Structured Query Language (SQL) – part 2

Learning Maps

Sequence	Title
1	Introduction to databases
2	Relational Databases
3	Relational Algebra
4	Structured Query Language – Part 1
5	Structured Query Language – Part 2
6	Constraints and Triggers
7	Entity Relationship Model
8	Functional Dependency
9	Normalization
10	Storage - Indexing
11	Query Processing
12	Transaction Management – Part 1
13	Transaction Management – Part 2

Intro > Overview

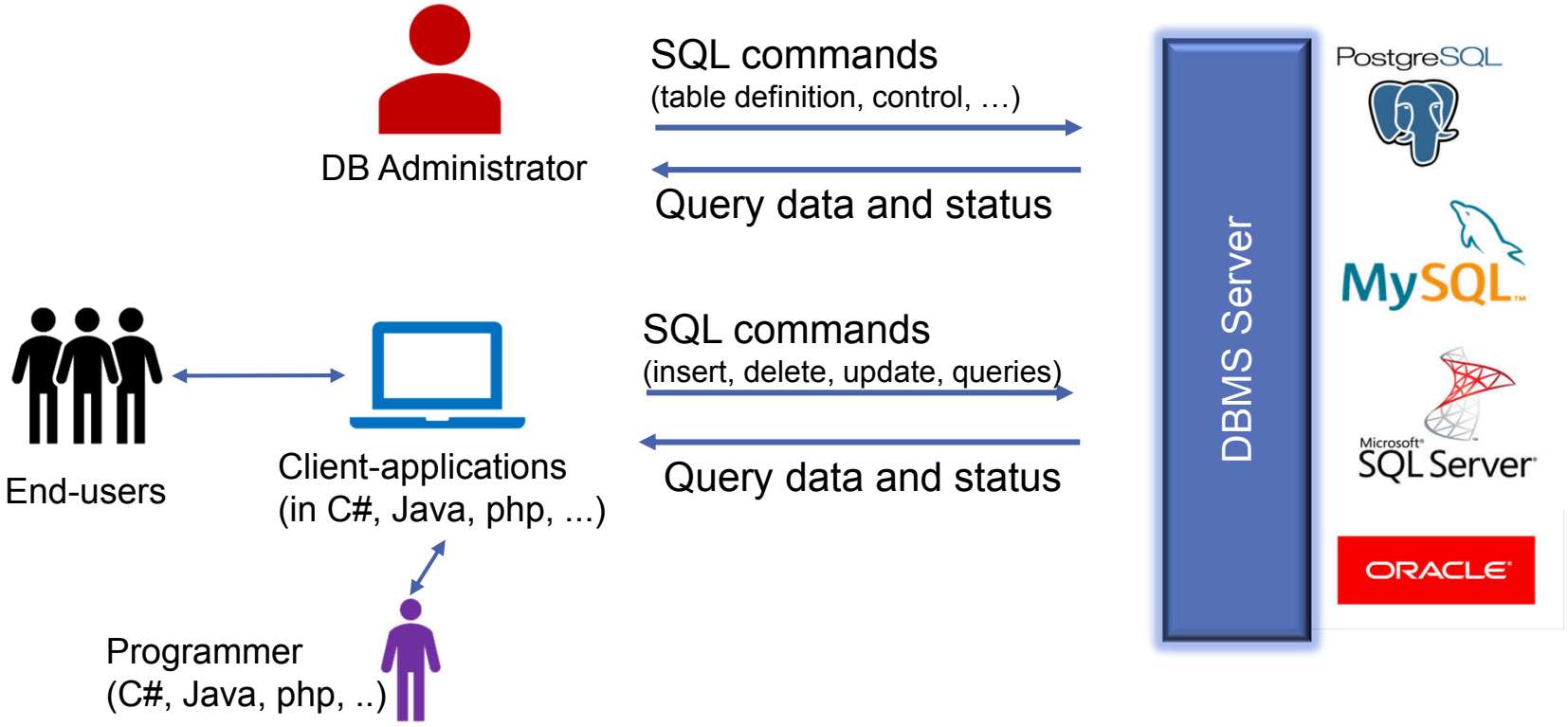
☐ A : Voice and PPT Overview
☐ B : Text-based Overview
■ C : Video and PPT Overview

Opening Message	→ In this lesson, we will study.
Lesson topic	1. Data Manipulation: SQL Retrieval statement (Part 2) 2. View 3. Privileges and User Management in SQL
Learning Goals	Upon completion of this lesson, students will be able to: 1. Write retrieval statement in SQL : from simple queries to complex ones 2. Create views and work correctly on predefined views 3. Have experience with a DBMS: manage user account and database access permissions

Intro > Keywords

Keyword	Description
DBMS	Database Management System : system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data
Query	A request (SQL statement) for information from a database
Subquery	A subquery (inner query, nested query) is a query within another (SQL) query.
Privileges	Database access permissions
View	A view is the result set of a stored query on the data, which the database users can query just as they would in a persistent database collection object.

