Subqueries

SQL supports writing queries within queries, or **nesting queries**

Outer query:

-The outermost query is a query whose result set is returned to the caller

Inner query(Sub-Query):

- is a query whose result is used by the outer query

- The inner query acts in place of an expression that is based on constants or variables and is evaluated at run time.

- A subquery can be single-valued, multivalued, or table-valued. That is, a subquery can return a single value(Scalar Subqueries), multiple values(Multivalued Subquerie), or a whole table result.

-Unlike the results of expressions that use constants, the result of a subquery can change, because of changes in the queried tables. When you use subqueries, you avoid the need for separate steps in your solutions that store intermediate query results in variables.

A subquery can be either self-contained or correlated.

Both self-contained and correlated subqueries can return a scalar or multiple values

Self-contained subquery: Subquery has no dependency on tables from the outer query

Correlated subquery: Subquery has dependency on tables from the outer query

Self-contained subqueries

Every subquery has an outer query that contains it.

Self-contained subqueries: are subqueries that are independent of the tables in the outer query. Self-contained subqueries are convenient to debug, because you can always highlight the inner query, run it, and ensure that it does what it’s supposed to do. Logically, the subquery code is evaluated only once before the outer query is evaluated, and then the outer query uses the result of the subquery.

The following sections take a look at some concrete examples of self-contained subqueries.

Self-contained scalar subquery

A scalar subquery is a subquery that returns a single value. Such a subquery can appear anywhere in the outer query where a single-valued expression can appear (such as ***WHERE* or *SELECT***).

For example, suppose you need to query the *Orders* table in the *TSQLV4* database and return information about the order that has the maximum order ID in the table. You could accomplish the task by using a variable. The code could retrieve the maximum order ID from the *Orders* table and store the result in a variable. Then the code could query the *Orders* table and filter the order where the order ID is equal to the value stored in the variable. The following code demonstrates this technique:

```
DECLARE @maxid AS INT = (SELECT MAX(orderid)
FROM Sales.Orders);
SELECT orderid, orderdate, empid, custid
FROM Sales.Orders
WHERE orderid = @maxid;
```

This query returns the following output:

```
orderid      orderdate   empid        custid
------------ ----------- ------------ -----------
11077        2016-05-06  1            65
```

You can substitute the variable with a scalar self-contained subquery, like so:

```
SELECT orderid, orderdate, empid, custid
FROM Sales.Orders
WHERE orderid = (SELECT MAX(O.orderid)
FROM Sales.Orders AS O);
```

SUBQUERY!!

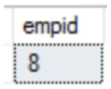
Because it is contained in where clause

For **a scalar subquery** to be valid, it must return no more than one value. If a scalar subquery returns more than one value, it fails at run time. If a scalar subquery returns no value, the empty result is converted to a *NULL*.

```
SELECT orderid
FROM Sales.Orders
WHERE empid =
(SELECT E.empid
FROM HR.Employees AS E
WHERE E.lastname LIKE N'C%');
```

Selects the empid from the subquery and SELECTS all the orderid that is associated with that empid

Sub query returns one value



empid
8

```
orderid
-----------
10262
10268
10276
10278
10279
...
11054
11056
11065
11068
11075

(104 row(s) affected)
```

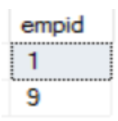
The subquery gets the employees lastname that starts with a C and SELECTS that employees empid to return. This is scalar because there is only one employees with last name starting with C

If the subquery returns more than one value, the query fails. For example, try running the query with employees whose last names start with *D*:

```sql
SELECT orderid
FROM Sales.Orders
WHERE empid =
(SELECT E.empid
FROM HR.Employees AS E
WHERE E.lastname LIKE N'D%');
```

The query fails because **the subquery returns two values.** And you cannot store two values into empid this can be solved by using the (IN) keyword, which is discussed below

The subquery returns two values for



empid
1
9

Self-contained multivalued subquery

IN: Subquery returns multiple values

A multivalued subquery is a subquery that returns multiple values as a single column. Some predicates, such as the *IN* predicate, operate on a multivalued subquery.

