

ORIE 3120

Lecture 6: SQL #5

Advanced JOINS

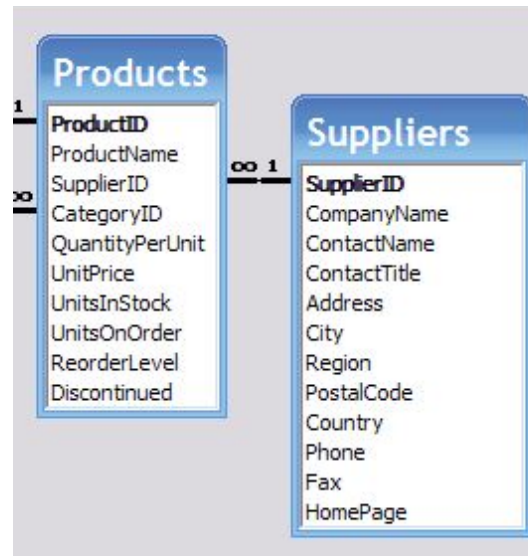
LIMIT, CAST, Square brackets, Subqueries

Recall: INNER JOIN

```
SELECT Suppliers.SupplierID, ProductName, CompanyName  
FROM Products INNER JOIN Suppliers  
ON Products.SupplierID = Suppliers.SupplierID
```

For each record in Products:

1. Find all records in Suppliers that match
Products.SupplierID = Suppliers.SupplierID
2. Return a joined record for every match



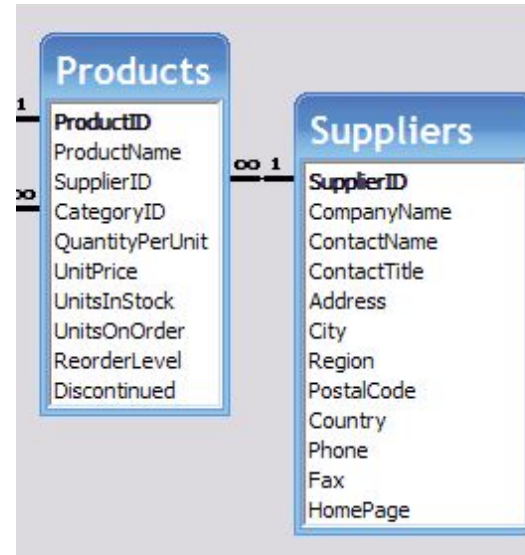
LEFT JOIN

LEFT JOIN

```
SELECT Products.SupplierID, ProductName, CompanyName  
FROM Products LEFT JOIN Suppliers  
ON Products.SupplierID = Suppliers.SupplierID
```

For each record in Products:

1. Find all records in Suppliers that match
Products.SupplierID = Suppliers.SupplierID
2. Return a joined record for every match
3. **If there are no matches, return a record
where the columns from Suppliers are NULL**



Example: LEFT JOIN

Products

ProductName	SupplierID
Aniseed Syrup	1
Chai	1
Chang	1
Chef Anton's Cajun Seasoning	2
Tofu	6

Suppliers

SupplierID	CompanyName
1	Exotic Liquids
2	New Orleans Cajun Delights
3	Grandma Kelly's Homestead

```
SELECT Products.SupplierID,  
       ProductName, CompanyName
```

```
FROM Products
```

```
LEFT JOIN Suppliers
```

```
ON Products.SupplierID =  
   Suppliers.SupplierID
```

SupplierID	ProductName	CompanyName
1	Aniseed Syrup	Exotic Liquids
1	Chai	Exotic Liquids
1	Chang	Exotic Liquids
2	Chef Anton's Cajun Seasoning	New Orleans Cajun Delights
6	Tofu	<i>NULL</i>

Example: LEFT JOIN

Products

ProductName	SupplierID
Aniseed Syrup	1
Chai	1
Chang	1
Chef Anton's Cajun Seasoning	2
Tofu	6

Suppliers

SupplierID	CompanyName
1	Exotic Liquids
2	New Orleans Cajun Delights
3	Grandma Kelly's Homestead

```
SELECT Products.SupplierID,  
       ProductName, CompanyName
```

```
FROM Suppliers
```

```
LEFT JOIN Products
```

```
ON Products.SupplierID =  
   Suppliers.SupplierID
```

SupplierID	ProductName	CompanyName
1	Aniseed Syrup	Exotic Liquids
1	Chai	Exotic Liquids
1	Chang	Exotic Liquids
2	Chef Anton's Cajun Seasoning	New Orleans Cajun Delights
NULL	NULL	Grandma Kelly's Homestead

RIGHT JOIN

RIGHT JOIN

```
SELECT Products.SupplierID, ProductName, CompanyName  
FROM Products RIGHT JOIN Suppliers  
ON Products.SupplierID = Suppliers.SupplierID
```

For each record in **Suppliers** (Suppliers is the table on the right):

1. Find all records in Products that match
Products.SupplierID = Suppliers.SupplierID
2. Return a joined record for every match
3. If there are no matches, return a record
where the columns from Products are NULL

RIGHT JOIN

- RIGHT JOIN is like left join, except that the role of the tables to the right and left of the “JOIN” keyword are swapped.
- SQLite doesn't support RIGHT JOIN
- We can achieve the same functionality using LEFT JOIN and swapping the two tables

You can get RIGHT JOIN's functionality in SQLite using a LEFT JOIN

If you want this...

```
SELECT Products.SupplierID, ProductName, CompanyName  
FROM Products RIGHT JOIN Suppliers  
ON Products.SupplierID = Suppliers.SupplierID
```

Do this instead...

```
SELECT Products.SupplierID, ProductName, CompanyName  
FROM Suppliers LEFT JOIN Products  
ON Products.SupplierID = Suppliers.SupplierID
```

Let's practice (Q1)

T1

id	a
1	57
2	23
3	9

T2

id	b
1	2
3	11
4	42
5	30
5	56
2	12
1	70

```
SELECT T1.id, T1.a, T2.b  
FROM T1  
LEFT JOIN T2  
ON T1.id = T2.id
```

How many records are returned?

