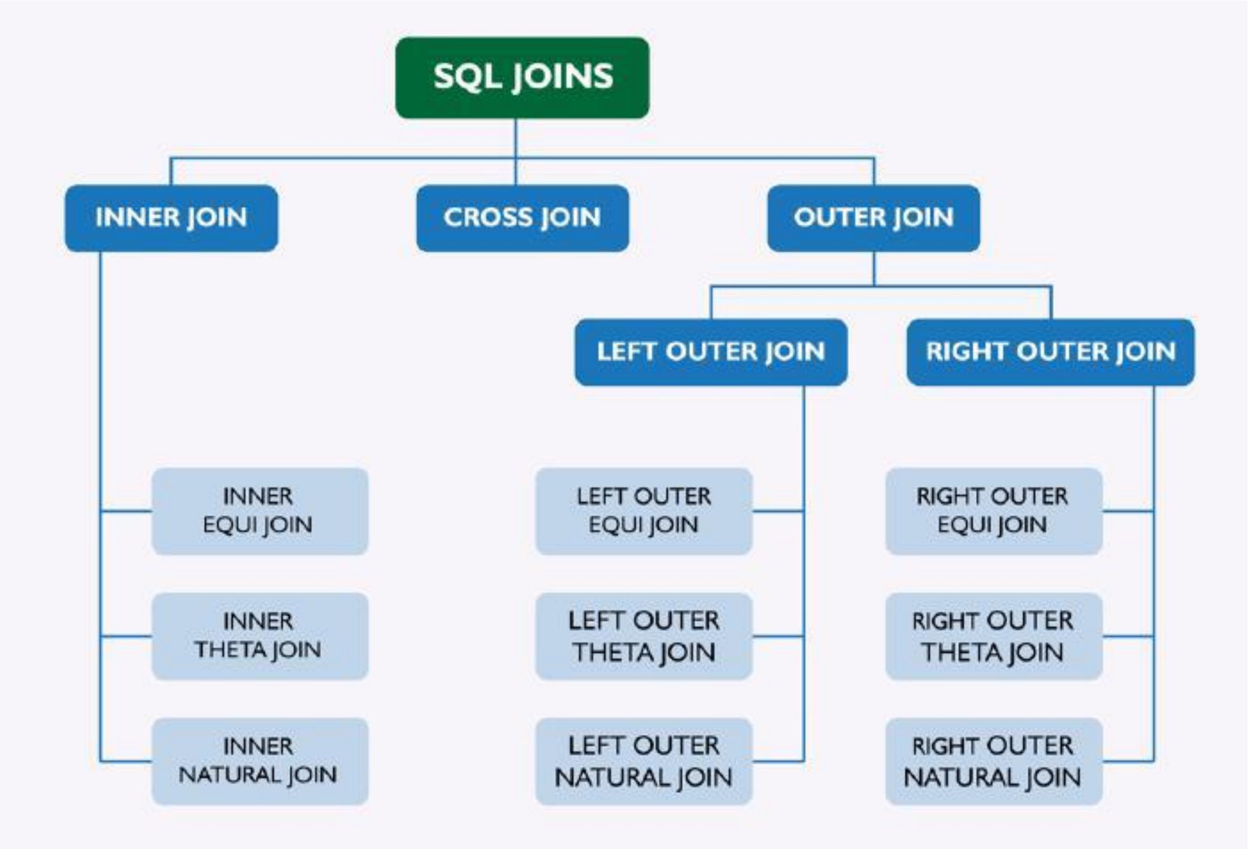
*A SQL JOIN is a method to retrieve data from two or more database tables. This article presents a basic overview of what data from a particular SQL join will look like. A popular way of understanding SQL joins is to visualize them using Venn diagrams, so each example have corresponding Venn diagram, appropriate `SELECT` statement and the result table.*

There are a few major kinds of SQL joins:

