Database Management Systems - I, CS 157A

SQL Group-by, Sub-query Clauses and Security

Agenda

- Functions
  - Group functions
- Outer Join
- Sub-queries
- Security

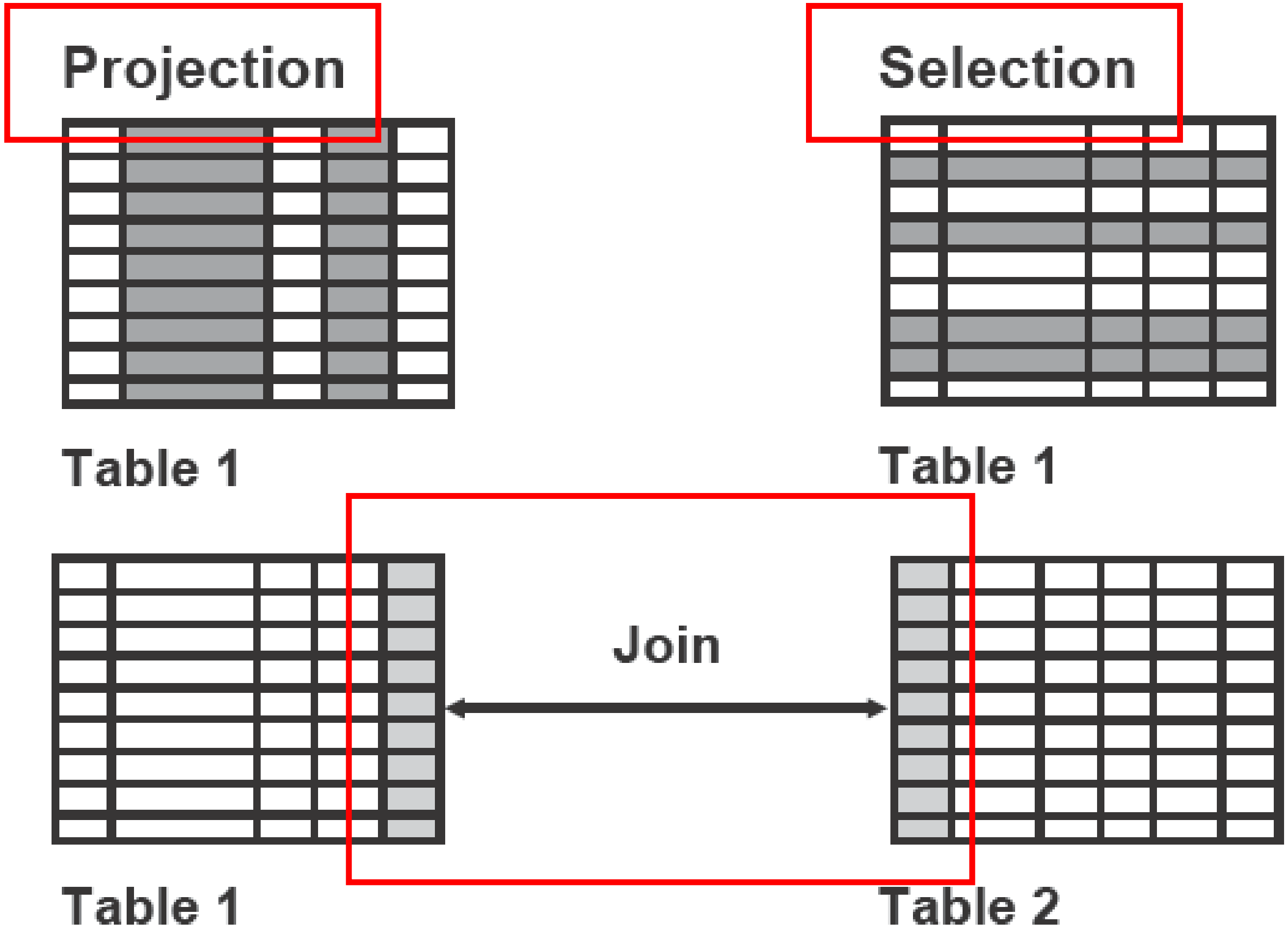
SQL Statements

DML (Data Manipulation Language)	SELECT

	INSERT
	UPDATE
	DELETE

DDL (Data Definition Language)	CREATE ALTER DROP
DCL and Transaction Control	GRANT REVOKE COMMIT ROLLBACK