- (a) 3
- (b) 4
- (c) 5
- (d) 6
- (e) 7

Let's practice (Q2)

T1

id	a
1	57
2	23
3	9

T2

id	b
1	2
3	11
4	42
5	30
5	56
2	12
1	70

```
SELECT T1.id, T1.a, T2.b
FROM T2
LEFT JOIN T1
ON T1.id = T2.id
```

How many records are returned?

- (a) 3
- (b) 4
- (c) 5
- (d) 6
- (e) 7

FULL OUTER JOIN

```
SELECT Suppliers.SupplierID, ProductName, CompanyName  
FROM Products FULL OUTER JOIN Suppliers  
ON Products.SupplierID = Suppliers.SupplierID
```

1. For each record in **Products**:
Find all records in Suppliers that match
Products.SupplierID = Suppliers.SupplierID;
return a joined record for every match
2. For each unmatched record in **Products**,
return a record where the columns from Suppliers are NULL
3. For each unmatched record in **Suppliers**:
return a record where the columns from Products are NULL

Example: OUTER JOIN

Products

ProductName	SupplierID
Aniseed Syrup	1
Chai	1
Chang	1
Chef Anton's Cajun Seasoning	2
Tofu	6

Suppliers

SupplierID	CompanyName
1	Exotic Liquids
2	New Orleans Cajun Delights
3	Grandma Kelly's Homestead

SELECT Products.SupplierID,
ProductName, CompanyName

FROM Products

FULL OUTER JOIN Suppliers

ON Products.SupplierID =
Suppliers.SupplierID

SupplierID	ProductName	CompanyName
1	Aniseed Syrup	Exotic Liquids
1	Chai	Exotic Liquids
1	Chang	Exotic Liquids
2	Chef Anton's Cajun Seasoning	New Orleans Cajun Delights
<i>NULL</i>	<i>NULL</i>	Grandma Kelly's Homestead
6	Tofu	<i>NULL</i>

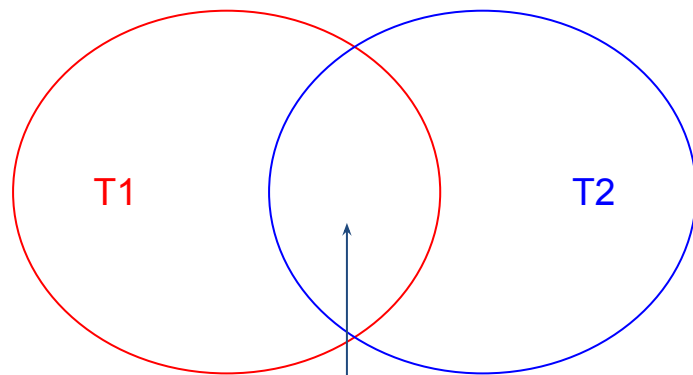
Here's a way to understand INNER, LEFT, RIGHT, and FULL OUTER JOINS

Suppose we run this query:

```
SELECT * FROM T1
```

```
INNER JOIN T2
```

```
ON T1.id = T2.id
```



We get records
with ids in this set

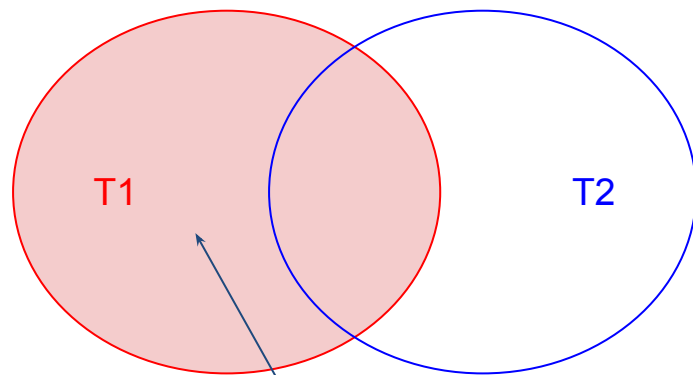
Here's a way to understand INNER, LEFT, RIGHT, and FULL OUTER JOINS