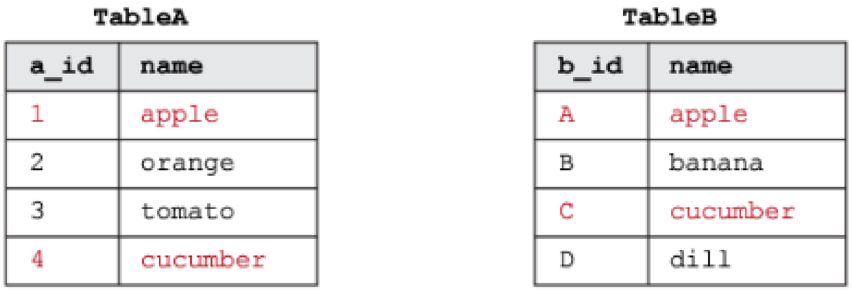
- INNER JOIN
- OUTER [LEFT | RIGHT | FULL] JOIN
- NATURAL JOIN
- CROSS JOIN

We distinguish the implementation of these joins based on the join operators:

- equi and
- theta, which will be described later.



For the purposes of this article, let's discuss joins using a simple example. Assume that we have two basic tables, TableA and TableB, which are filled with some example data. Since we'll be joining tables on `name` column, we distinguish the rows of the same name by highlighting them red.



**TableA**

| a_id | name |
|---|---|
| 1 | apple |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |

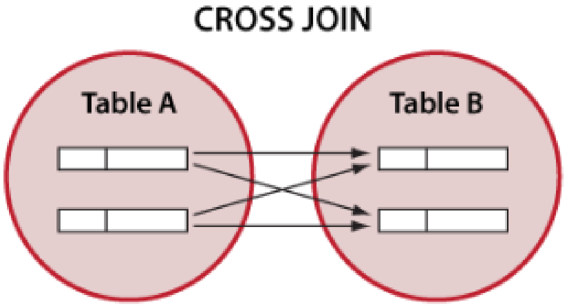
**TableB**

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| C | cucumber |
| D | dill |

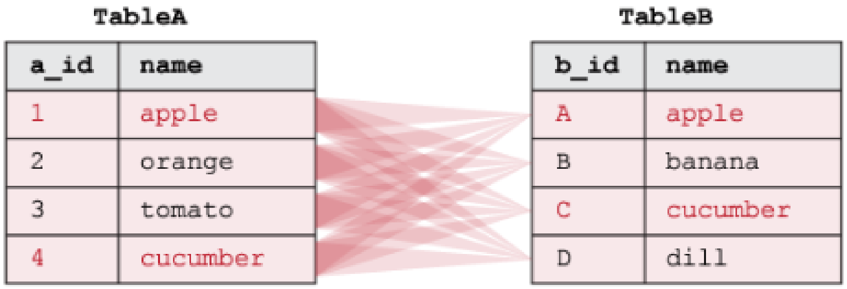
In the following sections, we'll look at what happens to this data when different types of joins are implemented.

## CROSS JOIN

A CROSS JOIN is a Cartesian product of TableA and TableB. Every row from TableA is matched with every row from TableB; that's why a CROSS JOIN doesn't make sense in most situations.



```
select *
from tableA
cross join tableB;
```