Lesson > Topic 1: Introduction



Database Schema

student(**student_id**, first_name,last_name, dob, gender,address,note,*clazz_id*)

clazz(**clazz_id**, name, *lecturer_id*, *monitor_id*)

subject(**subject_id**, name, credit, percentage_final_exam)

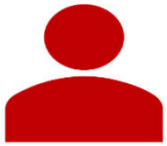
enrollment(***student_id*, *subject_id*, semester**, midterm_score, final_score)

lecturer(**lecturer_id**, first_name, last_name, dob, gender, address, email)

teaching(***subject_id*, *lecturer_id***)

grade(**code**, from_score, to_score)

Lesson > Topic 1: Introduction



Boss/ Manager

List of all female students ?

First name, last name and address of class monitors ?

List of students (id and fullname) have enrolled subject 'Học máy' in semester 20172?

List of students (id and fullname) having CPA >= 3.2?

Employee

Slide 7

O1 Oanh, 27/08/2018

Lesson > Topic 1: Introduction

student

student_id	first_name	last_name	dob	…	clazz_id
20160001	**Ngọc An**	**Bùi**	**3/18/1987**	**…**	
20160002	Anh	Hoàng	5/20/1987	…	20162101
20160003	**Thu Hồng**	**Trần**	**6/6/1987**	**…**	**20162101**
20160004	Minh Anh	Nguyễn	5/20/1987	…	20162101
20170001	Nhật Ánh	Nguyễn	5/15/1988	…	20172201

clazz

clazz_id	name	lecturer_id	monitor_id
20162101	CNTT1.01-K61	02001	20160003
20162102	CNTT1.02-K61		
20172201	CNTT2.01-K62	02002	20170001
20172202	CNTT2.02-K62		

subject

subject_id	name	credit	percentage_ final_exam
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	**Học máy**	**2**	**70**

enrollment

student_id	subject_id	semester	midterm_ score	final_ score
20160001	IT1110	20171	9	8.5
20160001	IT3080	20172	8	
20160001	IT3090	20172	6	9
20160001	IT4857	20172	7.5	9
20160001	**IT4866**	**20172**	**7**	**9**
20160002	IT3080	20172	9	
20160003	**IT4866**	**20172**	**7**	**6**
20160004	IT1110	20171	6	5

Lesson > Topic 2: Data Manipulation

```
SELECT[all|distinct]
      {*|{table_name.*|expr[alias]}|view_name.*}
            [,{table_name.*|expr[alias]}]...}
FROM table_name [alias][,table_name[alias]] ...
[WHERE condition]
[GROUP BY expr [,expr] ...]
[HAVING condition]
[{UNION|UNION ALL|INTERSECT|MINUS}
            SELECT ...]
[ORDER BY {expr|position} [ASC|DESC]
[,expr|position}[ASC|DESC]
```

Slide 9

O1 Oanh, 27/08/2018

2. Data Manipulation

2.1. Queries Involving more than one Relations

2.2. Subqueries

2.3. Full Relation Operations

2.4. Functions

2. ....

► 2.1 Queries Involving More Than One Relation

JOIN

- Syntax:

```
SELECT t1.c1, t1.c2, …, t2.c1, t2.c2
FROM t1, t2
WHERE condition_expression
```

- Example:

```
SELECT student.student_id, student.first_name,
student.last_name, clazz.name
FROM student, clazz
WHERE student.clazz_id = clazz.clazz_id
```

2. ....

