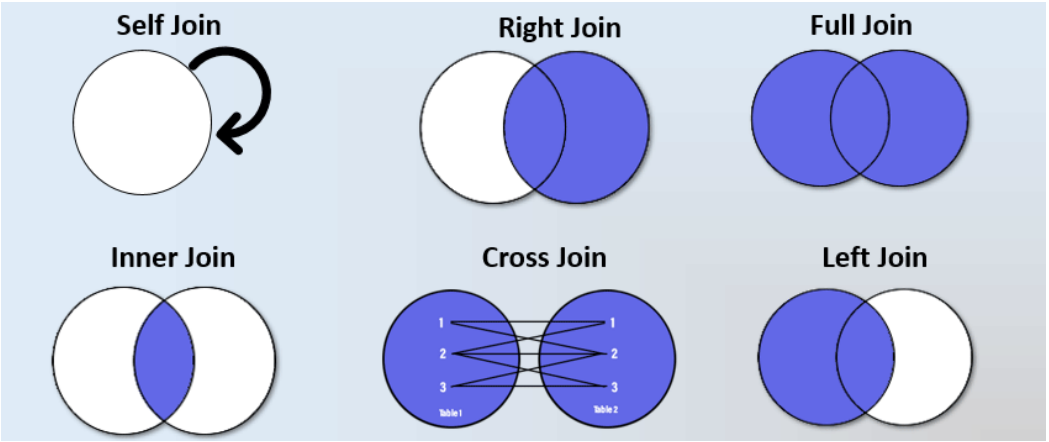
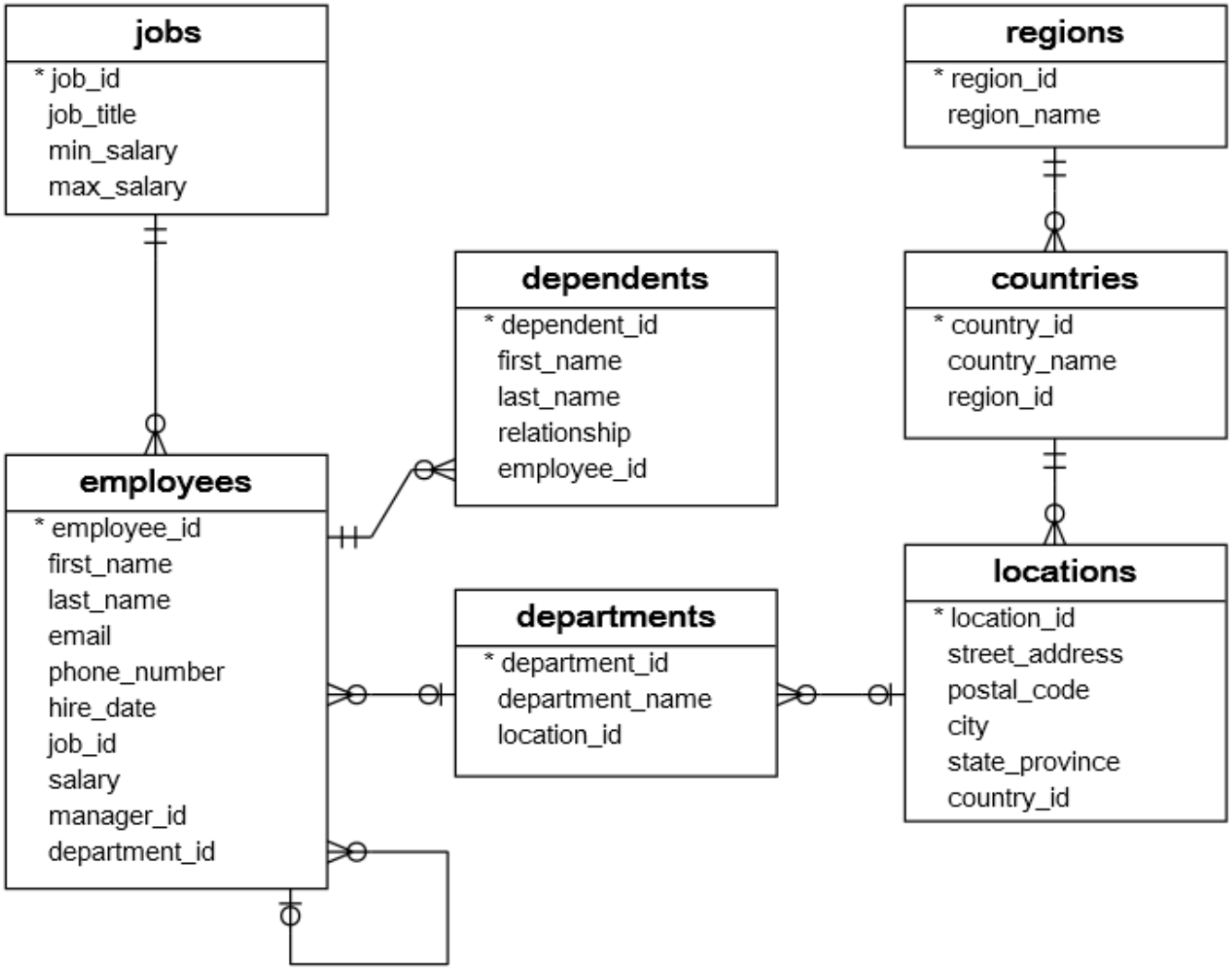
MySQL DML. SELECT Constructions 3.

