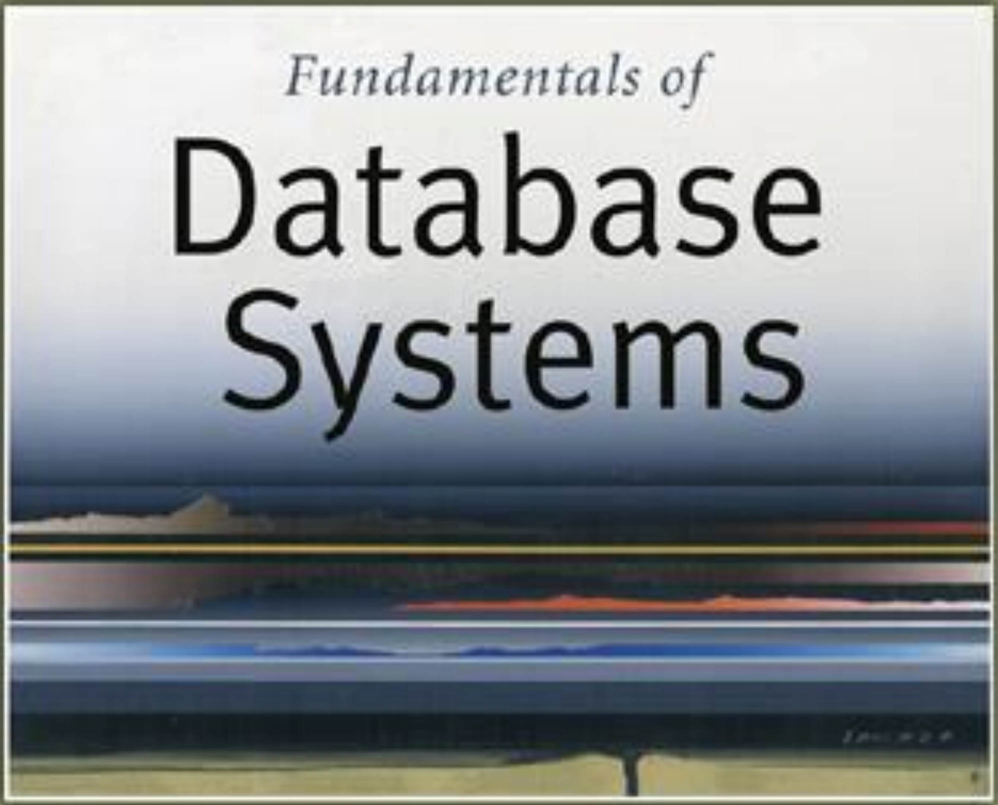


Fundamentals of

Database Systems

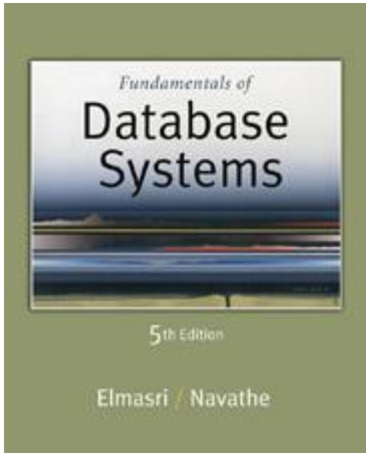
5th Edition

Elmasri / Navathe

Chapter 3

Structured Query Language- SQL

- By Jyoti Tryambake



Fundamentals of Database Systems

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SQL History

- IBM Sequel Language developed as a part of System R Project at the IBM San Jose Research Laboratory
- Renamed as Structured Query Language (SQL)
- ANSI and ISO standard SQL:
  - SQL-86
  - SQL-89
  - SQL-92
  - SQL: 1999
  - SQL: 2003,2005,2008, 2012, 2014, 2016, 2017,2019

SQL Facilities

- Data Definition Language (DDL)
- Data Manipulation Language (DML)
- Data Control Language (DCL)

Data Definition Language (DDL)

- Create and destroy databases and objects
  - creating a table or view
  - Altering/expanding definition of table
  - Creating/dropping an index
- Integrity constraints can be defined at the time of creation or later
- Primarily used by database admin during setup and removal phases of database object
- Commands are – create, update, drop

Data Definition Language (DDL)

- CREATE command
  - Create and manage independent database
  - For example, to maintain a database of customer contacts for your sales department and a personnel database for your Human Resource department
  - Command - creates an empty database named "Employees" on your DBMS
    - **CREATE DATABASE Employees;**

Data Definition Language (DDL)

- CREATE command
  - Next step is to create tables that will contain data
  - The CREATE TABLE command specifies
    - a new base relation by giving it a name,
    - specifying each of its attributes and their data types (INTEGER, FLOAT, DECIMAL(i,j), CHAR(n), VARCHAR(n) etc.)
    - A constraint may be specified on an attribute

Data Definition Language (DDL)

- CREATE command
  - The command:

```
CREATE TABLE personal_info
(first_name varchar(20) NOT NULL,
last_name varchar(20) NOT NULL,
employee_id int NOT NULL)
```

Creates a table titled "personal_info" in the current database

Data Definition Language (DDL)

- CREATE command
  - Also used for specifying the primary key attributes, and referential integrity constraints (foreign keys)
  - Key attributes can be specified via the PRIMARY KEY, FOREIGN KEY, REFERENCES and UNIQUE phrases

Data Definition Language (DDL)

- CREATE command
  - To specify CASCADE, SET NULL or SET DEFAULT on referential integrity constraints (foreign keys)

```
CREATE TABLE   dept_info
(DNAMEVARCHAR(10) NOT NULL,
DNUMBER INTEGER NOT NULL,
EMPLOYEE_ID int,
PRIMARY KEY (DNUMBER),
UNIQUE (DNAME),
FOREIGN KEY (EMPLOYEE_ID) REFERENCES
personal_info
ON DELETE SET DEFAULT ON UPDATE CASCADE  );
```

Constraints

There are 5 different referential actions: CASCADE, RESTRICT, NO ACTION, SET NULL, SET DEFAULT

CASCADE

- ON DELETE CASCADE means that if the parent record is deleted, any child records are also deleted.
- ON UPDATE CASCADE means that if the parent primary key is changed, the child value will also change to reflect that.
- ON UPDATE CASCADE ON DELETE CASCADE means that if you UPDATE **OR** DELETE the parent, the change is cascaded to the child.

Constraints

RESTRICT

- RESTRICT means that any attempt to delete and/or update the parent will fail throwing an error.
- This is the default behavior in the event that a referential action is not explicitly specified.
- For an ON DELETE or ON UPDATE that is not specified, the default action is always RESTRICT`.

Constraints (cont..)

NO ACTION

- NO ACTION: equivalent to RESTRICT.
- The MySQL Server rejects the delete or update operation for the parent table if there is a related foreign key value in the referenced table.

SET NULL

- SQL allows NULLs attribute values, a NOT NULL constraint may be specified if NULL is not permitted for a particular attribute
- SET NULL - Delete or update the row from the parent table, and set the foreign key column or columns in the child table to NULL.

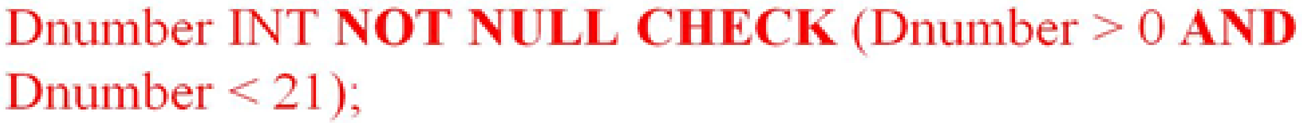
Constraints (cont..)

SET DEFAULT

- A default value for an attribute could be set and it will be included in new tuple if an explicit value is not provided for that attribute
- SET DEFAULT. allows the developer to specify a value to which to set the foreign key column(s) on an UPDATE or a DELETE.

CHECK

- Restrict attribute or domain values using CHECK clause following an attribute or domain definitions.



```
Dnumber INT NOT NULL CHECK (Dnumber > 0 AND
Dnumber < 21);
```

Example

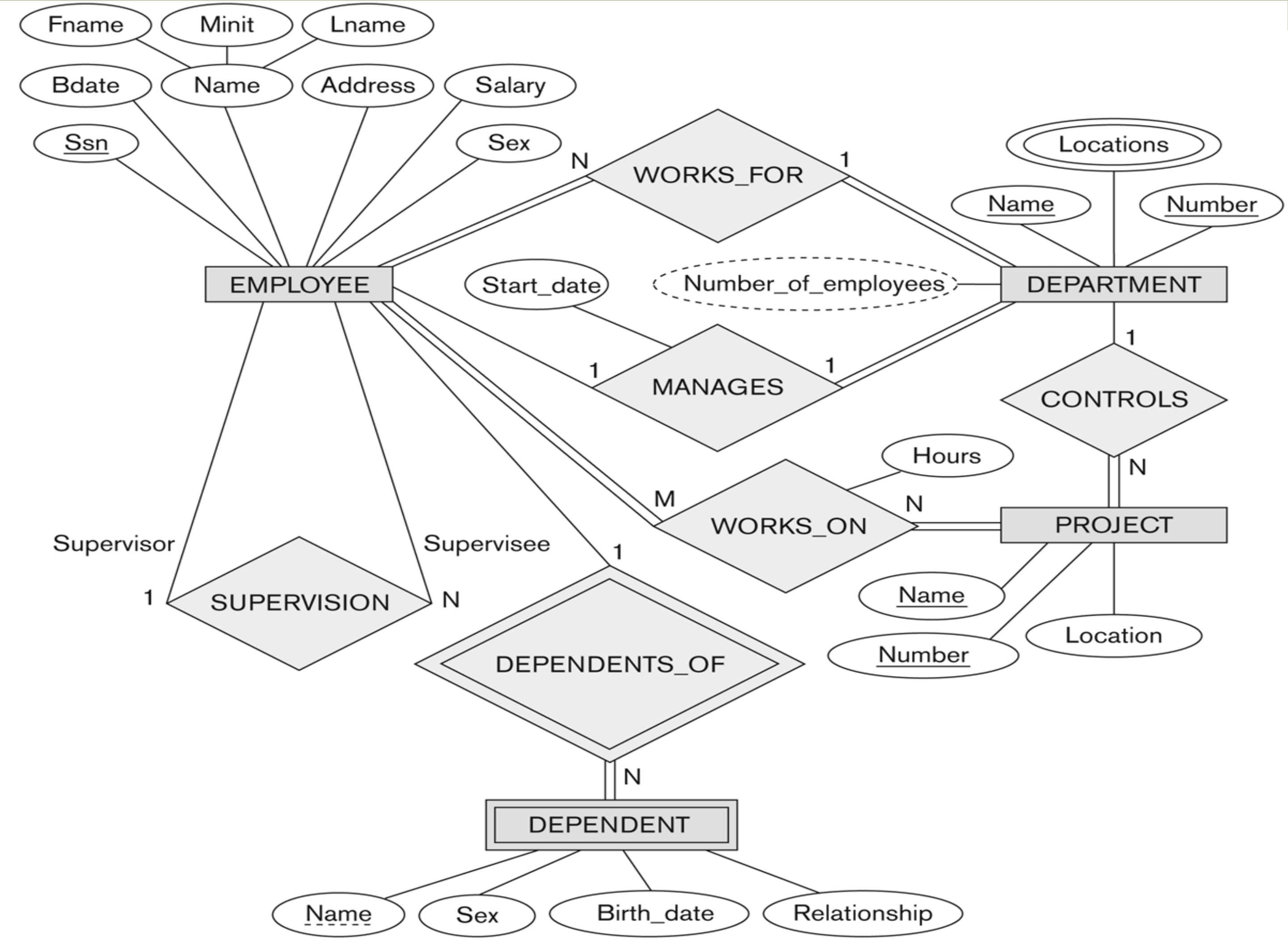
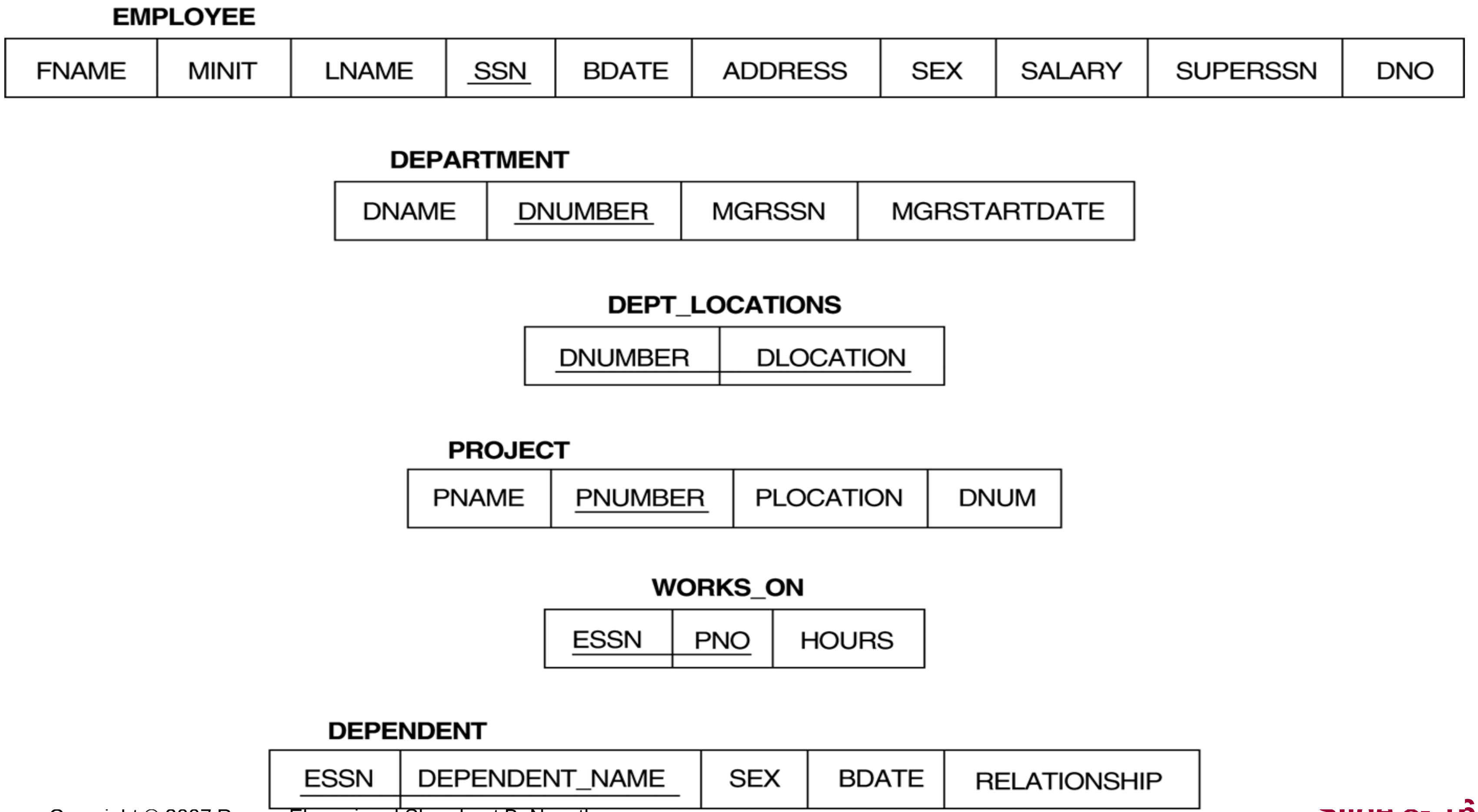


Figure 3.2
An ER schema diagram for the COMPANY database. The diagrammatic notation is introduced gradually throughout this chapter.

