Sub-queries

IMPROVING QUERY PERFORMANCE IN SQL SERVER

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Founder, Atamai Analytics

How do sub-queries look?

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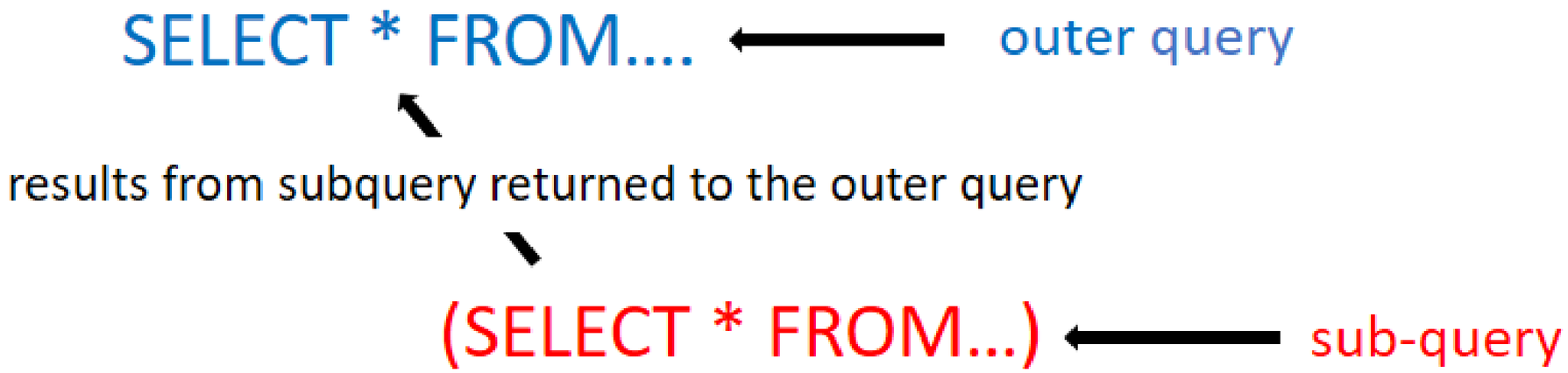

Sub-query with FROM

```
SELECT OrderID,
        CustomerID,
        NumDays
FROM
      (SELECT *,
      DATEDIFF(DAY,OrderDate,ShippedDate) AS NumDays
      FROM Orders) AS o
WHERE NumDays >= 35;
```

Sub-query with FROM

```
SELECT OrderID,
       CustomerID,
       NumDays
FROM
    (SELECT *,
     DATEDIFF(DAY,OrderDate,ShippedDate) AS NumDa
     FROM Orders) AS o
WHERE NumDays >= 35;
```

OrderID	CustomerID	NumDays
10380	HUNGO	35
10427	PICCO	35
10545	LAZYK	35
10593	LEHMS	35
10660	HUNGC	37
10777	GOURL	37
10924	BERGS	35

Sub-query with WHERE

```
SELECT CustomerID
      ,CompanyName
FROM Customers
WHERE CustomerID
      IN (SELECT CustomerID
          FROM Orders
          WHERE Freight > 800);
```

Sub-query with WHERE

```
SELECT CustomerID
       ,CompanyName
FROM Customers
WHERE CustomerID
         IN (SELECT CustomerID
         FROM Orders
         WHERE Freight > 800);
```

CustomerID	CompanyName
QUEEN	Queen Cozinha
QUICK	QUICK-Stop
SAVEA	Save-a-lot Markets

Sub-query with SELECT

```
SELECT CustomerID,
       CompanyName,
        (SELECT AVG(Freight)
        FROM Orders o
        WHERE c.CustomerID = o.CustomerID) AS AvgFreight
FROM Customers c;
```

Sub-query with SELECT

```
SELECT CustomerID,
       CompanyName,
        (SELECT AVG(Freight)
        FROM Orders o
        WHERE c.CustomerID = o.CustomerID) AS AvgFreight
FROM Customers c;
```

CustomerID	CompanyName	AvgFreight
ALFKI	Alfreds Futterkiste	37.6
ANATR	Ana Trujillo Emparedados y helados	24.4
ANTON	Antonio Moreno Taquería	38.4
...	...	...

