Database Systems I

Lab – Aggregate Functions, Group by, Having

Department of Information Technology
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Lecturer: Soma Soleimanzadeh

MySQL

Aggregate Functions

- **Aggregate functions** are functions that take a collection of values as input and return a single value.

- SQL built-in aggregate functions:
  - Average: **avg**
  - Total: **sum**
  - Minimum: **min**
  - Maximum: **max**
  - Count: **count**

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Some Points about Aggregate Functions

- Aggregate functions operate on a single column of a table.
- They eliminate null values first and operates only on the remaining **non-null values**.
- The function returns a single value.

COUNT	returns the number of values in the column
SUM	returns the sum of the values in the column
AVG	returns the mean of the values in the column
MAX	returns the largest value in the column
MIN	returns the smallest value in the column

General Syntax of SELECT Query

SELECT	column/columns or aggregate functions
FROM	table/tables
WHERE	**condition (predicate) on rows**
GROUP BY	one column
HAVING	**condition (predicate) on groups**
ORDER BY	column/columns

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Aggregate Functions (Example 1)

- Find the **minimum** and **maximum grade** and the **average grade** of all students in all classes.

```
select min(grade) AS minimum, max(grade) AS maximum, avg(grade) AS average
from Enroll;
```

Enroll

stuID	classCode	grade
S1002	M235	76.00
S1004	E227	50.00
S1005	H115	93.00
S1007	E227	82.00
S1007	E414	71.25
S1010	B226	75.00
S1011	E227	33.00
S1011	E314	57.50
S1012	C413	60.00
S1012	C416	50.50
S1013	M235	90.00
S1015	S226	88.70
S1017	H115	79.00
S1020	C321	40.00
S1020	C413	45.00
S1020	C416	48.00

Aggregate Functions (Example 2)

- Find the <u>total number of classes</u> that are held on **'Sunday'** or **'Tuesday'**.

```
select count(*) AS totalClasses
from class
where classDay in ('Sunday', 'Tuesday');
```

Class

classCode	teacherID	classDay	room	deptName
B226	BI01	Monday	4211	Biology
C126	CS03	Monday	9311	Computer Science
C321	CS03	Sunday	9308	Computer Science
C413	CS02	Tuesday	9308	Computer Science
C416	CS03	Thursday	9311	Computer Science
E227	EN01	Thursday	1206	English
E314	EN03	Monday	1204	English
E414	EN03	Sunday	1210	English
H115	HI01	Sunday	2108	History
M235	MA01	Thursday	5204	Mathematics
M425	MA01	Monday	5210	Mathematics
S226	SP02	Tuesday	1304	Sport

Aggregate Functions (Example 3)

- Find the **ID** of the student(s) with the lowest grade in any course.

```
select stuID
from enroll
where grade = (select min(grade)
               from enroll);
```

Enroll

stuID	classCode	grade
S1002	M235	76.00
S1004	E227	50.00
S1005	H115	93.00
S1007	E227	82.00
S1007	E414	71.25
S1010	B226	75.00
S1011	E227	33.00
S1011	E314	57.50
S1012	C413	60.00
S1012	C416	50.50
S1013	M235	90.00
S1015	S226	88.70
S1017	H115	79.00
S1020	C321	40.00
S1020	C413	45.00
S1020	C416	48.00

Aggregate Functions (Example 3)

- Find the **ID** of the student(s) that their grade in any course is more than the average grade of all students.

```
select distinct stuID
from enroll
where grade > (select avg(grade)
               from enroll);
```

Enroll

stuID	classCode	grade
S1002	M235	76.00
S1004	E227	50.00
S1005	H115	93.00
S1007	E227	82.00
S1007	E414	71.25
S1010	B226	75.00
S1011	E227	33.00
S1011	E314	57.50
S1012	C413	60.00
S1012	C416	50.50
S1013	M235	90.00
S1015	S226	88.70
S1017	H115	79.00
S1020	C321	40.00
S1020	C413	45.00
S1020	C416	48.00

Aggregate Functions and Join of Tables (Example 4)

- Find the **ID** and **first name** of the student(s) that their grade is more than the average grade of all students.

Student

stuID	lastName	firstName	major	credits
S1001	Smith	Tom	History	90
S1002	Chin	Ann	Mathematics	36
S1004	Smith	Jack	English	75
S1005	Lee	Perry	History	3
S1007	Streep	Sarah	English	81
S1010	Burns	Edward	Biology	63
S1011	Roberts	Mike	English	66
S1012	Damon	Tom	Computer Science	90
S1013	McCarthy	Owen	Mathematics	27
S1015	Jones	Mary	Sport	42
S1017	Ford	Jennifer	History	45
S1018	Nolan	Ryan	English	50
S1020	Rivera	Jane	Computer Science	15