REVIEW: SQL SELECT



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 ;
  ```

Membership Condition Using IN

- Use the **IN** operator to test for values in a list
-
```
SELECT   last_name, salary, manager_id
FROM     employees
WHERE  manager_id  IN  (100, 101, 201) ;
```

Using NULL Conditions

- Test for nulls with **IS NULL** operator

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

- Note: you cannot test with = (you need to use **IS** instead**)**
  - A null is not equal, or unequal to any value

ORDER-BY Clause

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

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

Sorting

- Sorting in descending order

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

- Sorting by column alias

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

Sorting (cont.)

- Sorting using column’s numeric position

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

- Sorting by multiple columns

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

Functions

Case-Conversion Functions

Function	Result
LOWER(‘SQL Course’)	sql course
UPPER(‘SQL Course’)	SQL COURSE
INITCAP(‘SQL Course’)	Sql Course

Example: Case-Conversion

```
SELECT      last_name, job_id, salary
FROM        employees
WHERE       last_name = ‘peng’;
```

0 rows returned.

```
SELECT      last_name, job_id, salary
FROM        employees
WHERE       LOWER(last_name) = ‘peng’;
```

1 rows returned.

Character Manipulation Functions

Function	Result
SUBSTR(‘HelloWorld’, 1 ,5)	Hello
LENGTH(‘HelloWorld’)	10
INSTR(‘HelloWorld’, ‘W’) – In String	6
LPAD(salary, 10, ‘*’) – left Pad	*****24000
RPAD(salary, 10, ‘*’) – right Pad	24000*****

Number Functions

Function	Result
ROUND(45.926, 2)	45.93
TRUNC(45.926, 2)	45.92
Remainder = MOD(1600, 300)	100

Group Functions

Function	Description
AVG	Average
COUNT	Number of rows
SUM	Sum values
MAX/MIN	Maximum / Minimum value

GROUP Functions and Null Value

- Group functions ignore null values in the column

```
SELECT      AVG(commision_pct)
FROM        employees;
```

Creating Groups of Data

- You can divide rows in a table into smaller groups using the GROUP BY clause

```
SELECT      column, group_function(column)
FROM        table
[WHREE      condition]
[GROUP BY   group_by_expression]
[ORDER BY   column];
```

Example: GROUP BY

- All columns in the SELECT list that are not in group functions must be in the GROUP BY clause

```
SELECT      department_id,   AVG(salary)
FROM        employees
GROUP BY    department_id;
```

Illegal Queries with Group Functions

```
SELECT      department_id, COUNT(name)
FROM        employees;
```

A GROUP_BY clause must be added to count the name for each dept!!

```
SELECT      department_id, job_id, COUNT(name)
FROM        employees
GROUP BY    department_id;
```

Either remove job_id, or

Add job_id in the GROUP_BY

Illegal Queries with Group Functions

- You cannot use the WHERE clause to restrict groups

```
SELECT      department_id,  AVG(salary)
FROM        employees
WHERE       AVG(salary) > 8000
GROUP BY    department_id;
```

- Use the **HAVING** clause to restrict groups

```
SELECT      department_id,  AVG(salary)
FROM        employees
GROUP BY    department_id
HAVING      AVG(salary) > 8000 ;
```

Restricting Group Results with the HAVING clause

- When you use the HAVING clause, Oracle server restricts groups as follows
  1. Rows are grouped
  2. The group function is applied
  3. Groups matching the HAVING clause are displayed

Subquery

Subquery (Nested SELECT)

```
SELECT     select_list
FROM       table
WHERE      expr  operator
                 (SELECT   select_list
                  FROM     table);
```

- The subquery (inner query) executes before the main query (outer query)
- The result of the subquery is used by the main query

Using Group Functions in a Subquery

```
SELECT    last_name, job_id, salary
FROM      employees
WHERE     salary =
          (SELECT   MIN(salary)
           FROM     employees);
```

- Select employee with minimum salary
- Note the subquery returns a single value, say 2500, to the outer query.

What’s Wrong with this Statement?

```
SELECT      last_name, salary
FROM        employees
WHERE       salary  =
            (SELECT      MIN(salary)
             FROM        employees
             GROUP BY    department_id) ;
```

- The subquery returns multiple values, one for each group. The = operator is a single-row comparison operator that expects only one value.

Multi-Row Subqueries

```
SELECT      last_name, salary
FROM        employees
WHERE       salary   IN
            (SELECT      MIN(salary)
            FROM         employees
            GROUP BY     department_id);
```

- The subquery returns multiple values, one for each group. We use IN operator here, which is a multi-row operator that expects one or more values.

Security and User Authorization in SQL

Authorization

- A file system identifies certain privileges on the objects (files) it manages:
  - Typically: <read, write, execute>

- A file system identifies certain participants to whom privileges may be granted.
  - Typically: <owner, a group, all users>

Privileges – (1)

- SQL identifies a more detailed set of privileges on objects (relations) than the typical file system
- Nine privileges in all, some of which can be restricted to one column of one relation

Privileges – (2)

- Some important privileges on a relation:

1. SELECT = right to query the relation
2. INSERT = right to insert tuples
   - May apply to only one attribute
3. UPDATE = right to update tuples
   - May apply to only one attribute
4. DELETE = right to delete tuples

Example: Privileges

- For the statement below:

