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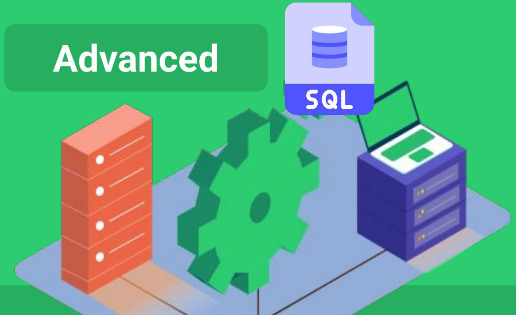
9

Advanced SQL Query
(PART 2)

CSF2600700 - BASIS DATA



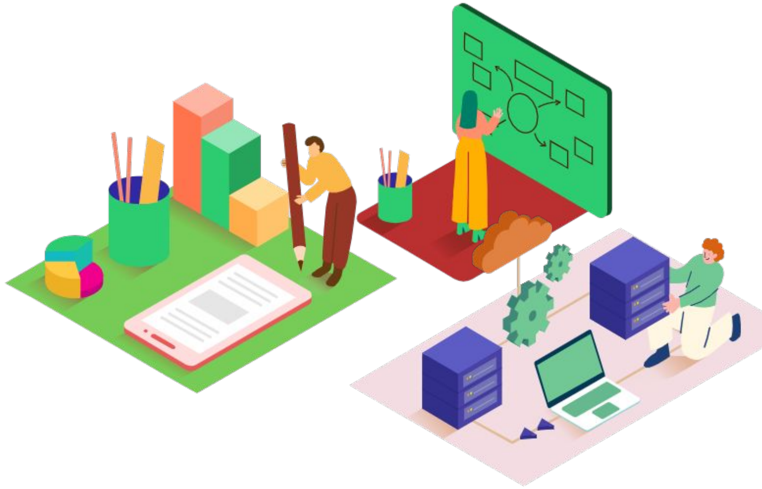
Acknowledgements

This slide is a modification to supplementary slide of
“Database System”, 7th edition, Elmasri/Navathe, 2015: **Chapter 7 More SQL: Complex Queries, Triggers, Views, and Schema Modification** used in “Basis Data” course in academic years 2018/2019 in the Faculty of Computer Science, Universitas Indonesia.

Review: SQL yang Sudah Di Pelajari

- **DDL: Data Definition Language**
- **Basic SQL Query**
- **Cartesian Product**

Outline



Explicit Sets

It is also possible to use an **explicit (enumerated) set of values** in the WHERE-clause rather than a nested query

Query 17: Retrieve the social security numbers of all employees who work on project number 1, 2, or 3.

Q17:

```
SELECT DISTINCT ESSN FROM WORKS_ON WHERE PNO IN (1, 2, 3);
```

Q17a:

```
SELECT DISTINCT ESSN FROM WORKS_ON WHERE PNO = ANY (array[1, 2, 3]);
```

Renaming Attribute

In SQL, its possible to rename attribute that **appears in the result of a query** by adding the qualifier AS followed by the desired new name

Q8A:

```
SELECT E.Lname AS EMPLOYEE_NAME,
       S.Lname AS SUPERVISOR_NAME
FROM EMPLOYEE E, EMPLOYEE S
WHERE E.SUPERSSN = S.SSN;
```

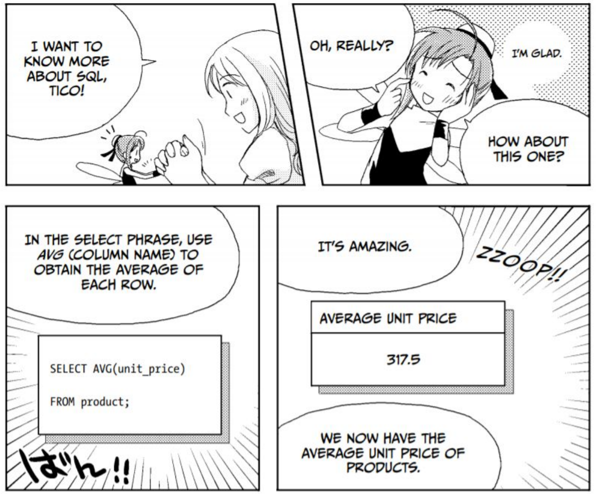
Aggregate Function

Include `COUNT`, `SUM`, `MAX`, `MIN`, and `AVG`

Query : Find the maximum salary, the minimum salary, and the average salary among all employees.

```
SELECT MAX(SALARY),MIN(SALARY),AVG(SALARY)
FROM EMPLOYEE;
```

