The Learning House
427 S. 4th Street #300
Louisville KY 40202

Relational Databases Unit

Lesson 6: MySQL Installation

Relations and Joins

SOFTWARE GUILD

Lesson Goals

- Explain how relational databases eliminate duplicate data
- Walk across table relations to get data from multiple tables

Why Relationships?

- There are several goals in mind when we create relationships in databases:
  1. Save memory by not replicating the same data repeatedly in a table
  2. Simplify updating relational data
  3. Simplify enforcing **constraints** on the data
- The process by which we eliminate duplicate data into separate tables is called **normalization**.
  - There are 5 normal forms, but most databases stop at the 3rd normal form.

1st Normal Form

- To be in the 1st Normal Form:
  - Each table must have a **primary key** that uniquely identifies a record.
  - The values in each column must be atomic (no multi-value attributes).
  - There are no repeating groups, e.g. two columns don't store similar information in the same table.

Example of Going to 1st Normal Form

- Take, for example, the table below.
- What if two people share the same name?
  - How would we uniquely identify them?
- There is no primary key, so this is called a **heap**.

FirstName	LastName	Telephone
Eric	Wise	555-1234
Jenny	GotYourNumber	867-5309

A Primary Key Must be Unique

- Most of the time, we use an auto-number or a GUID (globally unique identifier) to create a **surrogate key** (a key not based on the entity’s data). The database can generate and manage these when we create rows.

PersonID	FirstName	LastName	Telephone
1	Eric	Wise	555-1234
2	Jenny	GotYourNumber	867-5309

But what if we need to store more than one phone number?

- Often, requirements dictate that we store more than one phone number or keep a history of phone numbers. Inexperienced people want to do this:

PersonID	FirstName	LastName	Home	Mobile
1	Eric	Wise	555-1234	555-2345
2	Jenny	GotYourNumber	867-5309	111-2222

But normalization suggests we should move phone to another table:

PersonID	FirstName	LastName
1	Eric	Wise
2	Jenny	GotYourNumber

PhoneID	PersonID	Number	Type
1	1	555-1234	Home
2	1	555-2345	Mobile
3	2	867-5309	Home
4	2	111-2222	Mobile

2nd Normal Form

- We satisfied 1st Normal Form, but now we have duplicate information across rows.
- 2nd Normal Form Requires:
  - 1st Normal Form
  - Redundant data across multiple rows must be moved to a separate table and joined by a key.

Going 2nd Normal Form

PhoneID	PersonID	Number	PhoneTypeID
1	1	555-1234	1
2	1	555-2345	2
3	2	867-5309	1
4	2	111-2222	2

PhoneTypeID	TypeName
1	Home
2	Mobile

3rd Normal Form

- To reach 3rd Normal Form:
  - 1st and 2nd Normal Form must be met
  - Eliminate any field that does not depend on the primary key:
    - This means any field which is not dependent on the primary key but on another field must be moved
  - Most databases don’t go this far.

3rd Normal Form Example

Here, tournament and year are candidates for a key because they are unique, but the winner’s date of birth is dependent on the winner name, not the tournament. 3rd normal form would have us move the winner and DOB to a new table.

Tournament	Year	Winner	WinnerDOB
Indiana Invitational	1998	Al Fredrickson	July 21st, 1975
Cleveland Open	1999	Bob Albertson	Sept 28th, 1968
Des Moines Masters	1999	Al Fredrickson	July 21st, 1975
Indiana Invitational	1999	Chip Masterson	Mar 14th, 1977

Foreign Keys

- In the previous example, the CategoryID on Categories is the primary key, but it also exists on the Products table as a **Foreign Key**.
  - MySQL did not support foreign keys for a long time due to concerns that they would impact speed and performance. This means that **referential integrity** wasn't there and invalid data could easily be stored in MySQL.
  - Foreign keys in MySQL work on tables as long as they are of the **InnoDB** type.
- We don't have to join on foreign keys — we can join on any condition — but, for a good data model, you typically will (and the DBA will optimize the lookups for these matches).

Now that we’ve split all the data up…

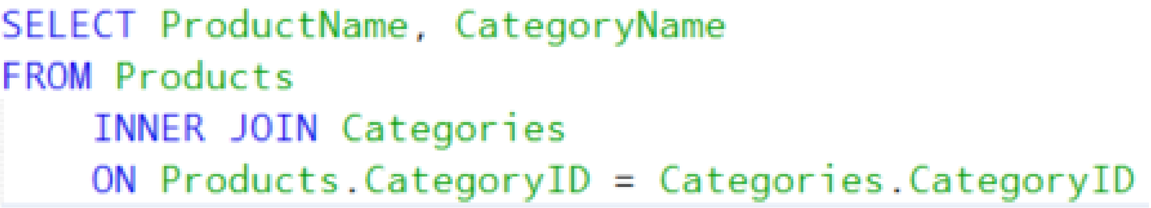
We need some joins!