```
INSERT  INTO  Beers(name)
    SELECT beer FROM  Sells
    WHERE NOT EXISTS
         (SELECT * FROM Beers
          WHERE name = beer);
```

beers that do not appear in Beers. We add them to Beers with a NULL manufacturer.

- We require privileges SELECT on Sells and Beers, and INSERT on Beers or Beers.name

Database Objects

- The objects on which privileges exist include stored tables and views

- Other privileges are the right to create objects of a type, e.g., triggers

- Views form an important tool for access control

Example: Views as Access Control

- We might not want to give the SELECT privilege on Emps(name, addr, salary)
- But it is safer to give SELECT on:

```
CREATE VIEW SafeEmps AS
    SELECT name, addr FROM Emps;
```

- Queries on SafeEmps do not require SELECT privilege on Emps, just on SafeEmps

Authorization ID's

- A user is referred to by *authorization ID*, typically their login name

- There is an **authorization ID** PUBLIC:
  - Granting a privilege to PUBLIC makes it available to any authorization ID

Granting Privileges

- You have all possible privileges on the objects, such as relations, that you create
- You may grant privileges to other users (authorization ID’s), including PUBLIC
- You may also grant privileges WITH GRANT OPTION, which lets the grantee also grant this privilege

The GRANT Statement

- To grant privileges, say:

```
GRANT <list of privileges>
ON    <relation or other object>
TO    <list of authorization ID’s>;
```

- If you want the recipient(s) to be able to pass the privilege(s) to others add:

```
WITH  GRANT OPTION
```

Example: GRANT

- Suppose you are the owner of Sells. You may say:

```
GRANT  SELECT, UPDATE(price)
ON     Sells
TO     sally;
```

- Now Sally has the right to issue any query on Sells and can update the price component/attribute only

Example: Grant Option

- Suppose we also grant:

```
GRANT UPDATE ON Sells TO sally
WITH GRANT OPTION;
```

- Now, Sally not only can update any attribute of Sells, but can grant to others the privilege UPDATE ON Sells:
  - □ Also, she can grant more specific (restricted) privileges like `UPDATE(price) ON Sells`

Revoking Privileges