Suppose we run this query:

```
SELECT * FROM T1
```

```
LEFT JOIN T2
```

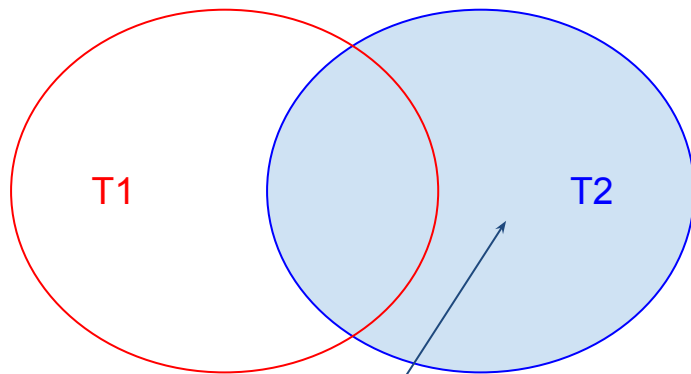
```
ON T1.id = T2.id
```



We get records
with ids in this set

Here's a way to understand INNER, LEFT, RIGHT, and FULL OUTER JOINS

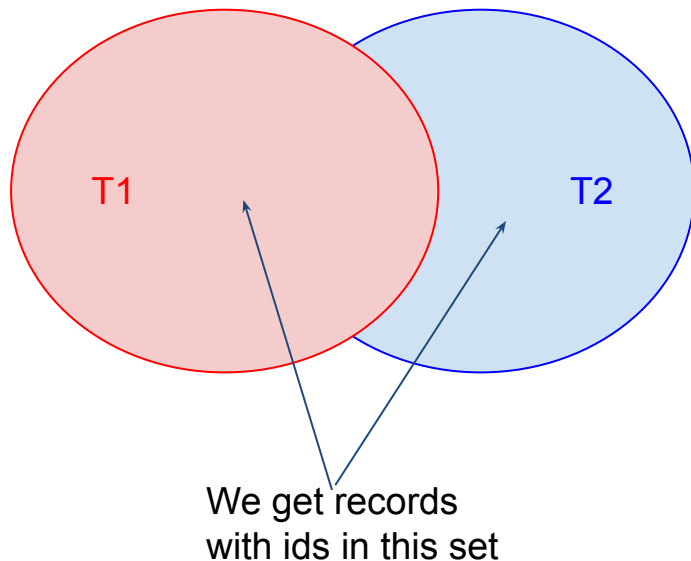
Suppose we run this query:
`SELECT * FROM T1`
RIGHT JOIN T2
`ON T1.id = T2.id`



We get records
with ids in this set

Here's a way to understand INNER, LEFT, RIGHT, and FULL OUTER JOINS

Suppose we run this query:
SELECT * FROM T1
FULL OUTER JOIN T2
ON T1.id = T2.id



FULL OUTER JOIN is not implemented in SQLite

That code I just showed you will work in other SQL implementations (MySQL, SQL Server, ...), but not in SQLite

But... we can create the same functionality using the UNION keyword

UNION

UNION combines the results from two SELECT statements

```
SELECT A,B FROM T
```

```
UNION
```

```
SELECT C,D FROM S
```

produces a record set with all of the records from the first query, + all of the records from the second, with duplicate records removed.

UNION combines the results from two SELECT statements

```
SELECT A,B FROM T
```

```
UNION ALL
```

```
SELECT C,D FROM S
```

produces a record set with all of the records
from the first query, + all of the records from the
second, **without** removing duplicates.

Here's how to reproduce a FULL OUTER JOIN in SQLite

We want this:

```
SELECT ProductName, CompanyName
```

```
FROM Products
```

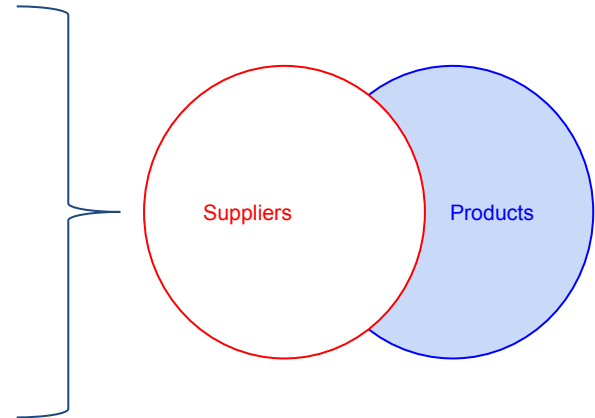
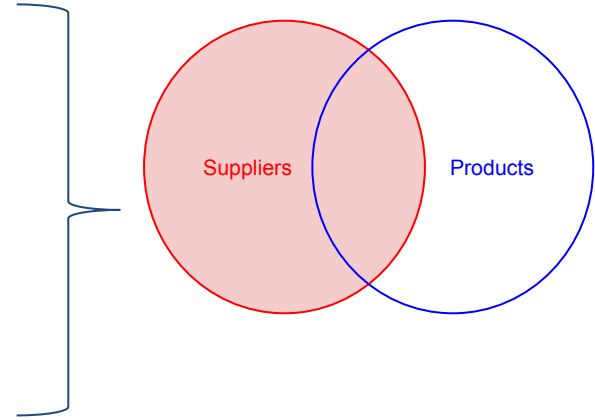
```
FULL OUTER JOIN Suppliers
```

```
ON Products.SupplierID = Suppliers.SupplierID
```


Write this query instead

```
SELECT ProductName, CompanyName  
  FROM Suppliers  
 LEFT JOIN Products  
   ON Products.SupplierID = Suppliers.SupplierID  
UNION ALL
```

```
SELECT ProductName, CompanyName  
  FROM Products  
 LEFT JOIN Suppliers  
   ON Products.SupplierID = Suppliers.SupplierID  
WHERE Suppliers.SupplierID IS NULL
```



Reminder: for WHERE/ON/CASE statements,
NULL has tricky behavior in comparisons

- `NULL = NULL` is false
- `NULL <> NULL` is false (`!=` is the same as `<>`)
- To check whether something is NULL or not, use `IS NULL` and `NOT IS NULL`

This has implications for JOINS on fields with NULLs


```
SELECT ProductName, CompanyName
```

```
FROM Suppliers
```

```
LEFT JOIN Products
```

```
ON Products.SupplierID = Suppliers.SupplierID
```

Since `NULL = NULL`
evaluates to false, the
records that match this ON
clause will never be NULL



```
UNION ALL
```

```
SELECT ProductName, CompanyName
```


```
FROM Products
```

```
LEFT JOIN Suppliers
```

```
ON Products.SupplierID = Suppliers.SupplierID
```

```
WHERE Suppliers.SupplierID IS NULL
```

As a consequence, we
won't duplicate records here



Let's practice (Q3)

T1

id	a
1	57
2	23
3	9

T2

id	b
1	2
3	11
4	42
5	30
5	56
2	12
1	70

```
SELECT T1.id, T1.a, T2.b  
FROM T2  
FULL OUTER JOIN T1  
ON T1.id = T2.id
```

How many records are returned?

