5.4: Selecting Data

IT2306 – Database Systems I

Level I - Semester 2

Detailed Syllabus

- 5.4.1 Queries:
  - SELECT Statement
- 5.4.2 Single Table:
  - all columns (*),
  - selecting specific columns (RA project operation),
  - unique values (DISTINCT),
  - Executing multiple statements (;),
  - WHERE clause (RA select operation),
  - Including or excluding rows (=, !=),
  - Relational Operators (=, !=, >, >=, <, <=),
  - Identifying Null values (IS NULL),
  - Where clause keywords (AND, OR, [NOT] BETWEEN, [NOT] IN, IS [NOT] NULL, [NOT] LIKE, ORDER BY)
  - Arithmetic Operators (+, -, *, /),
  - Expressions,
  - Display Labels,
  - Aggregate Functions: (COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING.)

Detailed Syllabus

- 5.4.3 Multiple Table:
  - RA join and product operations, Natural Join, Multiple Table Joins, Aliases for table names, Outer Join, UNION.
- 5.4.4 Functions:
  - Arithmetic (ROUND, TRUNC), String (TO_CHAR, UPPER, LOWER, Sub strings, Concatenation, TRIM), Date and Time (DAY, MONTH, YEAR, DATE, CURRENT).
- 5.4.5 Sub queries:
  - Nested Select Statement, Values returned by sub queries (single value, a list of values), EXISTS, Correlated nested queries.

Referential Integrity

SQL data definition for defining referential integrity constraints

Parent Table:

```
CREATE TABLE DEPARTMENT
(DEPT-NO  CHAR(3),
other column definitions
PRIMARY KEY (DEPT-NO) );
```

Dependent Table:

```
CREATE TABLE EMPLOYEE
        ( EMP-NO              CHAR(5),
          DEPT-NO             CHAR(3)
          other column definitions
          PRIMARY KEY (EMP-NO),
          FOREIGN KEY DEPT-N-FK (DEPT-NO)
                  REFERENCES DEPARTMENT
              ON DELETE SET NULL) );
```

Referential Integrity

Defining referential integrity rules in the SQL DDL is known as ***declarative*** referential integrity

Declarative referential integrity simplifies application programming and enables enforcement at the database server level, eliminating the possibility of programming errors

User Defined Integrity

User defined integrity constraints can be enforced by the database server using ***triggers*** and ***stored procedures***.

Triggers and stored procedures are user written routines which are stored and executed under the control of the database server.

They are often coded in proprietary procedural extensions to SQL,

e.g. Sybase's Transact SQL or Oracle's PL/SQL.

SQL for Data Manipulation

Manipulation

SQL allows a user or an application program to update the database by adding new data, removing old data, and modifying previously stored data.

Retrieval

SQL allows a user or an application program to retrieve stored data from the database and use it.

Most Commonly Used Commands

– SELECT
– INSERT
– UPDATE
– DELETE

SQL for Data Manipulation

- High-level Language for data manipulation
- It does not require predefined navigation path
- It does not require knowledge of any key items
- It is uniform language for end-users and programmers
- It operates on one or more tables based on set theory, not on a record at a time