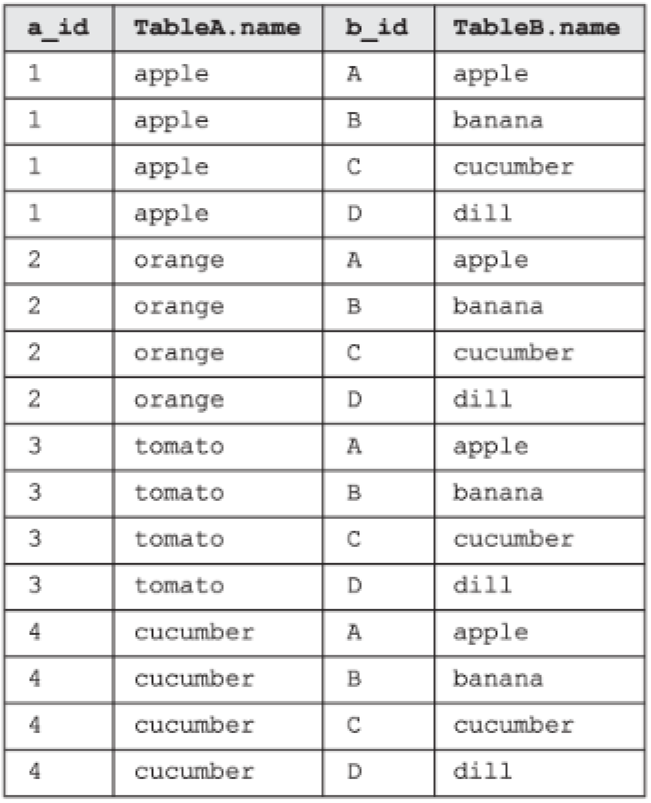
TableA

| a_id | name |
|---|---|
| 1 | apple |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |

TableB

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| C | cucumber |
| D | dill |

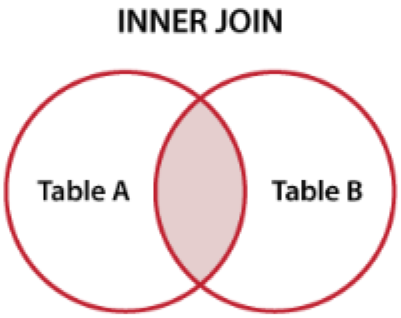
TableA and TableB contain 4 rows. The resulting table will have 4 * 4 = 16 rows and will look as follows:



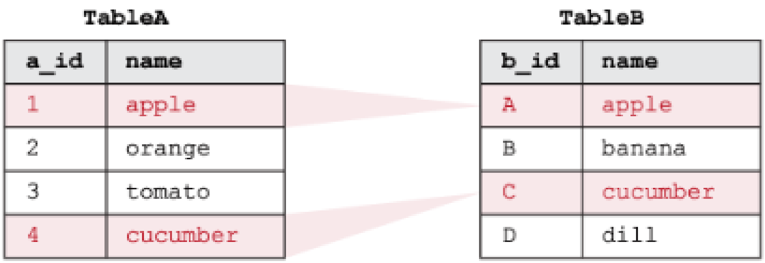
| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 1 | apple | A | apple |
| 1 | apple | B | banana |
| 1 | apple | C | cucumber |
| 1 | apple | D | dill |
| 2 | orange | A | apple |
| 2 | orange | B | banana |
| 2 | orange | C | cucumber |
| 2 | orange | D | dill |
| 3 | tomato | A | apple |
| 3 | tomato | B | banana |
| 3 | tomato | C | cucumber |
| 3 | tomato | D | dill |
| 4 | cucumber | A | apple |
| 4 | cucumber | B | banana |
| 4 | cucumber | C | cucumber |
| 4 | cucumber | D | dill |

# INNER JOIN

An INNER JOIN merges ONLY the matching rows in BOTH tables. A JOIN without any other JOIN keywords (like INNER, OUTER, LEFT, etc) is an INNER JOIN. Results are found in the overlapping area.



```
SELECT *
from tableA inner join tableB
on tableA.name = tableB.name
```



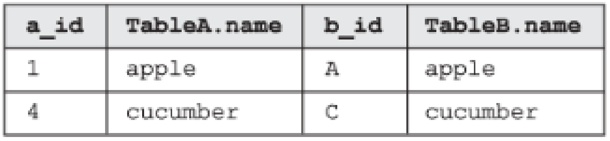
TableA

| a_id | name |
|---|---|
| 1 | apple |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |

TableB

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| C | cucumber |
| D | dill |

The resulting table will be as follows:

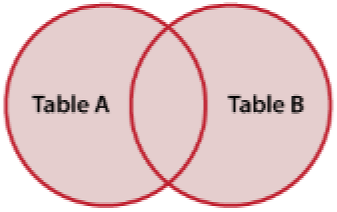


| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 1 | apple | A | apple |
| 4 | cucumber | C | cucumber |

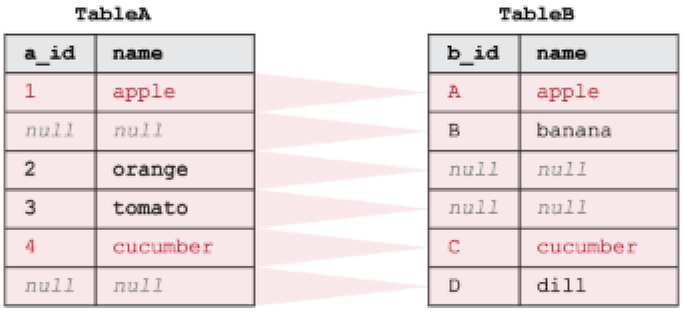
## OUTER JOINS

**FULL OUTER JOIN** returns matched and unmatched rows from both tables (it's an union of both). If there is no match, the missing side will contain null.