Enroll

stuID	classCode	grade
S1002	M235	76.00
S1004	E227	50.00
S1005	H115	93.00
S1007	E227	82.00
S1007	E414	71.25
S1010	B226	75.00
S1011	E227	33.00
S1011	E314	57.50
S1012	C413	60.00
S1012	C416	50.50
S1013	M235	90.00
S1015	S226	88.70
S1017	H115	79.00
S1020	C321	40.00
S1020	C413	45.00
S1020	C416	48.00

Aggregate Functions and Join of Tables (Example 4) – Answer

- Find the **ID** and **first name** of the student(s) that their grade is more than the average grade of all students.

```
select distinct student.stuID, firstName
from student, enroll
where student.stuID = enroll.stuID and grade > (select avg(grade)
                                                from enroll);
```

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Example 1 – Group by

- For each major in **Student** table, find the sum of all the credits the students with that major have.

major	Sum of Credits
History	90 + 3 + 45 = **138**
Mathematics	36 + 27 = **63**
English	75 + 81 +66 + 50 = **272**
Biology	**63**
Computer Science	90 + 15 = **105**
Sport	**42**

Student

stuID	lastName	firstName	major	credits
S1001	Smith	Tom	History	90
S1002	Chin	Ann	Mathematics	36
S1004	Smith	Jack	English	75
S1005	Lee	Perry	History	3
S1007	Streep	Sarah	English	81
S1010	Burns	Edward	Biology	63
S1011	Roberts	Mike	English	66
S1012	Damon	Tom	Computer Science	90
S1013	McCarthy	Owen	Mathematics	27
S1015	Jones	Mary	Sport	42
S1017	Ford	Jennifer	History	45
S1018	Nolan	Ryan	English	50
S1020	Rivera	Jane	Computer Science	15

Example 1 – Answer

- For each major in **Student** table, find the sum of all the credits the students with that major have.

```
select major, sum(credits)
from student
group by major;
```

Student

stuID	lastName	firstName	major	credits
S1001	Smith	Tom	History	90
S1002	Chin	Ann	Mathematics	36
S1004	Smith	Jack	English	75
S1005	Lee	Perry	History	3
S1007	Streep	Sarah	English	81
S1010	Burns	Edward	Biology	63
S1011	Roberts	Mike	English	66
S1012	Damon	Tom	Computer Science	90
S1013	McCarthy	Owen	Mathematics	27
S1015	Jones	Mary	Sport	42
S1017	Ford	Jennifer	History	45
S1018	Nolan	Ryan	English	50
S1020	Rivera	Jane	Computer Science	15

Example 2 – Group by

- By having **teacher** table, find the **total number of teachers** working at each department, **only if this number is more than 2**.

```
select deptname, count(*) As TotalTeachers
from teacher
group by deptname
having count(*)>2;
```

Teacher

teacherID	teacherName	deptName	teacherRank
BI01	Adams	Biology	Lecturer
CS01	Byrne	Computer Science	Assistant Prof
CS02	Smith	Computer Science	Assistant Lec
CS03	John	Computer Science	Lecturer
EN01	Smith	English	Professor
EN02	Leonardo	English	Assistant Lec
EN03	Kate	English	Lecturer
HI01	Kim	History	Assistant Prof
MA01	Julia	Mathematics	Assistant Lec
SP01	Maria	Sport	Professor
SP02	Sarah	Sport	Lecturer

Example 3 – Group by

- By having **Class** table, find the total number of classes hold in each department, only if this number is more than 1.

```
select deptname, count(*) As TotalClasses
from class
group by deptname
having count(*)>1;
```

Class

classCode	teacherID	classDay	room	deptName
B226	BI01	Monday	4211	Biology
C126	CS03	Monday	9311	Computer Science
C321	CS03	Sunday	9308	Computer Science
C413	CS02	Tuesday	9308	Computer Science
C416	CS03	Thursday	9311	Computer Science
E227	EN01	Thursday	1206	English
E314	EN03	Monday	1204	English
E414	EN03	Sunday	1210	English
H115	HI01	Sunday	2108	History
M235	MA01	Thursday	5204	Mathematics
M425	MA01	Monday	5210	Mathematics
S226	SP02	Tuesday	1304	Sport

Example 4 – Group by

- Find the **maximum grade of students** at each major, **only if this maximum grade is more than 85**. The result is arranged in ascending order of the maximum grade.

```
select major, max(grade) As maximumGrade
from student, enroll
where student.stuID = enroll.stuID
group by major
having max(grade)>85
order by max(grade);
```

Student

stuID	lastName	firstName	major	credits
S1001	Smith	Tom	History	90
S1002	Chin	Ann	Mathematics	36
S1004	Smith	Jack	English	75
S1005	Lee	Perry	History	3
S1007	Streep	Sarah	English	81
S1010	Burns	Edward	Biology	63
S1011	Roberts	Mike	English	66
S1012	Damon	Tom	Computer Science	90
S1013	McCarthy	Owen	Mathematics	27
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S1017	Ford	Jennifer	History	45
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Enroll

stuID	classCode	grade
S1002	M235	76.00
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S1015	S226	88.70
S1017	H115	79.00
S1020	C321	40.00
S1020	C413	45.00
S1020	C416	48.00