Examples

- Consider the following relational database schema corresponding to a COMPANY database



EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM

WORKS_ON

ESSN	PNO	HOURS

DEPENDENT

ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP

Specifying Key and Referential Integrity Constraints in SQL

```
CREATE TABLE EMPLOYEE
( . . . ,
Dno INT NOT NULL DEFAULT 1,
CONSTRAINT EMPPK        ←     Constraint name
PRIMARY KEY (Ssn),
CONSTRAINT EMPSUPERFK
FOREIGN KEY (Super_ssn) REFERENCES EMPLOYEE(Ssn)
ON DELETE SET NULL ON UPDATE CASCADE,
CONSTRAINT EMPDEPTFK
FOREIGN KEY(Dno) REFERENCES DEPARTMENT(Dnumber)
ON DELETE SET DEFAULT ON UPDATE CASCADE);
```

Slide 8- 17

Data Definition Language (DDL)

- ALTER command
  - Modify information - to make changes to the structure of a table without deleting and recreating it
  - For example, add a new attribute to the personal_info table -- an employee's salary
    - ALTER TABLE personal_info
      ADD salary money null
  - The "money" argument specifies that an employee's salary will be stored using a dollars and cents format
    - Example 2;

      ALTER TABLE personal_info ADD JOB VARCHAR(12);

Alter Command (cont.)

Various forms of Alter command with syntax:

To add a new column:

```
ALTER TABLE table_name ADD column_name datatype;
```

To delete a column:

```
ALTER TABLE table_name DROP COLUMN column_name;
```

To modify a column:

```
ALTER TABLE table_name MODIFY column_name datatype;
```

Alter Command (cont.)

Various forms of Alter command with syntax:

To rename table:

```
ALTER TABLE table_name RENAME TO new_table_name;
```

To rename the column:

```
ALTER TABLE table_name RENAME COLUMN
old_Column_name to new_Column_name;
```

Ex.

```
ALTER TABLE STUDENT ADD Address varchar2 (100);
ALTER TABLE STUDENT DROP COLUMN AGE;
```

Data Definition Language (DDL)

- DROP command
  - To permanently remove the table
    - DROP TABLE personal_info
  - To remove the entire database
    - DROP DATABASE employees

Data Manipulation Language (DML)

- Retrieving and updating information from more than two tables
- Commands are – select, update, delete, insert
  - **INSERT** command :
    - The INSERT command in SQL is used to add records to an existing table
    - Syntax:

INSERT INTO table-name (column-names)

VALUES (values)

Insert examples

Ex.

Problem:

Add a record for a new customer

INSERT INTO Customer (FirstName, LastName, City, Country, Phone)

VALUES ('Craig', 'Smith', 'New York', 'USA', 1-01-993 2800)

Problem:

Add a new customer named Anita Coats to the database

INSERT INTO Customer (FirstName, LastName)

VALUES ('Anita', 'Coats')

CUSTOMER
Id
FirstName
LastName
City
Country
Phone

Data Manipulation Language (DML)

- **SELECT** command :
  - Allows database users to retrieve the specific information they desire from an operational database
  - Example, the command shown below retrieves all of the information contained within the personal_info table

```
SELECT * FROM personal_info
```

    - the asterisk (*) is used as a wildcard in SQL - "Select everything from the personal_info table.“

Data Manipulation Language (DML)

- **SELECT** command :
  - Users limit the attributes that are retrieved from the database
  - For example, the Human Resources department may require a list of the last names of all employees in the company
    - SELECT last_name

      FROM personal_info

Data Manipulation Language (DML)

- **SELECT** command :
  - The WHERE clause can be used to limit the records that are retrieved to those that meet specified criteria
  - The following command retrieves all of the data contained within personal_info for records that have a salary value greater than $50,000:

```
SELECT *
FROM    personal_info
WHERE salary > $50,000
```

Data Manipulation Language (DML)

- **UPDATE** command :
  - To modify information contained within a table, either in bulk or individually
  - Syntax:
    - UPDATE table-name SET column-name = value, column-name = value, ...
  - For example, Each year, company gives all employees a 3% cost-of-living increase in their salary

    -
      ```
      UPDATE personal_info
            SET salary = salary * 1.03
      ```

    -
      ```
      UPDATE personal_info
            SET salary = salary + $5000
            WHERE employee_id = 2
      ```

Data Manipulation Language (DML)

- **DELETE** command :
  - The DELETE command with a WHERE clause can be used to remove specific record from the personal_info table:
  - Syntax:

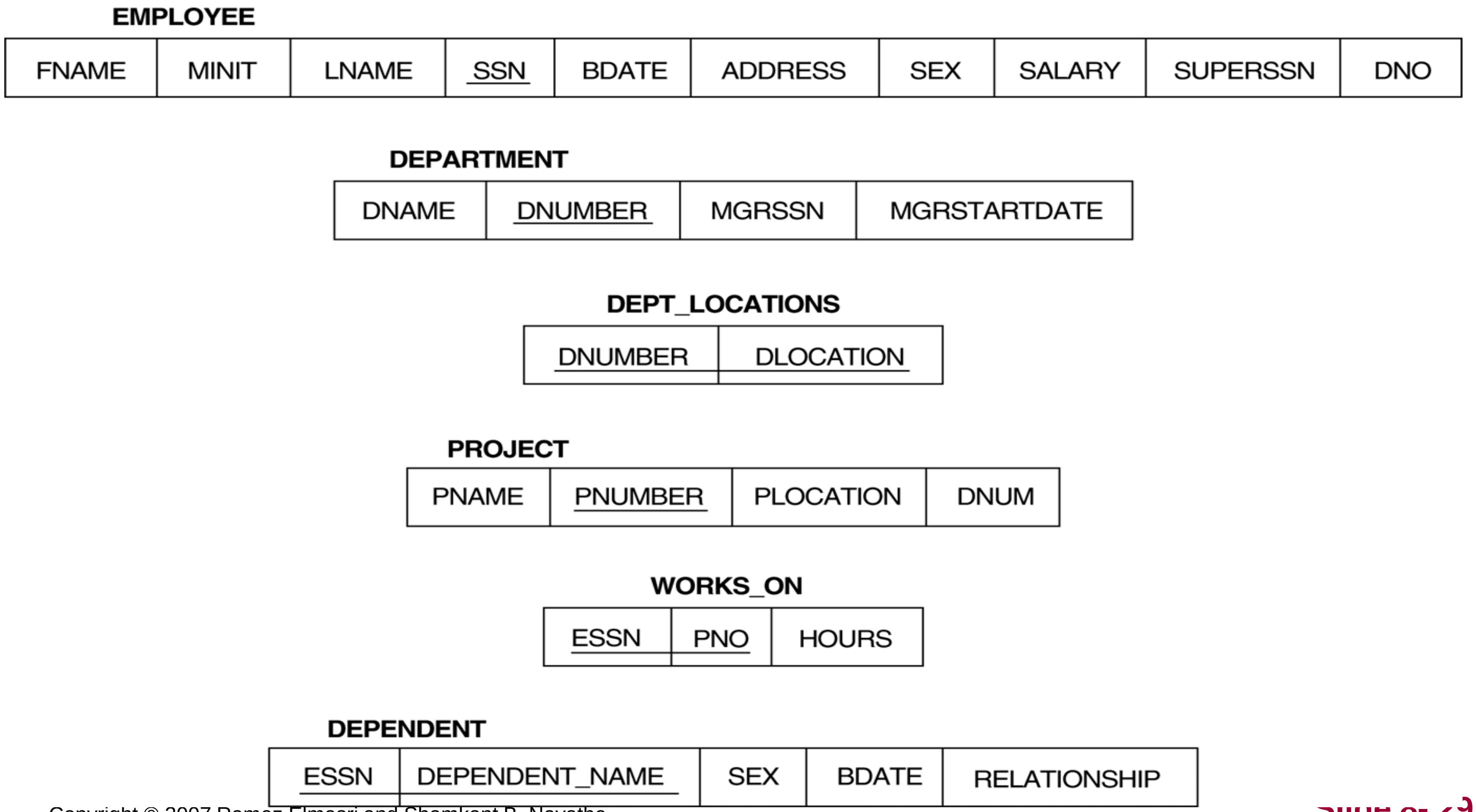
- DELETE from table-name WHERE condition

  - Example;
    - DELETE FROM personal_info
      WHERE employee_id = 2
    - DELETE all the records from the CUSTOMERS table

- - DELETE FROM CUSTOMERS;

Examples

- Consider the following relational database schema corresponding to a COMPANY database



EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

DEPT_LOCATIONS

DNUMBER	DLOCATION

PROJECT

PNAME	PNUMBER	PLOCATION	DNUM

WORKS_ON

ESSN	PNO	HOURS

DEPENDENT

ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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	1968-07-19	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

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1988-05-22
	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

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

- Example of a simple query on *one* relation
- Query 0: Retrieve the birthdate and address of the employee whose name is 'John B. Smith'.
- **Q0:**

```
Q0:     SELECT   BDATE, ADDRESS
        FROM     EMPLOYEE
        WHERE    FNAME='John' AND
        MINIT='B’
        AND      LNAME='Smith'
```

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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	1968-07-19	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

DEPT_LOCATIONS	DNUMBER	DLOCATION
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	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
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	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

WORKS_ON	ESSN	PNO	HOURS
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	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

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	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

- Query 1: Retrieve the name and address of all employees who work for the 'Research' department

```
Q1: SELECT      FNAME, LNAME,
ADDRESS
FROM        EMPLOYEE, DEPARTMENT
WHERE       DNAME='Research' AND
DNUMBER=DNO
```

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	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	1968-07-19	3321 Castle, Spring, TX	F	25000	987654321	4
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	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

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1988-05-22
	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

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
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	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
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	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

- Query 2: For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate

```
Q2:     SELECT PNUMBER, DNUM, LNAME, BDATE,
        ADDRESS
        FROM  PROJECT, DEPARTMENT,
        EMPLOYEE
        WHERE DNUM=DNUMBER AND
        MGRSSN=SSN  AND
        PLOCATION='Stafford'
```

- Query 2: For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate

Note:

- The join condition DNUM=DNUMBER relates a project to its controlling department
- The join condition MGRSSN=SSN relates the controlling department to the employee who manages that department
- A *missing WHERE-clause* indicates no condition; hence, *all tuples* of the relations in the FROM-clause are selected

- To retrieve all the attribute values of the selected tuples, a * is used, which stands for *all the attributes*

  - Examples:

```
Q:   SELECT  * FROM     EMPLOYEE
               WHERE    DNO=5

Q:   SELECT * FROM      EMPLOYEE,  DEPARTMENT
               WHERE    DNAME='Research' AND
                        DNO=DNUMBER
```

AND , OR, NOT clause

Problem: Get customer named Thomas Hardy

- SELECT Id, FirstName, LastName, City, Country

FROM Customer

WHERE FirstName = 'Thomas' AND LastName = 'Hardy'

Problem: List all customers from Spain or France

- SELECT Id, FirstName, LastName, City, Country

FROM Customer

WHERE Country = 'Spain' OR Country = 'France‘

Problem: List all customers that are not from the USA

- SELECT Id, FirstName, LastName, City, Country

FROM Customer

WHERE NOT Country = 'USA'

Order by

- ORDER BY allows sorting by one or more columns.
- Records can be returned in ascending or descending order. **The default sort order is ascending.**
- The general syntax is:

```
 SELECT column-names FROM table-name
  WHERE condition
  ORDER BY column-names ASC|DESC
```

Problem: List all suppliers in alphabetical order

```
SELECT CompanyName, ContactName, City, Country
FROM Supplier
ORDER BY CompanyName
```

Order by

Problem: List all customers in descending order

```
SELECT * FROM CUSTOMERS ORDER BY NAME
DESC;
```

Set Operations

Union

- combine the results of two or more Select statements
- it will eliminate duplicate rows from its result set
- number of columns and datatype must be same in both the tables.

Union all

This operation is similar to Union. But it also shows the duplicate rows.

Intersect

- combine two SELECT statements, but it only returns the records which are common from both SELECT statements.
- In case of **Intersect** the number of columns and data-type must be same.