FULL OUTER JOIN



```
Select *
FROM TableA
FULL OUTER JOIN TableB
On TableA.name = TableB.name;
```



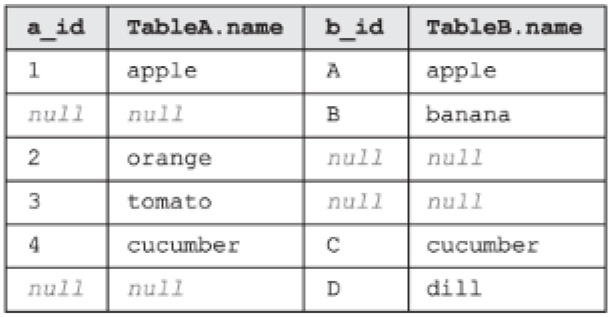
TableA

| a_id | name |
|---|---|
| 1 | apple |
| null | null |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |
| null | null |

TableB

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| null | null |
| null | null |
| C | cucumber |
| D | dill |

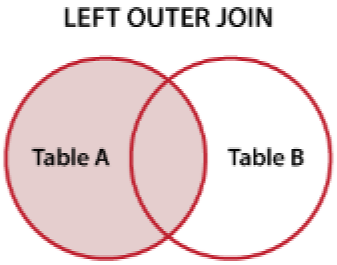
The resulting table will be as follows:



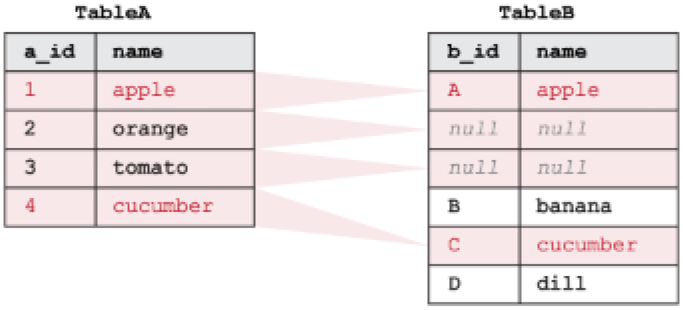
| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 1 | apple | A | apple |
| null | null | B | banana |
| 2 | orange | null | null |
| 3 | tomato | null | null |
| 4 | cucumber | C | cucumber |
| null | null | D | dill |

A **LEFT OUTER JOIN** returns all rows from the left table (TableA) with the matching rows from the right table (TableB) or *null* – if there is no match in the right table.

The results can be found in the entire left circle:



```
Select *
FROM TableA
LEFT OUTER JOIN TableB
on tableA.name = tableB.name;
```



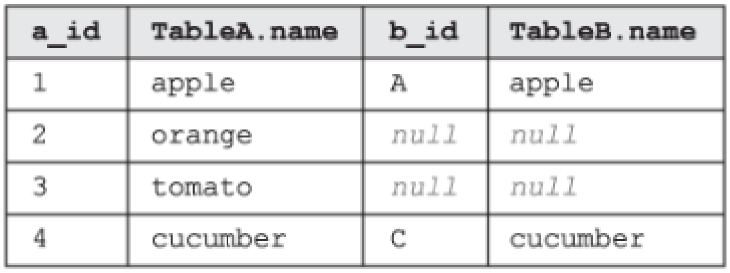
TableA

| a_id | name |
|---|---|
| 1 | apple |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |

TableB

| b_id | name |
|---|---|
| A | apple |
| *null* | *null* |
| *null* | *null* |
| B | banana |
| C | cucumber |
| D | dill |