Some SQL implementations may not allow more than one function in the SELECT-clause


I WANT TO KNOW MORE ABOUT SQL, TICO!
OH, REALLY?
I'M GLAD.
HOW ABOUT THIS ONE?
IN THE SELECT PHRASE, USE AVG (COLUMN NAME) TO OBTAIN THE AVERAGE OF EACH ROW.
ばんっ!!
IT'S AMAZING.
ZZOOP!!
WE NOW HAVE THE AVERAGE UNIT PRICE OF PRODUCTS.

```
SELECT AVG(unit_price)
FROM product;
```

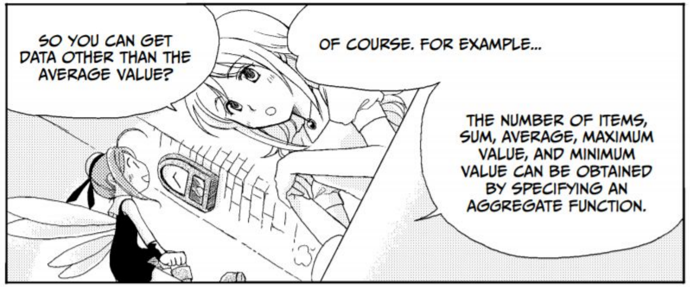
AVERAGE UNIT PRICE
317.5

Illustration: Takahashi & Azuma (2014)

Aggregate Function (Cntd.)

Query : Find the maximum salary, the minimum salary, and the average salary among employees who work for the 'Research' department.

```
SELECT MAX(SALARY), MIN(SALARY), AVG(SALARY)
FROM EMPLOYEE, DEPARTMENT
WHERE DNO=DNUMBER AND DNAME='Research‘;
```


SO YOU CAN GET DATA OTHER THAN THE AVERAGE VALUE?
OF COURSE. FOR EXAMPLE...
THE NUMBER OF ITEMS, SUM, AVERAGE, MAXIMUM VALUE, AND MINIMUM VALUE CAN BE OBTAINED BY SPECIFYING AN AGGREGATE FUNCTION.

AGGREGATE FUNCTIONS IN SQL

Function	Description
COUNT(*)	Obtains the number of rows
COUNT(column_name)	Obtains the number of times the column is not null
COUNT(DISTINCT column_name)	Obtains the number of distinct values in the column
SUM(column_name)	Obtains the sum of the column's values in all rows
AVG(column_name)	Obtains the average of the column's values in all rows
MAX(column_name)	Obtains the maximum value of the column
MIN(column_name)	Obtains the minimum value of the column

Illustration: Takahashi & Azuma (2014)

Aggregate Function (Cntd.)

Queries : Retrieve the total number of employees in the company (QA), and the number of employees in the 'Research' department (QB).

QA:

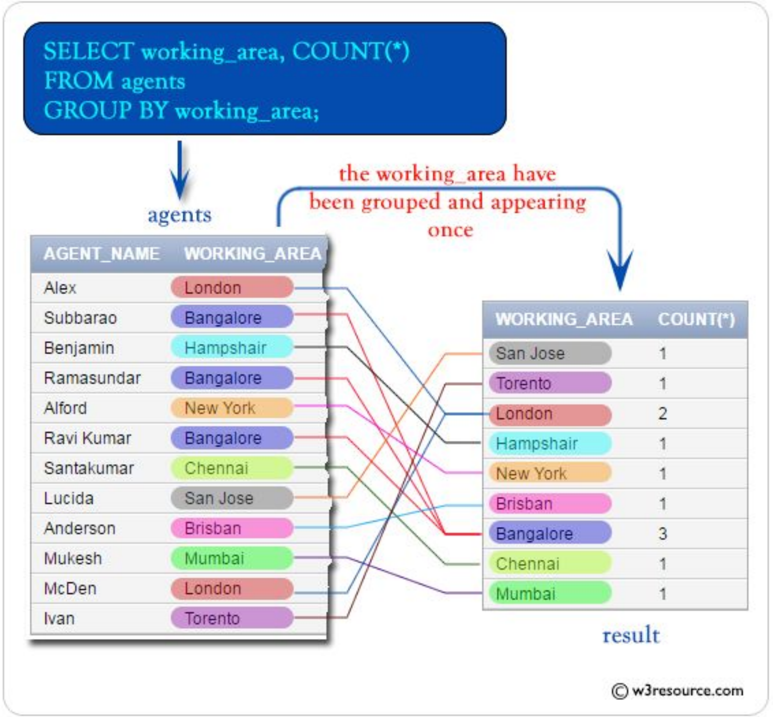
```
SELECT COUNT (*) FROM EMPLOYEE;
```

QB:

```
SELECT COUNT (*)
FROM EMPLOYEE, DEPARTMENT
WHERE DNO=DNUMBER AND DNAME='Research’;
```

Grouping

- ➔ In many cases, we want to apply the aggregate functions to subgroups of tuples in a relation
- ➔ Each subgroup of tuples consists of the set of tuples that have the same value for the grouping attribute(s)
- ➔ The function is applied to each subgroup independently
- ➔ SQL has a `GROUP BY`-clause for specifying the grouping attributes, which must also appear in the `SELECT`-clause



```
SELECT working_area, COUNT(*)
FROM agents
GROUP BY working_area;
```

AGENT_NAME	WORKING_AREA
Alex	London
Subbarao	Bangalore
Benjamin	Hampshair
Ramasundar	Bangalore
Alford	New York
Ravi Kumar	Bangalore
Santakumar	Chennai
Lucida	San Jose
Anderson	Brisban
Mukesh	Mumbai
McDen	London
Ivan	Torento

WORKING_AREA	COUNT(*)
San Jose	1
Torento	1
London	2
Hampshair	1
New York	1
Brisban	1
Bangalore	3
Chennai	1
Mumbai	1

Illustration: https://www.w3resource.com/sql/aggregate-functions/count-with-group-by.php

Grouping (Cntd.)

Query 24: For each department, retrieve the department number, the number of employees in the department, and their average salary.

Q24:

```
SELECT DNO, COUNT (*), AVG (SALARY)
FROM EMPLOYEE
GROUP BY DNO;
```

- ➔ In Q24, the EMPLOYEE tuples are divided into groups--each group having the same value for the grouping attribute DNO
- ➔ The COUNT and AVG functions are applied to each such group of tuples separately
- ➔ The SELECT-clause includes only the grouping attribute and the functions to be applied on each group of tuples
- ➔ A join condition can be used in conjunction with grouping

Grouping (Cntd.)

Query 25: For each project, retrieve the project number, project name, and the number of employees who work on that project.

Q25:

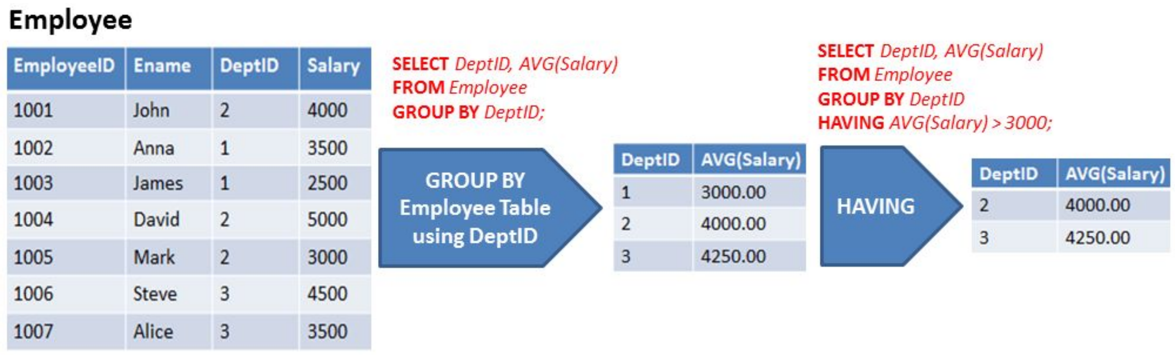
```
SELECT PNUMBER, PNAME, COUNT (*)
FROM PROJECT, WORKS_ON
WHERE PNUMBER=PNO
GROUP BY PNUMBER, PNAME
```