Set Operations

Minus

- combines result of two Select statements and return only those result which belongs to first set of result

Set Operations

Example on Union:
Query: select * from First **UNION** select * from second

Second	
ID	**Name**
2	adam
3	Chester

First	
ID	**Name**
1	abhi
2	adam

Result:

ID	**NAME**
1	abhi
2	adam
3	Chester

Set Operations

Example on Union all:
Query: select * from First **UNION ALL** select * from second

ID	Name
2	adam
3	Chester

ID	Name
1	abhi
2	adam

Result:

ID	NAME
1	abhi
2	adam
2	adam
3	Chester

Set Operations

Example on Intersect:

Query: select * from First **INTERSECT** select * from second

ID	Name
1	abhi
2	adam

ID	Name
2	adam
3	Chester

Result:

ID	NAME
2	adam

Set Operations

Example on Minus:

Query: select * from First **MINUS** select * from second

The above query will return only those rows which are unique in ‘First’

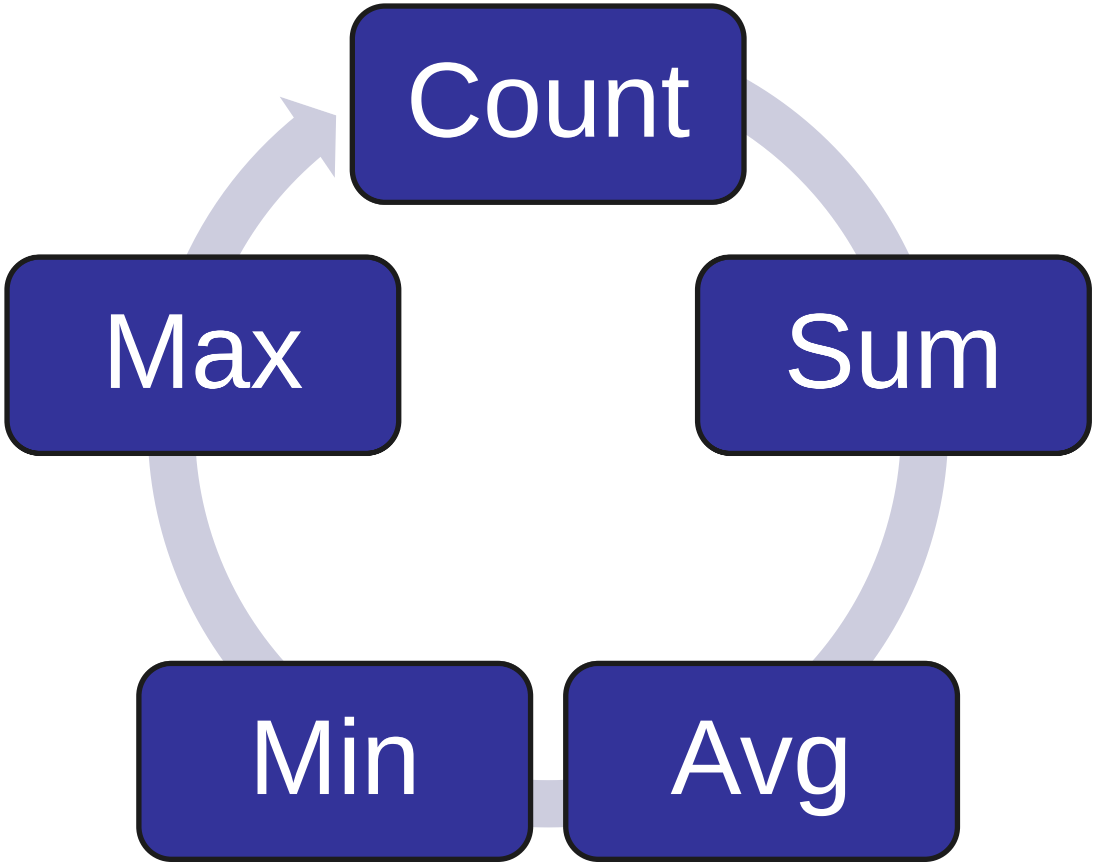
ID	Name
1	abhi
2	adam

ID	Name
2	adam
3	Chester

Result:

ID	NAME
1	abhi

Aggregate Functions



Count

Sum

Avg

Min

Max

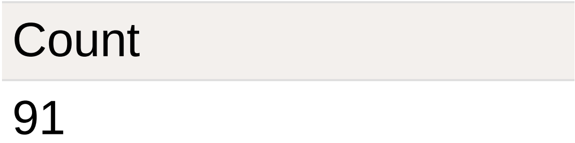
Aggregate Functions

- SELECT COUNT returns a count of the number of data values.
- SELECT SUM returns the sum of the data values.
- SELECT AVG returns the average of the data values.

Problem: Find the number of customers

- SELECT COUNT(Id)

FROM Customer

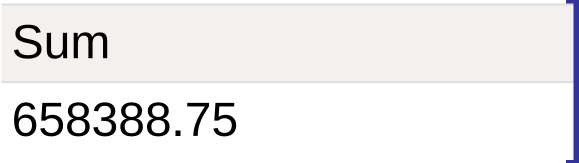


Count
91

Aggregate Functions

Problem: Compute the total amount sold in 2013

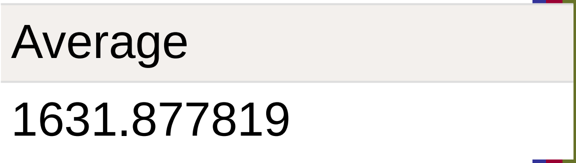
```
- SELECT SUM(TotalAmount)
FROM [Order]
WHERE YEAR(OrderDate) = 2013
```



Sum
658388.75

Problem: Compute the average size of all orders

```
- SELECT AVG(TotalAmount)
FROM [Order]
```



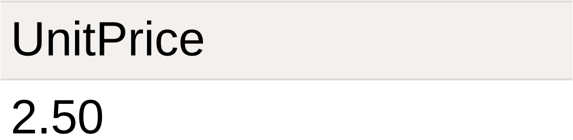
Average
1631.877819

Aggregate Functions

- SELECT MIN returns the minimum value for a column.
- SELECT MAX returns the maximum value for a column.

Problem: Find the cheapest product

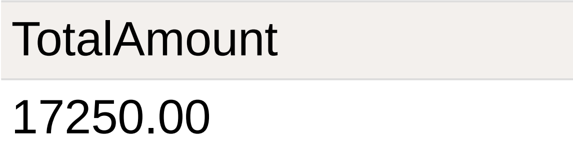
```
- SELECT MIN(UnitPrice)
FROM Product
```



UnitPrice
2.50

Problem: Find the largest order placed in 2014

```
- SELECT MAX(TotalAmount)
FROM [Order]
WHERE YEAR(OrderDate) = 2014
```



TotalAmount
17250.00

Distinct

- To eliminate duplicate tuples in a query result, the keyword **DISTINCT** is used
- For example, the result of Q1 may have duplicate SALARY values whereas Q2 does not have any duplicate values

```
Q1:    SELECT SALARY
       FROM EMPLOYEE

Q2:    SELECT DISTINCT SALARY
       FROM EMPLOYEE
```

Distinct

- DISTINCT can be used with aggregates: COUNT, AVG, MAX, etc.
- DISTINCT operates on a single column. DISTINCT for multiple columns is not supported.

Distinct examples

- **Problem**: List all supplier countries in alphabetical order.

```
SELECT DISTINCT Country
FROM Supplier
ORDER BY COUNTRY
```

- **Problem**: List the number of supplier countries

```
SELECT COUNT (DISTINCT Country)
FROM Supplier
```

Between

- WHERE BETWEEN returns values that fall within a given range.
- WHERE BETWEEN is a shorthand for >= AND <=.
- BETWEEN operator is inclusive: begin and end values are included.

The general syntax is:

SELECT column-names

FROM table-name

WHERE column-name BETWEEN value1 AND value2

Between

Problem: List all products between $10 and $20

Query:

```
SELECT Id, ProductName, UnitPrice
FROM Product
WHERE UnitPrice BETWEEN 10 AND 20
ORDER BY UnitPrice
```

Id	ProductName	UnitPrice
3	Aniseed Syrup	10.00
46	Spegesild	12.00
31	Gorgonzola Telino	12.50

In

- WHERE IN returns values that matches values in a list or subquery.
- WHERE IN is a shorthand for multiple OR conditions.

The general syntax is:

SELECT column-names

FROM table-name

WHERE column-name IN (values)

In

Problem: List all suppliers from the USA, UK, OR Japan

Query:

```
SELECT Id, CompanyName, City, Country
FROM Supplier
WHERE Country IN ('USA', 'UK', 'Japan')
```

Id	CompanyName	City	Country
1	Exotic Liquids	London	UK
2	New Orleans Cajun Delights	New Orleans	USA
3	Grandma Kelly's Homestead	Ann Arbor	USA
4	Tokyo Traders	Tokyo	Japan

Like

- WHERE LIKE determines if a character string matches a pattern.
- Use WHERE LIKE when only a fragment of a text value is known.
- WHERE LIKE supports two wildcard match options: % and _.

The general syntax is:

SELECT column-names

FROM table-name

WHERE column-name LIKE value

Optional Wildcard characters allowed in 'value' are % (percent) and _ (underscore).

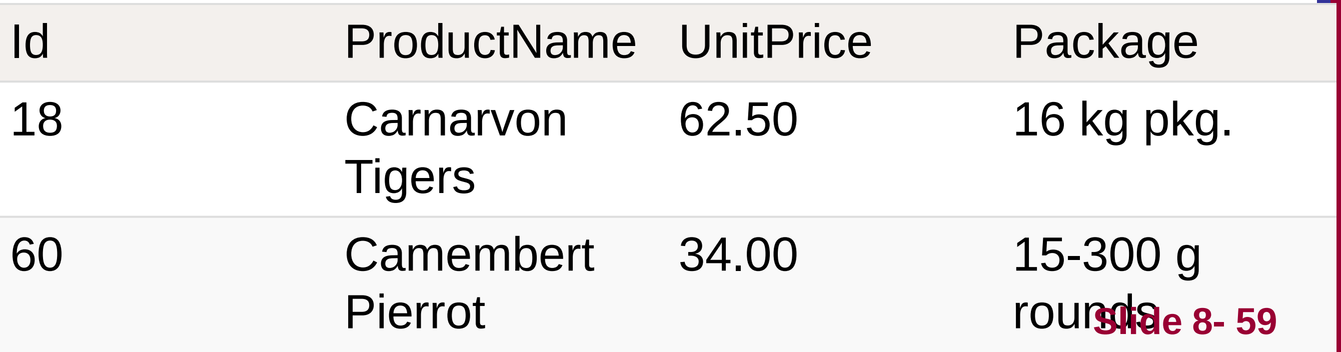
A % matches any string with zero or more characters.

An _ matches any single character.

Like

- **Problem**: List all products with names that start with 'Ca‘
- **Query**:

```
SELECT Id, ProductName, UnitPrice, Package
FROM Product
WHERE ProductName LIKE 'Ca%'
```



Id	ProductName	UnitPrice	Package
18	Carnarvon Tigers	62.50	16 kg pkg.
60	Camembert Pierrot	34.00	15-300 g rounds

Like

- **Problem**: List all products that start with 'Cha' or 'Chan' and have one more character.
- Query:

```
SELECT Id, ProductName, UnitPrice, Package
FROM Product
WHERE ProductName LIKE 'Cha_' OR ProductName LIKE 'Chan_'
```

Id	ProductName	UnitPrice	Package
1	Chai	18.00	10 boxes x 20 bags
2	Chang	19.00	24 - 12 oz bottles

Alias

- SQL aliases are used to give a table, or a column in a table, a temporary name.
- Aliases are often used to make column names more readable.
- An alias only exists for the duration of the query.

Syntax:

For Column

SELECT *column_name* AS *alias_name*

FROM *table_name;*

Alias

Examples:

1. Alias for columns

```
SELECT CustomerID as ID, CustomerName AS Customer
FROM Customers;
```

```
SELECT CustomerName, Address + ', ' + PostalCode + ' ' + City + ', ' +
Country AS Address
FROM Customers;
```

Alias

Syntax:

For Table

SELECT *column_name(s)*

FROM *table_name* AS *alias_name;*

Examples:

2. Alias for tables

SELECT o.OrderID, o.OrderDate, c.CustomerName

FROM Customers AS c, Orders AS o

WHERE c.CustomerName="Around the

Horn" AND c.CustomerID=o.CustomerID;

Alias

Problem: List total customers in each country.

Display results with easy to understand column headers.

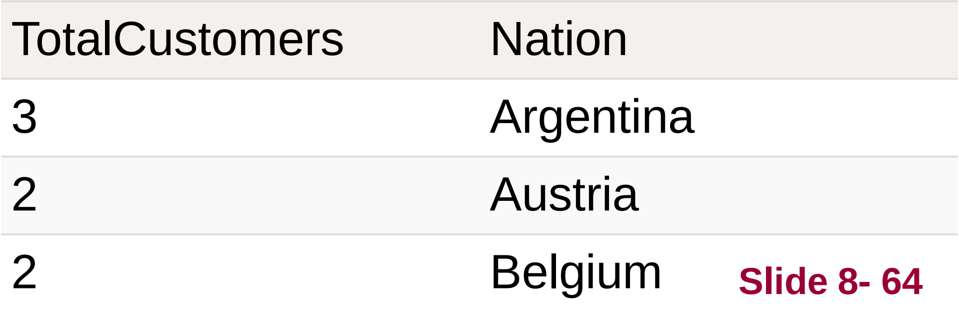
Query:

3. Alias for resultant table

SELECT COUNT(C.Id) AS TotalCustomers, C.Country AS Nation

FROM Customer C

GROUP BY C.Country



TotalCustomers	Nation
3	Argentina
2	Austria
2	Belgium

Alias

Problem: List details of customers who have placed orders (consider two tables- customer and order)

Query:

```
SELECT C.ID, C.NAME, C.AGE, O.AMOUNT FROM
CUSTOMERS AS C, ORDERS AS O WHERE C.ID =
O.CUSTOMER_ID;
```

NULL values

- **NULL** is the term used to represent a missing value.
- a NULL value is different than a zero value or a field that contains spaces.
- **IS NULL** or **IS NOT NULL** operators to check for a NULL value.
- Example:

```
SELECT ID, NAME, AGE, ADDRESS, SALARY FROM CUSTOMERS
WHERE SALARY IS NOT NULL;

SELECT ID, NAME, AGE, ADDRESS, SALARY FROM CUSTOMERS
WHERE SALARY IS NULL;
```

Group by

- The GROUP BY clause groups records into summary rows.
- GROUP BY returns one record for each group.
- GROUP BY also involves aggregates: COUNT, MAX, SUM, AVG, etc.
- GROUP BY can group one or more columns.

