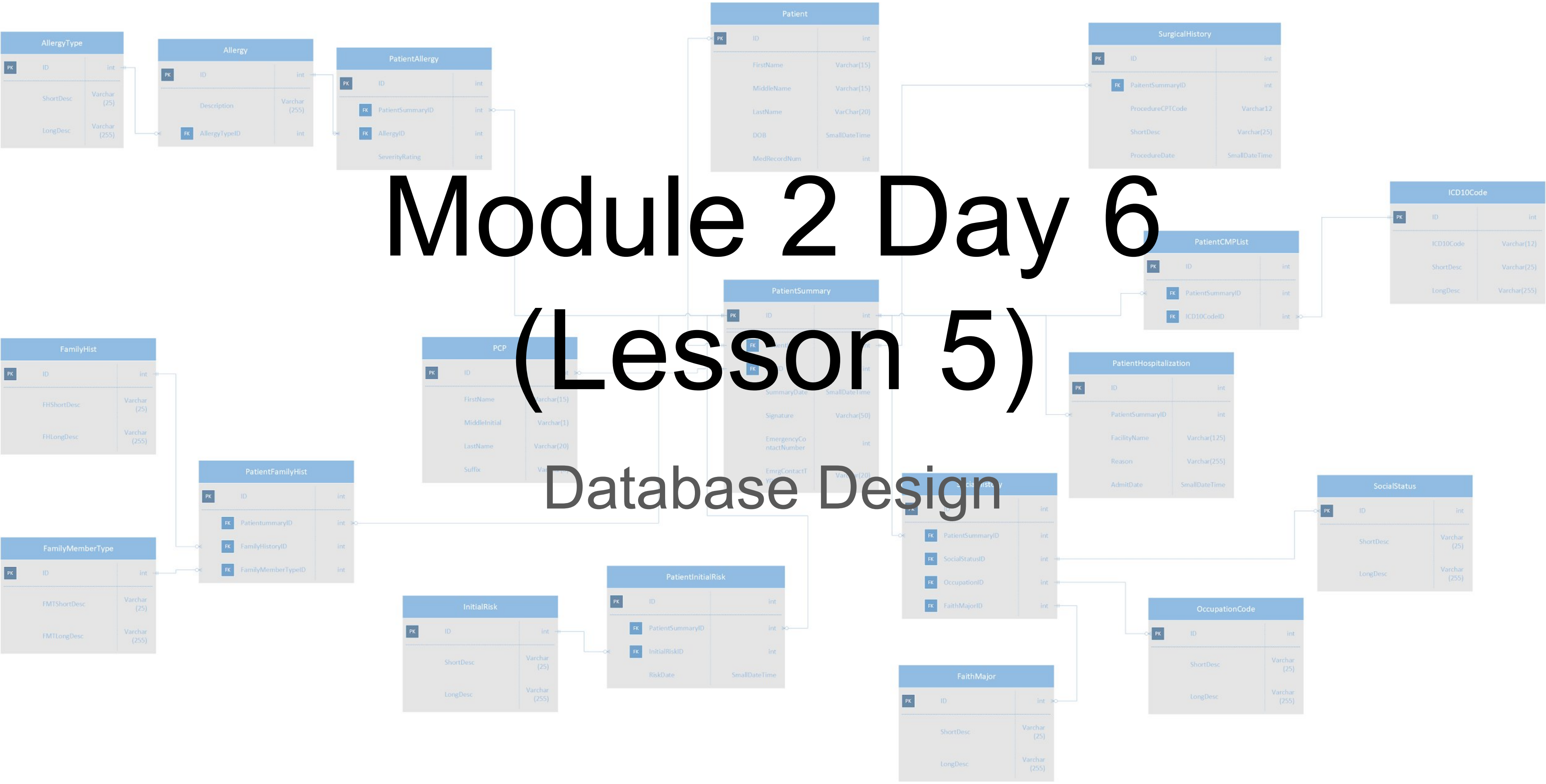


# Module 2 Day 6 (Lesson 5)

Database Design

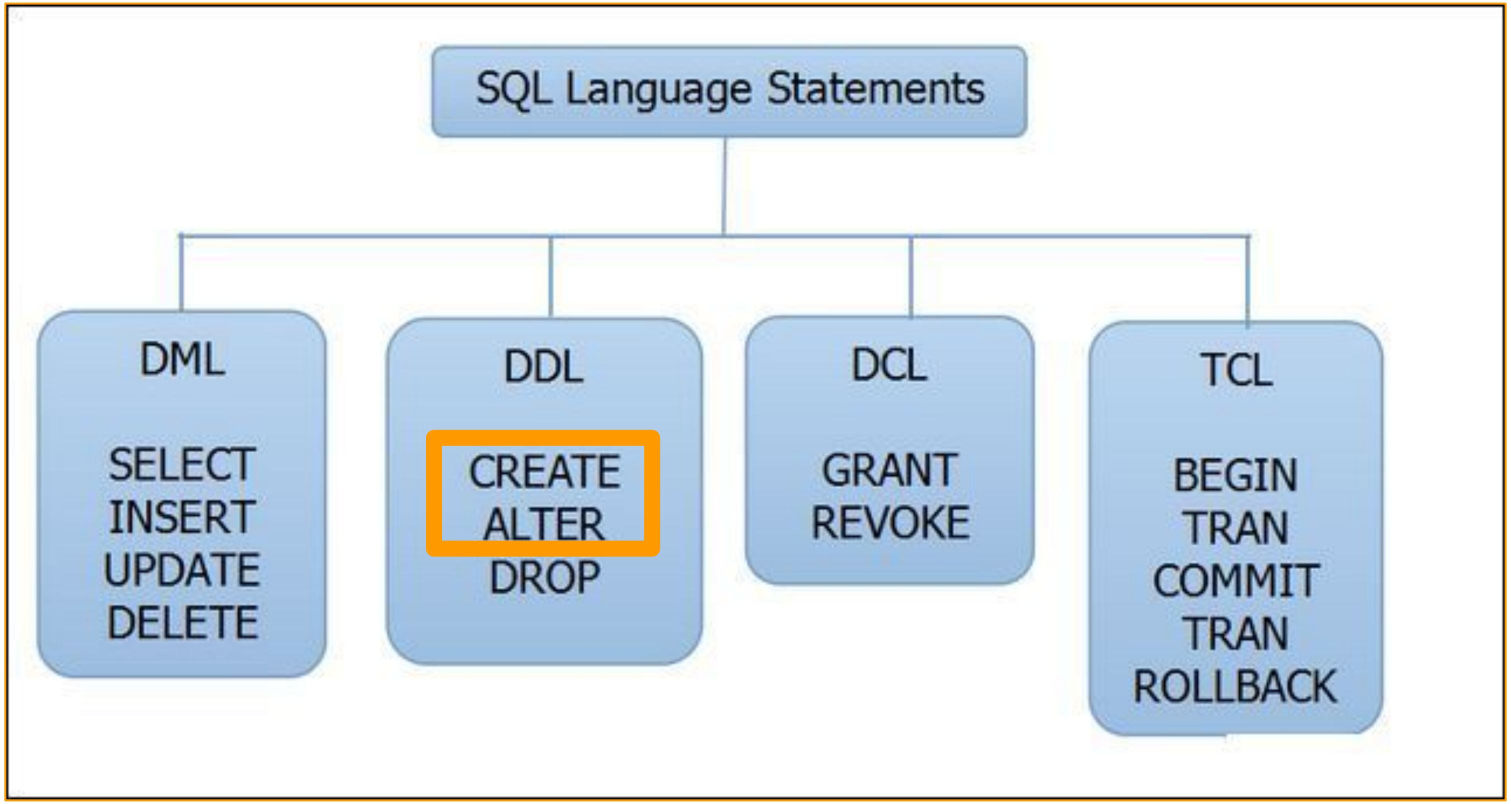
## DQL vs DML vs DDL

The SQL statements we have seen so far fall into a number of different categories:

- Data Query Language (**DQL****): SELECT
- Data Manipulation Language (**DML**): INSERT, UPDATE, DELETE
- Data Definition Language (**DDL**): CREATE, ALTER

The focus of this lecture will be DDL statements with appropriate constraints.

## The SQL Language Set



## Database Design - Normalization

Database normalization is a process used to organize a database into tables and columns.  The main idea with this is that a table should be about a specific topic with only supporting facts included.