Command: SELECT

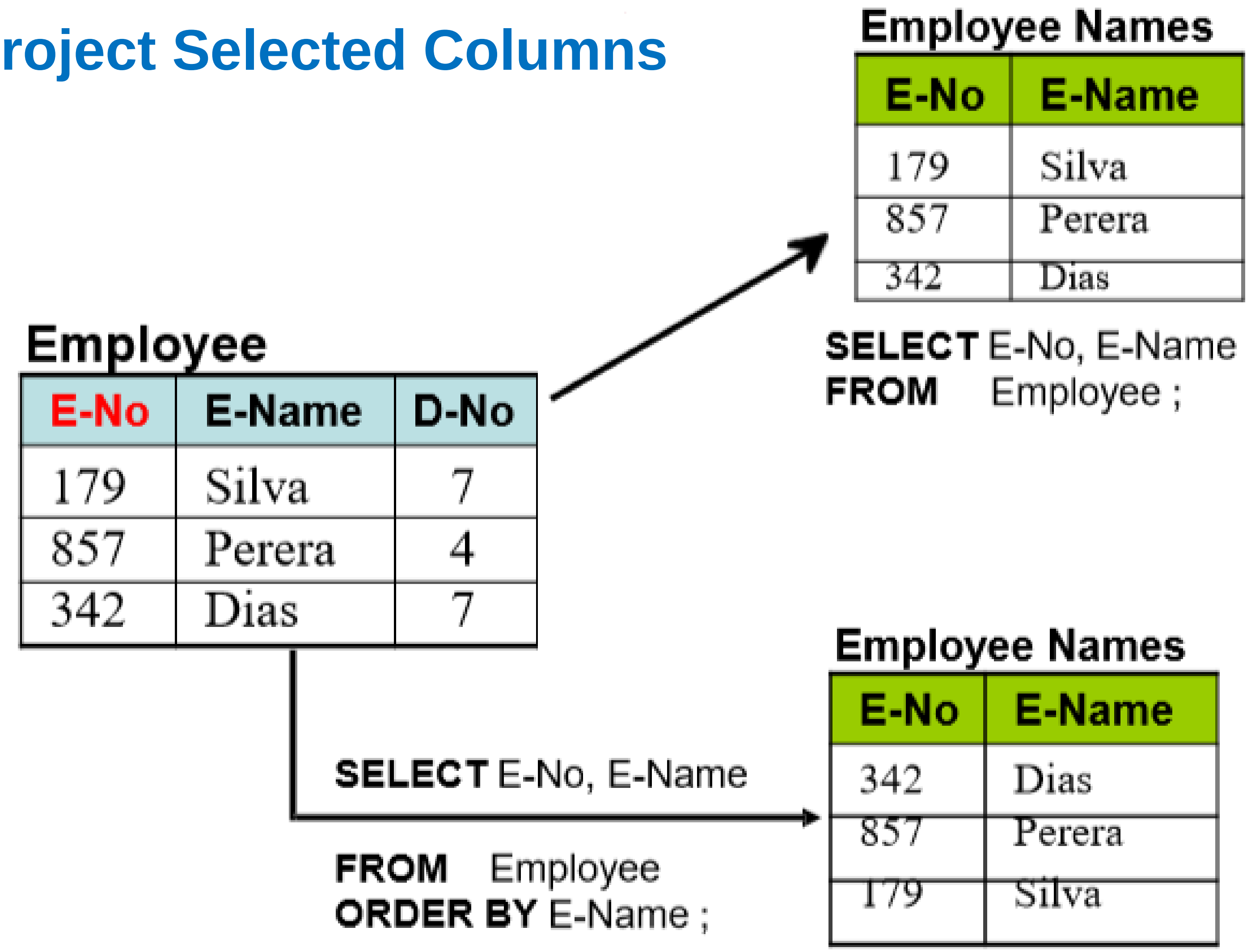
Function

-Retrieves data from one or more rows. Every SELECT statement produces a table of query results containing one or more columns and zero or more rows.

SELECT {[ALL, DISTINCT]} *[(select-item,), i]*
FROM *(table specification,)*
{WHERE (search condition)}
{GROUP BY (group-column,)}
{HAVING (search condition)}
{ORDER BY (sort specification,)}

Command: SELECT

Project Selected Columns



Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

Employee Names

E-No	E-Name
179	Silva
857	Perera
342	Dias

```
SELECT E-No, E-Name
FROM   Employee ;
```

Employee Names

E-No	E-Name
342	Dias
857	Perera
179	Silva

```
SELECT E-No, E-Name
FROM   Employee
ORDER BY E-Name ;
```

Command: SELECT

Restrict Rows

Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

```
SELECT *
FROM  Employee
WHERE D-No = '7' ;
```

Sales Employee

E-No	E-Name	D-No
179	Silva	7
342	Dias	7

```
SELECT E-No, E-Name
FROM   Employee
WHERE D-No = '7' ;
```