The general syntax is:

```
SELECT column-names
FROM table-name
WHERE condition
GROUP BY column-names
```

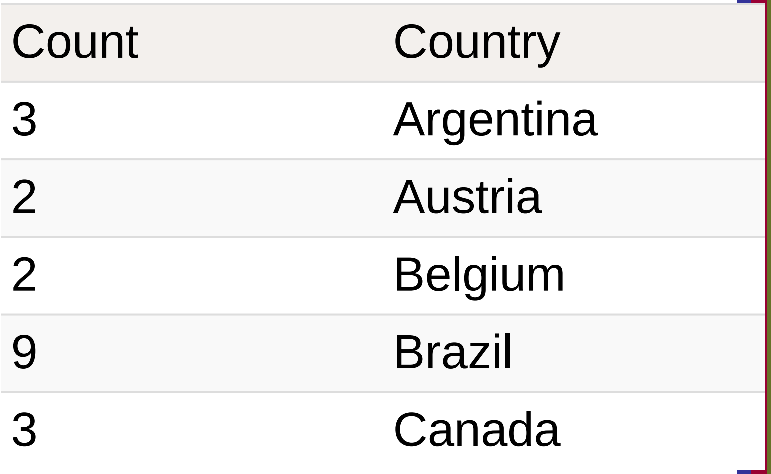
Group by

Problem: List the number of customers in each country

- SELECT COUNT(Id), Country

FROM Customer

GROUP BY Country



Count	Country
3	Argentina
2	Austria
2	Belgium
9	Brazil
3	Canada

Group by

employee_number	last_name	first_name	salary	dept_id
1001	Smith	John	62000	500
1002	Anderson	Jane	57500	500
1003	Everest	Brad	71000	501
1004	Horvath	Jack	42000	501

Problem: Calculate total salary offered by each department

Query:-

SELECT dept_id, SUM(salary) AS total_salaries FROM employees GROUP BY dept_id;

Result:	
dept_id	total_salaries
500	119500
501	113000

Group by

product_id	product_name	category_id
1	Pear	50
2	Banana	50
3	Orange	50
4	Apple	50
5	Bread	75
6	Sliced Ham	25
7	Kleenex	NULL

Query:-

```
SELECT category_id, COUNT(*) AS total_products FROM products
WHERE category_id IS NOT NULL GROUP BY category_id ORDER
BY category_id;
```

category_id	total_products
25	1
50	4
75	1

Group by

employee_number	last_name	first_name	salary	dept_id
1001	Smith	John	62000	500
1002	Anderson	Jane	57500	500
1003	Everest	Brad	71000	501
1004	Horvath	Jack	42000	501

Problem: Find min salary in each department

Query:

```
SELECT dept_id, MIN(salary) AS lowest_salary

FROM employees GROUP BY dept_id;
```

dept_id	lowest_salary
500	57500
501	42000

Having

- HAVING filters records that work on summarized GROUP BY results.
- HAVING applies to summarized group records, whereas WHERE applies to individual records.
- Only the groups that meet the HAVING criteria will be returned.
- HAVING requires that a GROUP BY clause is present.
- WHERE and HAVING can be in the same query.
- Syntax:

```
SELECT column-names
FROM table-name
WHERE condition
GROUP BY column-names
HAVING condition
```

Having

Problem: List the number of customers in each country. Only include countries with more than 10 customers.

Query:

```
SELECT COUNT(Id), Country
FROM Customer
GROUP BY Country
HAVING COUNT(Id) > 10
```

Result	
Count	Country
11	France
11	Germany
13	USA

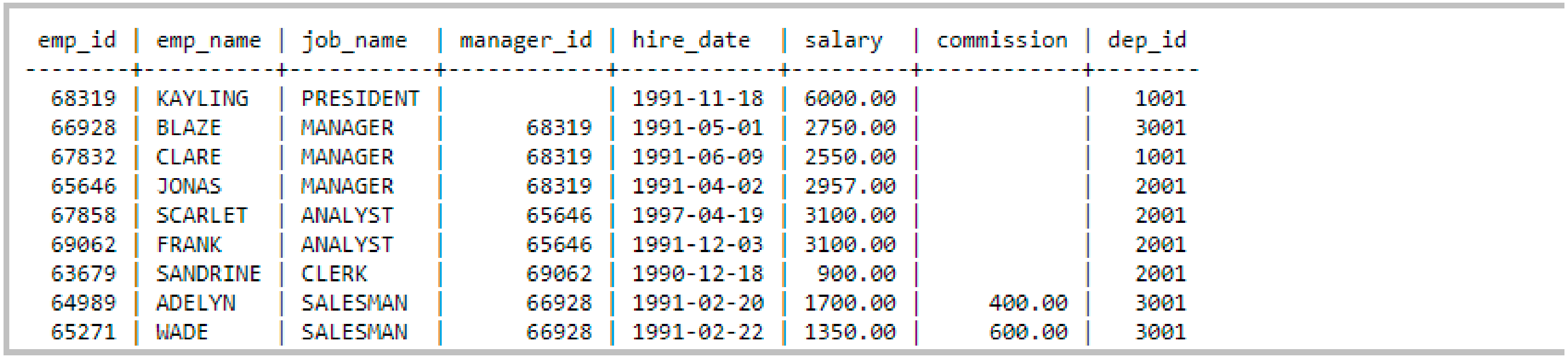
Having

Problem: Return only those records from department where the minimum salary is greater than 35000

Query:

```
SELECT department, MIN(salary) AS "Lowest salary"
FROM employees
GROUP BY department
HAVING MIN(salary) > 35000;
```

Sample table: employees



```
 emp_id | emp_name | job_name  | manager_id | hire_date  | salary  | commission | dep_id
--------+----------+-----------+------------+------------+---------+------------+--------
  68319 | KAYLING  | PRESIDENT |            | 1991-11-18 | 6000.00 |            |   1001
  66928 | BLAZE    | MANAGER   |      68319 | 1991-05-01 | 2750.00 |            |   3001
  67832 | CLARE    | MANAGER   |      68319 | 1991-06-09 | 2550.00 |            |   1001
  65646 | JONAS    | MANAGER   |      68319 | 1991-04-02 | 2957.00 |            |   2001
  67858 | SCARLET  | ANALYST   |      65646 | 1997-04-19 | 3100.00 |            |   2001
  69062 | FRANK    | ANALYST   |      65646 | 1991-12-03 | 3100.00 |            |   2001
  63679 | SANDRINE | CLERK     |      69062 | 1990-12-18 |  900.00 |            |   2001
  64989 | ADELYN   | SALESMAN  |      66928 | 1991-02-20 | 1700.00 |     400.00 |   3001
  65271 | WADE     | SALESMAN  |      66928 | 1991-02-22 | 1350.00 |     600.00 |   3001
```

Sample Queries

1. Display all data from *Employees* table for all employees who was hired before January 1st, 1992
2. Display the employee number, first name, job id and department number for all employees whose department number is not equal to 20, 60 and 80 (*Employees* table).
3. Display the last name, phone number, salary and manager number, for all employees whose manager number equals 100, 102 or 103 (*Employees* table).
4. Display the first name and salary for all employees whose first name ends with an *e* (*Employees* table).

Sample Queries

Solution

```
1. SELECT *
FROM employees
WHERE hire_date < '01-JAN-1992‘
2. SELECT employee_id , first_name , job_id, department_id
FROM employees
WHERE department_id NOT IN (20 , 60 , 80)
3. SELECT last_name , phone_number , salary , manager_id
FROM employees
WHERE manager_id IN (103 , 102 , 100)
4. SELECT first_name , salary
FROM employees
WHERE first_name LIKE '%e'
```

Sample Queries

5. Display the last name and department number for all employees where the second letter in their last name is *i* (*Employees* table).

6. Average salary per department

-Display the department number and average salary for each department.

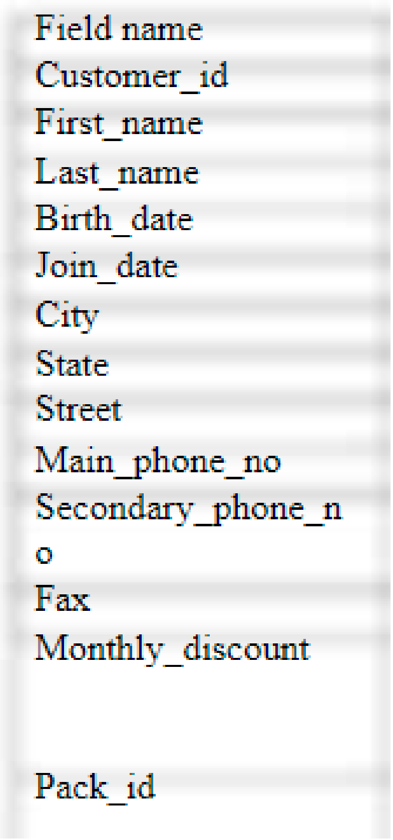
-Modify your query to display the results only for departments 50 or 80.

7. Display the department number, and the average salary for each department, for all departments whose number is in the range of 20 and 80, and their average salary is greater than 9000.

8. Customers and internet packages (*Customers* & *Packages* tables) –

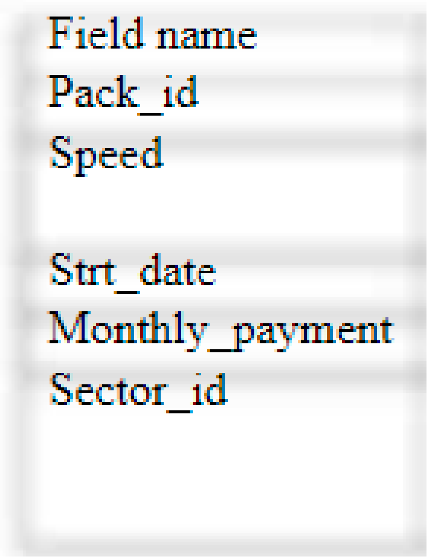
Write a query to display first name, last name, package number and internet speed for all customers whose package number equals 22 or 27, apply order by over last name

1. Customers



Field name
Customer_id
First_name
Last_name
Birth_date
Join_date
City
State
Street
Main_phone_no
Secondary_phone_no
Fax
Monthly_discount
Pack_id

2. Packages



Field name
Pack_id
Speed
Strt_date
Monthly_payment
Sector_id

Sample Queries

Solution

```
5. SELECT last_name , department_id
FROM employees
WHERE last_name LIKE '_i%‘

6. SELECT department_id , AVG(salary)
FROM employees
GROUP BY department_id

SELECT department_id , AVG(salary)
FROM employees
WHERE department_id IN (50, 80)
GROUP BY department_id

7. SELECT AVG(salary) , department_id
FROM employees
WHERE department_id BETWEEN 20 AND 80
GROUP BY department_id
HAVING AVG(salary) > 9000
```

```
8. SELECT cust.last_name ,
cust.first_name , cust.pack_id ,
pack.speed
FROM customers cust JOIN
packages pack
ON      cust.pack_id = pack.pack_id
WHERE cust.pack_id IN (27, 22)
ORDER BY cust.last_name
```

Any, All

ALL Operator:

The ALL operator returns TRUE if all of the subquery values meet the condition.

Query:

Select * from sales where total_amt > ALL (100, 340, 23)

(Without all,

Select * from sales where total_amt > 100 AND total_amt > 340 AND total_amt > 23)

ANY Operator:

The ANY operator returns TRUE if any of the subquery values meet the condition.

Query:

Select * from sales where total_amt > ANY (100, 340, 23)

(Without any,

Select * from sales where total_amt > 100 OR total_amt > 340 OR total_amt > 23)

Exists

- The Exists operator is used in queries where the query result depends on whether or not certain rows exist in a table.
- It evaluates to true if subquery returns atleast one row.

Query:

```
Select * from dept
Where not exists
(select * from emp where emp.deptno = dept.deptno)
```

Subquery

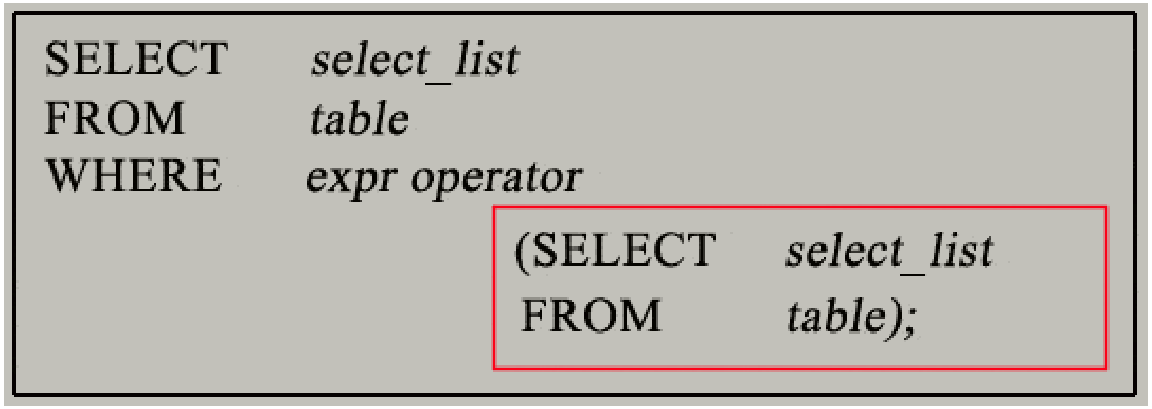
- A subquery is a SQL query nested inside a larger query.
- The subquery can be nested inside a SELECT, INSERT, UPDATE, or DELETE statement or inside another subquery.
- A subquery is usually added within the WHERE Clause of another SQL SELECT statement.