- (a) 3
- (b) 4
- (c) 5
- (d) 6
- (e) 7

Let's practice (Q4)

T1	
id	a
1	20
1	57
2	23
3	9

T2	
id	b
1	2
3	11
4	42
5	30
5	56
2	12
1	70

```
SELECT T1.id, T1.a, T2.b
FROM T2
FULL OUTER JOIN T1
ON T1.id = T2.id
```

How many records are returned?

- (a) 8
- (b) 9
- (c) 10
- (d) 11
- (e) 12

JOINS on multiple tables

We can join multiple tables

Approach 1: Do it in a sequence of views

Approach 2: Do it in one query

Approach #1:

T1		T2		T3	
id	a	id	b	id	c
1	20	1	2	1	-2
1	57	3	11	2	-11
2	23	4	42		
		5	30		
		2	12		
		1	70		

```
CREATE VIEW Q1 AS  
SELECT T1.id, T1.a, T2.b  
FROM T1  
INNER JOIN T2  
ON T1.id = T2.id
```

```
SELECT Q1.id, Q1.a, Q1.b,  
T3.c  
FROM Q1  
INNER JOIN T3  
ON Q1.id = T3.id
```


Approach #2:

T1		T2		T3	
id	a	id	b	id	c
1	20	1	2	1	-2
1	57	3	11	2	-11
2	23	4	42		
		5	30		
		2	12		
		1	70		

```
SELECT T1.id, T1.a, T2.b, T3.c
FROM T1
INNER JOIN T2
ON T1.id = T2.id
INNER JOIN T3
ON T1.id = T3.id
```

id	a	b	c
1	57	2	-2
1	57	70	-2
2	23	12	-11
1	20	2	-2
1	20	70	-2

Approach #2, alternate syntax:

T1		T2		T3	
id	a	id	b	id	c
1	20	1	2	1	-2
1	57	3	11	2	-11
2	23	4	42		
		5	30		
		2	12		
		1	70		

```
SELECT T1.id, T1.a, T2.b, T3.c
FROM T1, T2, T3
WHERE T1.id = T2.id
AND T1.id = T3.id
```

id	a	b	c
1	57	2	-2
1	57	70	-2
2	23	12	-11
1	20	2	-2
1	20	70	-2

Realistic Example

Orders (first 10 rows)

OrderID	CustomerID	Employee	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCountry
10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims	Western Europe	51100	France
10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61	Toms Spezialitäten	Luisenstr.48	Münster	Western Europe	44087	Germany
10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34	Victuailles en stock	2,rue du Commerce	Lyon	Western Europe	69004	France
10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3	Suprêmes délices	Boulevard Tirou,255	Charleroi	Western Europe	B-6000	Belgium
10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98	Chop-suey Chinese	Hauptstr.31	Bern	Western Europe	3012	Switzerland
10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33	Richter Supermarkt	Starenweg 5	Genève	Western Europe	1204	Switzerland
10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97	Wellington Importadora	Rua do Mercado,12	Resende	South America	08737-363	Brazil
10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91	HILARION-Abastos	Carrera 22 con Ave...	San Cristóbal	South America	5022	Venezuela

Customers (first 10 rows)

CustomerID	CompanyName	ContactName	ContactTitle	Address	City	Region	PostalCode	Country	Phone	Fax
ALFKI	Alfreds Futterkiste	Maria Anders	Sales Representative	Obere Str.57	Berlin	Western Europe	12209	Germany	030-0074321	030-0076545
ANATR	Ana Trujillo Empar...	Ana Trujillo	Owner	Avda.de la Constitu...	México D.F.	Central America	05021	Mexico	(5) 555-4729	(5) 555-3745
ANTON	Antonio Moreno Ta...	Antonio Moreno	Owner	Mataderos 2312	México D.F.	Central America	05023	Mexico	(5) 555-3932	NULL
AROUT	Around the Horn	Thomas Hardy	Sales Representative	120 Hanover Sq.	London	British Isles	WA1 1DP	UK	(171) 555-7788	(171) 555-6750
BERGS	Berglunds snabbköp	Christina Berglund	Order Administrator	Berguvsvägen 8	Luleå	Northern Europe	S-958 22	Sweden	0921-12 34 65	0921-12 34 67
BLAUS	Blauer See Delikat...	Hanna Moos	Sales Representative	Forsterstr.57	Mannheim	Western Europe	68306	Germany	0621-08460	0621-08924
BLONP	Blondesddsl père ...	Frédérique Citeaux	Marketing Manager	24,place Kléber	Strasbourg	Western Europe	67000	France	88.60.15.31	88.60.15.32
BOLID	Bólido Comidas pr...	Martín Sommer	Owner	C/ Araquil,67	Madrid	Southern Europe	28023	Spain	(91) 555 22 82	(91) 555 91 99
BONAP	Bon app	Laurence Lebihan	Owner	12,rue des Bouchers	Marseille	Western Europe	13008	France	91.24.45.40	91.24.45.41
BOTTM	Bottom-Dollar Mar...	Elizabeth Lincoln	Accounting Manager	23 Tsawassen Blvd.	Tsawassen	North America	T2F 8M4	Canada	(604) 555-4729	(604) 555-3745

Orders (first 10 rows)

OrderID	CustomerID	Employee	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCountry
10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims	Western Europe	51100	France
10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61	Toms Spezialitäten	Luisenstr.48	Münster	Western Europe	44087	Germany
10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34	Victuailles en stock	2,rue du Commerce	Lyon	Western Europe	69004	France
10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3	Suprêmes délices	Boulevard Tirou,255	Charleroi	Western Europe	B-6000	Belgium
10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98	Chop-suey Chinese	Hauptstr.31	Bern	Western Europe	3012	Switzerland
10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33	Richter Supermarkt	Starenweg 5	Genève	Western Europe	1204	Switzerland
10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97	Wellington Importadora	Rua do Mercado,12	Resende	South America	08737-363	Brazil
10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91	HILARION-Abastos	Carrera 22 con Ave...	San Cristóbal	South America	5022	Venezuela

Part of Customers

CustomerID	CompanyName
ALFKI	Alfreds Futterkiste
ANATR	Ana Trujillo Empar...
ANTON	Antonio Moreno Ta...
AROUT	Around the Horn
BERGS	Berglunds snabbköp
BLAUS	Blauer See Delikat...
BLONP	Blondesddsl père ...
BOLID	Bólido Comidas pr...
BONAP	Bon app
BOTTM	Bottom-Dollar Mar...