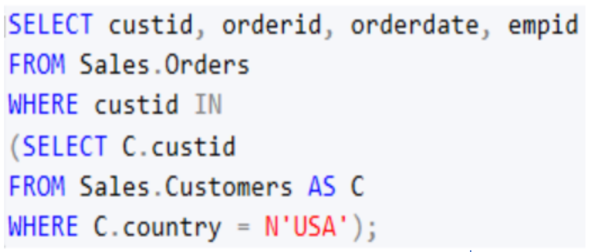
EXAMPLE:

```sql
SELECT orderid, empid
FROM Sales.Orders
WHERE empid IN
(SELECT E.empid
FROM HR.Employees AS E
WHERE E.lastname LIKE N'D%');
```

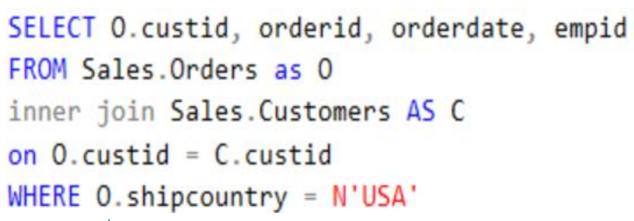
READ AS: WHERE empid FROM Sales.Orders is in the subquery.

Very similar to how a inner join works

EXAMPLE:



```sql
SELECT custid, orderid, orderdate, empid
FROM Sales.Orders
WHERE custid IN
(SELECT C.custid
FROM Sales.Customers AS C
WHERE C.country = N'USA');
```



```sql
SELECT O.custid, orderid, orderdate, empid
FROM Sales.Orders as O
inner join Sales.Customers AS C
on O.custid = C.custid
WHERE O.shipcountry = N'USA'
```

OUTPUTS THE SAME RESULTS

NOT IN(Same as a LEFT OUTER JOIN)

As with any other predicate, you can negate the *IN* predicate with the *NOT* operator.

For example, the following query returns customers who did not place any orders:

```
SELECT custid, companyname
FROM Sales.Customers
WHERE custid not in (SELECT O.custid FROM Sales.Orders as O)
```

The outer query returns customers with IDs that do not appear in the result of the subquery—in other words, customers who did not place orders.

The subquery returns the IDs of all customers that appear in the *Orders* table. In other words, it returns only the IDs of customers who placed orders.

Correlated subqueries(https://www.youtube.com/watch?v=0ETfzlAQqBQ&t=333s)

Correlated subqueries are subqueries that refer to **attributes** from the tables that appear in the **outer query.**

This means the subquery is dependent on the outer query and cannot be invoked independently. Logically, the subquery is evaluated separately for each outer row.

<u>The inner query is executed for every single record that will be returned by the outer query</u>

```sql
SELECT custid, orderid, orderdate, empid
FROM Sales.Orders AS O1
WHERE orderid =
(SELECT MAX(O2.orderid)
FROM Sales.Orders AS O2
WHERE O2.custid = O1.custid);
```

OUTER QUERY

The outer query examines every row in the Sales.Orders table which has 830 rows. But **only returns if the orderid matches(……**WHERE orderid = … **) that of the subquery**(MAX orderid), otherwise it is not returned.

INNER QUERY

Find the max of the custid where 02.custid=01.custid

So for each unique custid(1,2,3,4…) it will always return the same orderid

EX: the subquery for custid 1 will always return 11011 because that is the max orderid

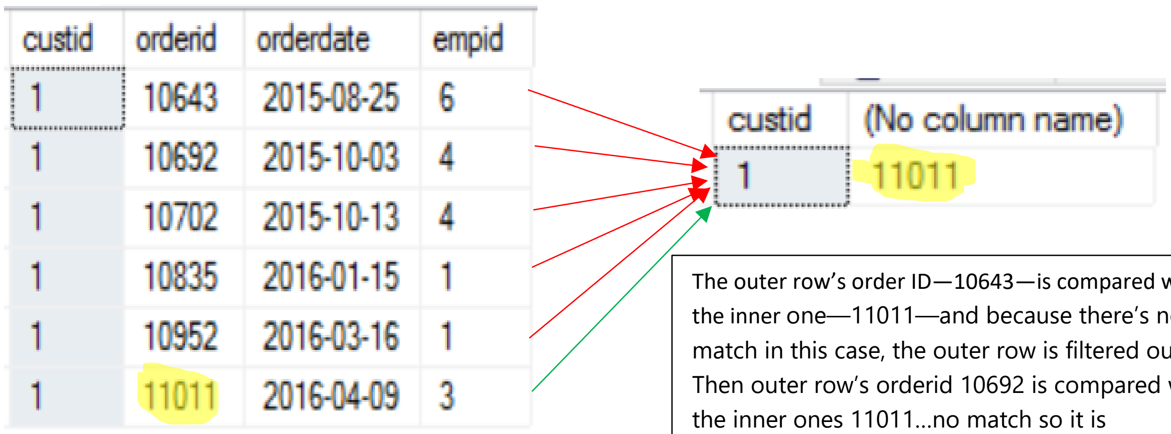
WALK THROUGH

CONSIDER THIS AS THE OUTER QUERY

```sql
SELECT custid, orderid, orderdate, empid
FROM Sales.Orders
WHERE custid = 1
```