The first join is the INNER JOIN. It allows us to join the data of two tables on a matching key.

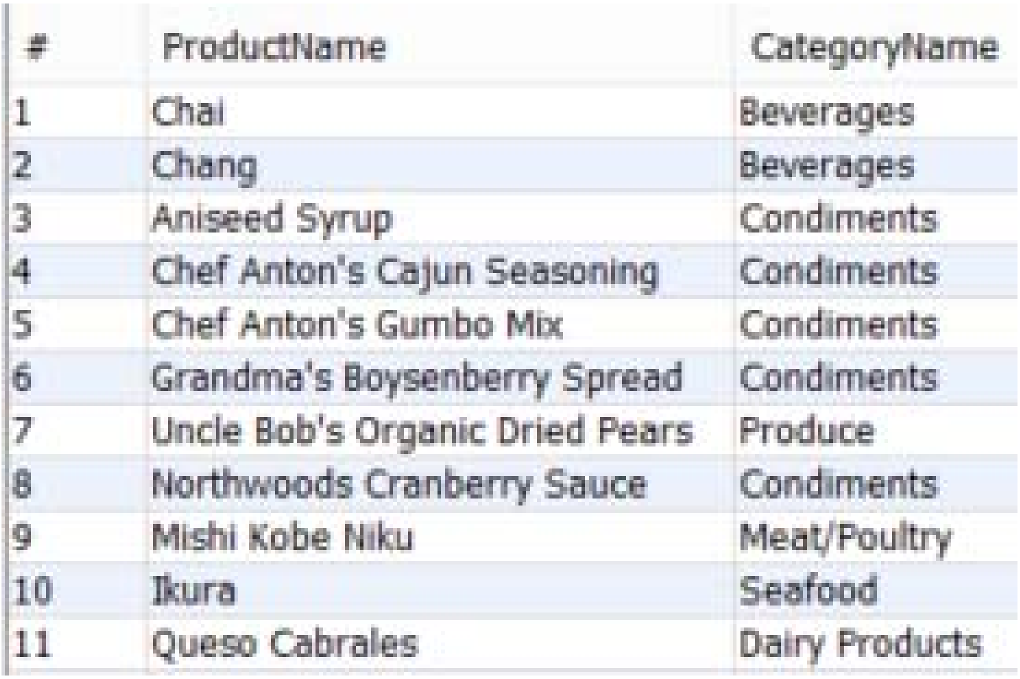
INNER JOIN returns rows where the key in both tables is an exact match.

For the INNER JOIN to work, we have to specify which tables and what field in each table to join on.

Typically, in a good data model, the join columns will be named the same, so we have to qualify the match with the table names.



```
SELECT ProductName, CategoryName
FROM Products
    INNER JOIN Categories
    ON Products.CategoryID = Categories.CategoryID
```