Lecture question Q5: Write a query that gives a list of OrderIDs, where

- CustomerID is replaced by CompanyName
- Orders without a matching CustomerID in Customers are included with CompanyName set to NULL

- SELECT OrderID, CompanyName **FROM Customers LEFT JOIN Orders ON**
Orders.CustomerID = Customers.CustomerID
- SELECT OrderID, CompanyName **FROM Orders LEFT JOIN Customers ON**
Orders.CustomerID = Customers.CustomerID
- SELECT OrderID, CompanyName **FROM Customers INNER JOIN Orders ON**
Orders.CustomerID = Customers.CustomerID
- SELECT OrderID, CompanyName **FROM Orders INNER JOIN Customers ON**
Orders.CustomerID = Customers.CustomerID

Orders (first 10 rows)

OrderID	CustomerID	Employee	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCountry
10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims	Western Europe	51100	France
10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61	Toms Spezialitäten	Luisenstr.48	Münster	Western Europe	44087	Germany
10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34	Victuailles en stock	2,rue du Commerce	Lyon	Western Europe	69004	France
10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3	Suprêmes délices	Boulevard Tirou,255	Charleroi	Western Europe	B-6000	Belgium
10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98	Chop-suey Chinese	Hauptstr.31	Bern	Western Europe	3012	Switzerland
10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33	Richter Supermarkt	Starenweg 5	Genève	Western Europe	1204	Switzerland
10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97	Wellington Importadora	Rua do Mercado,12	Resende	South America	08737-363	Brazil
10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91	HILARION-Abastos	Carrera 22 con Ave...	San Cristóbal	South America	5022	Venezuela

Part of Customers

CustomerID	CompanyName
ALFKI	Alfreds Futterkiste
ANATR	Ana Trujillo Empar...
ANTON	Antonio Moreno Ta...
AROUT	Around the Horn
BERGS	Berglunds snabbköp
BLAUS	Blauer See Delikat...
BLONP	Blondesddsl père ...
BOLID	Bólido Comidas pr...
BONAP	Bon app
BOTTM	Bottom-Dollar Mar...

Lecture question Q6: Write a query that gives a list of OrderIDs, where

- CustomerID is replaced by CompanyName
 - Orders without a matching CustomerID in Customers are NOT RETURNED
- SELECT OrderID, CompanyName **FROM Customers LEFT JOIN Orders ON**
Orders.CustomerID = Customers.CustomerID
 - SELECT OrderID, CompanyName **FROM Orders LEFT JOIN Customers ON**
Orders.CustomerID = Customers.CustomerID
 - SELECT OrderID, CompanyName **FROM Customers INNER JOIN Orders ON**
Orders.CustomerID = Customers.CustomerID
 - SELECT OrderID, CompanyName **FROM Orders INNER JOIN Customers ON**
Orders.CustomerID = Customers.CustomerID

```
SELECT OrderID, CompanyName  
FROM Orders  
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
```

OrderID	CompanyName
10248	Vins et alcools Chevalier
10249	Toms Spezialitäten
10250	Hanari Carnes
10251	Victuailles en stock
10252	Suprêmes délices
10253	Hanari Carnes
10254	Chop-suey Chinese
10255	Richter Supermarkt
10256	Wellington Importadora
10257	HILARION-Abastos

...

Here is the result from one of these queries

```
SELECT CompanyName, Orders.*
FROM Orders
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
```

CompanyName	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCountry
Vins et alcools Chevali...	10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38	Vins et alcool...	59 rue de l'Abbaye	Reims	Western Europe	51100	France
Toms Spezialitäten	10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61	Toms Spezial...	Luisenstr.48	Münster	Western Europe	44087	Germany
Hanari Carnes	10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
Victuailles en stock	10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34	Victuailles en ...	2,rue du Commerce	Lyon	Western Europe	69004	France
Suprêmes délices	10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3	Suprêmes dél...	Boulevard Tirou,255	Charleroi	Western Europe	B-6000	Belgium
Hanari Carnes	10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
Chop-suey Chinese	10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98	Chop-suey C...	Hauptstr.31	Bern	Western Europe	3012	Switzerland
Richter Supermarkt	10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33	Richter Super...	Starenweg 5	Genève	Western Europe	1204	Switzerland
Wellington Importadora	10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97	Wellington Im...	Rua do Mercado,12	Resende	South America	08737-363	Brazil
HILARION-Abastos	10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91	HILARION-Ab...	Carrera 22 con Ave....	San Cristóbal	South America	5022	Venezuela

...