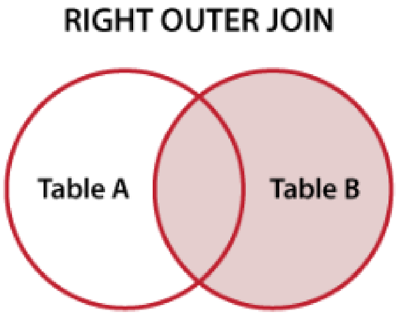
## The resulting table will be as follows:



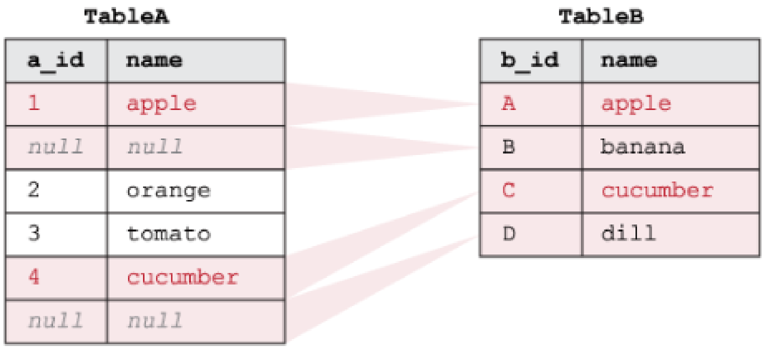
| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 1 | apple | A | apple |
| 2 | orange | *null* | *null* |
| 3 | tomato | *null* | *null* |
| 4 | cucumber | C | cucumber |

A **RIGHT OUTER JOIN** returns all rows from the right table (TableB) with the matching rows from the left table (TableA) or *null* – if there is no match in the left table.

The results can be found in the entire right circle:



```
Select *
FROM tableA
RIGHT OUTER JOIN tableB
On tableA.name = tableB.name
```



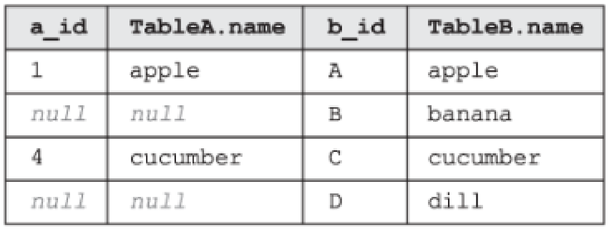
TableA

| a_id | name |
|---|---|
| 1 | apple |
| *null* | *null* |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |
| *null* | *null* |