```
REVOKE <list of privileges>
ON     <relation or other object>
FROM   <list of authorization ID's>;
```

- Your grant of these privileges can no longer be used by these users to justify their use of the privilege:
  - But they may still have the privilege because they obtained it independently from elsewhere

REVOKE Options

- We must append to the REVOKE statement either:

1. CASCADE: Now, any grants made by a revokee are also not in force, no matter how far the privilege was passed
2. RESTRICT: If the privilege has been passed to others, the REVOKE fails as a warning that something else must be done to “chase the privilege down”

Grant Diagrams

- Nodes = user/privilege/grant option? / is owner?
  - UPDATE ON R, UPDATE(a) on R, and UPDATE(b) ON R live in different nodes
  - SELECT ON R and SELECT ON R WITH GRANT OPTION live in different nodes
- Edge *X* → *Y* means that node *X* was used to grant *Y*

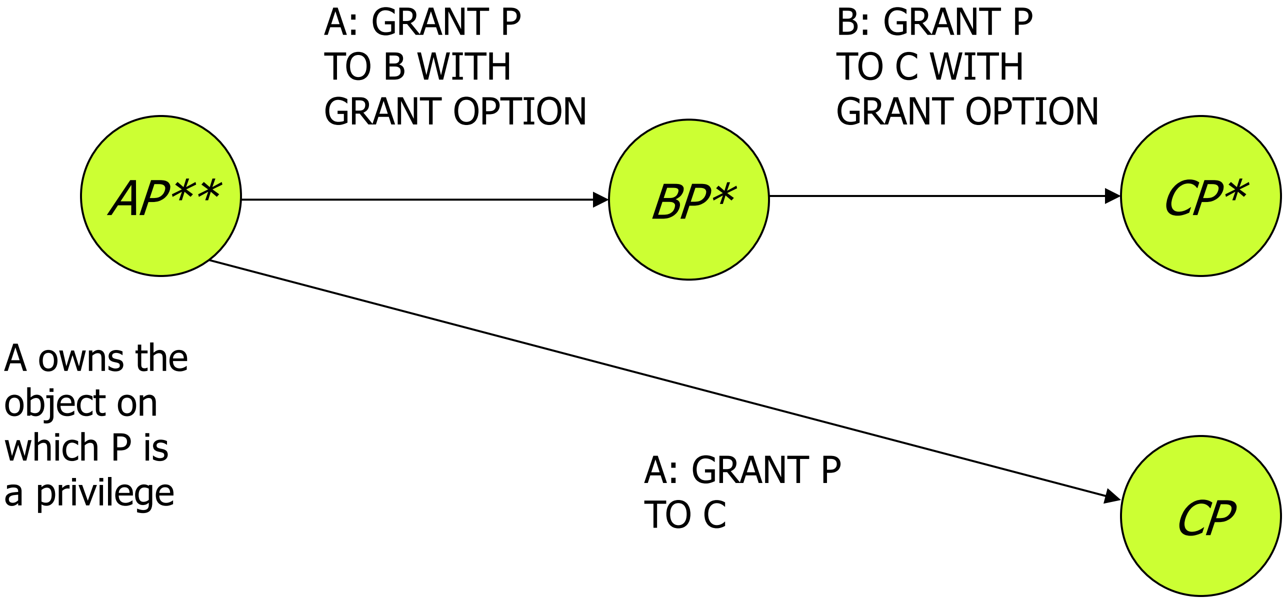
Notation for Nodes

- Use *AP* for the node representing authorization ID *A* having privilege *P*:
  - *P* * = privilege *P* with grant option
  - *P* ** = the source of the privilege *P*
    - I.e., *A* is the owner of the object on which *P* is a privilege
    - Note ** implies grant option

Manipulating Edges – (1)

- When *A* grants *P* to *B*, We draw an edge from *AP* * (A is not owner) or *AP* ** (if A is owner) to *BP*
  - Or to *BP* * if the grant is with grant option
- If *A* grants a subprivilege *Q* of *P* [say UPDATE(a) on R when *P* is UPDATE ON R] then the edge goes to *BQ* or *BQ* *, instead

Example: Grant Diagram



A: GRANT P
TO B WITH
GRANT OPTION

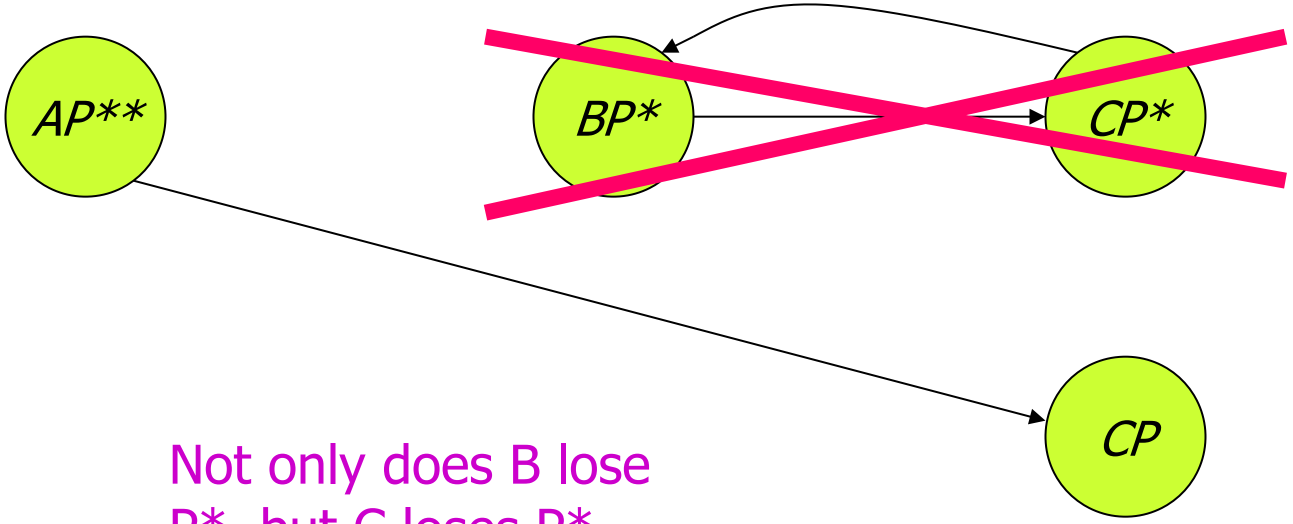
B: GRANT P
TO C WITH
GRANT OPTION

A owns the
object on
which P is
a privilege

A: GRANT P
TO C

Example: Grant Diagram

A executes
REVOKE P FROM B CASCADE;



Even had
C passed P
to B, both
nodes are
still cut off

Not only does B lose
P*, but C loses P*.
Delete BP* and CP*

However, C still
has P without grant
option because of
the direct grant.

Summary

- Functions
  - String function
  - Numeric functions
  - Group functions
- Outer Join
- Sub-query
- Security

END