You can ask for all of the fields from a table


```

SELECT CompanyName, Orders.*
FROM Orders
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
WHERE Customers.CustomerID IS NULL

```

CompanyName	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCount
NULL	10311	DUMO	1	2012-09-20	2012-10-04	2012-09-26	3	24.69	Du monde entier	67,rue des Cinquante Otages	Nantes	Western Europe	44000	France
NULL	10365	ANTO	3	2012-11-27	2012-12-25	2012-12-02	2	22	Antonio Moreno Ta...	Mataderos 2312	México D.F.	Central America	05023	Mexico
NULL	10372	QUEE	5	2012-12-04	2013-01-01	2012-12-09	2	890.78	Queen Cozinha	Alameda dos Canários,891	Sao Paulo	South America	05487-020	Brazil
NULL	10406	QUEE	7	2013-01-07	2013-02-18	2013-01-13	1	108.04	Queen Cozinha	Alameda dos Canários,891	Sao Paulo	South America	05487-020	Brazil
NULL	10409	OCEA	3	2013-01-09	2013-02-06	2013-01-14	1	29.83	Océano Atlántico L...	Ing.Gustavo Moncada 8585 ...	Buenos Aires	South America	1010	Argentina
NULL	10487	QUEE	2	2013-03-26	2013-04-23	2013-03-28	2	71.07	Queen Cozinha	Alameda dos Canários,891	Sao Paulo	South America	05487-020	Brazil
NULL	10507	ANTO	7	2013-04-15	2013-05-13	2013-04-22	1	47.45	Antonio Moreno Ta...	Mataderos 2312	México D.F.	Central America	05023	Mexico
NULL	10531	OCEA	7	2013-05-08	2013-06-05	2013-05-19	1	8.12	Océano Atlántico L...	Ing.Gustavo Moncada 8585 ...	Buenos Aires	South America	1010	Argentina
NULL	10535	ANTO	4	2013-05-13	2013-06-10	2013-05-21	1	15.64	Antonio Moreno Ta...	Mataderos 2312	México D.F.	Central America	05023	Mexico
NULL	10573	ANTO	7	2013-06-19	2013-07-17	2013-06-20	3	84.84	Antonio Moreno Ta...	Mataderos 2312	México D.F.	Central America	05023	Mexico

...

The LEFT JOIN gets these orders whose CustomerID doesn't match

```
SELECT CompanyName, Orders.*
FROM Orders
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
```

CompanyName	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalC	ShipCountry
Vins et alcools Chevali...	10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38	Vins et alcool...	59 rue de l'Abbaye	Reims	Western Europe	51100	France
Toms Spezialitäten	10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61	Toms Spezial...	Luisenstr.48	Münster	Western Europe	44087	Germany
Hanari Carnes	10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
Victuailles en stock	10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34	Victuailles en ...	2,rue du Commerce	Lyon	Western Europe	69004	France
Suprêmes délices	10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3	Suprêmes dél...	Boulevard Tirou,255	Charleroi	Western Europe	B-6000	Belgium
Hanari Carnes	10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17	Hanari Carnes	Rua do Paço,67	Rio de Janeiro	South America	05454-876	Brazil
Chop-suey Chinese	10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98	Chop-suey C...	Hauptstr.31	Bern	Western Europe	3012	Switzerland
Richter Supermarkt	10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33	Richter Super...	Starenweg 5	Genève	Western Europe	1204	Switzerland
Wellington Importadora	10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97	Wellington Im...	Rua do Mercado,12	Resende	South America	08737-363	Brazil
HILARION-Abastos	10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91	HILARION-Ab...	Carrera 22 con Ave....	San Cristóbal	South America	5022	Venezuela

...

Shippers (all rows)

ShipperID	CompanyName	Phone
1	Speedy Express	(503) 555-9831
2	United Package	(503) 555-3199
3	Federal Shipping	(503) 555-9931

What if we would like to see the name of the shipper?

```

SELECT Customers.CompanyName AS Customer, Shippers.CompanyName AS Shipper, Orders.*
FROM Orders
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
LEFT JOIN Shippers ON Orders.ShipVia = Shippers.ShipperID

```

Customer	Shipper	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight
Vins et alcools Chevalier	Federal Shipping	10248	VINET	5	2012-07-04	2012-08-01	2012-07-16	3	32.38
Toms Spezialitäten	Speedy Express	10249	TOMSP	6	2012-07-05	2012-08-16	2012-07-10	1	11.61
Hanari Carnes	United Package	10250	HANAR	4	2012-07-08	2012-08-05	2012-07-12	2	65.83
Victuailles en stock	Speedy Express	10251	VICTE	3	2012-07-08	2012-08-05	2012-07-15	1	41.34
Suprêmes délices	United Package	10252	SUPRD	4	2012-07-09	2012-08-06	2012-07-11	2	51.3
Hanari Carnes	United Package	10253	HANAR	3	2012-07-10	2012-07-24	2012-07-16	2	58.17
Chop-suey Chinese	United Package	10254	CHOPS	5	2012-07-11	2012-08-08	2012-07-23	2	22.98
Richter Supermarkt	Federal Shipping	10255	RICSU	9	2012-07-12	2012-08-09	2012-07-15	3	148.33
Wellington Importadora	United Package	10256	WELLI	3	2012-07-15	2012-08-12	2012-07-17	2	13.97
HILARION-Abastos	Federal Shipping	10257	HILAA	4	2012-07-16	2012-08-13	2012-07-22	3	81.91

...

...