Types of sub-queries

Uncorrelated sub-query

```
SELECT CustomerID
       ,CompanyName
FROM Customers
WHERE CustomerID IN
         (SELECT CustomerID
         FROM Orders
         WHERE Freight > 800);
```

- Sub-query *does not* contain a reference to the outer query
- Sub-query *can* run independently of the outer query
- Used with `WHERE` and `FROM`

Correlated sub-query

```
SELECT CustomerID,
       CompanyName,
        (SELECT AVG(Freight)
        FROM Orders o
        WHERE c.CustomerID = o.CustomerID) AS AvgFreight
FROM Customers c;
```

- Sub-query *contains* a reference to the outer query
- Sub-query *cannot* run independently of the outer query
- Used with `WHERE` and `SELECT`

Sub-query performance

Correlated

- Sub-query executes for each row in the outer query

Uncorrelated

- Sub-query executes only once and returns the results to the outer query

Sub-query vs. INNER JOIN

Correlated sub-query

```
SELECT CustomerID,
       CompanyName,
        (SELECT AVG(Freight)
        FROM Orders o
        WHERE c.CustomerID = o.CustomerID) AS AvgFreight
FROM Customers c;
```

INNER JOIN

```
SELECT c.CustomerID,
       c.CompanyName,
       AVG(o.Freight)
FROM Customers c
INNER JOIN Orders o
    ON c.CustomerID = o.CustomerID
GROUP BY c.CustomerID,
         c.CompanyName;
```

Let's practice!