▶ 2.1 Queries Involving More Than One Relation

Operational semantics

clazz

clazz_id	name	lecturer_id	monitor_id
20162101	CNTT1.01-K61	02001	20160003
20162102	CNTT1.02-K61		
20172201	CNTT2.01-K62	02002	20170001
20172202	CNTT2.02-K62		

student

student_id	first_name	last_name	…	clazz_id
20160001	Ngọc An	Bùi		
20160002	Anh	Hoàng		20162101
20160003	Thu Hồng	Trần		20162101
20160004	Minh Anh	Nguyễn		20162101
20170001	Nhật Ánh	Nguyễn		20172201

List of classes with monitor names (firstname, lastname):

```
SELECT clazz.clazz_id, name,
       student.last_name,        3
       student.first_name
FROM clazz, student              1
WHERE student_id = monitor_id    2
```

result

clazz_id	name	last_name	first_name
20162101	CNTT1.01-K61	Trần	Thu Hồng
20172201	CNTT2.01-K62	Nguyễn	Nhật Ánh

Tuple-variables loop over all tuples of each relation in FROM clause

2. ....

▶ 2.1 Queries Involving More Than One Relation

Tuple variables : AS keyword in FROM clause

- Used for naming variables:

  SELECT …
  FROM <table_name> [AS] <variable_name>, …
  [WHERE …]

  – **AS**: optional,
  – <variable_name>: used in the whole SQL statement

- Example:

```
SELECT c.clazz_id, name, s.last_name, s.first_name
FROM clazz AS c, student s
WHERE s.student_id = c.monitor_id
```

2. ....

▶ 2.1 Queries Involving More Than One Relation

Queries with more than 2 relations

student(**student_id**, first_name,last_name, dob, gender,address,note,*clazz_id*)

subject(**subject_id**, name, credit, percentage_final_exam)

enrollment(***student_id*, *subject_id*, semester**, midterm_score, final_score)

List of students have enrolled subjects in semester 20172. The list composes of st udent fullname, subject name, subject credit:

```
SELECT last_name ||' ' ||first_name as fullname,
        sj.name as subjectname, credit
FROM student s, enrollment e, subject sj
WHERE s.student_id = e.student_id
        AND sj.subject_id = e.subject_id
        AND semester = '20172'
```

2. ....

2.1 Queries Involving More Than One Relation

student

student_id	first_name	last_name	dob	…	clazz_id
20160001	Ngọc An	Bùi	3/18/1987	…	
20160002	Anh	Hoàng	5/20/1987	…	20162101
20160003	Thu Hồng	Trần	6/6/1987	…	20162101
20160004	Minh Anh	Nguyễn	5/20/1987	…	20162101
20170001	Nhật Ánh	Nguyễn	5/15/1988	…	20172201

subject

subject_id	name	credit	percentage_final_exam
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	Học máy	2	70
LI0001	life's happy song	5	
LI0002	%life's happy song 2	5	

enrollment

student_id	subject_id	semester	midterm_score	final_score
20160001	IT1110	20171	9	8.5
20160001	IT3080	20172	8	
20160001	IT3090	20172	6	9
20160001	IT4857	20172	7.5	9
20160001	IT4866	20172	7	9
20160002	IT3080	20172	9	
20160003	IT1110	20171	7	6
20160004	IT1110	20171	6	5

result

student_id	fullname	subjectname	credit
20160001	Bùi Ngọc An	Cơ sở dữ liệu	3
20160001	Bùi Ngọc An	Mạng máy tính	3
20160002	Hoàng Anh	Mạng máy tính	3
20160001	Bùi Ngọc An	Học máy	2
20160001	Bùi Ngọc An	Thị giác máy tính	3

2. ....

► 2.1 Queries Involving More Than One Relation

Self-join

subject(**subject_id**, name, credit, percentage_final_exam)

Find all pairs of subject id having the *same name* but the credit of the first subject is less than credit of the second one

```
SELECT sj1.subject_id, sj2. subject_id
FROM subject sj1, subject sj2
WHERE sj1.name = sj2.name
        AND sj1.credit < sj2.credit
```

2. ....

▶ 2.2 Sub-queries

- A SELECT-FROM-WHERE statement can be used within a clause of another outer query. It can be
  - within a WHERE clause
  - within a FROM clause
- Creates an intermediate result
- No limit to the number of levels of nesting
- Objectives:
  - Check if an element is in a set (IN, NOT IN)
  - Set comparison >ALL, >=ALL, <ALL,<=ALL,=ALL, ANY (SOME)
  - Check if a relation is empty or not (EXISTS, NOT EXISTS)

2. ....