Subquery

- The comparison operators can be used, such as **>, <, or =.**
- The comparison operator can also be a multiple-row operator, such as **IN, ANY, or ALL**.
- A subquery is also called an inner query or inner select, while the statement containing a subquery is also called an outer query or outer select.
- **The inner query executes first before its parent query so that the results of an inner query can be passed to the outer query.**

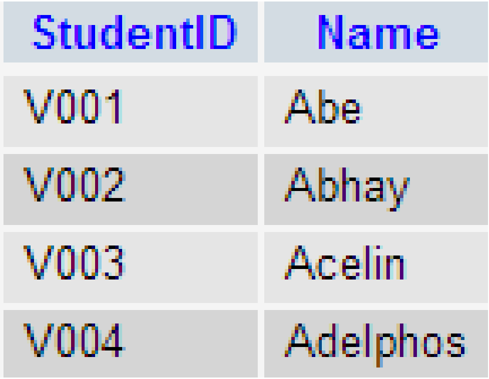
Subquery

Syntax:

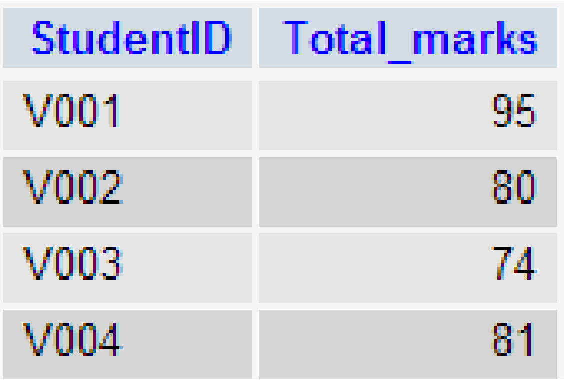


```
SELECT    select_list
FROM      table
WHERE     expr operator
                   (SELECT    select_list
                    FROM      table);
```

Example: following two tables 'student' and 'marks' with common field 'StudentID'.



StudentID	Name
V001	Abe
V002	Abhay
V003	Acelin
V004	Adelphos



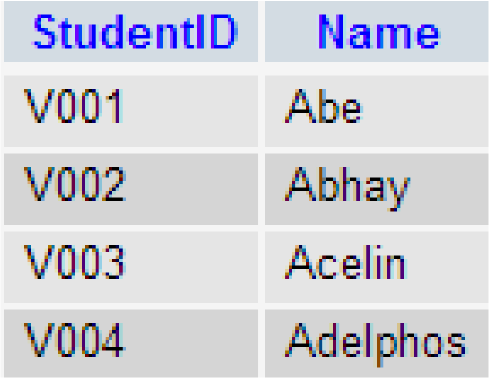
StudentID	Total_marks
V001	95
V002	80
V003	74
V004	81

Subquery

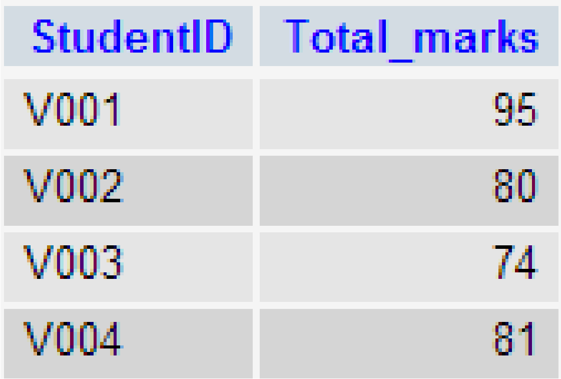
Problem - write a query to identify all students who get better marks than that of the student who's StudentID is 'V002‘

Solution:

We require two queries;



StudentID	Name
V001	Abe
V002	Abhay
V003	Acelin
V004	Adelphos



StudentID	Total_marks
V001	95
V002	80
V003	74
V004	81

First query:-

returns the marks (stored in Total_marks field) of 'V002'

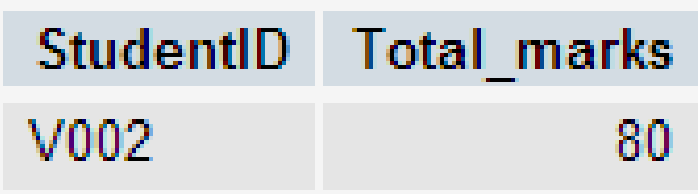
Second query:-

identifies the students who get better marks than the result of the first query.

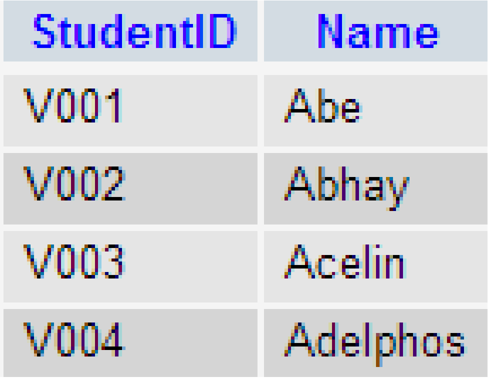
Subquery

First query:-

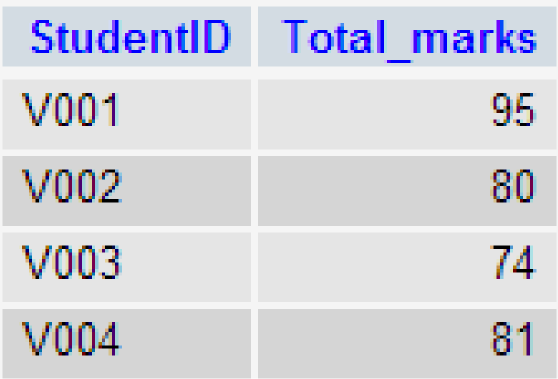
SELECT * FROM marks WHERE studentid = 'V002';



StudentID	Total_marks
V002	80



StudentID	Name
V001	Abe
V002	Abhay
V003	Acelin
V004	Adelphos



StudentID	Total_marks
V001	95
V002	80
V003	74
V004	81

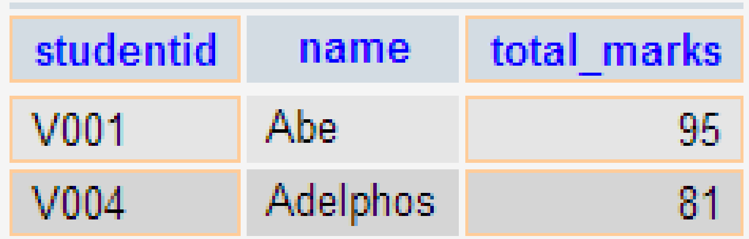
Second query:-

SELECT a.studentid, a.name, b.total_marks

FROM student a, marks b

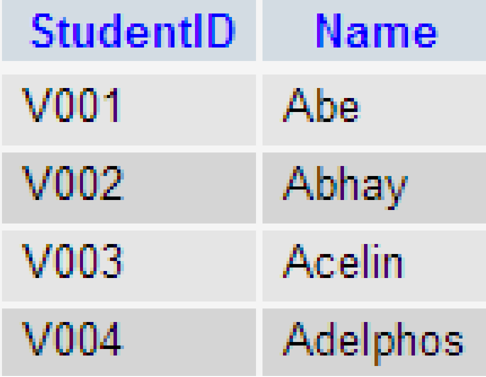
WHERE a.studentid = b.studentid

AND b.total_marks >80;

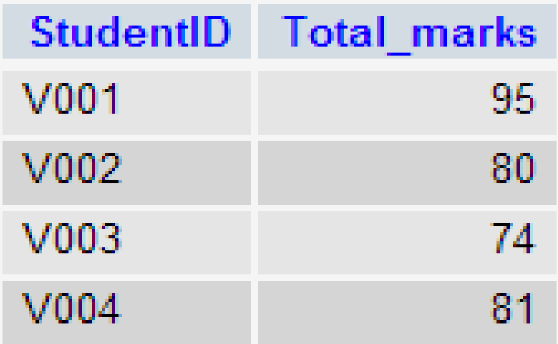


studentid	name	total_marks
V001	Abe	95
V004	Adelphos	81

Subquery



StudentID	Name
V001	Abe
V002	Abhay
V003	Acelin
V004	Adelphos

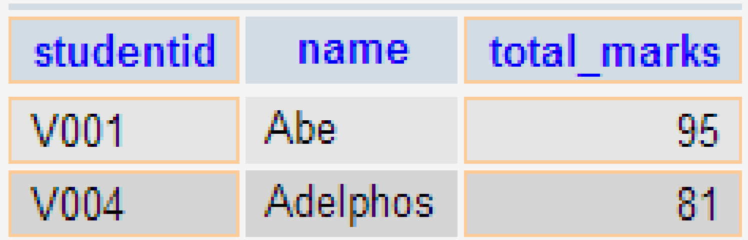


StudentID	Total_marks
V001	95
V002	80
V003	74
V004	81

Subquery:-

```
SELECT a.studentid, a.name, b.total_marks

FROM student a, marks b

WHERE a.studentid = b.studentid

AND b.total_marks >

(SELECT total_marks FROM marks WHERE studentid = 'V002‘);
```

Query result:



studentid	name	total_marks
V001	Abe	95
V004	Adelphos	81

Subquery Guidelines

- A subquery must be enclosed in parentheses.
- A subquery must be placed on the right side of the comparison operator.
- If a subquery (inner query) returns a null value to the outer query, the outer query will not return any rows when using certain comparison operators in a WHERE clause.
- Only one ORDER BY clause can be used for a SELECT statement, and if specified, it must be the last clause in the main SELECT statement.

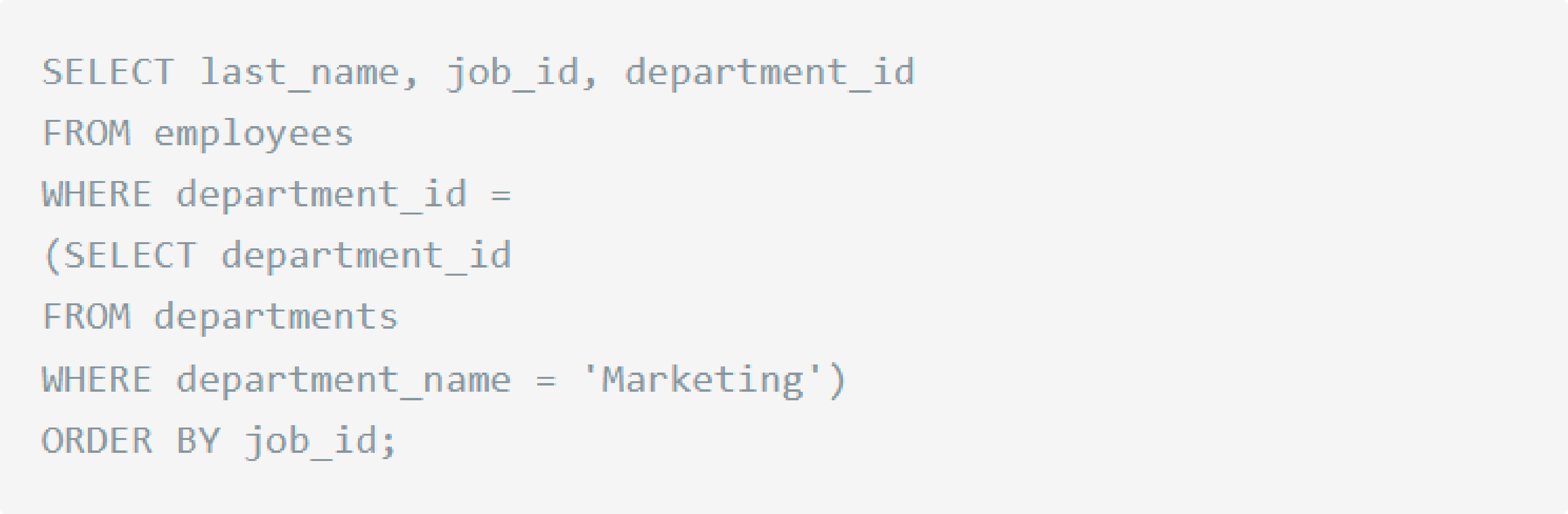
Types of Subquery

- Single row subquery : Returns zero or one row.
- Multiple row subquery : Returns one or more rows.
- Multiple column subqueries : Returns one or more columns.
- Correlated subqueries : Reference one or more columns in the outer SQL statement. The subquery is known as a correlated subquery because the subquery is related to the outer SQL statement.
- Nested subqueries : Subqueries are placed within another subquery.

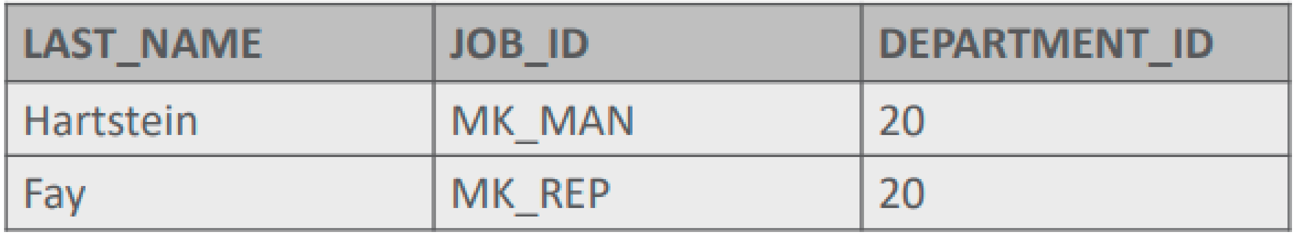
Single Row Subquery – Ex 1

- A single row subquery returns zero or one row to the outer SQL statement.
- Subquery can be placed in a WHERE clause, a HAVING clause, or a FROM clause of a SELECT statement.
- Ex- **Select list of employees work in marketing department**.

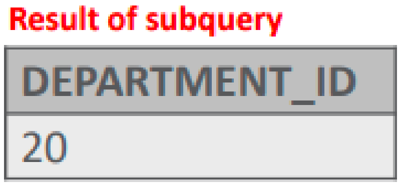
Single Row Subquery – Ex 1 (cont.)



```
SELECT last_name, job_id, department_id
FROM employees
WHERE department_id =
(SELECT department_id
FROM departments
WHERE department_name = 'Marketing')
ORDER BY job_id;
```



LAST_NAME	JOB_ID	DEPARTMENT_ID
Hartstein	MK_MAN	20
Fay	MK_REP	20



Result of subquery

DEPARTMENT_ID
20

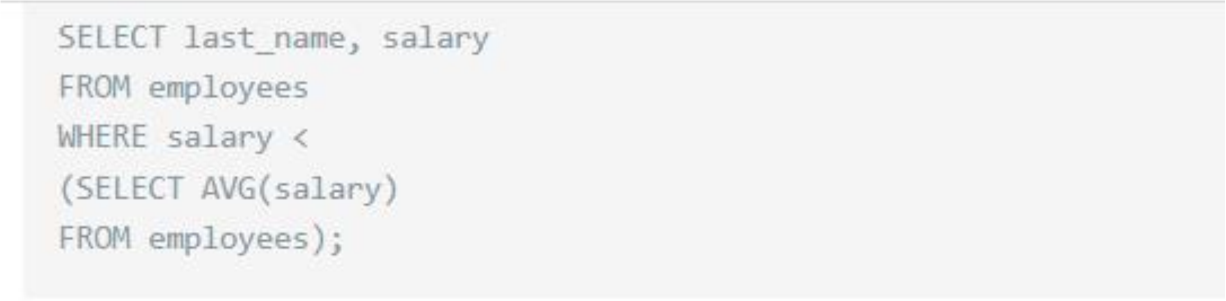
The sub-query finds the department_id for ‘Marketing’, the outer query uses the returned *department_id* to display rows from the employees table.