IMPROVING QUERY PERFORMANCE IN SQL SERVER

Presence and absence

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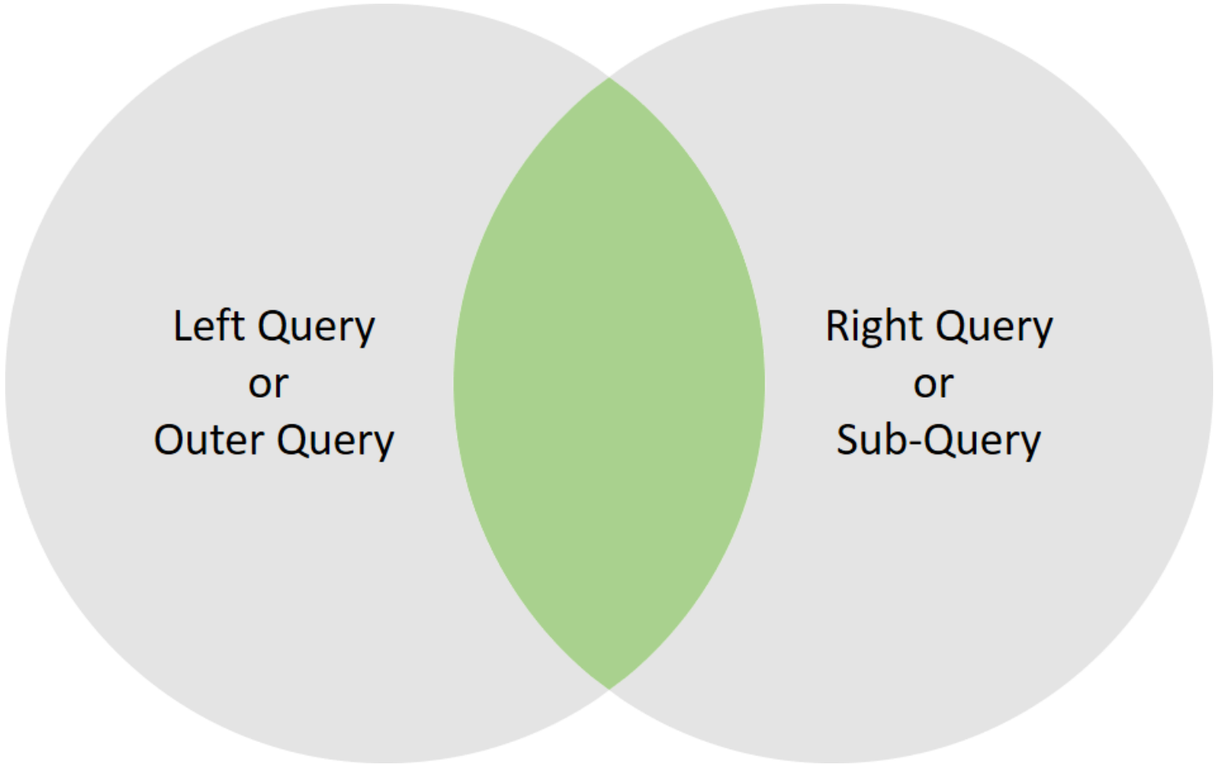
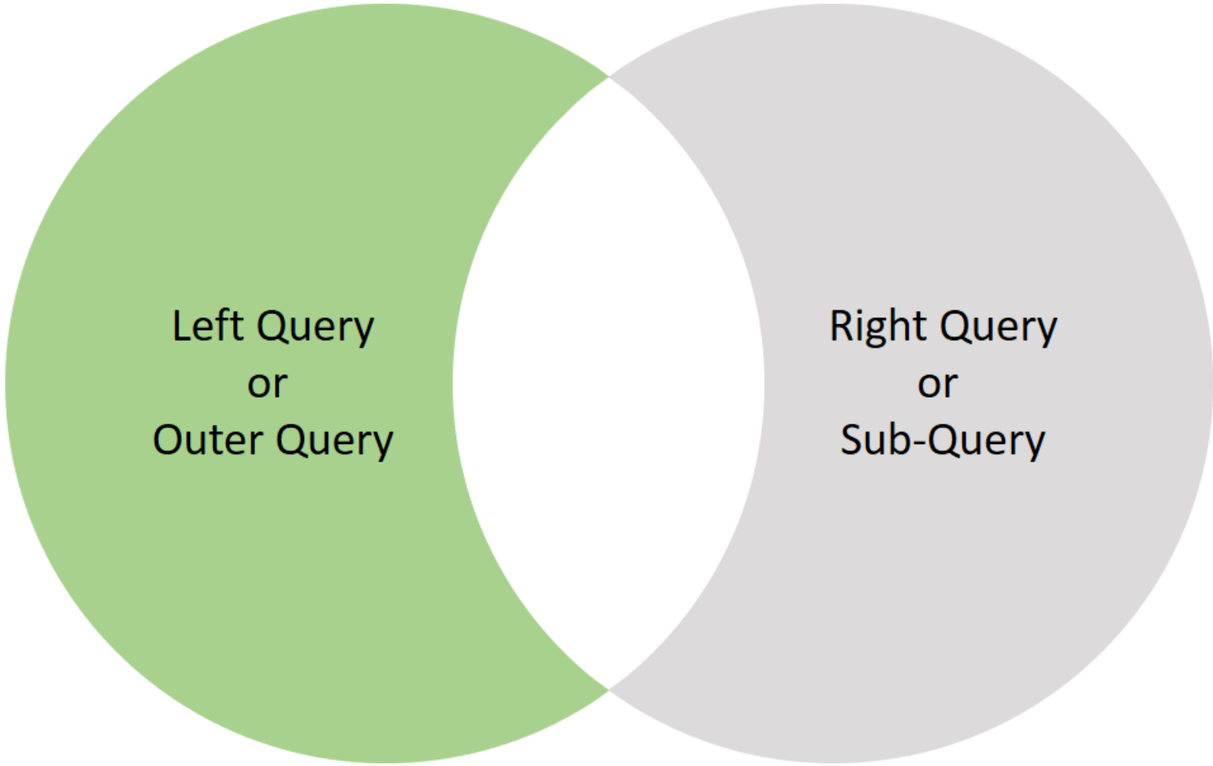
Venn diagram - presence

Data present in both tables.