Sales Employee

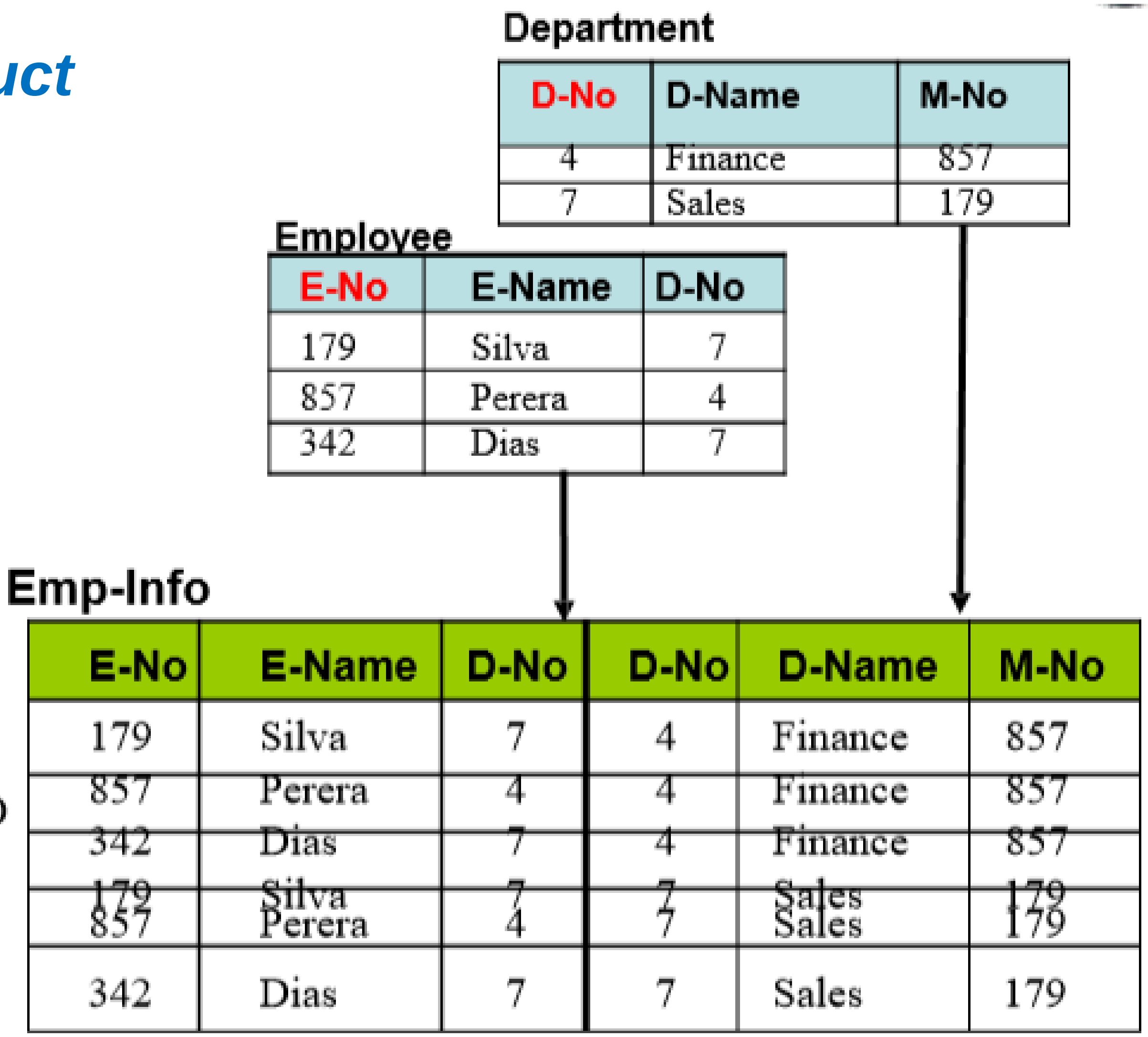
E-No	E-Name
179	Silva
342	Dias

Restrict Rows and Project Columns

Command: SELECT

Cartesian Product

```
SELECT
        E.*, D.*
FROM
Employee E, Department D
```



Department

D-No	D-Name	M-No
4	Finance	857
7	Sales	179

Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

Emp-Info

E-No	E-Name	D-No	D-No	D-Name	M-No
179	Silva	7	4	Finance	857
857	Perera	4	4	Finance	857
342	Dias	7	4	Finance	857
179	Silva	7	7	Sales	179
857	Perera	4	7	Sales	179
342	Dias	7	7	Sales	179

SQL Data Retrieval

Basic Search Conditions:

- Comparison

– Equal to	=
– Not equal to	!= or <> or ^=
– Less than to	<
– Less than or equal to	<=
– Greater than to	>
– Greater than or equal to	>=

SQL Data Retrieval

Basic Search Conditions:

- Range ([NOT] BETWEEN)
  - expres-1 [NOT] BETWEEN expres-2 AND expres-3
  - Example: WEIGHT BETWEEN 50 AND 60
- Set Membership ([NOT] IN)
  - Example 1: WHERE Emp_No IN (‘E1’, ‘E2’, ‘E3’)
  - Example 2: WHERE Emp_No IN (Select Emp_No
    FROM Employee WHERE Dept_No=‘7’)

SQL Data Retrieval

Basic Search Conditions:

- Pattern Matching ([NOT] LIKE)
  - expres-1 [NOT] LIKE {special-register | host-variable | string-constant}
  - Example: WHERE Proj_Name LIKE “INFORM%”
- Null Value (IS [NOT] NULL)
  - Example: WHERE Proj_Name IS NOT NULL

SQL Data Retrieval

Compound Search Conditions

- **AND, OR and NOT**
- *Example:*

  WHERE Proj_Name LIKE ‘INFORM%’ AND Emp_Name = ‘DIAS’

SQL Data Retrieval

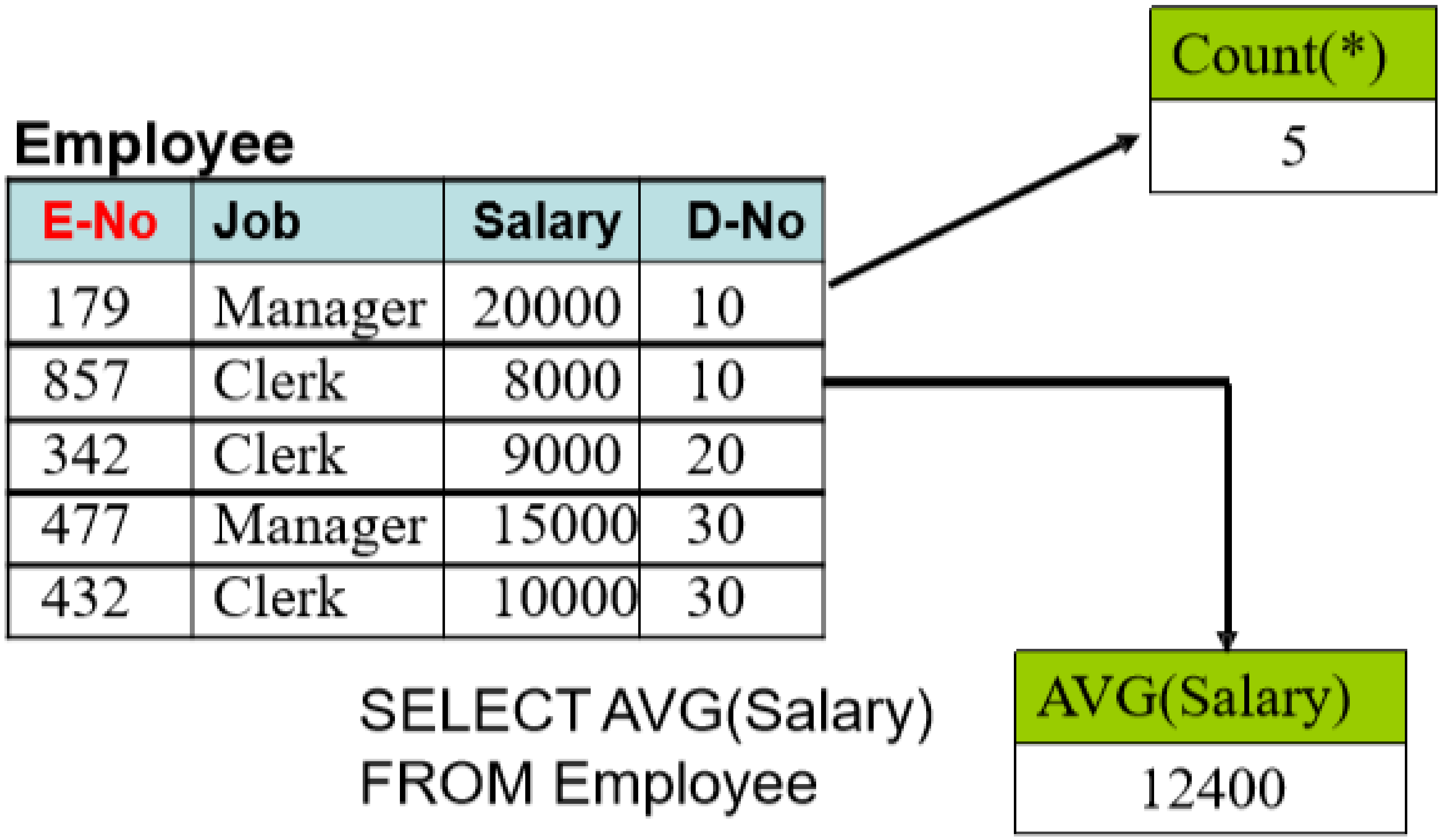
SQL Query Features

- Summary Queries
  - *Summarize data from the database. In general, summary queries use SQL functions to collapse a column of data values into a single value that summarizes the column. (AVG, MIN, MAX, SUM, COUNT..)*