In this case, the grouping and functions are applied after the joining of the two relations

The `HAVING` Clause

Sometimes we want to retrieve the values of these functions for only those groups that **satisfy certain conditions**

The `HAVING`-clause is used for specifying a selection condition on groups (rather than on individual tuples)



Employee

EmployeeID	Ename	DeptID	Salary
1001	John	2	4000
1002	Anna	1	3500
1003	James	1	2500
1004	David	2	5000
1005	Mark	2	3000
1006	Steve	3	4500
1007	Alice	3	3500

```
SELECT DeptID, AVG(Salary)
FROM Employee
GROUP BY DeptID;
```

DeptID	AVG(Salary)
1	3000.00
2	4000.00
3	4250.00

```
SELECT DeptID, AVG(Salary)
FROM Employee
GROUP BY DeptID
HAVING AVG(Salary) > 3000;
```

DeptID	AVG(Salary)
2	4000.00
3	4250.00

Illustration: https://www.datacamp.com/community/tutorials/group-by-having-clause-sql

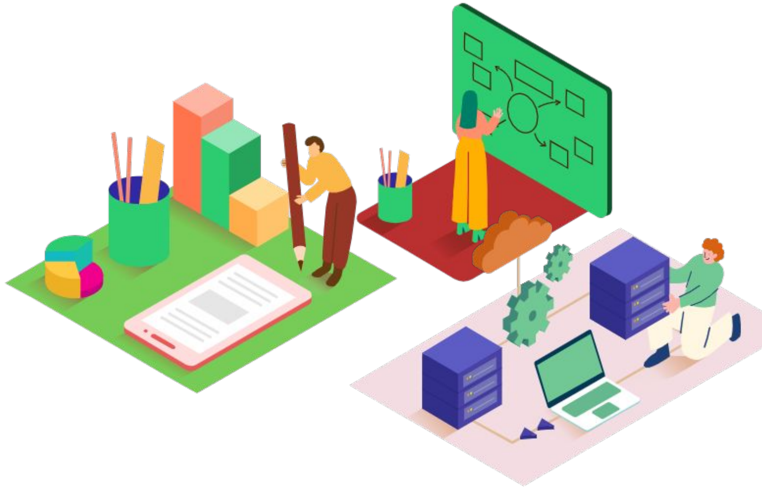
The HAVING Clause (Cntd.)

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

Q26:

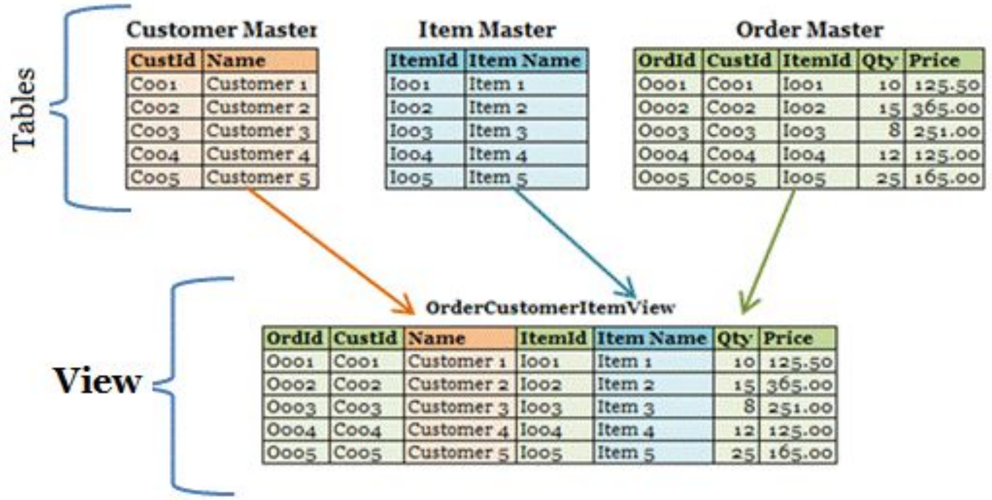
```
SELECT PNUMBER, PNAME, COUNT (*)
FROM PROJECT, WORKS_ON
WHERE PNUMBER=PNO
GROUP BY PNUMBER, PNAME HAVING COUNT (*) > 2;
```