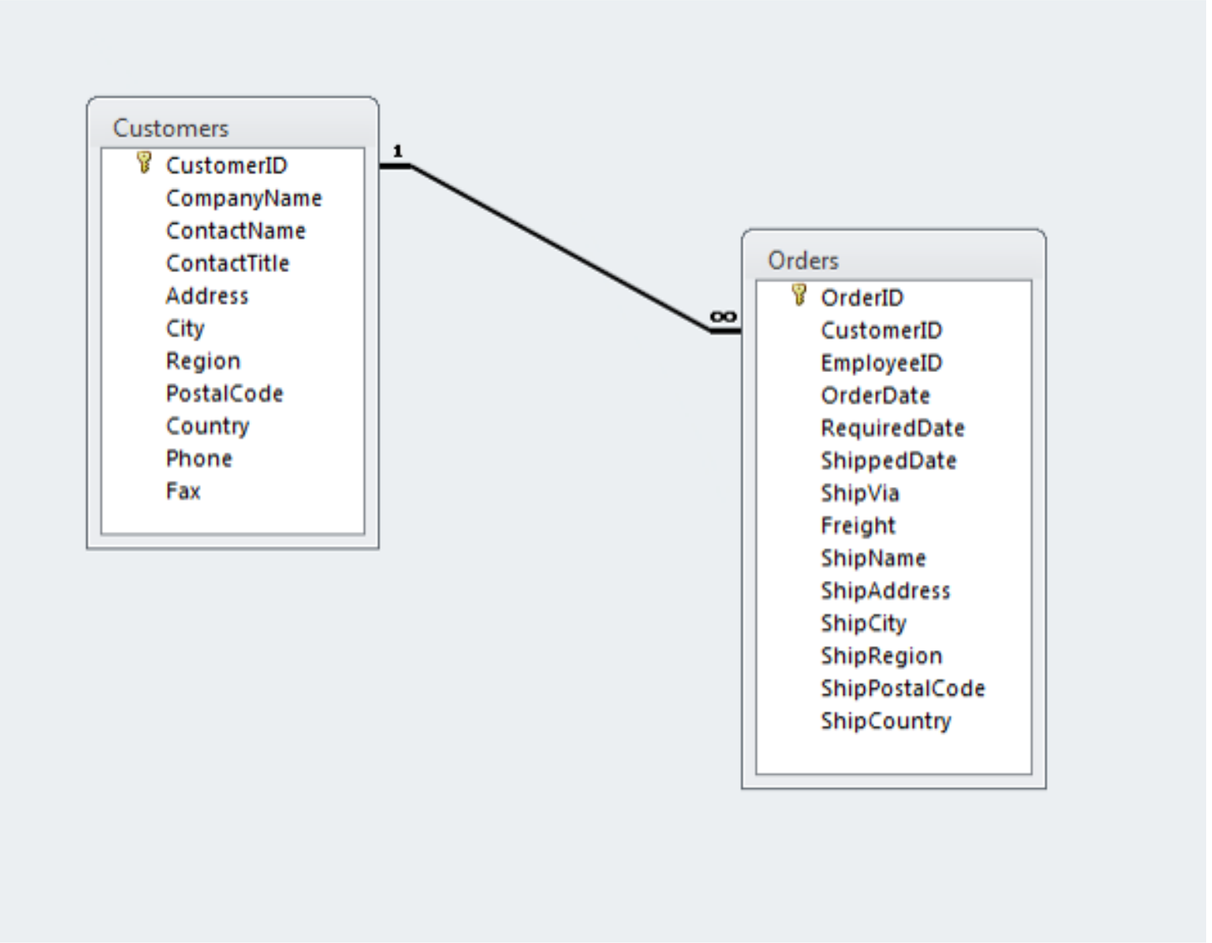


Venn diagram - absence

Data present in the left table but absent in the right table.



Customer Orders database



INTERSECT

```
SELECT CustomerID
FROM Customers




SELECT CustomerID
FROM Orders;
```

INTERSECT

```
SELECT CustomerID
FROM Customers

INTERSECT

SELECT CustomerID
FROM Orders;
```

CustomerID
ALFKI
LAUGB
QUICK
REGGC
SPLIR
CHOPS
...