Now we have the name of the shipper.
 We now need to qualify CompanyName since it shows up
 in two tables (and means different things)

```

SELECT Employees.LastName, Customers.CompanyName AS Customer, Shippers.CompanyName AS Shipper, Orders.*
FROM Orders
LEFT JOIN Customers ON Orders.CustomerID = Customers.CustomerID
LEFT JOIN Shippers ON Orders.ShipVia = Shippers.ShipperID
LEFT JOIN Employees ON Orders.EmployeeID = Employees.EmployeeID

```

LastName	Customer	Shipper	OrderID	CustomerID	EmployeeID	OrderDate
Buchanan	Vins et alcools Chevalier	Federal Shipping	10248	VINET	5	2012-07-04
Suyama	Toms Spezialitäten	Speedy Express	10249	TOMSP	6	2012-07-05
Peacock	Hanari Carnes	United Package	10250	HANAR	4	2012-07-08
Leverling	Victuailles en stock	Speedy Express	10251	VICTE	3	2012-07-08
Peacock	Suprêmes délices	United Package	10252	SUPRD	4	2012-07-09
Leverling	Hanari Carnes	United Package	10253	HANAR	3	2012-07-10
Buchanan	Chop-suey Chinese	United Package	10254	CHOPS	5	2012-07-11
Dodsworth	Richter Supermarkt	Federal Shipping	10255	RICSU	9	2012-07-12
Leverling	Wellington Importadora	United Package	10256	WELLI	3	2012-07-15
Peacock	HILARION-Abastos	Federal Shipping	10257	HILAA	4	2012-07-16

...

We can add in information from the employee table

```

SELECT e.LastName, c.CompanyName AS Customer, s.CompanyName AS Shipper, o.*
FROM Orders AS o
LEFT JOIN Customers AS c ON o.CustomerID = c.CustomerID
LEFT JOIN Shippers AS s ON o.ShipVia = s.ShipperID
LEFT JOIN Employees AS e ON o.EmployeeID = e.EmployeeID

```

LastName	Customer	Shipper	OrderID	CustomerID	EmployeeID	OrderDate
Buchanan	Vins et alcools Chevalier	Federal Shipping	10248	VINET	5	2012-07-04
Suyama	Toms Spezialitäten	Speedy Express	10249	TOMSP	6	2012-07-05
Peacock	Hanari Carnes	United Package	10250	HANAR	4	2012-07-08
Leverling	Victuailles en stock	Speedy Express	10251	VICTE	3	2012-07-08
Peacock	Suprêmes délices	United Package	10252	SUPRD	4	2012-07-09
Leverling	Hanari Carnes	United Package	10253	HANAR	3	2012-07-10
Buchanan	Chop-suey Chinese	United Package	10254	CHOPS	5	2012-07-11
Dodsworth	Richter Supermarkt	Federal Shipping	10255	RICSU	9	2012-07-12
Leverling	Wellington Importadora	United Package	10256	WELLI	3	2012-07-15
Peacock	HILARION-Abastos	Federal Shipping	10257	HILAA	4	2012-07-16

...

You can rename tables

```
SELECT Shippers.CompanyName AS Shipper, COUNT(*) AS NumOrders
FROM Orders
LEFT JOIN Shippers ON ShipVia = ShipperID
GROUP BY 1
```

Shipper	NumOrders
Federal Shipping	255
Speedy Express	249
United Package	326

You can combine JOIN with GROUP BY

Self JOINS

You can join a table against itself

```
SELECT  M1.Name, M1.MarathonTime,  
        M2.MarathonTime AS EqualOrBetterTime  
FROM Marathoners AS M1  
INNER JOIN Marathoners AS M2  
ON M1.MarathonTime >= M2.MarathonTime
```



Marathoners

Name	MarathonTime
Kipsang	2:03:13
Mutai	2:03:13
Kipchoge	2:03:05
Bekele	2:03:03
Kimetto	2:02:57

Name	MarathonTime	EqualOrBetterTime
Kipsang	2:03:13	2:03:13
Kipsang	2:03:13	2:03:13
Kipsang	2:03:13	2:03:05
Kipsang	2:03:13	2:03:03
Kipsang	2:03:13	2:02:57
Mutai	2:03:13	2:03:13
Mutai	2:03:13	2:03:13
Mutai	2:03:13	2:03:05
Mutai	2:03:13	2:03:03
Mutai	2:03:13	2:02:57
Kipchoge	2:03:05	2:03:05
Kipchoge	2:03:05	2:03:03
Kipchoge	2:03:05	2:02:57
Bekele	2:03:03	2:03:03
Bekele	2:03:03	2:02:57
Kimetto	2:02:57	2:02:57

You'll use this trick in a homework to create rankings

```
SELECT M1.Name,  
       M1.MarathonTime,  
       M2.MarathonTime AS EqualOrBetterTime  
FROM Marathoners AS M1  
INNER JOIN Marathoners AS M2  
ON M1.MarathonTime >= M2.MarathonTime
```

Marathoners

Name	MarathonTime
Kipsang	2:03:13
Mutai	2:03:13
Kipchoge	2:03:05
Bekele	2:03:03
Kimetto	2:02:57

Name	MarathonTime	EqualOrBetterTime
Kipsang	2:03:13	2:03:13
Kipsang	2:03:13	2:03:13
Kipsang	2:03:13	2:03:05
Kipsang	2:03:13	2:03:03
Kipsang	2:03:13	2:02:57
Mutai	2:03:13	2:03:13
Mutai	2:03:13	2:03:13
Mutai	2:03:13	2:03:05
Mutai	2:03:13	2:03:03
Mutai	2:03:13	2:02:57
Kipchoge	2:03:05	2:03:05
Kipchoge	2:03:05	2:03:03
Kipchoge	2:03:05	2:02:57
Bekele	2:03:03	2:03:03
Bekele	2:03:03	2:02:57
Kimetto	2:02:57	2:02:57

Name	MarathonTime	Rank
Kimetto	2:02:57	1
Bekele	2:03:03	2
Kipchoge	2:03:05	3
Kipsang	2:03:13	5
Mutai	2:03:13	5

LIMIT

Use the LIMIT keyword to get only the first few results from a query

```
SELECT * FROM Products  
ORDER BY UnitsInStock + UnitsOnOrder DESC  
LIMIT 5
```