Single Row Subquery – Ex 2

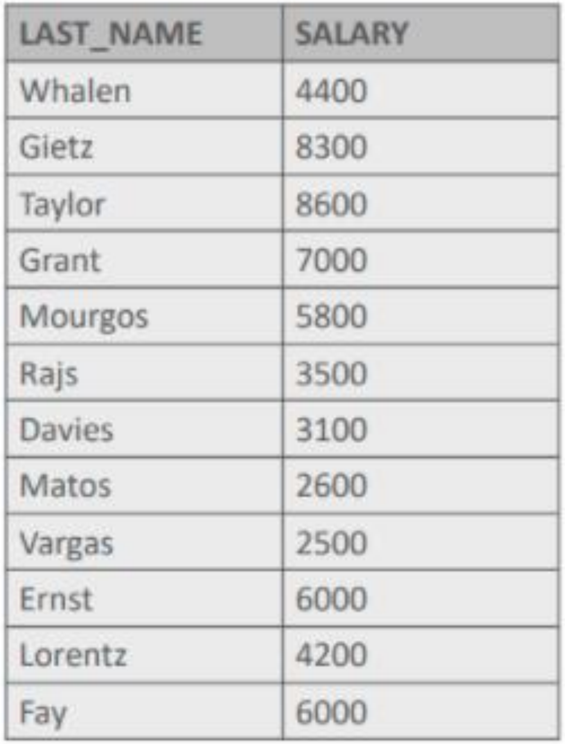
Which employees earn less than the average salary?

- The subquery first finds the average salary for all employees,
- the outer query then returns employees with a salary of less than the average.

Single Row Subquery – Ex 2 (cont.)

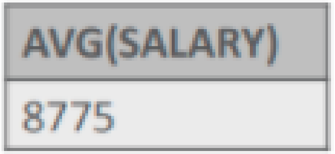


```
SELECT last_name, salary
FROM employees
WHERE salary <
(SELECT AVG(salary)
FROM employees);
```



LAST_NAME	SALARY
Whalen	4400
Gietz	8300
Taylor	8600
Grant	7000
Mourgos	5800
Rajs	3500
Davies	3100
Matos	2600
Vargas	2500
Ernst	6000
Lorentz	4200
Fay	6000

Result of subquery



AVG(SALARY)
8775

Single Row Subquery – Ex 3

Consider table agent

- **Problem:** Retrieve the agent_name, agent_code, phone_no from the agents table whose agent_name is 'Alex'.
  - (retrieve record based on **agent_code**)

AGENT_CODE | AGENT_NAME | WORKING_AREA | COMMISSION | PHONE_NO | COUNTRY

Single Row Subquery – Ex 3 (cont.)

AGENT_CODE | AGENT_NAME | WORKING_AREA | COMMISSION | PHONE_NO | COUNTRY

- Inner query:

```
SELECT agent_code FROM agents WHERE agent_name = 'Alex';
```

Output:

```
AGENT_CODE
 ----------
A003
```

- Outer query:

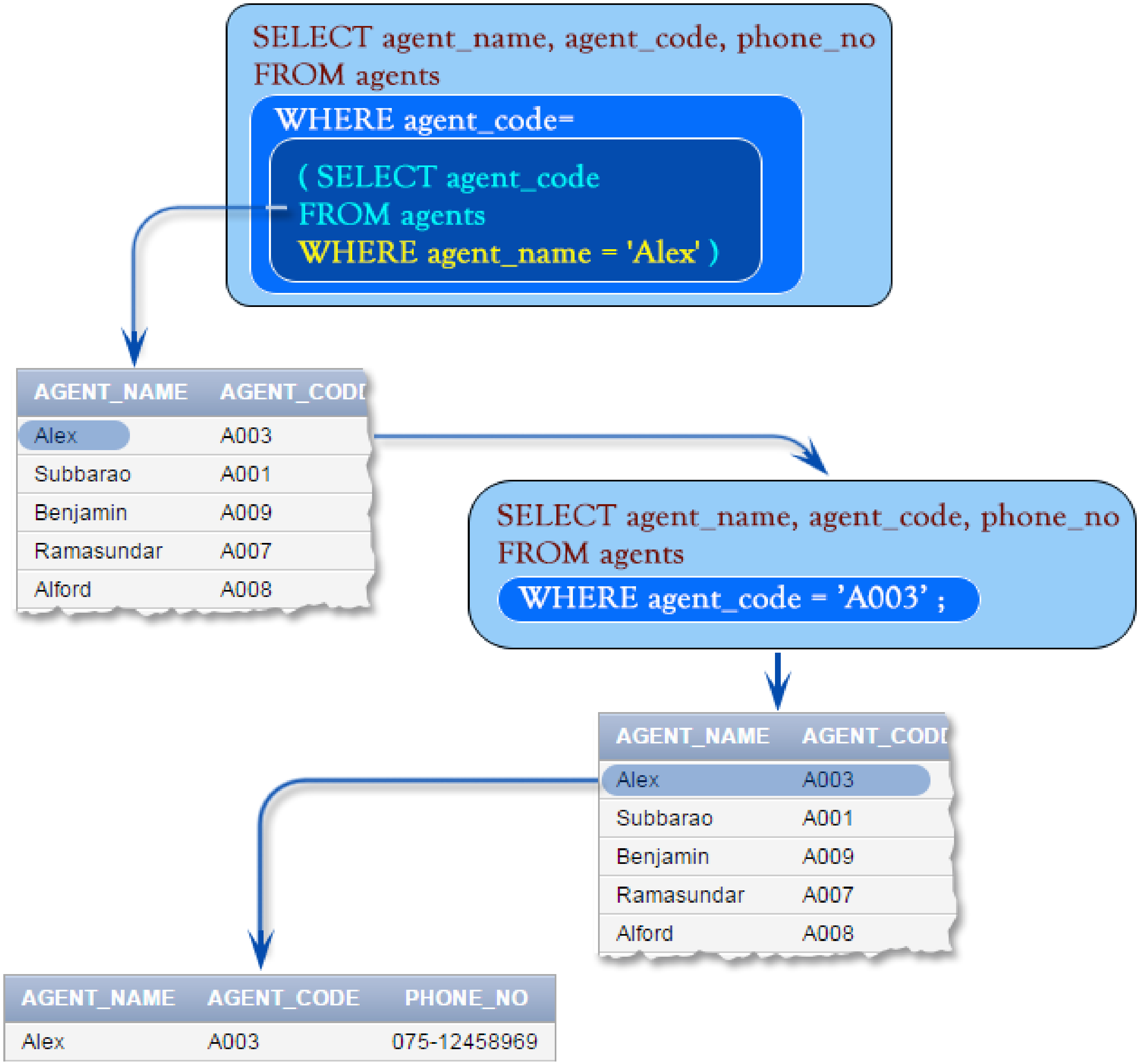
```
SELECT agent_name, agent_code, phone_no FROM agents WHERE

agent_code = 'A003';
```

Single Row Subquery- Ex 3 (cont.)

AGENT_CODE | AGENT_NAME | WORKING_AREA | COMMISSION | PHONE_NO | COUNTRY

Subquery:

```
SELECT agent_name, agent_code, phone_no FROM agents

WHERE agent_code =

(SELECT agent_code FROM agents

WHERE agent_name = 'Alex');
```



```
SELECT agent_name, agent_code, phone_no
FROM agents
WHERE agent_code=
    ( SELECT agent_code
    FROM agents
    WHERE agent_name = 'Alex' )
```

AGENT_NAME	AGENT_CODI
Alex	A003
Subbarao	A001
Benjamin	A009
Ramasundar	A007
Alford	A008

```
SELECT agent_name, agent_code, phone_no
FROM agents
WHERE agent_code = 'A003' ;
```

AGENT_NAME	AGENT_CODI
Alex	A003
Subbarao	A001
Benjamin	A009
Ramasundar	A007
Alford	A008

AGENT_NAME	AGENT_CODE	PHONE_NO
Alex	A003	075-12458969

Single Row Subquery – Ex 4

- Other comparison operators such as **<>, >, <, <=** can be used with a single subquery.
- Example:

Obtain order_num, ord_amt, ord_date, cust_code, agent_code from order table where order amount is more than the average order amount placed on date='12-02-2018'.

Single Row Subquery – Ex 4 (cont.)

- **Example:**

Obtain order_num, ord_amt, ord_date, cust_code, agent_code from order table where order amount is more than the average order amount placed on date=’12-02-2018’.

Query:

```
SELECT ord_num,ord_amount,ord_date,cust_code, agent_code
FROM orders
WHERE ord_amount>
(SELECT AVG(ord_amount) FROM orders
WHERE ord_date='20-APR-08');
```

Multiple Row Subquery

- Multiple row subquery returns one or more rows to the outer SQL statement.
- You may use the IN, ANY, or ALL operator in outer query to handle a subquery that returns multiple rows.

Using IN operator with a Multiple Row Subquery

- IN operator is used to check a value within a set of values. The list of values may come from the results returned by a subquery.

Multiple Row Subquery

- Example:

Consider agent and order tables

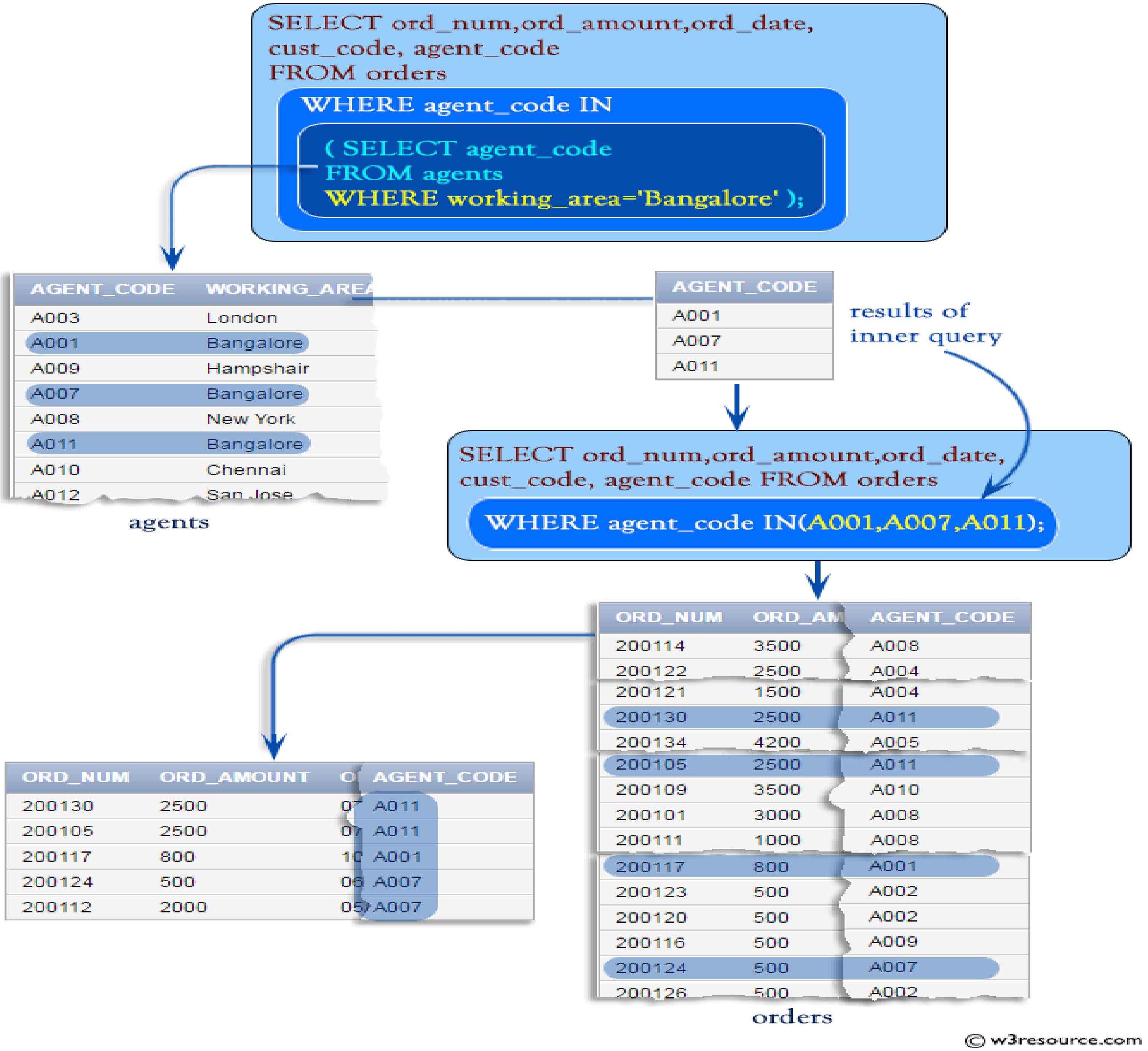
Outer query: 'agent_code' of 'orders' table must be in the list within IN operator in inner query

Inner query:

'working_area' of 'agents' table must be 'Bangalore',

Query:

```
SELECT ord_num,ord_amount,ord_date, cust_code, agent_code
FROM orders
WHERE agent_code IN ( SELECT agent_code FROM agents WHERE
working_area='Bangalore');
```



```
SELECT ord_num,ord_amount,ord_date,
cust_code, agent_code
FROM orders
WHERE agent_code IN
  ( SELECT agent_code
  FROM agents
  WHERE working_area='Bangalore' );
```