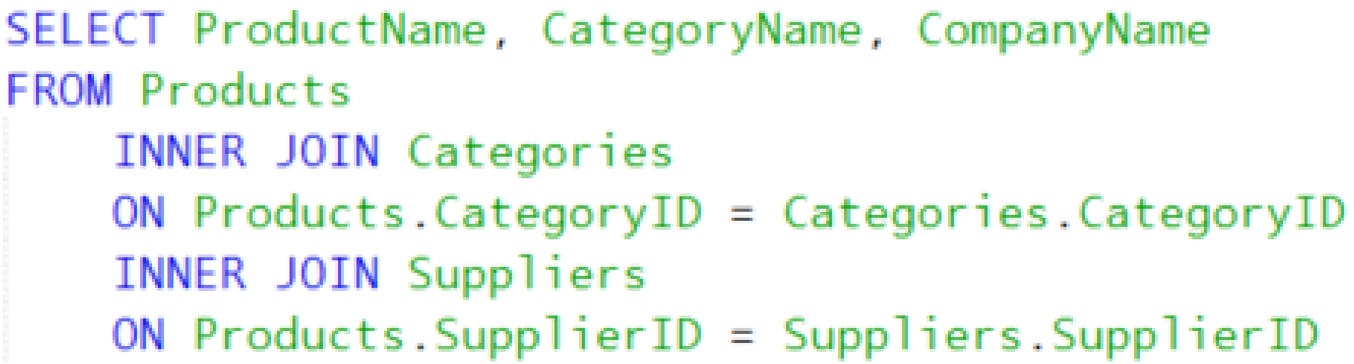


#	ProductName	CategoryName
1	Chai	Beverages
2	Chang	Beverages
3	Aniseed Syrup	Condiments
4	Chef Anton's Cajun Seasoning	Condiments
5	Chef Anton's Gumbo Mix	Condiments
6	Grandma's Boysenberry Spread	Condiments
7	Uncle Bob's Organic Dried Pears	Produce
8	Northwoods Cranberry Sauce	Condiments
9	Mishi Kobe Niku	Meat/Poultry
10	Ikura	Seafood
11	Queso Cabrales	Dairy Products

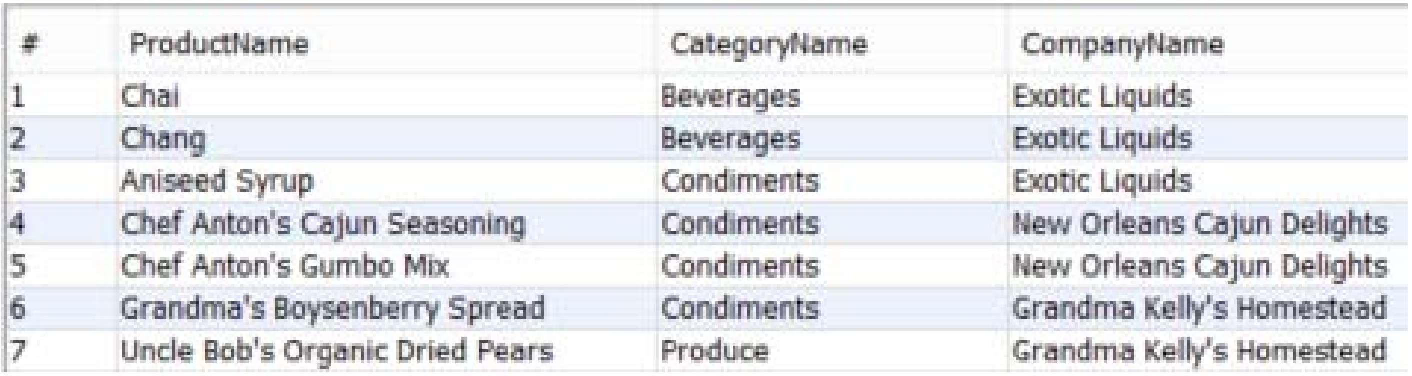
Note About Inner Joins

Keep in mind that if the join column is null in the adjoining table, the record will not be displayed in the result set! They must be an exact match!

We can join almost (256) as many tables as we like



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



#	ProductName	CategoryName	CompanyName
1	Chai	Beverages	Exotic Liquids
2	Chang	Beverages	Exotic Liquids
3	Aniseed Syrup	Condiments	Exotic Liquids
4	Chef Anton's Cajun Seasoning	Condiments	New Orleans Cajun Delights
5	Chef Anton's Gumbo Mix	Condiments	New Orleans Cajun Delights
6	Grandma's Boysenberry Spread	Condiments	Grandma Kelly's Homestead
7	Uncle Bob's Organic Dried Pears	Produce	Grandma Kelly's Homestead

Lab Exercises

- Get a list of each employee and their territories.
- Get the Customer Name, Order Date, and each order detail's Product name for USA customers only.
- Get all the order information where Chai was sold.

LEFT JOINS

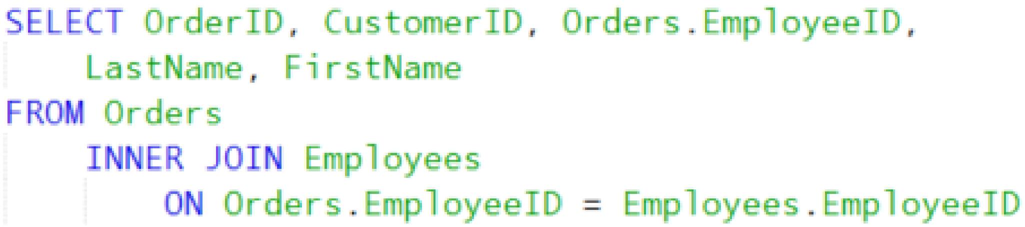
Whereas an inner join matches on exact matches, a left join contains all records from the left table and only matching records in the right table.