Id	ProductName	SupplierId	CategoryId	QuantityPerUnit	UnitPrice	UnitsInStock	UnitsOnOrder	ReorderLevel	Discontinued
75	Rhönbräu Klosterbier	12	1	24 - 0.5 l bottles	7.75	125	0	25	0
40	Boston Crab Meat	19	8	24 - 4 oz tins	18.4	123	0	30	0
6	Grandma's Boysenberry Spread	3	2	12 - 8 oz jars	25	120	0	25	0
55	Pâté chinois	25	6	24 boxes x 2 pies	24	115	0	20	0
61	Sirop d'érable	29	2	24 - 500 ml bottles	28.5	113	0	25	0

Warning: if the query you LIMIT
doesn't use ORDER BY, the records you
get are out of your control

```
SELECT * FROM Products
```

```
ORDER BY UnitsInStock + UnitsOnOrder DESC
```

```
LIMIT 5
```

Id	ProductName	SupplierId	CategoryId	QuantityPerUnit	UnitPrice	UnitsInStock	UnitsOnOrder	ReorderLevel	Discontinued
75	Rhönbräu Klosterbier	12	1	24 - 0.5 l bottles	7.75	125	0	25	0
40	Boston Crab Meat	19	8	24 - 4 oz tins	18.4	123	0	30	0
6	Grandma's Boysenberry Spread	3	2	12 - 8 oz jars	25	120	0	25	0
55	Pâté chinois	25	6	24 boxes x 2 pies	24	115	0	20	0
61	Sirop d'érable	29	2	24 - 500 ml bottles	28.5	113	0	25	0

CAST

Use the CAST keyword to change the datatype of a field

Table name: Product		
	Name	Data type
1	Id	INTEGER
2	ProductName	VARCHAR (8000)
3	SupplierId	INTEGER
4	CategoryId	INTEGER
5	QuantityPerUnit	VARCHAR (8000)
6	UnitPrice	DECIMAL
7	UnitsInStock	INTEGER
8	UnitsOnOrder	INTEGER
9	ReorderLevel	INTEGER
10	Discontinued	INTEGER

```
SELECT  UnitPrice,  
        UnitPrice/10,  
        CAST(UnitPrice AS Double)/10,  
        UnitPrice/10.0,  
        1.0*UnitPrice/10  
FROM Product
```

UnitPrice	UnitPrice / 10	CAST (UnitPrice AS Double) / 10	UnitPrice / 10.0	1.0 * UnitPrice / 10
18	1	1.8	1.8	1.8
19	1	1.9	1.9	1.9
10	1	1	1	1
22	2	2.2	2.2	2.2
21.35	2.135	2.135	2.135	2.135

Square Brackets

If you have a field or table whose name is the same as a keyword, enclose it in brackets

```
1 SELECT COUNT(*) FROM Order
```

Status

[10:27:45] Error while executing SQL query on database 'Northwind_small (1)': near "Order": syntax error

```
1 SELECT COUNT(*) FROM [Order]
```

[10:28:26] Query finished in 0.000 second(s).

Subqueries

From Recitation 2

View name: **Q100TotalMinutesActualAgainstTargetDetail**

```
1 SELECT ProductID, WeekNo, WCType, WorkCenterID,  
2 ShiftID, Demand, TransitionMinutesActual,  
3 ProductionMinutesActual, ThruputTarget, TransitionTarget,  
4 Demand/ThruputTarget*60 AS ProductionMinutesTarget,  
5 TransitionMinutesActual + ProductionMinutesActual AS TotalMinutesActual,  
6 Demand/ThruputTarget * 60 + TransitionTarget AS TotalMinutesTarget  
7 FROM ProductionHistory
```

View name: **Q110PlantWideThruputPerformance**

```
1 SELECT  
2 SUM(TotalMinutesActual) As SumTotalMinutesActual,  
3 SUM(TotalMinutesTarget) AS SumTotalMinutesTarget,  
4 (SUM(TotalMinutesActual)-SUM(TotalMinutesTarget))/SUM(TotalMinutesTarget)*100 AS PlantWideScore  
5 FROM Q100TotalMinutesActualAgainstTargetDetail
```

Instead, you can use a subquery

```
WITH SubQ100TotalMinutesActualAgainstTargetDetail AS (  
    SELECT ProductID, WeekNo, WCType, WorkCenterID,  
        ShiftID, Demand, TransitionMinutesActual,  
        ProductionMinutesActual, ThruputTarget, TransitionTarget,  
        Demand/ThruputTarget*60 AS ProductionMinutesTarget,  
        TransitionMinutesActual + ProductionMinutesActual AS TotalMinutesActual,  
        Demand/ThruputTarget * 60 + TransitionTarget AS TotalMinutesTarget  
    FROM ProductionHistory  
)  
  
SELECT  
SUM(TotalMinutesActual) As SumTotalMinutesActual,  
SUM(TotalMinutesTarget) AS SumTotalMinutesTarget,  
(SUM(TotalMinutesActual)-SUM(TotalMinutesTarget))/SUM(TotalMinutesTarget)*100 AS PlantWideScore  
FROM SubQ100TotalMinutesActualAgainstTargetDetail
```

Subquery Syntax

WITH SubQueryName1 AS (

....

)

SELECT

In the select statement at the bottom, you can use SubQueryName1 as if it were a view

Syntax for Two or More Subqueries

```
WITH SubQueryName1 AS (
```

```
....
```

```
),
```

```
SubQueryName2 AS (
```

```
)
```

```
SELECT ....
```

You can have multiple subqueries, separated by commas

When should you use a subquery?

- If you don't have permission to create a view
[in internships & jobs, you probably won't have permission]
- If your intermediate results wouldn't be used by anyone else

When should you NOT use a subquery?

- Subqueries let you make very complicated queries
- Only do this when necessary
- Strive for simplicity