Summary



1. HR sample database.

You can use SQL Tutorial site https://www.sqltutorial.org/seeit/ for online testing examples and exercises on real DB.



2. SELECT Statement Full Syntax

To query data from a table, you use the SQL SELECT statement, where contains the syntax for selecting columns, selecting rows, grouping data, joining tables, and performing simple calculations.

```
-- Complete SELECT query
SELECT DISTINCT column, AGG_FUNC(column_or_expression), …
FROM mytable
    JOIN another_table
      ON mytable.column = another_table.column
    WHERE constraint_expression
    GROUP BY column
    HAVING constraint_expression
    ORDER BY column ASC/DESC
    LIMIT count OFFSET COUNT;
```

Each query begins with finding the data that we need in a database, and then filtering that data down into something that can be processed and understood as quickly as possible. Because each part of the query is executed sequentially, it's important to understand the order of execution so that you know what results are accessible where.

The SELECT statement is one of the most complex commands in SQL include many clauses:

- **SELECT** − This is one of the fundamental query command of SQL. It is similar to the projection operation of relational algebra. It selects the attributes based on the condition described by WHERE clause.
- **FROM** − This clause takes a relation name as an argument from which attributes are to be selected/projected. In case more than one relation names are given, this clause corresponds to Cartesian product.
- **JOIN** – for querying data from one, two or multiple related tables
- **WHERE** – This clause defines predicate or conditions for filtering data based on a specified condition.
- **GROUP BY** – for grouping data based on one or more columns
- **HAVING** – for filtering groups
- **ORDER BY** – for sorting the result set
- **LIMIT** – for limiting rows returned

You will learn about these clauses in the subsequent tutorials on Practice Works PW-01, PW-02, PW-03 and PW-04.

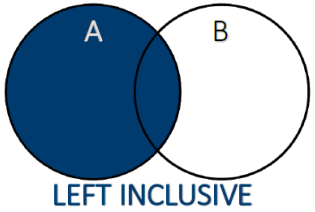
8. SELECT - Joining Multiple Tables

So far, you have learned how to use the SELECT statement to query data from a single table. However, the SELECT statement is not limited to query data from a single table. The SELECT statement can link multiple tables together.

A join is a method of linking data between one (self-join), two, or more tables based on values of the common column between the tables.

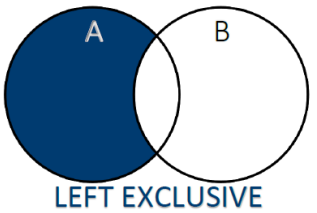
The process of linking tables is called joining. SQL provides many kinds of joins such as:

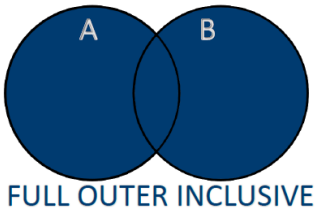
- INNER JOIN – returns records that have matching values in both (multiple) tables.
- LEFT [OUTER] JOIN – returns all records from the left table, and the matched records from the right table.
- RIGHT [OUTER] JOIN – returns all records from the right table, and the matched records from the left table
- FULL [OUTER] JOIN – returns all records when there is a match in either left or right table.
- [CROSS] JOIN – produce a Cartesian product of rows of the joined tables using the cross join operation.
- SELF JOIN – join a table to itself using either the inner join or left join clause.