► 2.2 Sub-queries

Subquery provides scalar value

- A sub-query provide a single value ➔ we can use it as if it were a constant

```
SELECT *
FROM student
WHERE clazz_id = (SELECT clazz_id
                  FROM clazz
                  WHERE name = 'CNTT1.01-K61');
```

2. ....

► 2.2 Sub-queries

IN operators

- Syntax:

  <tuple> [**NOT**] **IN** <subquery>

- Example: First name, last name and address of class monitors ?

student(**student_id**, first_name,last_name, dob, gender,address,note,*clazz_id*)

clazz(**clazz_id**, name, *lecturer_id*, *monitor_id*)

```
SELECT first_name, last_name, address
FROM student
WHERE student_id IN (SELECT monitor_id FROM clazz);
```

2. ....

► 2.2 Sub-queries

EXISTS

- Syntax:

  [NOT] EXISTS (<subquery>)

  EXISTS (<subquery>): TRUE iff <subquery> result is **not empty**

- Example : subjects having no lecturer?

  teaching(***subject_id, lecturer_id***)

  subject(**subject_id**, name, credit, percentage_final_exam)

```
SELECT * FROM subject s
WHERE not exists (SELECT *
                  FROM teaching
                  WHERE subject_id = s.subject_id)
```

2. ....

► 2.2 Sub-queries

ALL, ANY

- Syntax:
  - <expression> <*comparison_operator*> **ALL** | **ANY** <subquery>
  - <*comparison_operator*>: **>, <, <=, >=, =, <>**

```
SELECT *
FROM subject
WHERE credit >= ALL (SELECT credit FROM subject);
```

2. ....

► 2.2 Sub-queries

ALL, ANY

- x **>=ALL** <subquery>

  TRUE iff there is **no tuple larger** than X in <subquery> result

- x **= ANY** <subquery>

  TRUE iff *x* **equals at least one tuple** in <subquery> result

- x **> ANY** <subquery>

  TRUE iff *x* is **not the smallest tuple** produced by <subquery>

2. ....

▶ 2.2 Sub-queries

Examples

subject

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	Học máy	2	70

```
SELECT *
FROM subject
WHERE credit > ANY(SELECT credit
                   FROM subject);
```

result

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60

```
SELECT *
FROM subject
WHERE credit >= ALL(SELECT credit FROM subject);
```

result

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60

2. ....

► 2.2 Sub-queries

Subquery in FROM Clause

- Subquery is used as a relation in a FROM clause
- Must give it a tuple-variable alias

- Ex.: *List of lecturers teaching subject whose id is 'IT3090'*

```
SELECT l.*
FROM lecturer l,
        (SELECT lecturer_id
        FROM teaching
        WHERE subject_id = 'IT3090') lid
WHERE l.lecturer_id = lid.lecturer_id
```

2. ....

► 2.2 Sub-queries

SQL Join Expressions

- Product:
  - R CROSS JOIN S
- Natural join: (Be careful!)
  - R NATURAL JOIN S
- Theta join:
  - R [INNER] JOIN S ON <condition>
- Outer join:
  - R [LEFT|RIGHT|FULL] OUTER JOIN S ON <condition>
  - R NATURAL [LEFT|RIGHT|FULL] OUTER JOIN S

2. ....

▶ 2.2 Sub-queries

OUTER JOINS

- R [LEFT|RIGHT|FULL] OUTER JOIN S ON <condition>
- R NATURAL [LEFT|RIGHT|FULL] OUTER JOIN S

R

a	b	c
1	An	5
2	Binh	5
3	Cuong	7

S

a	c	d
1	5	X
1	7	Y
2	5	Z
4	1	Z

R FULL OUTER JOIN S ON (R.a = S.a)

R.a	b	R.c	S.a	S.c	d
1	An	5	1	5	X
1	An	5	1	7	Y
2	Binh	5	2	5	Z
3	Cuong	7	NULL	NULL	NULL
NULL	NULL	NULL	4	1	Z

R NATURAL LEFT OUTER JOIN S

R.a	b	R.c	S.a	S.c	d
1	An	5	1	5	X
2	Binh	5	2	5	Z
3	Cuong	7	NULL	NULL	NULL

2. ....