Outline



Views in SQL

- ➔ A view is a “virtual” table that is derived from other tables
- ➔ Allows for limited update operations (since the table may not physically be stored)
- ➔ Allows full query operations
- ➔ A convenience for expressing certain operations



Customer Master

CustId	Name
C001	Customer 1
C002	Customer 2
C003	Customer 3
C004	Customer 4
C005	Customer 5

Item Master

ItemId	Item Name
I001	Item 1
I002	Item 2
I003	Item 3
I004	Item 4
I005	Item 5

Order Master

OrdId	CustId	ItemId	Qty	Price
O001	C001	I001	10	125.50
O002	C002	I002	15	365.00
O003	C003	I003	8	251.00
O004	C004	I004	12	125.00
O005	C005	I005	25	165.00

OrderCustomerItemView

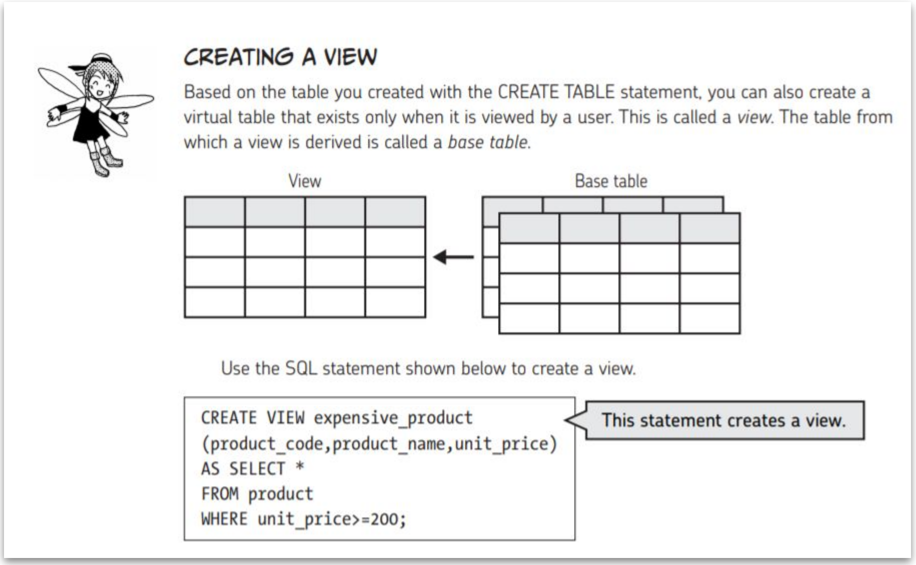
OrdId	CustId	Name	ItemId	Item Name	Qty	Price
O001	C001	Customer 1	I001	Item 1	10	125.50
O002	C002	Customer 2	I002	Item 2	15	365.00
O003	C003	Customer 3	I003	Item 3	8	251.00
O004	C004	Customer 4	I004	Item 4	12	125.00
O005	C005	Customer 5	I005	Item 5	25	165.00

Illustration: sql-datatools.com

Specification of Views

SQL command: `CREATE VIEW`

- ➔ A table (view) name
- ➔ a possible list of attribute names (for example, when arithmetic operations are specified or when we want the names to be different from the attributes in the base relations)
- ➔ A query to specify the table contents



CREATING A VIEW

Based on the table you created with the CREATE TABLE statement, you can also create a virtual table that exists only when it is viewed by a user. This is called a *view*. The table from which a view is derived is called a *base table*.