CONSIDER THIS AS THE INNER QUERY

```sql
SELECT custid, MAX(orderid)
FROM Sales.Orders
WHERE custid = 1
GROUP BY custid
```



custid	orderid	orderdate	empid
1	10643	2015-08-25	6
1	10692	2015-10-03	4
1	10702	2015-10-13	4
1	10835	2016-01-15	1
1	10952	2016-03-16	1
1	11011	2016-04-09	3

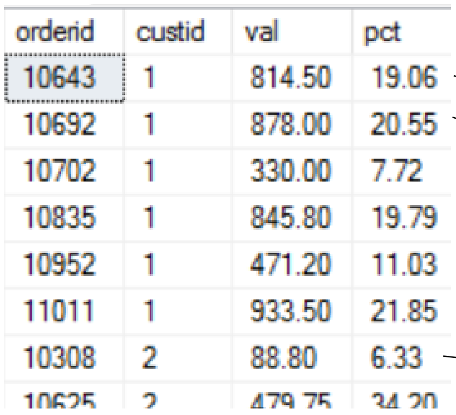
custid	(No column name)
1	11011

The outer row's order ID—10643—is compared with the inner one—11011—and because there's no match in this case, the outer row is filtered out. Then outer row's orderid 10692 is compared with the inner ones 11011…no match so it is filtered…this happens until there is a match

ANOTHER EXAMPLE

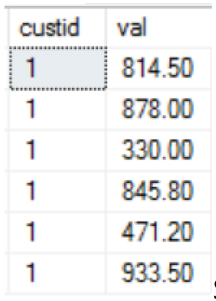
```sql
SELECT orderid, custid, val,
CAST(100 * val / (SELECT SUM(O2.val)
                  FROM Sales.OrderValues AS O2
                  WHERE O2.custid = O1.custid)

AS NUMERIC(5,2)) AS pct
FROM Sales.OrderValues AS O1
ORDER BY custid, orderid;
```



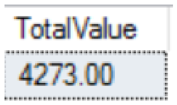
orderid	custid	val	pct
10643	1	814.50	19.06
10692	1	878.00	20.55
10702	1	330.00	7.72
10835	1	845.80	19.79
10952	1	471.20	11.03
11011	1	933.50	21.85
10308	2	88.80	6.33
10625	2	479.75	34.20

SUBQUERY



custid	val
1	814.50
1	878.00
1	330.00
1	845.80
1	471.20
1	933.50

= SUM



TotalValue
4273.00

1) 100 * 814.50 / (4273.00) = 19.06

1) 100 * 878.00 / $(\underbrace{4273.00}_{\text{Sum of all value with custid 1}})$ = 20.55

.

.

2) 100 * 88.80 / $(\underbrace{1402.95}_{\text{Sum of all value with custid 2}})$ = 6.33

The EXISTS predicate: (is a two valued predicate)

T-SQL supports a predicate called EXISTS that accepts a subquery as input and returns TRUE if the subquery returns any rows and FALSE otherwise. For example, the following query returns customers from Spain who placed orders:

```
SELECT custid, companyname
FROM Sales.Customers AS C
WHERE country = N'Spain'
AND EXISTS (SELECT * FROM Sales.Orders AS O
WHERE O.custid = C.custid);
```

The **outer query** against the Customers table filters only customers from Spain for whom the EXISTS predicate returns TRUE.

The EXISTS predicate returns TRUE if the current customer has related orders in the Orders table.

One of the benefits of using the EXISTS predicate is that you can intuitively phrase queries that sound like English. For example, this query can be read just as you would say it in ordinary English: <u>Return customers from Spain if they have any orders where the order's customer ID is the same as the customer's customer ID.</u>

ANOTHER EXAMPLE:

```
SELECT custid, companyname
FROM Sales.Customers AS C
WHERE EXISTS
(SELECT *
FROM Sales.Orders AS O
WHERE O.custid = C.custid
AND EXISTS
(SELECT *
FROM Sales.OrderDetails AS OD
WHERE OD.orderid = O.orderid
AND OD.ProductID = 12));
```

NOT EXISTS

```
SELECT custid, companyname
FROM Sales.Customers AS C
WHERE country = N'Spain'
AND NOT EXISTS (SELECT *
FROM Sales.Orders AS O
WHERE O.custid = C.custid);
```