There are three main reasons to normalize a database:
**1) Minimize or Eliminate duplicate data**
**2) Minimize or Eliminate data modification issues**
**3) Simplify queries**

(https://www.essentialsql.com/get-ready-to-learn-sql-database-normalization-explained-in-simple-english/)

## Normal Forms

Before a single CREATE statement is run, the tables and their relationships need to be considered. The most commonly used design is 3NF (Third Normal Form). There are 6 Normal Forms, but we think of and talk about the first three:

**First Normal Form** – The information is stored in a relational table with each column containing atomic values. There are no repeating groups of columns, fields with multiple entries, or concatenated facts.

**Second Normal Form** – The table is in first normal form and all the columns depend on the table’s primary key.

**Third Normal Form** – the table is in second normal form and all of its columns are not transitively dependent on the primary key. Which is to say that there are no dependencies between the columns in the table.

(https://www.essentialsql.com/get-ready-to-learn-sql-database-normalization-explained-in-simple-english/)

## Normal Forms: 3NF

While there are several levels of “normal form” compliance, the third normal form is generally good enough for 99% of all situations.

An informal intuitive definition of 3NF is as follows:

There are no attributes of an entity, a row, ( also known as a tuple) that are not directly determined by the value of the primary key when evaluated over the total population of the table. In other words, you must consider the entire population of possible values when considering the normalization.

## Normal Forms: 3NF Progression - The Data

Suppose we have the following table, as it stands, this table is in 2NF:

| **InvoiceNumber (PK)** | **InvoiceDate** | **Inventory ID** | **Inventory Description** |
|---|---|---|---|
| 1000 | 10/1/2019 | 45 | Hammer |
| 1001 | 10/3/2019 | 28 | Nails |
| 1002 | 10/3/2019 | 17 | Screwdriver |
| 1003 | 10/4/2019 | 45 | Hammer |

Some questions to consider:

- Is an invoice date directly related to an invoiceNumber? → Yes
- Is an inventory description directly related to an invoiceNumber? → No

# Normal Forms: 3NF Progression - The Problem

Suppose we need a Spanish version of this database, and we need to update the inventory description to display *Martillo* instead of Hammer. This change would require an UPDATE statement affecting 2 rows.

| InvoiceNumber (PK) | InvoiceDate | Inventory ID | Inventory Description |
|---|---|---|---|
| **1000** | **10/1/2019** | **45** | Martillo **Hammer** |
| 1001 | 10/3/2019 | 28 | Nails |
| 1002 | 10/3/2019 | 17 | Screwdriver |
| **1003** | **10/4/2019** | **45** | Martillo **Hammer** |

# Normal Forms: 3NF Progression - The Solution

In this situation, we could have split up the data into 2 tables, thus we end up with a less risky query, affecting only 1 row:

| InvoiceNumber (PK) | InvoiceDate | Inventory ID |
|---|---|---|
| **1000** | **10/1/2019** | **45** |
| 1001 | 10/3/2019 | 28 |
| 1002 | 10/3/2019 | 17 |
| **1003** | **10/4/2019** | **45** |

| Inventory ID (pk) | Description |
|---|---|
| 28 | Nails |
| 17 | Screwdriver |
| **45** | Martillo |

## Many to Many Relationships in 3NF

When there are 2 entities for which there is a “many to many” relationship, we will end up with 3 tables in a 3NF design.

Look back to the dvdstore database:

- An actor can be a cast member of several movies.
- A movie can have several actors.

This is a “many to many” relationship.

# Many to Many Relationships: The Problem

Actor

| Actor_Id | Name |
|---|---|
| 1 | Clint Westworld |
| 2 | Adam Aimy |

Film

| Film_Id | Title |
|---|---|
| 1 | The Ok, Horrible, and Ridiculous |
| 2 | Two Donkeys for Brother Samuel |
| 3 | Departure |
| 4 | Find Me If You Haven't |

Duplicated Data !?