▶ 2.2 Sub-queries

Example

List of all classes with monitor names (firstname and lastname, NULL if class has not yet a monitor)

clazz

clazz_id	name	lecturer_id	monitor_id
20162101	CNTT1.01-K61	02001	20160003
20162102	CNTT1.02-K61		
20172201	CNTT2.01-K62	02002	20170001
20172202	CNTT2.02-K62		

student

student_id	first_name	last_name	…	clazz_id
20160001	Ngọc An	Bùi	…	
20160002	Anh	Hoàng	…	20162101
20160003	Thu Hồng	Trần	…	20162101
20160004	Minh Anh	Nguyễn	…	20162101
20170001	Nhật Ánh	Nguyễn	…	20172201

```
SELECT clazz.clazz_id, name, last_name,
first_name
FROM clazz c LEFT OUTER JOIN student
        ON (student_id = monitor_id);
```

result

clazz_id	name	last_name	first_name
20172202	CNTT2.02-K62	NULL	NULL
20162102	CNTT1.02-K61	NULL	NULL
20162101	CNTT1.01-K61	Trần	Thu Hồng
20172201	CNTT2.01-K62	Nguyễn	Nhật Ánh

2. ....

► 2.2 Sub-queries

Union, Intersection and Difference of Queries

- <subquery> **UNION** <subquery>
- <subquery> **INTERSECT** <subquery>
- <subquery> **EXCEPT** <subquery>

Ex.: **List of subjets having any enrollment?**

```
SELECT * FROM subject
EXCEPT
SELECT s.*
FROM subject s NATURAL JOIN enrollment e ;
```

2. ....

► 2.3 Full-Relation Operations

Eliminating Duplicates

- Remove duplicate tuples : DISTINCT

```
SELECT DISTINCT student_id FROM enrollment;
```

- UNION | INTERSECT | EXCEPT : remove duplicate rows

- UNION | INTERSECT | EXCEPT **ALL**:
  - does **not** remove duplicate rows

2. ....

▶ 2.3 Full-Relation Operations

Aggregation Operators

- SUM, AVG, COUNT, MIN, MAX: applied to a column in a SELECT
- COUNT(*) counts the number of tuples

```
SELECT AVG(credit), MAX(credit)
FROM subject;
```

result

AVG	MAX
3.57	5

```
SELECT AVG(credit), MAX(credit)
FROM subject
WHERE subject_id LIKE 'IT%';
```

result

AVG	MAX
3.0	4

subject

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	Học máy	2	70
LI0001	life's happy song	5	
LI0002	%life's happy song 2	5	

2. ....

▶ 2.3 Full-Relation Operations

Eliminating Duplicates in an Aggregation

- Use DISTINCT inside aggregation

```
SELECT count(*) a,
       count(percentage_final_exam) b,
       count(distinct
percentage_final_exam) c,
       AVG(credit) d,
       AVG(distinct credit) e
FROM subject;
```

result

a	b	c	d	e
7	5	3	3.57	3.5

subject

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	Học máy	2	70
LI0001	life's happy song	5	
LI0002	%life's happy song 2	5	

2. ....

▶ 2.3 Full-Relation Operations

NULL's ignored in Aggregation

- NULL : no contribution
- no non-NULL values in a column ➔ the result: NULL
  - Exception: COUNT of an empty set is 0

```
SELECT AVG(percentage_final_exam)
FROM subject; ➔ 64

SELECT AVG(percentage_final_exam),
       count(percentage_final_exam)
FROM subject
WHERE subject_id NOT LIKE 'IT%';
```

result

AVG	COUNT
NULL	0

subject

subject_id	name	credit	perc…
IT1110	Tin học đại cương	4	60
IT3080	Mạng máy tính	3	70
IT3090	Cơ sở dữ liệu	3	70
IT4857	Thị giác máy tính	3	60
IT4866	Học máy	2	70
LI0001	life's happy song	5	
LI0002	%life's happy song 2	5	

2. ....

▶ 2.3 Full-Relation Operations

Grouping results

- Syntax:

```
SELECT ...
FROM ...
[WHERE condition]
GROUP BY expr [,expr]...
```

student

student_id	first_name	last_name	…	gender	…	clazz_id
20160001	Ngọc An	Bùi	…	M	…	
20160002	Anh	Hoàng	…	M	…	20162101
20160003	Thu Hồng	Trần	…	F	…	20162101
20160004	Minh Anh	Nguyễn	…	F	…	20162101
20170001	Nhật Ánh	Nguyễn	…	F	…	20172201

- Example:

```
SELECT clazz_id, count(student_id)
FROM student
GROUP BY clazz_id;
```

result

clazz_id	count
NULL	1
20162101	3
20172201	1

2. ....