EXCEPT

```
SELECT CustomerID
FROM Customers




SELECT CustomerID
FROM Orders;
```

EXCEPT

```
SELECT CustomerID
FROM Customers

EXCEPT

SELECT CustomerID
FROM Orders;
```

CustomerID
FISSA
PARIS

INTERSECT and EXCEPT

Advantages

- Great for data interrogation
- Remove duplicates from the returned results

Disadvantages

- The number and order of columns in the `SELECT` statement must be the same between queries

Let's practice!

IMPROVING QUERY PERFORMANCE IN SQL SERVER

Alternative methods 1

IMPROVING QUERY PERFORMANCE IN SQL SERVER

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EXISTS

```
SELECT CustomerID,
       CompanyName,
       ContactName
FROM Customers c
WHERE EXISTS
        (SELECT 1
         FROM Orders o
         WHERE c.CustomerID = o.CustomerID);
```

CustomerID	CompanyName	ContactName
ALFKI	Alfreds Futterkiste	Maria Anders
LAUGB	Laughing Bacchus Wine Cellars	Yoshi Tannamuri
QUICK	QUICK-Stop	Horst Kloss
...	...	...

IN

```
SELECT CustomerID,
       CompanyName,
       ContactName
FROM Customers
WHERE CustomerID IN
        (SELECT CustomerID
         FROM Orders);
```

CustomerID	CompanyName	ContactName
ALFKI	Alfreds Futterkiste	Maria Anders
LAUGB	Laughing Bacchus Wine Cellars	Yoshi Tannamuri
QUICK	QUICK-Stop	Horst Kloss
...	...	...

EXISTS vs. IN

- `EXISTS` will stop searching the sub-query when the condition is TRUE
- `IN` collects all the results from a sub-query before passing to the outer query
- Consider using `EXISTS` instead of `IN` with a sub-query

NOT EXISTS

```
SELECT CustomerID,
       CompanyName,
       ContactName
FROM Customers c
WHERE NOT EXISTS
        (SELECT 1
         FROM Orders o
         WHERE c.CustomerID = o.CustomerID);
```

CustomerID	CompanyName	ContactName
FISSA	FISSA Fabrica Inter. Salchichas S.A.	Diego Roel
PARIS	Paris spécialités	Marie Bertrand

NOT IN

```
SELECT CustomerID,
       CompanyName,
       ContactName
FROM Customers
WHERE CustomerID NOT IN
        (SELECT CustomerID
         FROM Orders);
```

CustomeID	CompanyName	ContactName
FISSA	FISSA Fabrica Inter. Salchichas S.A.	Diego Roel
PARIS	Paris spécialités	Marie Bertrand

NOT IN and NULLs

```
SELECT UNStatisticalRegion AS UN_Region
      ,CountryName
      ,Capital
FROM Nations
WHERE Capital NOT IN
        (SELECT NearestPop
         FROM Earthquakes);
```

UN_Region	CountryName	Capital

Handling NOT IN NULLs

```
SELECT UNStatisticalRegion AS UN_Region
      ,CountryName
      ,Capital
FROM Nations
WHERE Capital NOT IN
        (SELECT NearestPop
         FROM Earthquakes
         WHERE NearestPop IS NOT NULL);
```

UN_Region	CountryName	Capital
South Asia	India	New Delhi
East Asia and Pacific	Indonesia	Jakarta
East Asia and Pacific	East Timor	Dili
Sahara Africa	Comoros	Moroni
...	...	...

EXISTS, NOT EXISTS, IN and NOT IN

Advantages

- Results can contain any column from the outer query, and in any order

Disadvantages

- The way NOT IN handles NULL values in the sub-query

Let's practice!