- Sub-Queries
  - *Use the results of one query to help define another query*

SQL Data Retrieval

Summarizing Data

```
SELECT COUNT(*)
FROM Employee
```



Employee

E-No	Job	Salary	D-No
179	Manager	20000	10
857	Clerk	8000	10
342	Clerk	9000	20
477	Manager	15000	30
432	Clerk	10000	30

Count(*)
5

```
SELECT AVG(Salary)
FROM Employee
```

AVG(Salary)
12400

SQL Data Retrieval

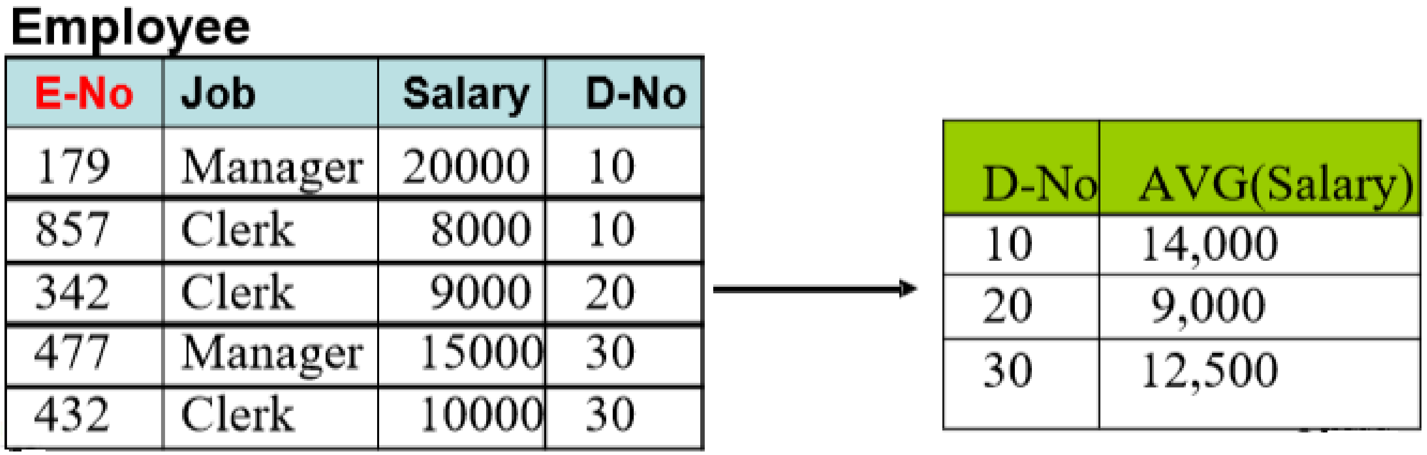
SELECT STATEMENT May also contain

[GROUP BY [HAVING] ORDER BY]

- GROUP BY

  A result of a previous specified clause is grouped using the group by clause.

e.g.
```
SELECT      d-no, AVG(salary)
FROM        employee
GROUP BY    d-no
```



Employee

E-No	Job	Salary	D-No
179	Manager	20000	10
857	Clerk	8000	10
342	Clerk	9000	20
477	Manager	15000	30
432	Clerk	10000	30