▶ 2.3 Full-Relation Operations

Grouping results

- Operational semantic:

```
SELECT clazz_id, count(student_id)    3
FROM student                          1
WHERE gender = 'F'
GROUP BY clazz_id;                    2
```

result

clazz_id	count
20162101	2
20172201	1

- Each element of the SELECT list must be either:
  - Aggregated, or
  - An attribute on the GROUP BY list

2. ....

▶ 2.3 Full-Relation Operations

HAVING

- Syntax:

```
SELECT ...
FROM ...
[WHERE condition]
GROUP BY expr [,expr]...
HAVING <condition on group>
```

- Example:

```
SELECT clazz_id, count(student_id)
FROM student
WHERE gender = 'F'
GROUP BY clazz_id
HAVING count(student_id) >= 10
```

2. ....

▶ 2.3 Full-Relation Operations

HAVING

- Operational semantic:

```
SELECT clazz_id, count(student_id)      4
FROM student                            1
WHERE gender = 'F'
GROUP BY clazz_id                       2
HAVING count(student_id) >= 2;          3
```

result

clazz_id	count
20162101	2

- Requirements on HAVING conditions:
  - Anything goes in a subquery
  - Outside subqueries, they may refer to attributes only if they are:
    - either a grouping attribute,
    - or aggregated

2. ....

▶ 2.3 Full-Relation Operations

HAVING

- Example: **Which subject in which semester has it the most enrollments ?**

```
SELECT subject_id, semester, count(student_id)
FROM enrollment
GROUP BY subject_id, semester
HAVING count(student_id) >= ALL
                    (SELECT count(student_id)
                     FROM enrollment
                     GROUP BY subject_id, semester);
```

result

subject_id	semester	count
IT4857	20172	1
IT3090	20172	1
IT4866	20172	1
IT3080	20172	2
IT1110	20171	4

result

subject_id	semester	count
IT1110	20171	4

2. ....

▶ 2.3 Full-Relation Operations

Ordering results

- Syntax and operational semantic:

```
SELECT ...                                                    4
FROM ...
[WHERE condition]                                             1
[GROUP BY expr [,expr]... ]                                   2
[HAVING …]                                                    3
ORDER BY {expr|position} [ASC|DESC]
         [{,expr|position}[ASC|DESC]                          5
```

2. ....

▶ 2.3 Full-Relation Operations

Ordering results

- Example:

```
SELECT subject_id, semester, count(student_id)
FROM enrollment
GROUP BY subject_id, semester
ORDER BY semester,
         count(student_id) DESC, subject_id;
```

result

subject_id	semester	count
IT4857	20172	1
IT3090	20172	1
IT4866	20172	1
IT3080	20172	2
IT1110	20171	4

result

subject_id	semester	count
IT1110	20171	4
IT3080	20172	2
IT3090	20172	1
IT4857	20172	1
IT4866	20172	1

2. ....

2.4 Functions

- Aggregate functions: MAX, MIN, SUM, AVG, COUNT
- Functions applying on individual tuples:
  - Mathematic functions: ABS, SQRT, LOG, EXP, SIGN, ROUND, ..
  - String functions: LEN, LEFT, RIGHT, MID,…
  - Date/Time functions: DATE, DAY, MONTH, YEAR, HOUR, MINUTE, …
  - Format modification: FORMAT
  - Remark:
    - In general, common functions are similar between different DBMSs,
    - Some functions have different formats or names,… especially for date,time and string data types ➔ **Consulting documents for each DBMS**

2. ....

▶ 2.4 Functions

Example

```
SELECT s.student_id, last_name ||' '|| first_name fullname, midterm_score, final_score,
        (midterm_score * (1-1.0*percentage_final_exam/100) +
                final_score*1.0*percentage_final_exam/100) score
FROM student s, enrollment e, subject sj
WHERE s.student_id = e.student_id AND sj.subject_id = e.subject_id
        AND e.subject_id = 'IT1110';
```

result

student_id	fullname	midterm_score	final_score	score
20160003	Trần Thu Hồng	7	6	6.4
20160004	Nguyễn Minh Anh	6	5	5.4
20170001	Nguyễn Nhật Ánh	8	7.5	7.7
20160001	Bùi Ngọc An	9	8.5	8.7

2. ....