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Alternative methods 2

IMPROVING QUERY PERFORMANCE IN SQL SERVER

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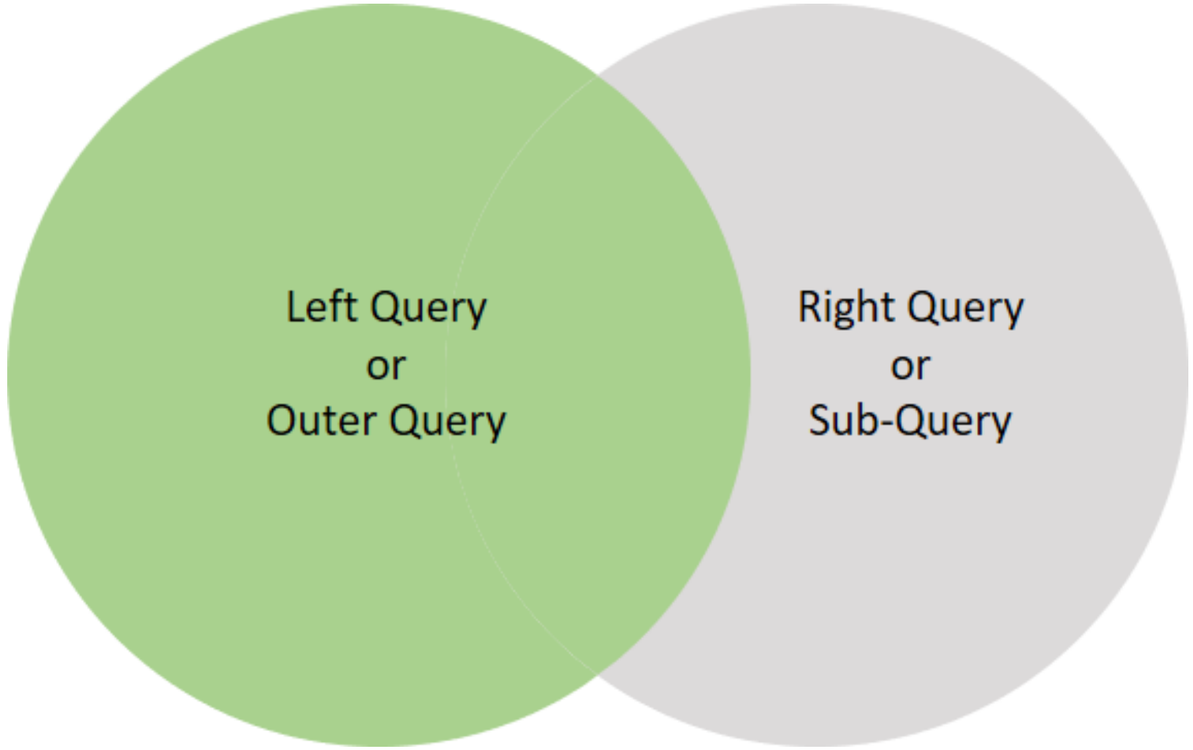
INNER JOIN

```
SELECT c.CustomerID
      ,c.CompanyName
      ,o.OrderID
      ,o.OrderDate
      ,o.ShippedDate
      ,o.Freight
FROM Customers c
INNER JOIN Orders o
    ON c.CustomerID = o.CustomerID
```