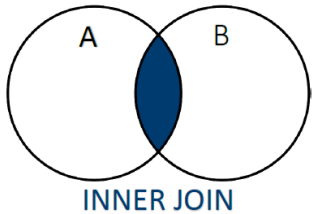


SQL JOINS

LEFT INCLUSIVE	RIGHT INCLUSIVE
SELECT *[Select List]* FROM TableA A LEFT OUTER JOIN TableB B ON A.Key= B.Key	SELECT *[Select List]* FROM TableA A RIGHT OUTER JOIN TableB B ON A.Key= B.Key
LEFT EXCLUSIVE	**RIGHT EXCLUSIVE**
SELECT *[Select List]* FROM TableA A LEFT OUTER JOIN TableB B ON A.Key= B.Key WHERE B.Key IS NULL	SELECT *[Select List]* FROM TableA A LEFT OUTER JOIN TableB B ON A.Key= B.Key WHERE A.Key IS NULL
FULL OUTER INCLUSIVE	**FULL OUTER EXCLUSIVE**
SELECT *[Select List]* FROM TableA A FULL OUTER JOIN TableB B ON A.Key = B.Key	SELECT *[Select List]* FROM TableA A FULL OUTER JOIN TableB B ON A.Key = B.Key WHERE A.Key IS NULL OR B.Key IS NULL
INNER JOIN	
SELECT *[Select List]* FROM TableA A INNER JOIN TableB B ON A.Key = B.Key	

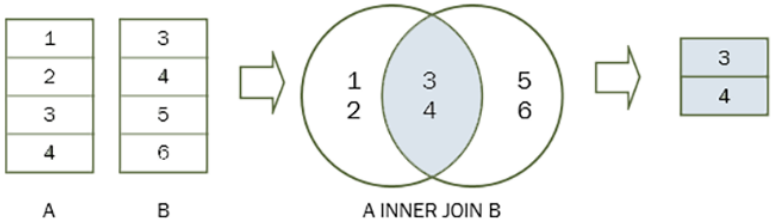






8.1. INNER JOIN

- The Inner Join clause links two (or more) tables by a relationship between two columns. Whenever you use the inner join clause, you normally think about the intersection.
- For each row in 1th table, the Inner Join clause finds the matching rows in the 2th table and matched rows is included in final result set.
- We have two tables: A and B. Table A has four rows: (1, 2, 3, 4) and table B has four rows: (3, 4, 5, 6)
- When table A joins with the table B using the inner join, we have the result set (3, 4) that is the intersection of the table A and table B.
- The following Venn diagram illustrates the Inner Join of two tables.



Syntax of the Inner Join.

- The INNER JOIN clause appears after the FROM clause. The condition to match between table A and table B is specified after the ON keyword. This condition is called join condition.
- Notice that both tables have the same column name, therefore we had to qualify the column using the syntax table.column (B.n = A.n).
- If the column name of the A and B tables is fk and id the following statement illustrates the inner join clause:

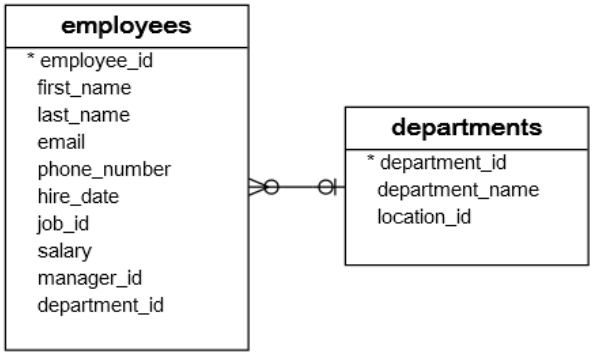
```
SELECT *
FROM A
INNER JOIN B ON A.fk_b = B.id;
```

The INNER JOIN clause can join three or more tables as long as they have relationships, typically foreign key relationships. For example:

```
SELECT A.columns, B.columns
FROM A
INNER JOIN B ON A.fk_b = B.id
INNER JOIN C ON A.fk_c = C.id;
```

Example 1. SQL Inner Join 2 tables example.