D-No	AVG(Salary)
10	14,000
20	9,000
30	12,500

SQL Data Retrieval

SELECT STATEMENT May also contain

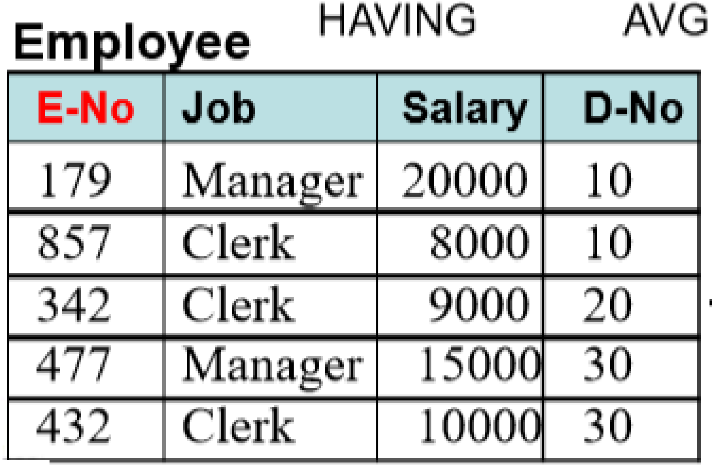
[GROUP BY [HAVING] ORDER BY]

- HAVING

  Used for select groups that meet specified conditions.

  Always used with GROUP BY clause.

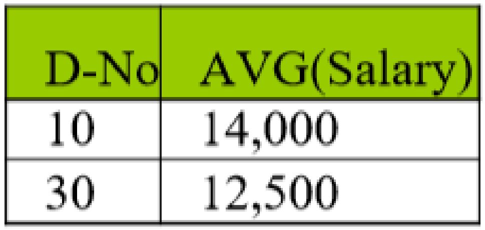
```
SELECT      d-no, AVG(salary)
FORM        employee
GROUP BY    d-no
HAVING      AVG(salary)>12000
```



Employee

E-No	Job	Salary	D-No
179	Manager	20000	10
857	Clerk	8000	10
342	Clerk	9000	20
477	Manager	15000	30
432	Clerk	10000	30

$\longrightarrow$



D-No	AVG(Salary)
10	14,000
30	12,500

Command: SELECT

Equi Join

Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

Department

D-No	D-Name	M-No
4	Finance	857
7	Sales	179

Emp-Info

E-No	E-Name	D-No	D-No	D-Name	M-No
179	Silva	7	7	Sales	179
857	Perera	4	4	Finance	857
342	Dias	7	7	Sales	179

```
SELECT   Employee.*, Department.*
FROM     Employee, Department
WHERE    Employee.D-No = Department.D-No ;
```

```
SELECT  E.*, D.*
FROM    Employee E
JOIN    Department D
ON      E.D-No = D.D-No;
```

```
SELECT   E.*, D.*
FROM     Employee E, Department D
WHERE    E.D-No = D.D-No ;
```

Command: SELECT

Inner Join

```
SELECT E.*, D.*
FROM Employee E
INNER JOIN Department D ON E.D-No = D.D-No;
```

Outer Joins: Left, Right, Full

Left Outer Join

```
SELECT E.*, D.*
FROM Employee E LEFT OUTER JOIN Department D ON E.D-No = D.D-No;
```

Command: SELECT

Department

D-No	D-Name	M-No
2	Finance	850
7	Sales	179

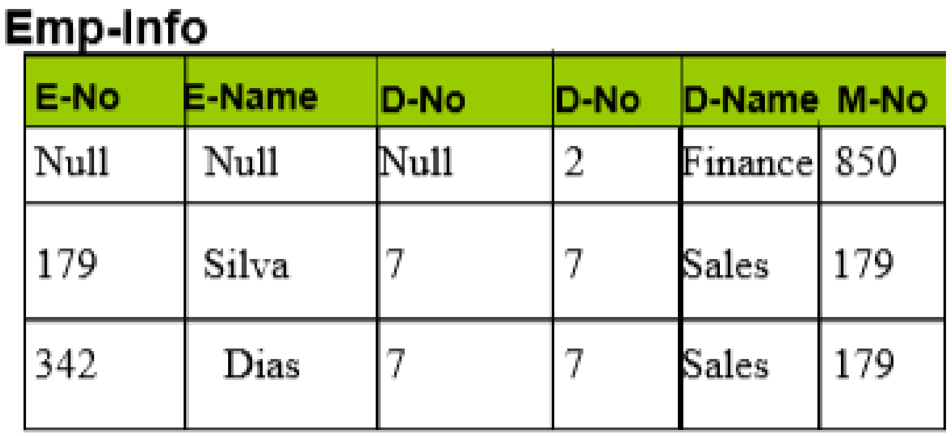
Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

Emp-Info

E-No	E-Name	D-No	D-No	D-Name	M-No
179	Silva	7	7	Sales	179
857	Perera	4	Null	Null	Null
342	Dias	7	7	Sales	179