▶ 2.4 Functions

Example

```
SELECT sjid, name, MIN(score), MAX(score), AVG(score), stddev_pop(score)
FROM  (SELECT student_id sid, e.subject_id sjid, name,
                    (midterm_score*(1-1.0*percentage_final_exam/100)+
                                final_score*1.0*percentage_final_exam/100) score
            FROM enrollment e, subject sj
            WHERE sj.subject_id = e.subject_id) AS t
WHERE upper(sjid) LIKE 'IT%'
GROUP BY sjid, name;
```

result

sjid	name	min	max	avg	stddev
IT1110	Tin học đại cương	5.4	8.7	7.05	1.254
IT3080	Mạng máy tính				
IT3090	Cơ sở dữ liệu	8.1	8.1	8.1	0
IT4857	Thị giác máy tính	8.25	8.25	8.25	0
IT4866	Học máy	8.4	8.4	8.4	0

3. VIEW

3.1. View definition

3.2. Accessing views

3.3. Updatable views

3.4. Materialized views

3. …

What is a VIEW ?

- A *view* is a relation defined in terms of stored tables (called *base tables*) and other views
- Two kinds:
  - *Virtual* = not stored in the database; just a query for constructing the relation
  - *Materialized* = actually constructed and stored
- Declaring views:

  CREATE [MATERIALIZED] VIEW <name> AS <query>;

  - Default is virtual

3. …

▶ View Removal

- Dropping views: DROP VIEW <name>;

  DROP VIEW female_student;
- Affection:
  - Deleting the definition of views: the female_student view no longer exists
  - No tuples of the base relation (student relation) is affected

3. …

- Accessing a view

- Declare:

```
CREATE VIEW monitor AS
        SELECT student_id, first_name, last_name, dob, clazz_id
        FROM student, clazz
        WHERE student_id = monitor_id ;
```

- Query a view as if it were a base table

```
SELECT student_id, first_name, last_name, dob
FROM monitor
WHERE clazz_id = '20172201' ;
```

- A limited ability to modify views

3. …

▶ Updatable views

- The SQL rules are complex
- They permit modifications on views that are defined by selecting (using SELECT, not SELECT DISTINCT) some attributes from one relation *R* (which may itself be an updatable view):
  - The WHERE clause must not involve *R* in a subquery
  - The FROM clause can only consist of one occurrence of *R* and no other relation
  - The list in the SELECT clause must include enough attributes that for every tuple inserted into the view (other attributes filled with NULL values or the proper default)

3. …

▶ Updatable views - Example

- Base table: `student(student_id, first_name,last_name, dob, gender,address,note,clazz_id)`
- Updatable view

```
CREATE VIEW female_student AS
        SELECT student_id, first_name, last_name FROM student
        WHERE gender = 'F';
```

- Insert into views:

```
INSERT INTO female_student VALUES('20160301', 'Hoai An', 'Tran');
```

means

```
INSERT INTO student(student_id, first_name, last_name)
VALUES ('20160301', 'Hoai An', 'Tran');
```

3. …

▶ Updatable views - Example

- Delete from views:

```
DELETE FROM female_student WHERE first_name LIKE '%An' ;
```

means

```
DELETE FROM student
WHERE first_name LIKE '%An'  AND gender = 'F';
```

- Update views:

```
UPDATE female_student SET first_name = 'Hoài Ân'
WHERE first_name = 'Hoai An' ;
```

means

```
UPDATE female_student SET first_name = 'Hoài Ân'
WHERE first_name = 'Hoai An'  AND gender = 'F';
```

3. …

▶ Views and INSTEAD OF trigger

- Generally, it is impossible to modify a virtual view, because it do esn't exist.
- But an INSTEAD OF trigger (next lesson) lets us interpret view modifications in a way that makes sense

```
CREATE TRIGGER delete_viewtrigger
  INSTEAD OF DELETE ON monitor
  FOR EACH ROW
  BEGIN
        UPDATE clazz SET monitor_id = NULL
        WHERE clazz_id = OLD.clazz_id;
  END;
```

3. …

▶ Materialized Views

- Results of a query can be stored
- This enables much more efficient access

- Problems:
  - each time a base table changes, the materialized view may change

- Solutions:
  - Periodic reconstruction (REFRESH) of the materialized view
  - Triggers (next lesson)