We will use the employees and departments table to demonstrates how the INNER JOIN clause works.



Each employee belongs to one and only one department, while each department can have more than one employee. The relationship between the employees and departments table is one-to-many.

The department_id column in the employees table is the foreign key column that links the employees to the departments table.

To get the information of the department id 1, 2 and 3 we used the IN operator in the WHERE clause to get rows with department_id 1, 2, 3.

```
SELECT
       department_id,
       department_name
FROM
       departments
WHERE
       department_id IN (1, 2, 3);
```

department_id	department_name
1	Administration
2	Marketing
3	Purchasing

To get the information of employees who work in the department id 1, 2, 3, you use the following query:

```
SELECT
       first_name,
       last_name,
       department_id
FROM
       employees
WHERE
       department_id IN (1, 2, 3)
ORDER BY
       department_id;
```

first_name	last_name	department_id
Jennifer	Whalen	1
Michael	Hartstein	2
Pat	Fay	2
Den	Raphaely	3
Alexander	Khoo	3
Shelli	Baida	3
Sigal	Tobias	3
Guy	Himuro	3
Karen	Colmenares	3

To combine data from these two tables, you use an Inner Join clause as the following query:

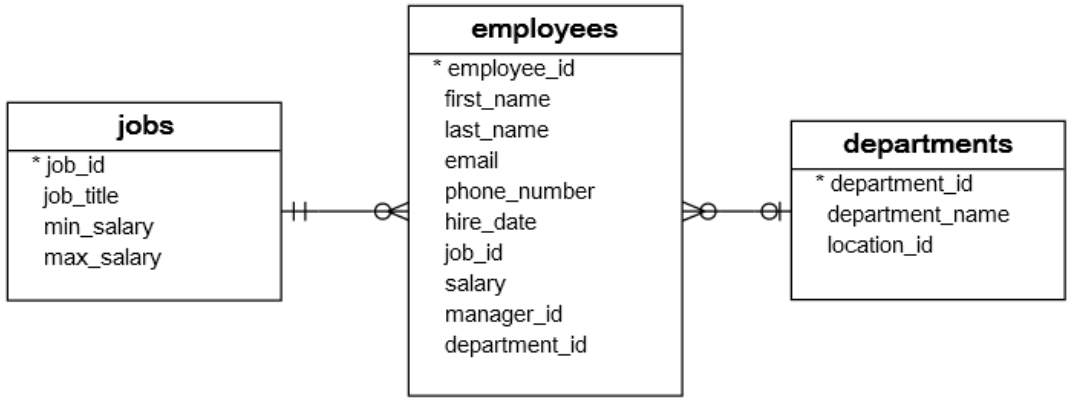
```
SELECT
    first_name,
    last_name,
    employees.department_id,
    departments.department_id,
    department_name
FROM
    employees
INNER JOIN
    departments ON employees.department_id = departments.department_id
WHERE
    employees.department_id IN (1 , 2, 3);
```

first_name	last_name	department_id	department_id	department_name
Jennifer	Whalen	1	1	Administration
Michael	Hartstein	2	2	Marketing
Pat	Fay	2	2	Marketing
Den	Raphaely	3	3	Purchasing
Alexander	Khoo	3	3	Purchasing
Shelli	Baida	3	3	Purchasing
Sigal	Tobias	3	3	Purchasing
Guy	Himuro	3	3	Purchasing
Karen	Colmenares	3	3	Purchasing

Example 2. SQL Inner Join 3 tables example.

Each employee holds one job while a job may be held by many employees. The relationship between the jobs table and the employees table is one-to-many.

The following query uses the inner join clauses to join 3 tables: employees, departments, and jobs to get the first name, last name, job title, and department name of employees who work in department id 1, 2, 3.