Command: SELECT



Emp-Info

E-No	E-Name	D-No	D-No	D-Name	M-No
Null	Null	Null	2	Finance	850
179	Silva	7	7	Sales	179
342	Dias	7	7	Sales	179

Right Outer Join

```
SELECT E.*, D.*
FROM Employee E RIGHT OUTER JOIN Department D
                                    ON E.D-No = D.D-No;
```

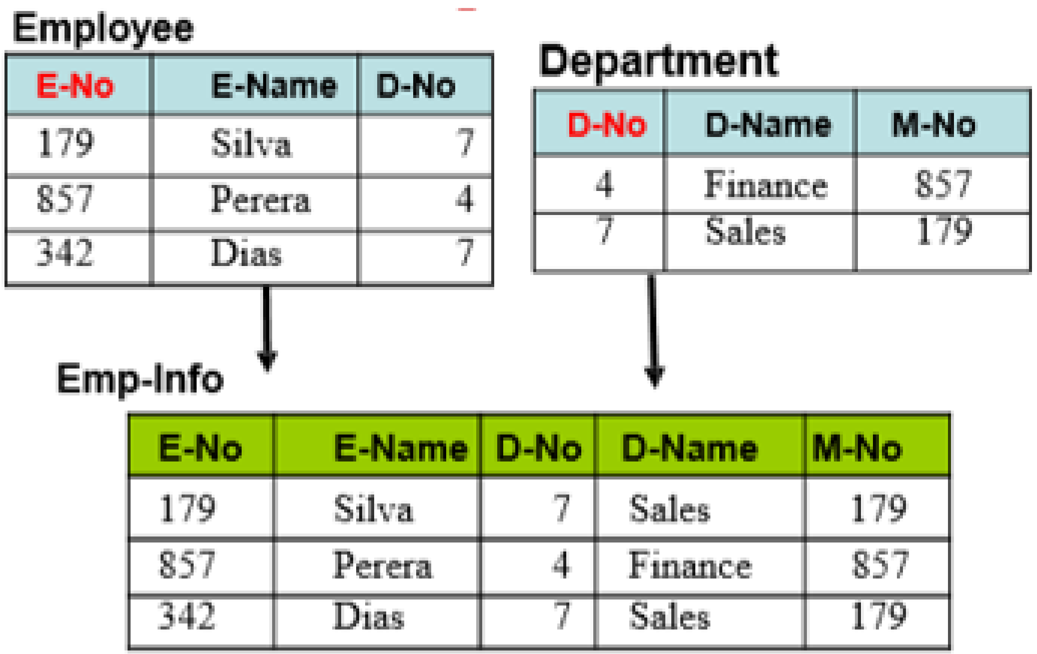
Full Outer Join

```
SELECT E.*, D.*
FROM Employee E FULL OUTER JOIN Department D
                                    ON E.D-No = D.D-No;
```

SELECT * FROM table1 NATURAL JOIN table2;

Command: SELECT

Natural Join



Employee

E-No	E-Name	D-No
179	Silva	7
857	Perera	4
342	Dias	7

Department

D-No	D-Name	M-No
4	Finance	857
7	Sales	179

Emp-Info

E-No	E-Name	D-No	D-Name	M-No
179	Silva	7	Sales	179
857	Perera	4	Finance	857
342	Dias	7	Sales	179

SELECT	*
FROM	Employee
NATURAL JOIN	Department

SQL Data Retrieval

Nested Queries

- A sub query is a SELECT statement that nest inside the WHERE clause of another SELECT statement.
- The results are need in solving the main query.

Get a list of all suppliers supplying part P2.

```
SELECT sname  FROM supplier  WHERE sno IN
(SELECT sno FROM supply WHERE pno = ‘P2’);

SELECT sname  FROM supplier, supply WHERE
supplier.sno = supply.sno and pno = ‘P2’;

SELECT ename , salary  FROM employee WHERE
salary = (SELECT MIN (salary) FROM employee)
```

SQL Data Retrieval

Nested Queries

Sub queries with EXISTS

e.g. find all publishers who publish business books

```
SELECT   DISTINCT   pub_name
FROM publishers
WHERE EXISTS
(SELECT * FROM title
 WHERE pub_id = publishers.pub_id and type = “business”)
```

DISTINCT – will remove multiple occurrences