Actor

| Actor_Id | Film_Id | Name |
|---|---|---|
| 1 | 1 | Clint Westworld |
| 1 | 2 | Clint Westworld |
| 1 | 3 | Clint Westworld |
| 2 | 3 | Adam Aimy |
| 2 | 4 | Adam Aimy |

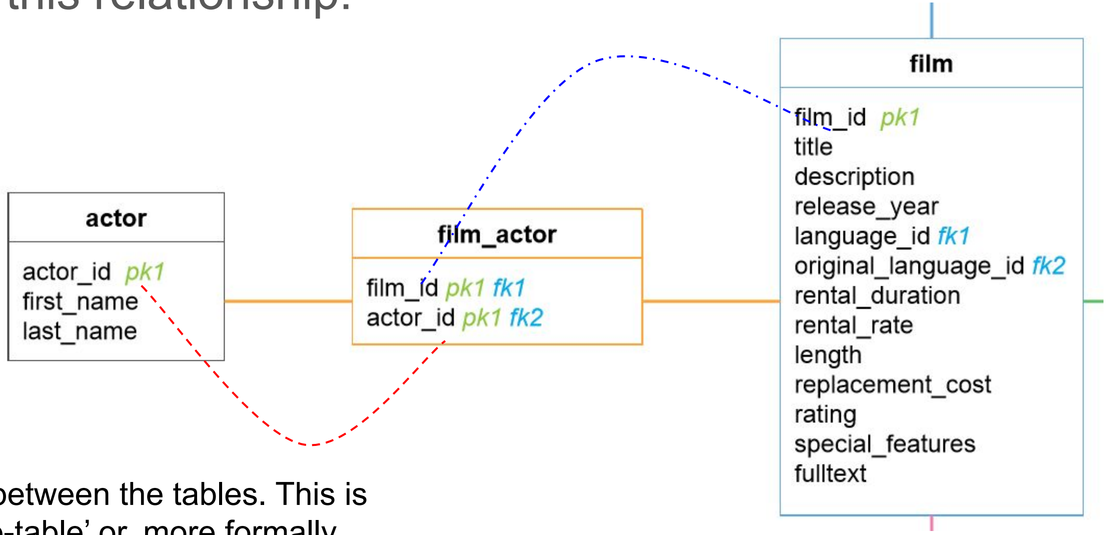
Compound PK Dependent on Another Table !?

Film

| Film_Id | Title |
|---|---|
| 1 | The Ok, Horrible, and Ridiculous |
| 2 | Two Donkeys for Brother Samuel |
| 3 | Departure |
| 4 | Find Me If You Haven't |

## Many to Many Relationships: The Solution

For this relationship to work we have defined two foreign keys in the film_actor table, they are the primary keys of each of the other two tables.  Three tables are used to describe this relationship:



Film_actor serves as a link between the tables. This is often referred to as a ‘bridge-table’ or, more formally, and associative entity

## Many to Many: Creating The Tables

We are now ready to evaluate the syntax for table creation and alteration. This is the Create table syntax for all 3 of the previous tables:

```
CREATE TABLE film_actor (
    actor_id integer NOT NULL,
    film_id integer NOT NULL,
    CONSTRAINT pk_film_actor_actor_id_film_id PRIMARY KEY (actor_id, film_id)
);
```

```
CREATE TABLE actor (
    actor_id serial NOT NULL,
    first_name varchar(45) NOT NULL,
    last_name varchar(45) NOT NULL,
    CONSTRAINT pk_actor_actor_id
PRIMARY KEY (actor_id)
);
```

```
CREATE TABLE film (
    film_id serial NOT NULL,
    title varchar(255) NOT NULL,
    description varchar(512),
    release_year smallint,
    ...
    CONSTRAINT pk_film_film_id PRIMARY KEY (film_id),
    CONSTRAINT ck_film_rating CHECK (rating IN ('G', 'PG', 'PG-13', 'R', 'NC-17'))
);
```

In ***film_actor*** are **actor_id** and **film_id** defined asforeign keys yet?

## Creating Tables Example

We finish by specifying that actor_id and film_id are actually foreign keys. The RDBMS does not assume this just because the columns have the same name, we must use the ALTER command:

```
ALTER TABLE film_actor
ADD FOREIGN KEY(film_id)
REFERENCES film(film_id);

ALTER TABLE film_actor
ADD FOREIGN KEY(actor_id)
REFERENCES actor(actor_id);
```