AGENT_CODE	WORKING_AREA
A003	London
A001	Bangalore
A009	Hampshair
A007	Bangalore
A008	New York
A011	Bangalore
A010	Chennai
A012	San Jose

agents

AGENT_CODE
A001
A007
A011

results of inner query

```
SELECT ord_num,ord_amount,ord_date,
cust_code, agent_code FROM orders
WHERE agent_code IN(A001,A007,A011);
```

ORD_NUM	ORD_AM	AGENT_CODE
200114	3500	A008
200122	2500	A004
200121	1500	A004
200130	2500	A011
200134	4200	A005
200105	2500	A011
200109	3500	A010
200101	3000	A008
200111	1000	A008
200117	800	A001
200123	500	A002
200120	500	A002
200116	500	A009
200124	500	A007
200126	500	A002

orders

ORD_NUM	ORD_AMOUNT	O	AGENT_CODE
200130	2500	07	A011
200105	2500	07	A011
200117	800	10	A001
200124	500	06	A007
200112	2000	05/	A007

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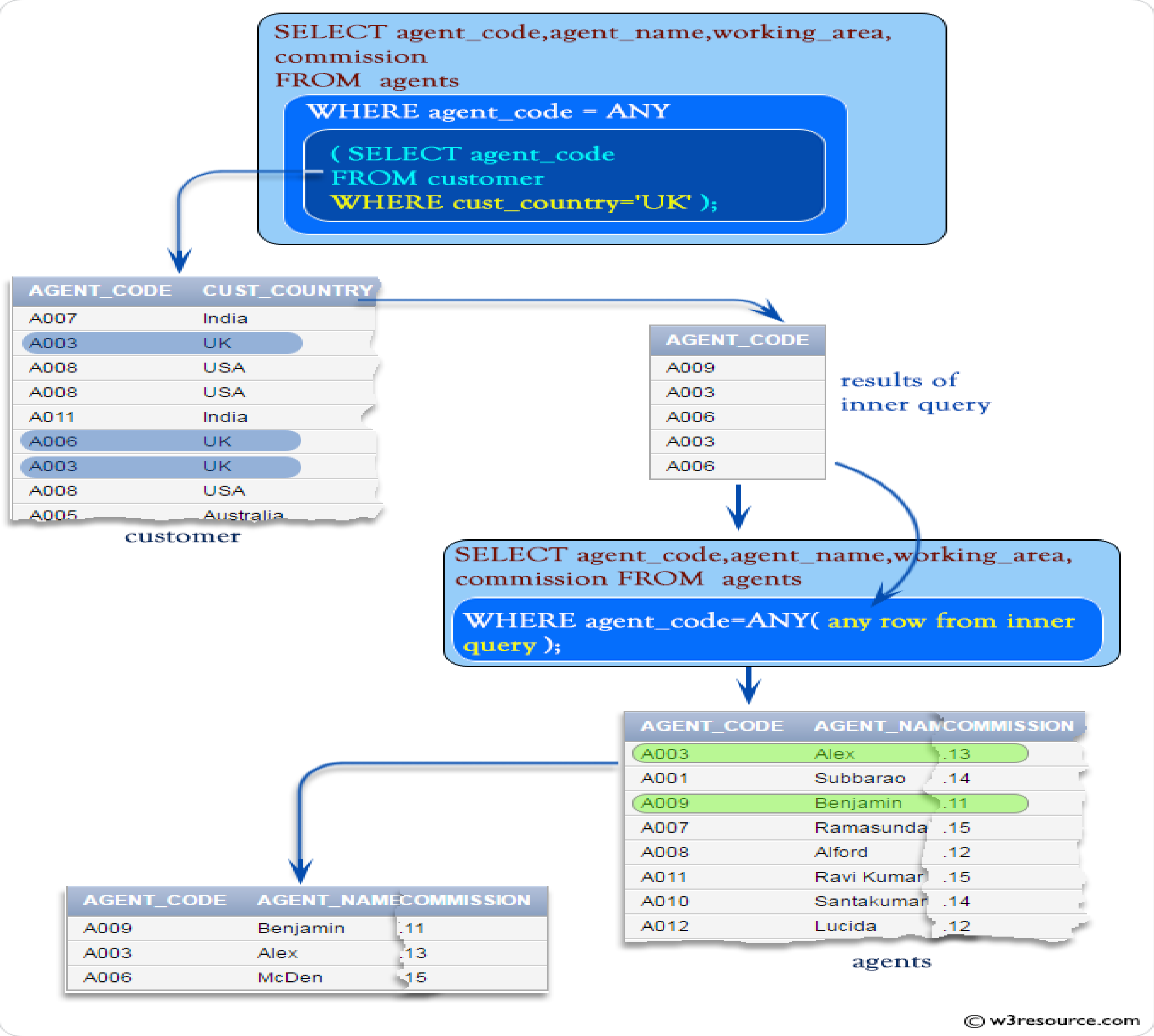
Multiple Row Subquery

Using ANY with a Multiple Row Subquery

- Use the ANY operator to compare a value with any value in a list.
- Place an =, <>, >, <, <= or >= operator before ANY in your query.
- The following example uses ANY to check if any of the agent who belongs to the country 'UK'.
- Query:

```
SELECT agent_code,agent_name,working_area,commission
FROM agents
WHERE agent_code = ANY
( SELECT agent_code FROM customer WHERE cust_country='UK');
```



```
SELECT agent_code,agent_name,working_area,
commission
FROM  agents
WHERE agent_code = ANY
( SELECT agent_code
FROM customer
WHERE cust_country='UK' );
```

AGENT_CODE	CUST_COUNTRY
A007	India
A003	UK
A008	USA
A008	USA
A011	India
A006	UK
A003	UK
A008	USA
A005	Australia

customer

AGENT_CODE
A009
A003
A006
A003
A006

results of inner query

```
SELECT agent_code,agent_name,working_area,
commission FROM  agents
WHERE agent_code=ANY( any row from inner
query );
```

AGENT_CODE	AGENT_NAME	COMMISSION
A003	Alex	.13
A001	Subbarao	.14
A009	Benjamin	.11
A007	Ramasunda	.15
A008	Alford	.12
A011	Ravi Kumar	.15
A010	Santakumar	.14
A012	Lucida	.12

agents

AGENT_CODE	AGENT_NAME	COMMISSION
A009	Benjamin	.11
A003	Alex	13
A006	McDen	15

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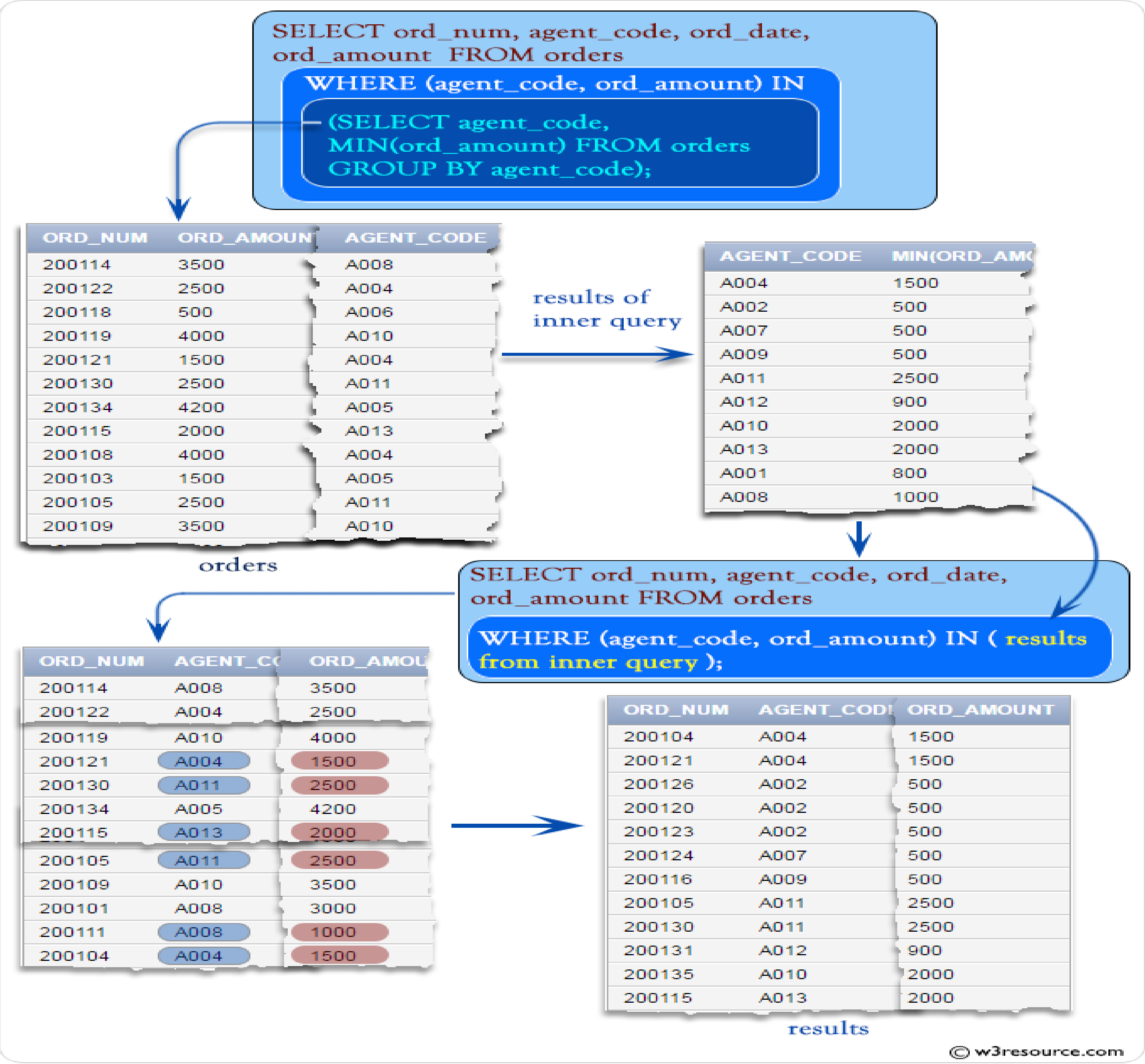
Multiple Column Subquery

- Subquery returns multiple columns
- **The following example retrieves the order amount with the lowest price, group by agent code.**

```
select ord_num, agent_code, ord_date, ord_amount from orders
where(agent_code, ord_amount) IN
(SELECT agent_code, MIN(ord_amount)
FROM orders
GROUP BY agent_code);
```



```
SELECT ord_num, agent_code, ord_date,
ord_amount  FROM orders
WHERE (agent_code, ord_amount) IN
(SELECT agent_code,
MIN(ord_amount) FROM orders
GROUP BY agent_code);
```

ORD_NUM	ORD_AMOUN	AGENT_CODE
200114	3500	A008
200122	2500	A004
200118	500	A006
200119	4000	A010
200121	1500	A004
200130	2500	A011
200134	4200	A005
200115	2000	A013
200108	4000	A004
200103	1500	A005
200105	2500	A011
200109	3500	A010

orders

AGENT_CODE	MIN(ORD_AMC
A004	1500
A002	500
A007	500
A009	500
A011	2500
A012	900
A010	2000
A013	2000
A001	800
A008	1000

```
SELECT ord_num, agent_code, ord_date,
ord_amount FROM orders
WHERE (agent_code, ord_amount) IN ( results
from inner query );
```

ORD_NUM	AGENT_C	ORD_AMOU
200114	A008	3500
200122	A004	2500
200119	A010	4000
200121	A004	1500
200130	A011	2500
200134	A005	4200
200115	A013	2000
200105	A011	2500
200109	A010	3500
200101	A008	3000
200111	A008	1000
200104	A004	1500

ORD_NUM	AGENT_CODI	ORD_AMOUNT
200104	A004	1500
200121	A004	1500
200126	A002	500
200120	A002	500
200123	A002	500
200124	A007	500
200116	A009	500
200105	A011	2500
200130	A011	2500
200131	A012	900
200135	A010	2000
200115	A013	2000

results

Correlated Subquery

- Correlated Subqueries are used to select data from a table referenced in the outer query
- The subquery is known as a correlated because the subquery is related to the outer query. The outer query is executed first and inner query is executed for each records of outer query.
- In this type of queries, a table alias (also called a correlation name) must be used to specify which table reference is to be used.

Correlated Subquery

Steps of Correlated Subqueries:

1. Executes the outer Query

2. For Each row of outer query inner subquery is executed once

3. The result of correlated subquery determines whether the fetched row should be the part of our output results

4. The Process is Repeated for all Rows

Correlated Subquery

- Example:

Select the students whose marks have been entered into MARKS table.

Query:

Referred by outer query

```
SELECT * FROM STUDENT s WHERE STD_ID IN
(SELECT STD_ID FROM MARKS m WHERE s.STD_ID = m.STD_ID);
```

- outer query column and inner query column are joined to get the result. This query fetches all the records from STUDENT table and joins with the STD_ID in MARKS table. It returns the records only if there is a matching STD_ID in MARKS.

Correlated Subquery

- **Query:**

SELECT * FROM STUDENT s WHERE EXISTS

(SELECT STD_ID FROM MARKS m WHERE s.STD_ID = m.STD_ID);

The EXISTS operator is used to test for the existence of any record in a subquery.

The EXISTS operator returns true if the subquery returns one or more records.