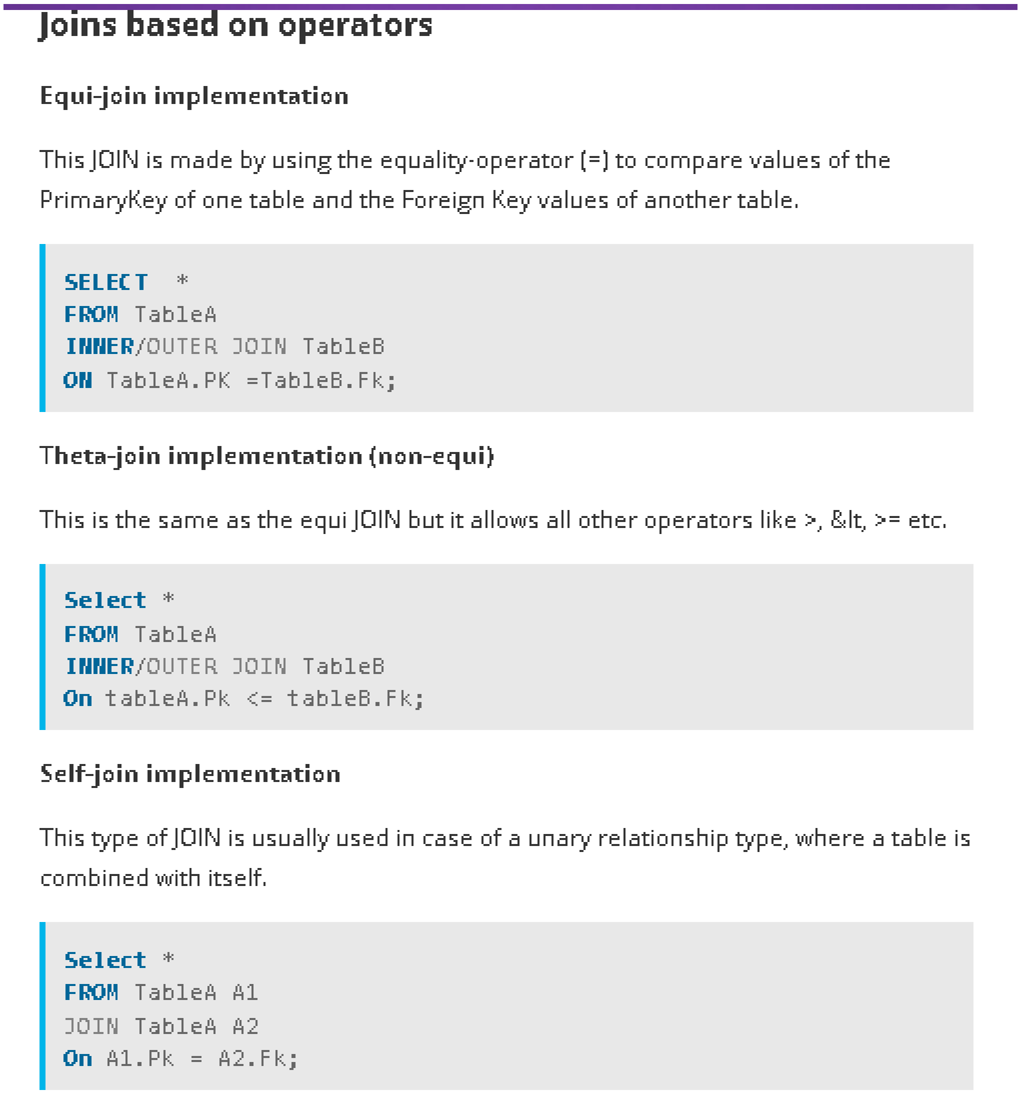
TableB

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| C | cucumber |
| D | dill |

The resulting table will be as follows:



| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 1 | apple | A | apple |
| *null* | *null* | B | banana |
| 4 | cucumber | C | cucumber |
| *null* | *null* | D | dill |



## Joins based on operators

### Equi-join implementation

This JOIN is made by using the equality-operator (=) to compare values of the PrimaryKey of one table and the Foreign Key values of another table.

```
SELECT  *
FROM TableA
INNER/OUTER JOIN TableB
ON TableA.PK =TableB.Fk;
```

### Theta-join implementation (non-equi)

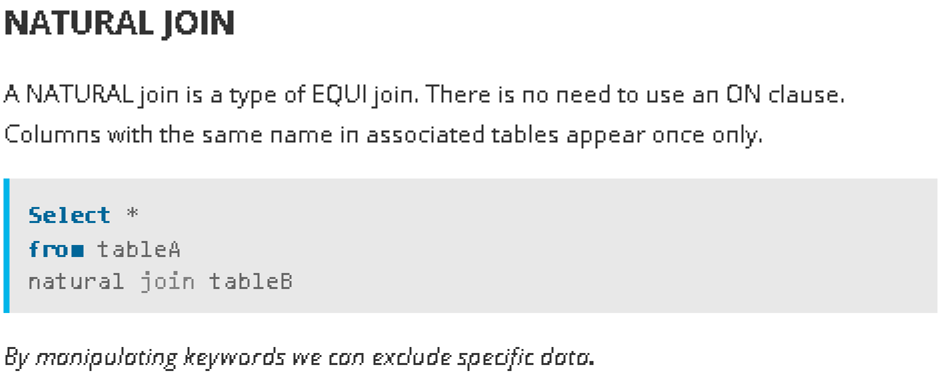
This is the same as the equi JOIN but it allows all other operators like >, &lt, >= etc.

```
Select *
FROM TableA
INNER/OUTER JOIN TableB
On tableA.Pk <= tableB.Fk;
```

