```
mysql> Select e.lname as employee_name, s.lname as
supervisor_name from employee as e, employee as s w
here e.super_ssn = s.ssn;
+---------------+-----------------+
| employee_name | supervisor_name |
+---------------+-----------------+
| Smith         | Wong            |
| Wong          | Borg            |
| English       | Wong            |
| Narayan       | Wong            |
| Wallace       | Borg            |
| Jabbar        | Wallace         |
| Zelaya        | Wallace         |
+---------------+-----------------+
7 rows in set (0.00 sec)
```

Aggregate Functions in SQL

Used to summarize information from multiple tuples into a single-tuple summary

Built-in aggregate functions

- **`COUNT`**, **`SUM`**, **`MAX`**, **`MIN`**, and **`AVG`**

Grouping

- Create subgroups of tuples before summarizing

To select entire groups, `HAVING` clause is used

Aggregate functions can be used in the `SELECT` clause or in a `HAVING` clause

Renaming Results of Aggregation

```
SELECT SUM(Salary),
MAX(Salary),
MIN(Salary), AVG(Salary)
FROM EMPLOYEE;
```

```
mysql> SELECT SUM(Salary), MAX(Salary), MIN(Salary), AVG(Sal
ary) FROM EMPLOYEE;
+-------------+-------------+-------------+-------------+
| SUM(Salary) | MAX(Salary) | MIN(Salary) | AVG(Salary) |
+-------------+-------------+-------------+-------------+
|      281000 |       55000 |       25000 |  35125.0000 |
+-------------+-------------+-------------+-------------+
1 row in set (0.00 sec)
```

Renaming Results of Aggregation

```
SELECT SUM(Salary) AS
Total_Sal, MAX(Salary)
AS Highest_Sal,
MIN(Salary) AS
Lowest_Sal, AVG(Salary)
AS Average_Sal FROM
EMPLOYEE;
```

```
mysql> SELECT SUM(Salary) AS Total_Sal, MAX(Salary) AS Highe
st_Sal, MIN(Salary) AS Lowest_Sal, AVG(Salary) AS Average_Sa
l FROM EMPLOYEE;
+-----------+-------------+------------+-------------+
| Total_Sal | Highest_Sal | Lowest_Sal | Average_Sal |
+-----------+-------------+------------+-------------+
|    281000 |       55000 |      25000 |  35125.0000 |
+-----------+-------------+------------+-------------+
1 row in set (0.00 sec)
```

Aggregate Functions in SQL (cont'd.)

Query 20. Find the sum of the salaries of all employees of the 'Research' department, as well as the maximum salary, the minimum salary, and the average salary in this department.

```
SELECT SUM(Salary),
MAX(Salary),
MIN(Salary), AVG(Salary)
FROM (EMPLOYEE join
department on
dno=dnumber) where
dname='research';
```

```
mysql> SELECT SUM(Salary), MAX(Salary), MIN(Salary), AVG(Sal
ary) FROM (EMPLOYEE join department on dno=dnumber) where dn
ame='research';
+-------------+-------------+-------------+-------------+
| SUM(Salary) | MAX(Salary) | MIN(Salary) | AVG(Salary) |
+-------------+-------------+-------------+-------------+
|      133000 |       40000 |       25000 |  33250.0000 |
+-------------+-------------+-------------+-------------+
1 row in set (0.00 sec)
```

Aggregate Functions in SQL (cont'd.)

Queries 21 and 22. Retrieve the total number of employees in the company (Q21) and the number of employees in the 'Research' department (Q22).

Select count(*) from employee;

Select count(*) from employee, department where dno=dnumber and dname='research';

```
mysql> Select count(*) from employee;
+----------+
| count(*) |
+----------+
|        8 |
+----------+
1 row in set (0.02 sec)

mysql> Select count(*) from employee, department where dno=d
number and dname='research';
+----------+
| count(*) |
+----------+
|        4 |
+----------+
1 row in set (0.00 sec)
```

Aggregate Functions on Booleans

SOME and ALL may be applied as functions on Boolean Values.

SOME returns true if at least one element in the collection is TRUE (similar to OR)

ALL returns true if all of the elements in the collection are TRUE (similar to AND)

Grouping: The GROUP BY Clause

Partition relation into subsets of tuples

- Based on **grouping attribute(s)**
- Apply function to each such group independently

`GROUP BY` clause

- Specifies grouping attributes

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

Group BY example

SELECT Dno, COUNT(*), AVG(Salary) FROM EMPLOYEE GROUP BY Dno;

```
mysql> SELECT Dno, COUNT(*), AVG(Salary) FROM EMPLOYEE GROUP
 BY Dno;
+-----+----------+-------------+
| Dno | COUNT(*) | AVG(Salary) |
+-----+----------+-------------+
|   5 |        4 |  33250.0000 |
|   1 |        1 |  55000.0000 |
|   4 |        3 |  31000.0000 |
+-----+----------+-------------+
3 rows in set (0.01 sec)
```

Group BY example

```
SELECT Pnumber,
Pname, COUNT(*) FROM
PROJECT, WORKS_ON
WHERE Pnumber=Pno
GROUP BY Pname;
```

```
mysql> SELECT Pnumber, Pname, COUNT(*) FROM PROJECT, WORKS_O
N WHERE Pnumber=Pno GROUP BY Pname;
+---------+-----------------+----------+
| Pnumber | Pname           | COUNT(*) |
+---------+-----------------+----------+
|      10 | Computerization |        3 |
|      30 | Newbenefits     |        3 |
|       1 | ProductX        |        2 |
|       2 | ProductY        |        3 |
|       3 | ProductZ        |        2 |
|      20 | Reorganization  |        3 |
+---------+-----------------+----------+
6 rows in set (0.01 sec)
```

Grouping: The GROUP BY and HAVING Clauses (cont'd.)

`HAVING` clause

Provides a condition to select or reject an entire group:

Query 26. For each project *on which more than two employees work,* retrieve the project number, the project name, and the number of employees who work on the project.

```
SELECT Pnumber,
Pname, COUNT(*) FROM
PROJECT, WORKS_ON
WHERE Pnumber=Pno
GROUP BY Pnumber
HAVING COUNT(*) > 2;
```

```
mysql> SELECT Pnumber, Pname, COUNT(*) FROM PROJECT, WORKS_O
N WHERE Pnumber=Pno GROUP BY Pnumber HAVING COUNT(*) > 2;
+---------+-----------------+----------+
| Pnumber | Pname           | COUNT(*) |
+---------+-----------------+----------+
|       2 | ProductY        |        3 |
|      10 | Computerization |        3 |
|      20 | Reorganization  |        3 |
|      30 | Newbenefits     |        3 |
+---------+-----------------+----------+
4 rows in set (0.00 sec)
```

In-Class Activity

Schema & Data: https://github.com/tolgahanakgun/Elmasri-Database

a. Retrieve the names of all employees who work in the department that has the employee with the highest salary among all employees.
b. Retrieve the names of all employees whose supervisor's supervisor has ''888665555' for ssn
c. Retrieve the names of employees who make at least 10,000 USD more than the employee who is paid the least in the company
d. Create a view that has the department name, manager name, and manager salary for every department
e. Create a view that has the employee name, supervisor name, and employee salary for each employee who works in the 'research' department

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Ponnurangam.kumaraguru

/in/ponguru

ponguru

Thank you for attending the class!!!

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