Say, for example, an internet order has no EmployeeID assigned to it

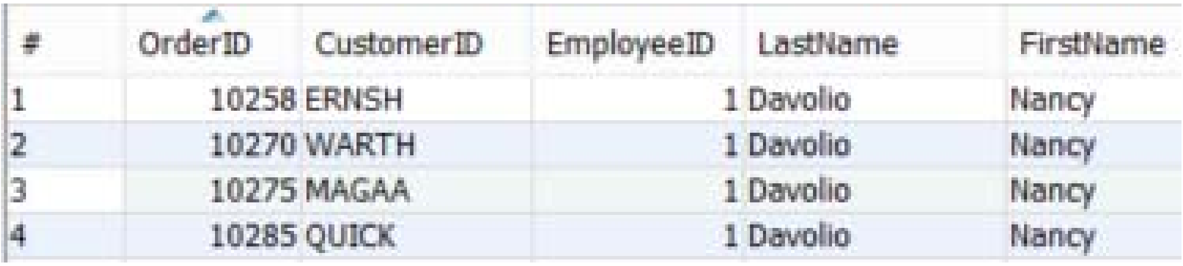
If we inner join orders to employee, the internet records will be excluded because there is no match.

If we left join from orders, we would get all of the orders regardless of the employee attached.

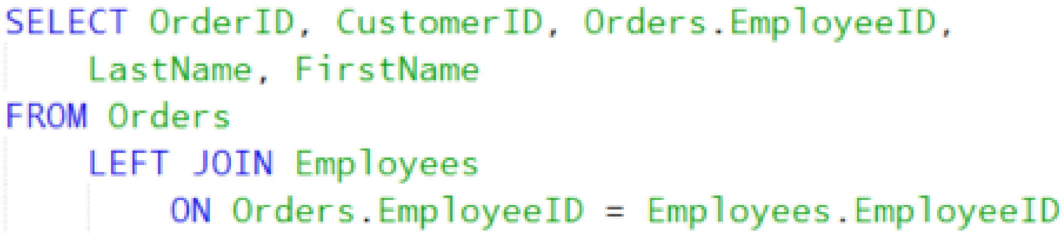
Right joins are the same as left joins, except reversed.



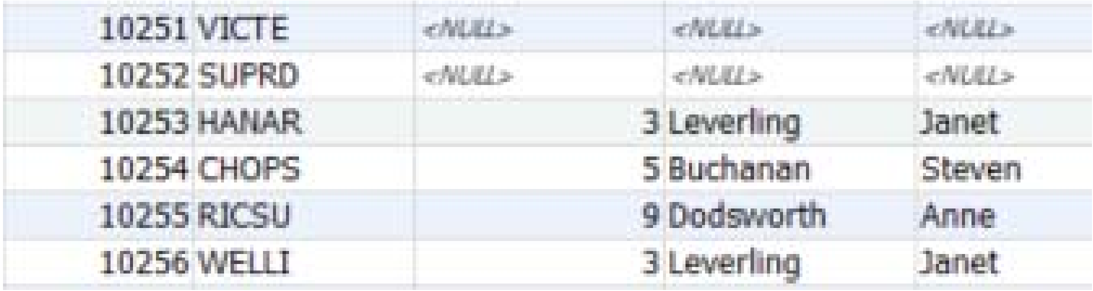
```
SELECT OrderID, CustomerID, Orders.EmployeeID,
    LastName, FirstName
FROM Orders
    INNER JOIN Employees
        ON Orders.EmployeeID = Employees.EmployeeID
```



#	OrderID	CustomerID	EmployeeID	LastName	FirstName
1	10258	ERNSH	1	Davolio	Nancy
2	10270	WARTH	1	Davolio	Nancy
3	10275	MAGAA	1	Davolio	Nancy
4	10285	QUICK	1	Davolio	Nancy



```
SELECT OrderID, CustomerID, Orders.EmployeeID,
    LastName, FirstName
FROM Orders
    LEFT JOIN Employees
        ON Orders.EmployeeID = Employees.EmployeeID
```