4. Privileges and User Management in SQL

4.1. Privileges

4.2. Creating users

4.3. Granting and Revoking privileges

4. Privileges and User Management in SQL

▶ Privileges

- SELECT, INSERT, DELETE, UPDATE: privileges on table/view
- REFERENCES: privilege on a relation; the right to refer to that r elation in an integrity constraint
- USAGE: the right to use that element in one's own declarations
- TRIGGER: privilege on a relation; the right to define triggers on t hat relation
- EXECUTE: the right to execute a piece of code, such as a proce dure or function
- UNDER: the right to create subtypes of a given type

4. Privileges and User Management in SQL

▶ Creating users

- Syntax: variations in different database plateforms
  - Creating an user in Oracle, MySQL:
    CREATE USER *username* IDENTIFIED BY *password*;
  - Creating an user in PostgreSQL:
    CREATE USER *username*
    [[WITH] options] PASSWORD *password*;
  - Deleting:
    DROP USER *username* [CASCADE];
- Example:
    CREATE USER *toto* IDENTIFIED BY *pwdtoto*

4. Privileges and User Management in SQL

▶ Granting privileges

- Syntax:

  GRANT <privilege list> ON <database element> TO <user list>

  [WITH GRANT OPTION] ;

  - <privilege list> : INSERT, SELECT, …, ALL PRIVILEGES
  - <database element>: a table, a view
  - WITH GRANT OPTION:
    - the user may grant the privilege to other user
- Example:

  GRANT SELECT, INSERT ON student TO tom WITH GRANT OPTION;

4. Privileges and User Management in SQL

▶ Revoking privileges

- Syntax:

  REVOKE <privilege list> ON <database element> FROM <user list>

  [CASCADE | RESTRICT] ;

  – CASCADE: revoke any privileges that were granted *only* because of the re voked privileges

  – RESTRICT: the revoke statement cannot be executed if the revoked privile ges have been passed on to others

  REVOKE GRANT OPTION FOR …..; : remove the grant option

- Example:

  REVOKE INSERT ON student FROM tom CASCADE;

Remarks

- Complex query
  - Clauses in SQL statement are not exchangeable
  - A query executed successfully, it is not sure that the query is correct
  - A query provides correct results at a moment, it is not sure that the query is correct
  - Be careful with "natural join"
- Virtual vs. materialized view
- Privileges and User Management
  - Superuser account is not for every body
  - An user no need to access all database objects

Quiz

No	Question (Multiple Choice)	Answer (1,2,3,4)	Commentary
1	What does the following SQL statement result? SELECT * FROM student WHERE (1=0); A. An empty relation with the same structure of "student" B. A relation with the same structure and data as "student" C. The query raises error	A	Expression (1=0) gives false value, so all tuples of student do not satisfy this condition. There is no tuple in result relation.
2	We must always has join conditions if there are more than one relation in FROM clause ? A. Yes B. No	B	No, it is as cross join (called a Cartesian product), but the product by itself is rarely a useful operation
3	Can we put the condition in HAVING clause into the WHERE clause ? A. Sometimes yes B. No, never C. Yes, we can	A	Conditions in HAVING clause and in WHERE clause are not the same meaning. Conditions in HAVING clause apply to groups as a whose. Conditions in WHERE clause apply to individual tuples. - If condition in HAVING clause refers to grouping attribute, then this condition can be placed in WHERE clause. - If condition in HAVING clause refers to aggregated attributes, it can not be moved to WHERE clause.
4	What does the following SQL statement result? SELECT student_id FROM enrollment WHERE subject_id = 'IT3090' AND subject_id = 'IT4859' A. Empty relation B. List of student_ids that have enrolled both two subjects IT3090 and IT4859. C. List of student_ids that have enrolled at least one subject whose subject_id is IT3090 or IT4859	A	The condition in WHERE clause is always false.

Outro > Summary

No	Topic	Summary
1	Data manipulation (part 2)	- Joins operators - Subqueries : in FROM clause and in WHERE clause - Aggregation operators - Grouping and aggregation in SQL - Condition in WHERE clause vs. Condition in HAVING clause - Controlling the output: duplicate elimination, ordering the result
2	View	- View definition - View accessing - Updatable view - Materialized view
3	Privileges and User Managements	- Privileges - Creating user - Granting / Revoking privileges

You've just have an overview of ……

Next lesson:

Constraints and Triggers

1. Constraints
2. Triggers