Returning previous or next values

Suppose you need to query the *Orders* table in the *TSQLV4* database and return, for each order, information about the current order and also the previous order ID. The tricky part is that the concept of “previous” implies order, and rows in a table have no order. One way to achieve this objective is with a T-SQL expression that means “the maximum value that is smaller than the current value.” You could use the following T-SQL expression, which is based on a correlated subquery, for this:

```
SELECT orderid, orderdate, empid, custid,
(SELECT MAX(O2.orderid)
FROM Sales.Orders AS O2
WHERE O2.orderid < O1.orderid) AS prevorderid
FROM Sales.Orders AS O1;
```

Read as:

From Sales.Orders as O2, Where O2.orderid is less than O1.orderid, Select the max orderid from O2. Then give it an alias name prevorderid

```
orderid     orderdate   empid       custid      prevorderid
----------- ----------- ----------- ----------- -----------
10248       2014-07-04  5           85          NULL
10249       2014-07-05  6           79          10248
10250       2014-07-08  4           34          10249
10251       2014-07-08  3           84          10250
10252       2014-07-09  4           76          10251
...
11073       2016-05-05  2           58          11072
11074       2016-05-06  7           73          11073
11075       2016-05-06  8           68          11074
11076       2016-05-06  4           9           11075
11077       2016-05-06  1           65          11076

(830 row(s) affected)
```

because there’s no order before the first order, the subquery returned a *NULL* for the first order.

Returns the next orderid

```
SELECT orderid, orderdate, empid, custid,
(SELECT MIN(O2.orderid)
FROM Sales.Orders AS O2
WHERE O2.orderid > O1.orderid) AS nextorderid
FROM Sales.Orders AS O1;
```

```
orderid     orderdate   empid       custid      nextorderi
----------- ----------- ----------- ----------- ----------
10248       2014-07-04  5           85          10249
10249       2014-07-05  6           79          10250
10250       2014-07-08  4           34          10251
10251       2014-07-08  3           84          10252
10252       2014-07-09  4           76          10253
...
11073       2016-05-05  2           58          11074
11074       2016-05-06  7           73          11075
11075       2016-05-06  8           68          11076
11076       2016-05-06  4           9           11077
11077       2016-05-06  1           65          NULL

(830 row(s) affected)
```

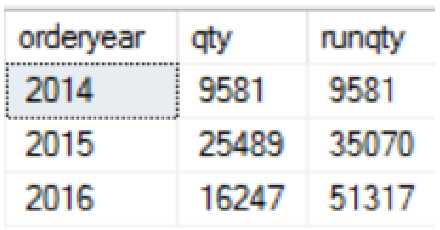
Using running aggregates

Running aggregates are aggregates that accumulate values based on some order. In this section, I use the *Sales.OrderTotalsByYear* view to demonstrate a technique that calculates those. The view has total order quantities by year. Query the view to examine its contents:

```sql
SELECT orderyear, qty
FROM Sales.OrderTotalsByYear;
```

```
orderyear   qty
----------- -----------
2016        16247
2014        9581
2015        25489
```

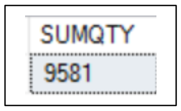
```sql
SELECT orderyear, qty,
(SELECT SUM(O2.qty)
FROM Sales.OrderTotalsByYear AS O2
WHERE O2.orderyear <= O1.orderyear) AS runqty
FROM Sales.OrderTotalsByYear AS O1
ORDER BY orderyear;
```



orderyear	qty	runqty
2014	9581	9581
2015	25489	35070
2016	16247	51317

Sums everything that is less than or equal 2014 (9581)

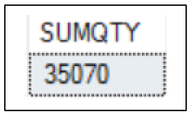
```sql
SELECT SUM(O2.qty) as SUMQTY
FROM Sales.OrderTotalsByYear AS O2
WHERE O2.orderyear <= '2014'
```



SUMQTY
9581

Sums everything that is less than or equal to 2015 (9581 + 25489)

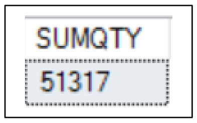
```sql
SELECT SUM(O2.qty) as SUMQTY
FROM Sales.OrderTotalsByYear AS O2
WHERE O2.orderyear <= '2015'
```



SUMQTY
35070

Sums everything that is less than or equal to 2016 (9581 + 25489 + 16247)

```sql
SELECT SUM(O2.qty) as SUMQTY
FROM Sales.OrderTotalsByYear AS O2
WHERE O2.orderyear <= '2016'
```



SUMQTY
51317