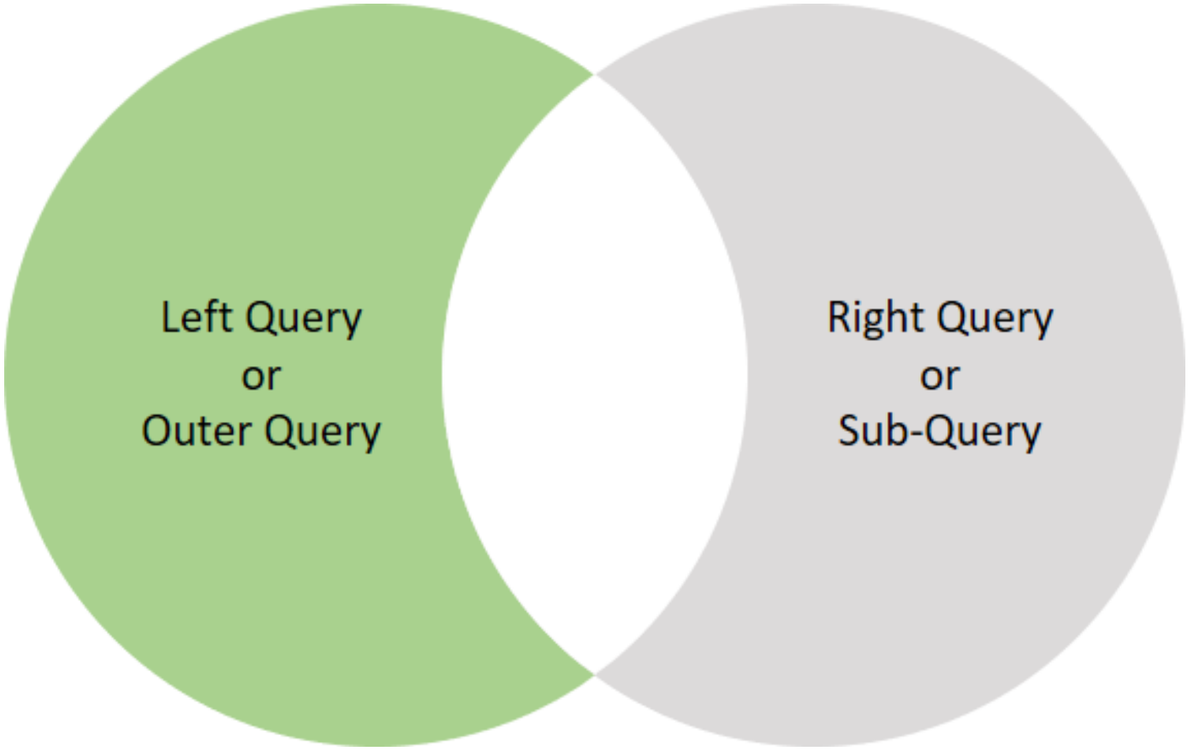
CustomerID	CompanyName	OrderID	...
VINET	Vins et alcools Chevalier	10248	...
HANAR	Hanari Carnes	10250	...
VICTE	Victuailles en stock	10251	...
SUPRD	Suprêmes délices	10252	...
...	...	...	...

LEFT OUTER JOIN

Inclusive LEFT OUTER JOIN



Exclusive LEFT OUTER JOIN



Exclusive LEFT OUTER JOIN

```
SELECT c.CustomerID
      ,c.CompanyName
      ,o.OrderID
      ,o.OrderDate
      ,o.ShippedDate
      ,o.Freight
FROM Customers c
LEFT OUTER JOIN Orders o
    ON c.CustomerID = o.CustomerID
WHERE o.CustomerID IS NULL
```

CustomerID	CompanyName	OrderID	...
FISSA	FISSA Fabrica Inter. Salchichas S.A.	NULL	...
PARIS	Paris spécialités	NULL	...

Review: INTERSECT and EXCEPT

`INTERSECT` : checks for presence

`EXCEPT` : checks for absence

Advantages

- Great for data interrogation
- Remove duplicates from the returned results

Disadvantage

- The number and order of columns in the `SELECT` statement must be the same between queries

Review: EXISTS and NOT EXISTS

`EXISTS` : checks for presence

`NOT EXISTS` : checks for absence

Advantages

- The sub-query will stop searching as soon as it evaluates to TRUE
- Results can contain any column from the outer query, and in any order

Disadvantage

- Results can only contain columns from the outer query

Review: IN and NOT IN

`IN` : checks for presence

`NOT IN` : checks for absence

Advantage

- Results can contain any column from the outer query, and in any order

Disadvantages

- Results can only contain columns from the outer query
- No results returned because of the way `NOT IN` handles nulls in the sub-query

Review: INNER JOIN and exclusive L.O.J

`INNER JOIN` : checks for presence

exclusive `LEFT OUTER JOIN` : checks for absence

Advantage

- Results can contain any column, from all joined queries, in any order

Disadvantage

- Requirement to add the `IS NULL` `WHERE` filter condition with the exclusive `LEFT OUTER JOIN`

Let's practice!

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