- **Query:**

SELECT * FROM STUDENT s WHERE NOT EXISTS

(SELECT STD_ID FROM MARKS m WHERE s.STD_ID = m.STD_ID);

Subquery Vs Correlated Subquery

Sub Query	Correlated Sub Query
Inner Query is executed First.	Outer Query is executed first.
Inner query is executed only once and its result is used by outer query.	Inner query is executed for each of the records that outer query returns.
Uses using =, <, >, >=, <=, IN, BETWEEN operators.	Can use using =, <, >, >=, <=, IN, BETWEEN operators, but it mainly uses EXISTS and NOT EXISTS clause.
Always outer query columns are compared with inner query but there are no explicit joins in the inner query with outer query columns.	There should be some joins between the outer and inner query columns in the inner query.
Is always used in the WHERE clause.	Is used in WHERE clause as well as columns of SELECT statement.
Performance is better as inner query is executed only once and outer query is executed based on the result of inner query.	Correlated subqueries evaluate once for each row of the outer query. It will be bit slow if the outer table has large number of records. This is because, when each record of outer query is retrieved, the inner query is executed. The number of execution of inner query depends on the number of records returned by the outer query. *Rather than incur the overhead of this correlated subquery, a join can be used.*

Nested Subquery

- A subquery can be nested inside other subqueries. The Execution of Nested suubquery always follows bottom up approach.
- Execution steps:

Step 1:
Executed Bottom query:
Step 2:
Execute The Second Query which is above bottom query:
Step 3:
Excecuted the Top Query

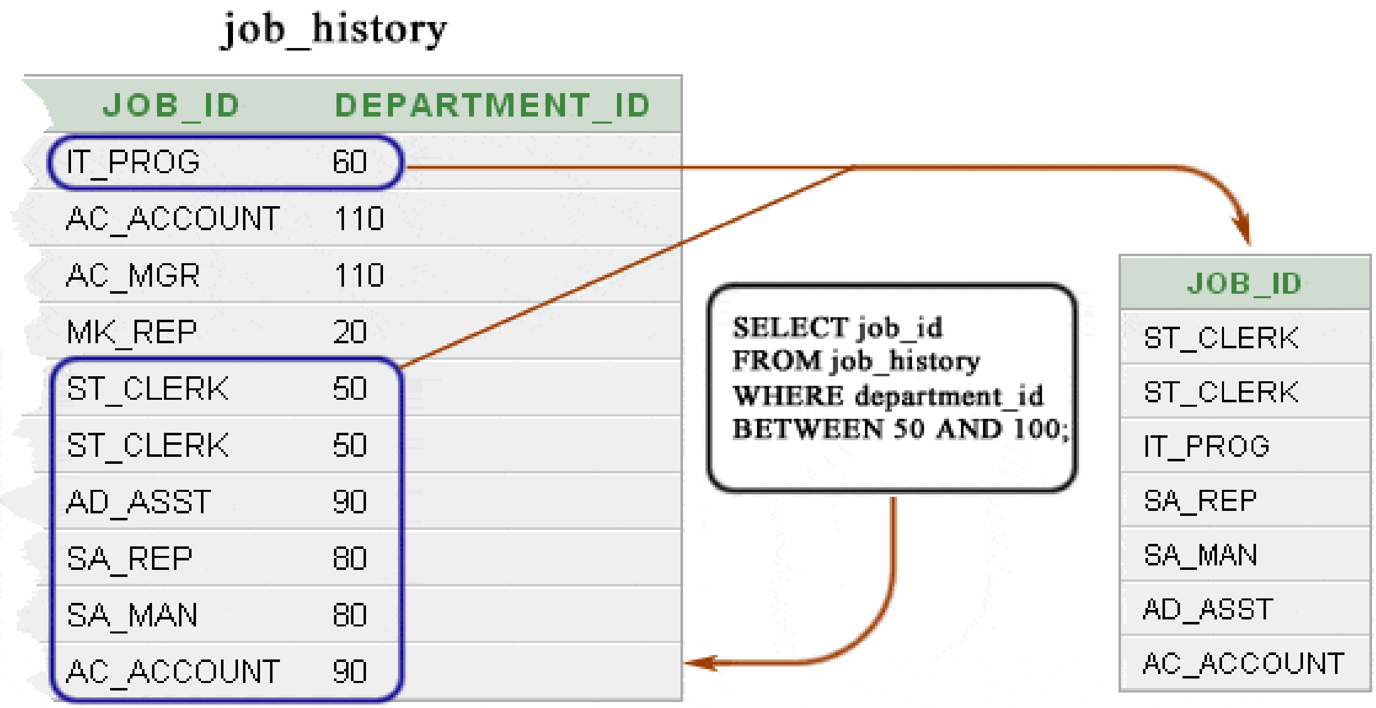
Nested Subquery

- A subquery can be nested inside other subqueries. The Execution of Nested suubquery always follows bottom up approach.
- Example: consider employee and job tables

```
SELECT job_id,AVG(salary)
 FROM employees
GROUP BY job_id HAVING AVG(salary)<
(SELECT MAX(AVG(min_salary))
FROM jobs WHERE job_id IN
(SELECT job_id
FROM job_history
WHERE department_id BETWEEN 50 AND 100)
 GROUP BY job_id);
```

Nested Subquery

- This example contains three queries: *a nested subquery, a subquery, and the outer query.*
- Sequence of execution:
- **Nested:** SELECT job_id FROM job_history WHERE department_id BETWEEN 50 AND 100;



job_history

JOB_ID	DEPARTMENT_ID
IT_PROG	60
AC_ACCOUNT	110
AC_MGR	110
MK_REP	20
ST_CLERK	50
ST_CLERK	50
AD_ASST	90
SA_REP	80
SA_MAN	80
AC_ACCOUNT	90

```
SELECT job_id
FROM job_history
WHERE department_id
BETWEEN 50 AND 100;
```

JOB_ID
ST_CLERK
ST_CLERK
IT_PROG
SA_REP
SA_MAN
AD_ASST
AC_ACCOUNT

Nested Subquery

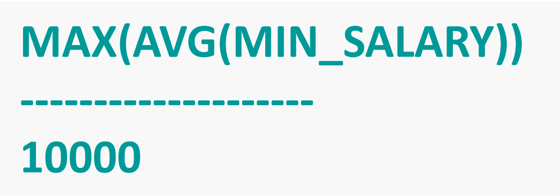
- Now the subquery that receives output from the nested subquery stated previously.

Subquery: SELECT MAX(AVG(min_salary)) FROM jobs

WHERE job_id IN

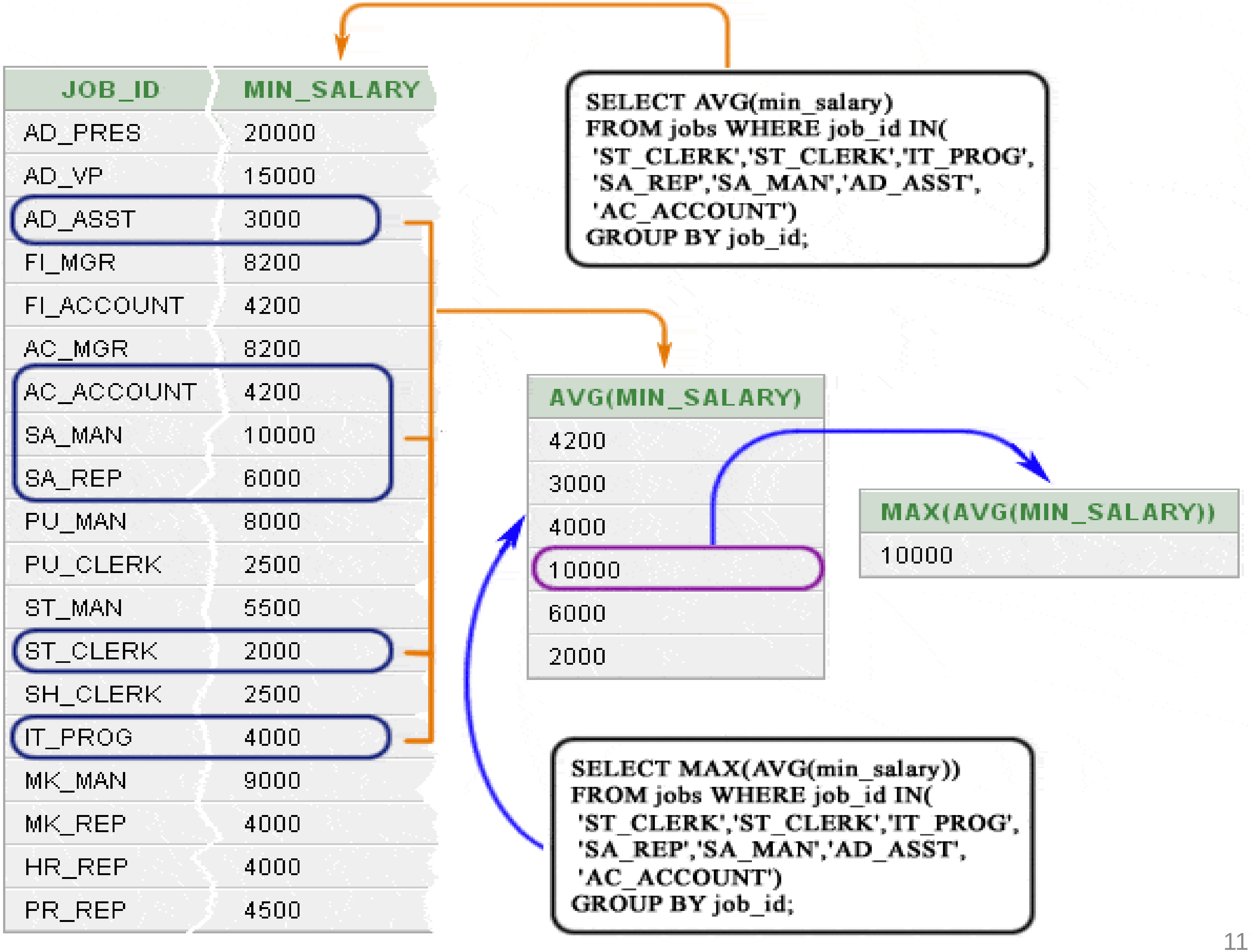
('ST_CLERK','ST_CLERK','IT_PROG', 'SA_REP','SA_MAN','AD_ASST', ' AC_ACCOUNT')

GROUP BY job_id;



```
MAX(AVG(MIN_SALARY))
--------------------
10000
```

Nested Subquery



JOB_ID	MIN_SALARY
AD_PRES	20000
AD_VP	15000
AD_ASST	3000
FI_MGR	8200
FI_ACCOUNT	4200
AC_MGR	8200
AC_ACCOUNT	4200
SA_MAN	10000
SA_REP	6000
PU_MAN	8000
PU_CLERK	2500
ST_MAN	5500
ST_CLERK	2000
SH_CLERK	2500
IT_PROG	4000
MK_MAN	9000
MK_REP	4000
HR_REP	4000
PR_REP	4500

jobs

```
SELECT AVG(min_salary)
FROM jobs WHERE job_id IN(
 'ST_CLERK','ST_CLERK','IT_PROG',
 'SA_REP','SA_MAN','AD_ASST',
 'AC_ACCOUNT')
GROUP BY job_id;
```

AVG(MIN_SALARY)
4200
3000
4000
10000
6000
2000

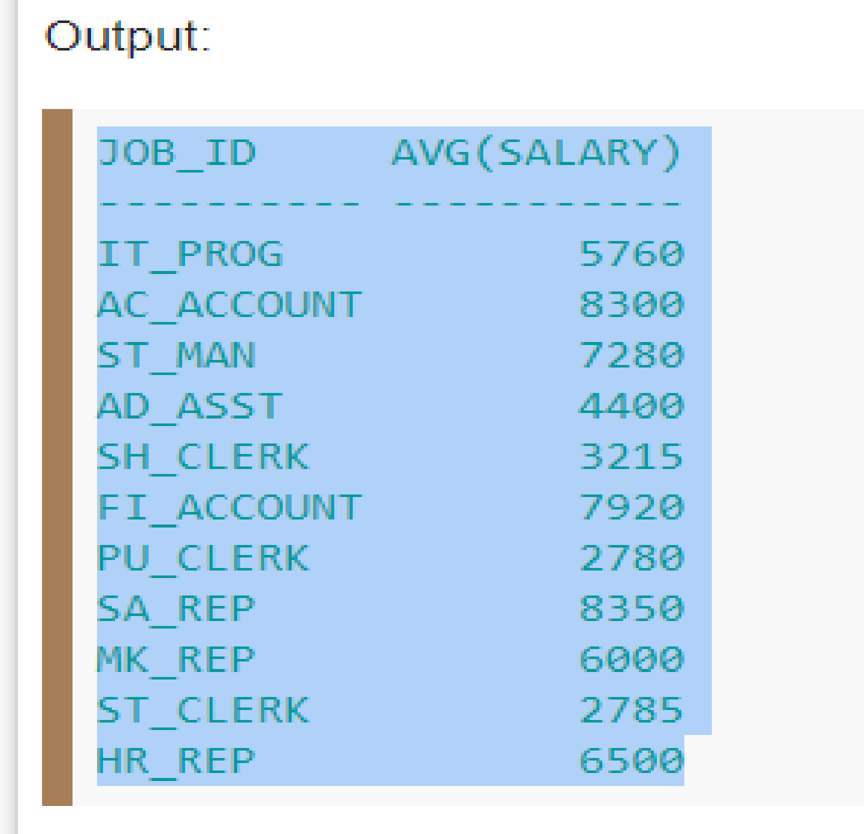
MAX(AVG(MIN_SALARY))
10000

```
SELECT MAX(AVG(min_salary))
FROM jobs WHERE job_id IN(
 'ST_CLERK','ST_CLERK','IT_PROG',
 'SA_REP','SA_MAN','AD_ASST',
 'AC_ACCOUNT')
GROUP BY job_id;
```

Nested Subquery

- **Outer Query:** SELECT job_id, AVG(salary) FROM employees GROUP BY job_id HAVING AVG(salary)<10000;

The outer query returns the job_id, average salary of employees that are less than maximum of average of min_salary returned by the previous query



Output:

```
JOB_ID      AVG(SALARY)
----------- -----------
IT_PROG            5760
AC_ACCOUNT         8300
ST_MAN             7280
AD_ASST            4400
SH_CLERK           3215
FI_ACCOUNT         7920
PU_CLERK           2780
SA_REP             8350
MK_REP             6000
ST_CLERK           2785
HR_REP             6500
```

Subqueries with INSERT, UPDATE, DELETE statement

- **Query:**

```
1. INSERT INTO neworder

SELECT * FROM orders

WHERE advance_amount in(2000,5000);

2. UPDATE neworder SET ord_date='15-JAN-10'

WHERE ord_amount-advance_amount<

(SELECT MIN(ord_amount) FROM orders);

3. DELETE FROM neworder

WHERE advance_amount<

(SELECT MAX(advance_amount) FROM orders);
```

SQL Facilities (cont..)

- Data Control Language (DCL)
  - Database security control including privileges and revoke privileges
  - Commands are – grant, revoke (refer advanced sql ppt)

References

- Navathe
- Korth

- Web
  - https://www.postgresqltutorial.com/
  - https://sqldatabasetutorials.com/sql-db/single-row-subqueries/