### Self-join implementation

This type of JOIN is usually used in case of a unary relationship type, where a table is combined with itself.

```
Select *
FROM TableA A1
JOIN TableA A2
On A1.Pk = A2.Fk;
```



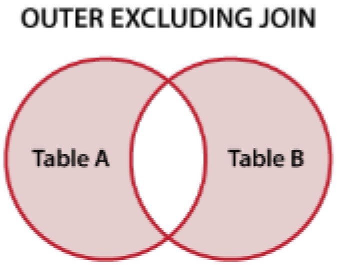
## NATURAL JOIN

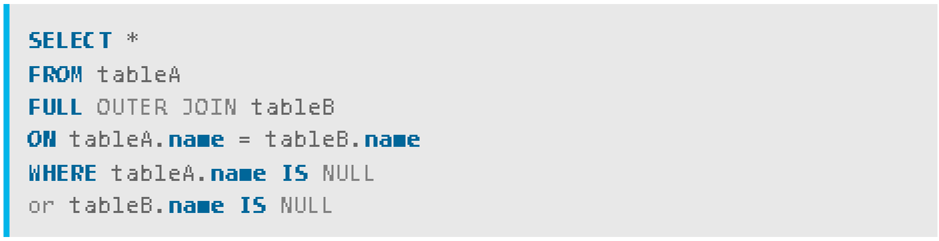
A NATURAL join is a type of EQUI join. There is no need to use an ON clause. Columns with the same name in associated tables appear once only.

```
Select *
from tableA
natural join tableB
```

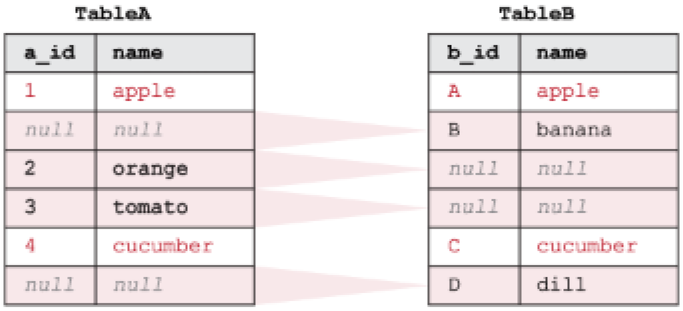
*By manipulating keywords we can exclude specific data.*

An **OUTER EXCLUDING JOIN** returns all of the records in TableA and all of the records in TableB that don't match.





```
SELECT *
FROM tableA
FULL OUTER JOIN tableB
ON tableA.name = tableB.name
WHERE tableA.name IS NULL
or tableB.name IS NULL
```



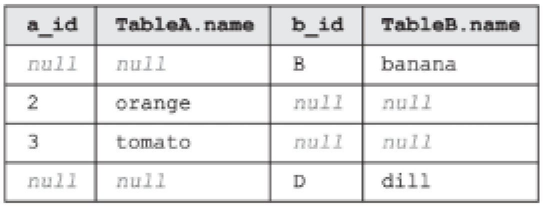
TableA

| a_id | name |
|---|---|
| 1 | apple |
| null | null |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |
| null | null |

TableB

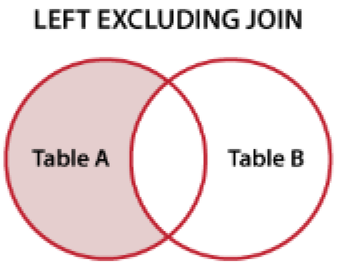
| b_id | name |
|---|---|
| A | apple |
| B | banana |
| null | null |
| null | null |
| C | cucumber |
| D | dill |

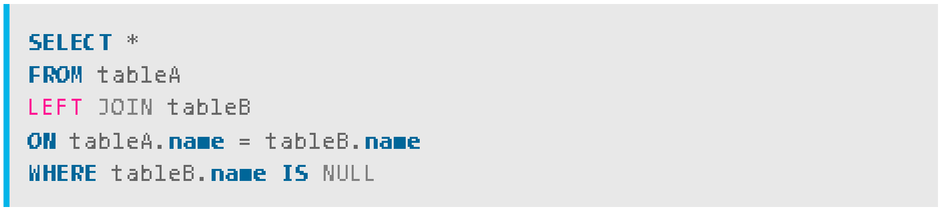
The resulting table will be as follows:



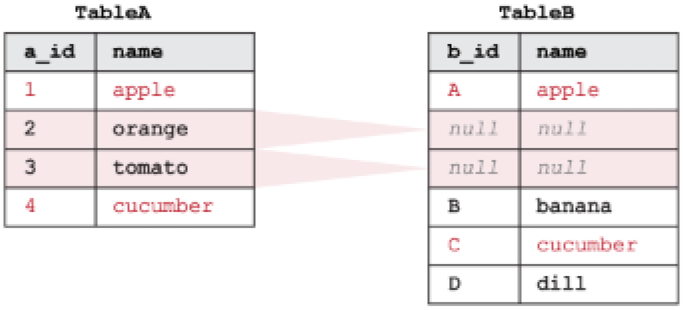
| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| null | null | B | banana |
| 2 | orange | null | null |
| 3 | tomato | null | null |
| null | null | D | dill |

A **LEFT EXCLUDING JOIN** returns all of the records in TableA that don't match any record in TableB.





```
SELECT *
FROM tableA
LEFT JOIN tableB
ON tableA.name = tableB.name
WHERE tableB.name IS NULL
```



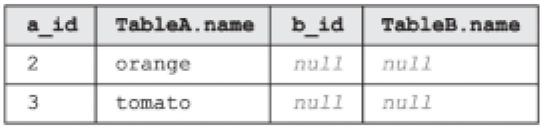
TableA

| a_id | name |
|---|---|
| 1 | apple |
| 2 | orange |
| 3 | tomato |
| 4 | cucumber |

TableB

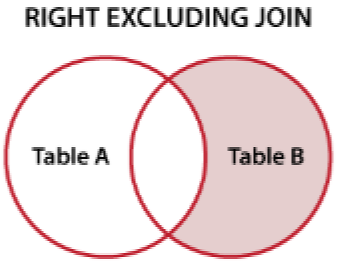
| b_id | name |
|---|---|
| A | apple |
| *null* | *null* |
| *null* | *null* |
| B | banana |
| C | cucumber |
| D | dill |

The resulting table will be as follows:

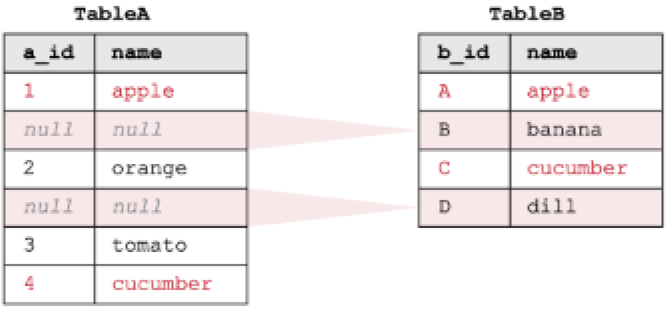


| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| 2 | orange | *null* | *null* |
| 3 | tomato | *null* | *null* |

A **RIGHT EXCLUDING JOIN** returns all of the records in TableB that don't match ar records in TableA.


RIGHT EXCLUDING JOIN

```
SELECT *
FROM tableA
RIGHT JOIN tableB
ON tableA.name = tableB.name
WHERE tableA.name IS NULL
```

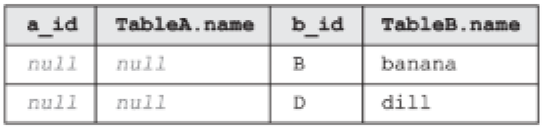

TableA

| a_id | name |
|---|---|
| 1 | apple |
| *null* | *null* |
| 2 | orange |
| *null* | *null* |
| 3 | tomato |
| 4 | cucumber |

TableB

| b_id | name |
|---|---|
| A | apple |
| B | banana |
| C | cucumber |
| D | dill |

The resulting table will be as follows:



| a_id | TableA.name | b_id | TableB.name |
|---|---|---|---|
| *null* | *null* | B | banana |
| *null* | *null* | D | dill |