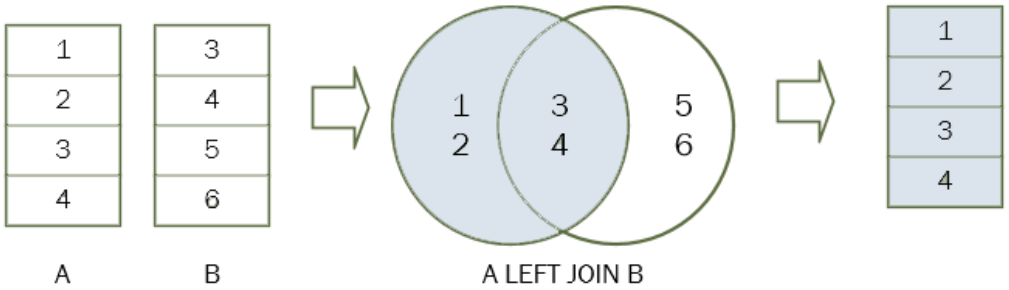


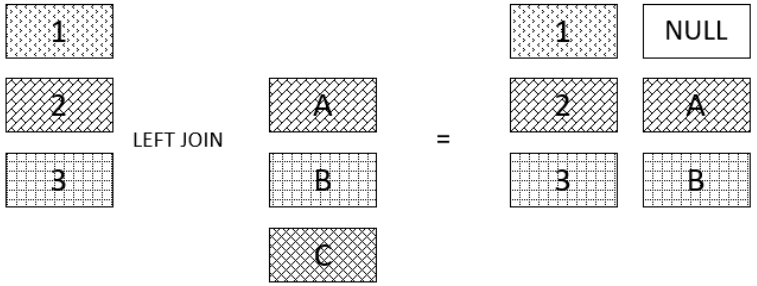

```
SELECT
       first_name,
       last_name,
       job_title,
       department_name
FROM
       employees e
INNER JOIN departments d ON d.department_id = e.department_id
INNER JOIN jobs j ON j.job_id = e.job_id
WHERE
       e.department_id IN (1, 2, 3);
```

first_name	last_name	job_title	department_name
Jennifer	Whalen	Administration Assistant	Administration
Michael	Hartstein	Marketing Manager	Marketing
Pat	Fay	Marketing Representative	Marketing
Den	Raphaely	Purchasing Manager	Purchasing
Alexander	Khoo	Purchasing Clerk	Purchasing
Shelli	Baida	Purchasing Clerk	Purchasing
Sigal	Tobias	Purchasing Clerk	Purchasing
Guy	Himuro	Purchasing Clerk	Purchasing
Karen	Colmenares	Purchasing Clerk	Purchasing

8.2. LEFT [OUTER] JOIN

- The previous Inner Join clause eliminates the rows that do not match with a row of the other table.
- The Left Outer Join, however, returns all rows from the left table whether or not there is a matching row in the right table.
- Note that the OUTER keyword is optional.
- Because non-matching rows in the right table are filled with the NULL values, you can apply the LEFT JOIN clause to miss-match rows between tables (IS NULL construction).
- Suppose we have two tables A and B. The table A has four rows 1, 2, 3 and 4. The table B also has four rows 3, 4, 5, 6.
- When we join table A with table B, all the rows in table A (the left table) are included in the result set whether there is a matching row in the table B or not.
- The following Venn diagram illustrates the Left Outer Join of two tables.



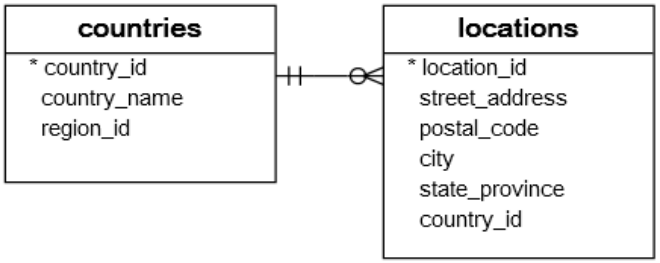


Syntax of the Left Outer Join.

- The LEFT JOIN clause appears after the FROM clause. The condition that follows the ON keyword is called the join condition.
- Notice that both tables have the same column name, therefore we had to qualify the column using the syntax table.column (B.n = A.n).
- In SQL, we use the following syntax to Left Outer Join table A with table B.

```
SELECT
      A.*
FROM
      A
LEFT JOIN
      B ON B.id = A.fk;
```

Example 1. SQL Left Outer Join 2 tables example.



Let's take a look at the countries and locations tables.

Each location belongs to one and only one country while each country can have zero or more locations. The relationship between the countries and locations tables is one-to-many.

The country_id column in the locations table is the foreign key that links to the country_id column in the countries table.