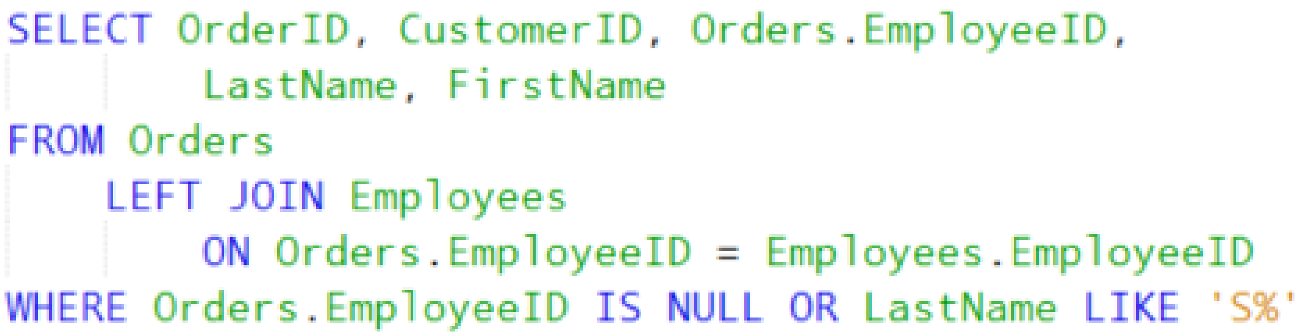
10251	VICTE	<NULL>	<NULL>	<NULL>
10252	SUPRD	<NULL>	<NULL>	<NULL>
10253	HANAR	3	Leverling	Janet
10254	CHOPS	5	Buchanan	Steven
10255	RICSU	9	Dodsworth	Anne
10256	WELLI	3	Leverling	Janet

Full Outer Joins

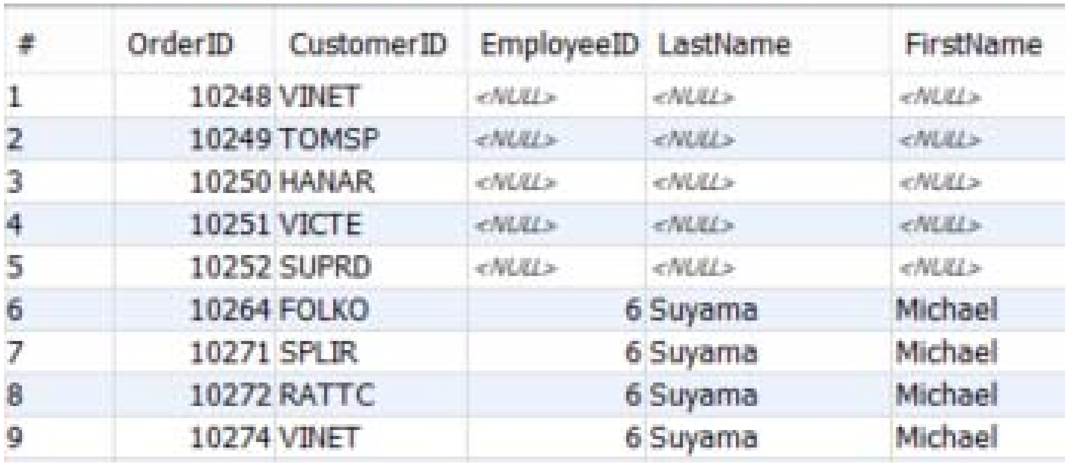
- Full outer joins are the combination of left and right joins. It is the equivalent of saying “give me all rows from both tables regardless of whether they match.”
- Non-matching records in either table will have nulls for the other table’s columns

Filtering on Nulls

To filter on nulls, use the IS NULL or IS NOT NULL predicate:



```
SELECT OrderID, CustomerID, Orders.EmployeeID,
        LastName, FirstName
FROM Orders
    LEFT JOIN Employees
        ON Orders.EmployeeID = Employees.EmployeeID
WHERE Orders.EmployeeID IS NULL OR LastName LIKE 'S%'
```



#	OrderID	CustomerID	EmployeeID	LastName	FirstName
1	10248	VINET	<NULL>	<NULL>	<NULL>
2	10249	TOMSP	<NULL>	<NULL>	<NULL>
3	10250	HANAR	<NULL>	<NULL>	<NULL>
4	10251	VICTE	<NULL>	<NULL>	<NULL>
5	10252	SUPRD	<NULL>	<NULL>	<NULL>
6	10264	FOLKO	6	Suyama	Michael
7	10271	SPLIR	6	Suyama	Michael
8	10272	RATTC	6	Suyama	Michael
9	10274	VINET	6	Suyama	Michael

Fin

- Next up: Query Writing Strategies!