View
Base table

Use the SQL statement shown below to create a view.

```
CREATE VIEW expensive_product
(product_code,product_name,unit_price)
AS SELECT *
FROM product
WHERE unit_price>=200;
```

This statement creates a view.

SQL Views: An Example

Specify a different WORKS_ON table:

```
CREATE VIEW WORKS_ON_NEW AS
SELECT FNAME, LNAME, PNAME, HOURS
     FROM EMPLOYEE, PROJECT, WORKS_ON
     WHERE SSN=ESSN AND PNO=PNUMBER;
```

Using a Virtual Table

We can specify SQL queries on a newly create table (view):

```
SELECT FNAME, LNAME
FROM WORKS_ON_NEW
WHERE PNAME='Seena';
```

When no longer needed, a view can be dropped:

```
DROP VIEW WORKS_ON_NEW;
```

Efficient View Implementation

Query modification: present the view query in terms of a query on the underlying base tables

Disadvantage: inefficient for views defined via complex queries (especially if additional queries are to be applied to the view within a short time period)

Efficient View Implementation (Cntd.)

View materialization: involves physically creating and keeping a temporary table

- ➔ assumption: other queries on the view will follow
- ➔ concerns: maintaining correspondence between the base table and the view when the base table is updated
- ➔ strategy: incremental update

View Update

Update on a single view without aggregate operations: update may map to an update on the underlying base table

Views involving joins: an update may map to an update on the underlying base relations

Not always possible

Un-updatable Views

Views defined using groups and aggregate functions are not updateable

Views defined on multiple tables using joins are generally not updateable

`WITH CHECK OPTION` must be added to the definition of a view if the view is to be updated

➔ to allow check for updatability and to plan for an execution strategy

```
CREATE VIEW authors_CA AS
(SELECT * FROM Authors WHERE state='CA' ) WITH CHECK OPTION;
```

Summary of SQL Queries

A query in SQL can consist of up to six clauses, but only the first two, SELECT and FROM, are mandatory. The clauses are specified in the following order:

```
SELECT <attribute list>
FROM <table list>
[WHERE <condition>]
[GROUP BY <grouping attribute(s)>]
[HAVING <group condition>]
[ORDER BY <attribute list>]
```

Summary of SQL Queries (Cntd.)

➔ The `SELECT`-clause lists the attributes or functions to be retrieved
➔ The `FROM`-clause specifies all relations (or aliases) needed in the query but not those needed in nested queries
➔ The `WHERE`-clause specifies the conditions for selection and join of tuples from the relations specified in the FROM clause
➔ `GROUP BY` specifies grouping attributes
➔ `HAVING` specifies a condition for selection of groups
➔ `ORDER BY` specifies an order for displaying the result of a query
➔ A query is evaluated by first applying the WHERE-clause, then GROUP BY and HAVING, and finally the `SELECT` clause

Exercise

1. Tampilkan rata-rata salary pada pegawai perempuan.
2. Tampilkan jumlah project yang dikerjakan oleh setiap pegawai.
3. Tampilkan nama departemen dan jumlah project yang ditangani department tersebut.
4. Tampilkan nama depan semua pegawai yang bekerja di sebuah department yang memiliki pegawai dengan salary tertinggi.
5. Untuk setiap department, tampilkan nama departemen dan rata-rata salary pegawai yang bekerja pada department tersebut.
6. Untuk setiap department yang rata-rata salary pegawainya kurang dari 50000, tampilkan nama department beserta jumlah pegawainya.
7. Untuk setiap supervisor, tampilkan nama depan supervisor dan akumulasi jumlah jam kerja employee yang disupervisinya. Tampilkan hanya yang akumulasi jumlah jam kerjanya employee lebih dari 50 jam.
8. Buatlah sebuah view bernama EMPLOYEE_DEPENDENT yang berisi daftar nama depan pegawai yang memiliki dependent dan jumlah dependant yang dimilikinya

Q&A