To query the country names of US, UK, and China, you use the following statement.

```
SELECT
	country_id, country_name
FROM
	countries
WHERE
	country_id IN ('US', 'UK', 'CN');
```

country_id	country_name
CN	China
UK	United Kingdom
US	United States of America

The following query retrieves the locations located in the US, UK and China:

```
SELECT
	country_id, street_address, city
FROM
	locations
WHERE
	country_id IN ('US', 'UK', 'CN');
```

country_id	street_address	city
US	2014 Jabberwocky Rd	Southlake
US	2011 Interiors Blvd	South San Francisco
US	2004 Charade Rd	Seattle
UK	8204 Arthur St	London

Now, we use the LEFT JOIN clause to join the countries table with the locations table as the following query:

```
SELECT
	c.country_name, c.country_id,
	l.country_id, l.street_address, l.city
FROM
	countries c
LEFT JOIN locations l ON l.country_id = c.country_id
WHERE
	c.country_id IN ('US', 'UK', 'CN')
```

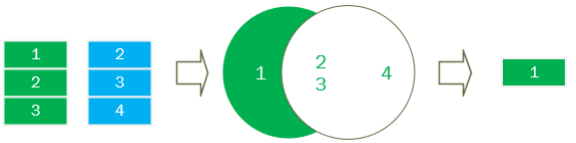
country_name	country_id	country_id	street_address	city
United States of America	US	US	2014 Jabberwocky Rd	Southlake
United States of America	US	US	2011 Interiors Blvd	South San Francisco
United States of America	US	US	2004 Charade Rd	Seattle
United Kingdom	UK	UK	8204 Arthur St	London
United Kingdom	UK	UK	Magdalen Centre, The Oxford Science Park	Oxford
China	CN	NULL	NULL	NULL

- The condition in the WHERE clause is applied so that the statement only retrieves the data from the US, UK, and China rows.
- Because we use the LEFT JOIN clause, all rows that satisfy the condition in the WHERE clause of the countries table are included in the result set.
- For each row in the countries table, the LEFT JOIN clause finds the matching rows in the locations table.
- If at least one matching row found, the database engine combines the data from columns of the matching rows in both tables.
- In case there is no matching row found e.g., with the country_id CN, the row in the countries table is included in the result set and the row in the locations table is filled with NULL values.

Because non-matching rows in the right table are filled with the NULL values, you can apply the LEFT JOIN clause to miss-match rows between tables. For example, to find the country that does not have any locations in the locations table, you use the following query:

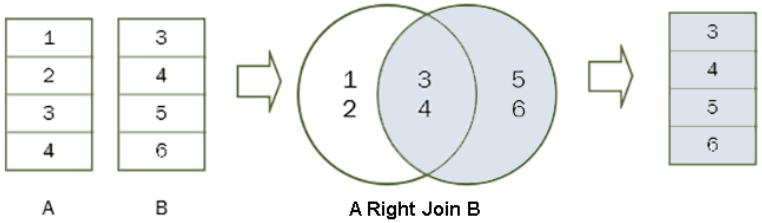
```
SELECT
       country_name -- or *
FROM
       countries c
LEFT JOIN locations l ON l.country_id = c.country_id
WHERE
       l.location_id IS NULL
ORDER BY
       country_name;
```

country_name
Argentina
Australia
Belgium
Brazil
China
Denmark
Egypt
France



8.3. RIGHT [OUTER] JOIN

- The Right Outer Join is symmetrical analog of the Left Outer Join, however, returns all rows from the right table whether or not there is a matching row in the left table.
- The following Venn diagram illustrates the Right Outer Join of two tables.

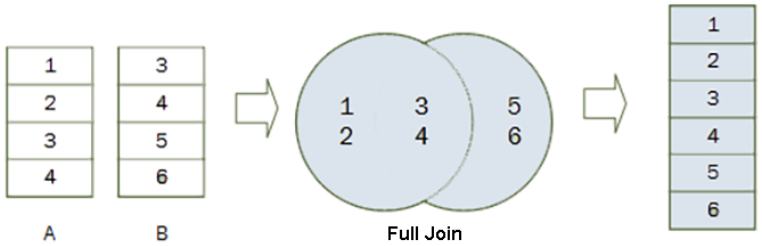


Syntax of the Right Outer Join.

```
SELECT A.*
FROM A
RIGHT JOIN
       B ON B.id = A.fk;
```

8.4. FULL [OUTER] JOIN

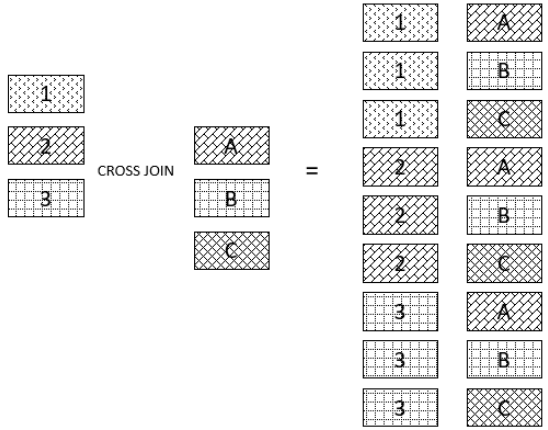
- In theory, a Full Outer Join is the combination of a left join and a right join. The full outer join includes all rows from the joined tables whether or not the other table has the matching row.
- If the rows in the joined tables do not match, the result set of the Full Outer Join contains NULL values for every column of the table that lacks a matching row.
- For the matching rows, a single row that has the columns populated from the joined table is included in the result set.
- Note that the OUTER keyword is optional.
- The following Venn diagram illustrates the Full Outer Join of two tables.



Syntax of the Full Outer Join.

```
SELECT column_list
FROM A
FULL JOIN B ON B.id = A.fk;
```

8.5. [CROSS] JOIN



- CROSS JOIN - Cartesian product (all possible combos of each table).
- The following picture illustrates the Cartesian product of two tables:
- Note that the CROSS keyword is optional.
- Note that unlike the Inner Join, Left Join, and Full Join, the CROSS JOIN clause does not have a join condition.

Syntax of the CROSS JOIN clause

```
SELECT column_list
FROM A
JOIN B;
```

The following statement is equivalent to the one that uses the Cross Join clause above:

```
SELECT
    column_list
FROM
    A,
    B;
```

Example 1.

```
SELECT *
FROM table1 as a CROSS JOIN table2 as b;
```

Example 2.

If you add a WHERE clause, in case table t1 and t2 has a relationship, the CROSS JOIN works like the INNER JOIN clause as shown in the following query:

```
SELECT * FROM t1
CROSS JOIN t2
WHERE t1.id = t2.id;
```

8.6. Self Joins

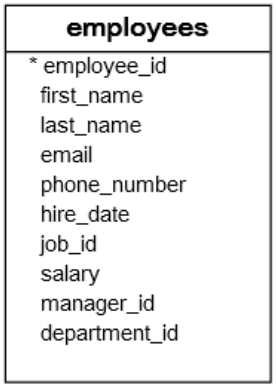
- We join a table to itself to evaluate the rows with other rows in the same table.
- To perform the Self Join, we use either an Inner Join, Left Join or Right Join clause.
- Because the same table appears twice in a single query, we have to use the table aliases.
- The following statement illustrates how to join a table to itself.

```
SELECT
      column1, column2, column3, ...
FROM
      table1 A
INNER JOIN table1 B ON B.column1 = A.column2;
```

- In this statement joins the table1 to itself using an INNER JOIN clause.
- A and B are the table aliases of the table1.
- The B.column1 = A.column2 is the join condition.
- Besides the INNER JOIN clause, you can use the LEFT JOIN or RIGHT JOIN clause.

Example 1.

See the following employees table.



The manager_id column specifies the manager of an employee. The following statement joins the employees table to itself to query the information of who reports to whom.

```
SELECT
    e.first_name || ' ' || e.last_name AS employee,
    m.first_name || ' ' || m.last_name AS manager
FROM
    employees e
        INNER JOIN
    employees m ON m.employee_id = e.manager_id
ORDER BY manager;
```

employee	manager
Bruce Ernst	Alexander Hunold
David Austin	Alexander Hunold
Valli Pataballa	Alexander Hunold
Diana Lorentz	Alexander Hunold
Alexander Khoo	Den Raphaely
Shelli Baida	Den Raphaely
Sigal Tobias	Den Raphaely
Guy Himuro	Den Raphaely
Karen Colmenares	Den Raphaely

Example 2.

The president does not have any manager. In the employees table, the manager_id of the row that contains the president is NULL.

Because the Inner Join clause only includes the rows that have matching rows in the other table, therefore the president did not show up in the result set of the query above.

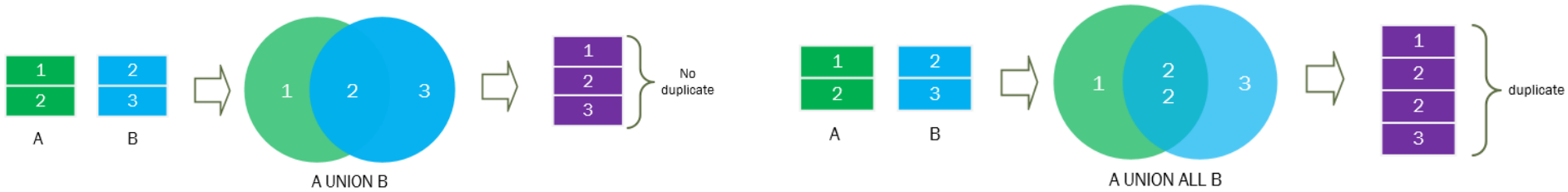
To include the president in the result set, we use the LEFT JOIN clause instead of the INNER JOIN clause as the following query.

```
SELECT
    e.first_name || ' ' || e.last_name AS employee,
    m.first_name || ' ' || m.last_name AS manager
FROM
    employees e
        LEFT JOIN
    employees m ON m.employee_id = e.manager_id
ORDER BY manager;
```

employee	manager
Steven King	NULL
Bruce Ernst	Alexander Hunold
David Austin	Alexander Hunold
Valli Pataballa	Alexander Hunold
Diana Lorentz	Alexander Hunold
Alexander Khoo	Den Raphaely
Shelli Baida	Den Raphaely
Sigal Tobias	Den Raphaely
Guy Himuro	Den Raphaely

9. SELECT UNION and UNION ALL

- The UNION operator combines result sets of two or more SELECT statements into a single result set.
- To use the UNION operator, you write the individual SELECT statements and join them by the keyword UNION.
- The columns returned by the SELECT statements must have the same or convertible data type, size, and be the same order.
- The UNION is different from the JOIN that the join combines *columns* of multiple tables while the union combines *rows* of the tables.
- The database system performs the following steps:
    - First, execute each SELECT statement individually.
    - Second, combine result sets and remove duplicate rows to create the combined result set. To retain the duplicate rows in the result set, you use the UNION ALL operator.
    - Third, sort the combined result set by the column specified in the ORDER BY clause.
- The following picture illustrates A UNION B and A UNION ALL B:

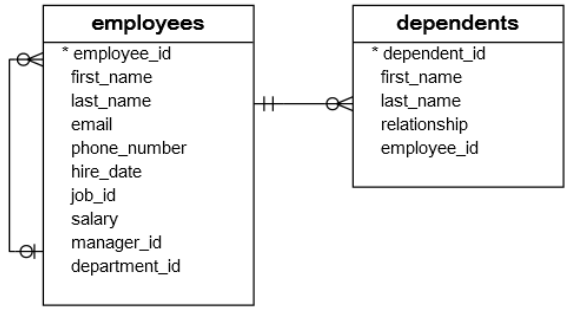


Syntax of the UNION operator to combine result sets of two queries

```
SELECT
    column1, column2
FROM
    table1
UNION - or UNION ALL
SELECT
    column3, column4
FROM
    table2;
```

Example 1.

See the following employees and dependents tables:



The following statement uses the UNION operator to combine the first name and last name of employees and dependents.

```
SELECT
	first_name,
	last_name
FROM
	employees
UNION
SELECT
	first_name,
	last_name
FROM
	dependents
ORDER BY
	last_name;
```

first_name	last_name
Fred	Austin
David	Austin
Hermann	Baer
Kirsten	Baer
Sandra	Baida
Shelli	Baida
Audrey	Bell
Sarah	Bell

10. SELECT Subqueries

- **Subquery – show you how to nest a query inside another query to form a more flexible query for querying data.**
- Correlated Subquery – introduce you to the correlated subquery which is a subquery that uses values from the outer query.
- EXISTS – show you how to check for the existence of the row returned from a subquery.
- ALL – illustrate how to query data by comparing values in a column of the table with a set of columns.
- ANY – query data if a value in a column of a table matches one of value in a set.