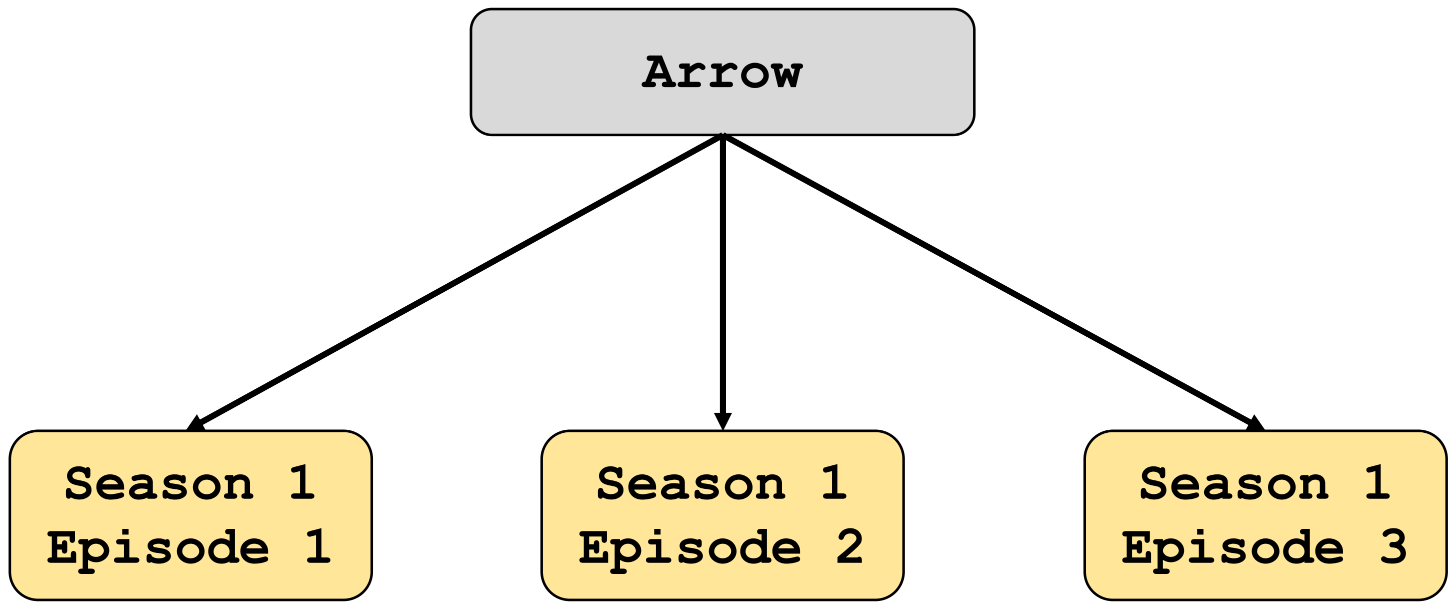
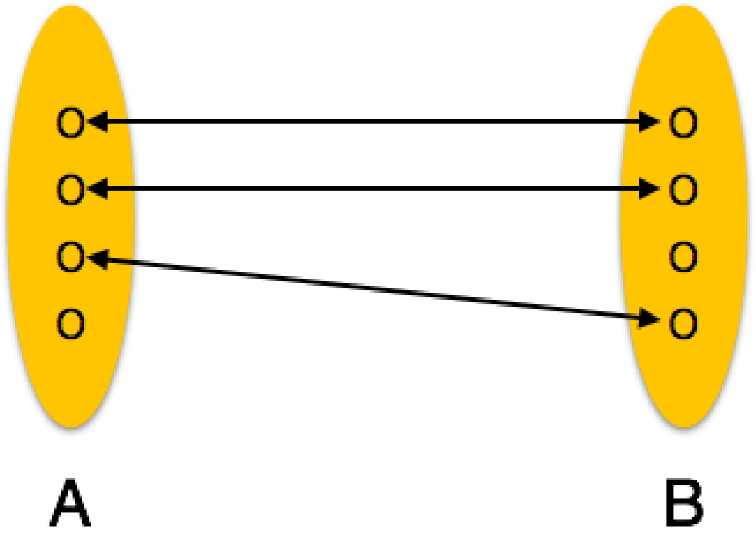
Day 23

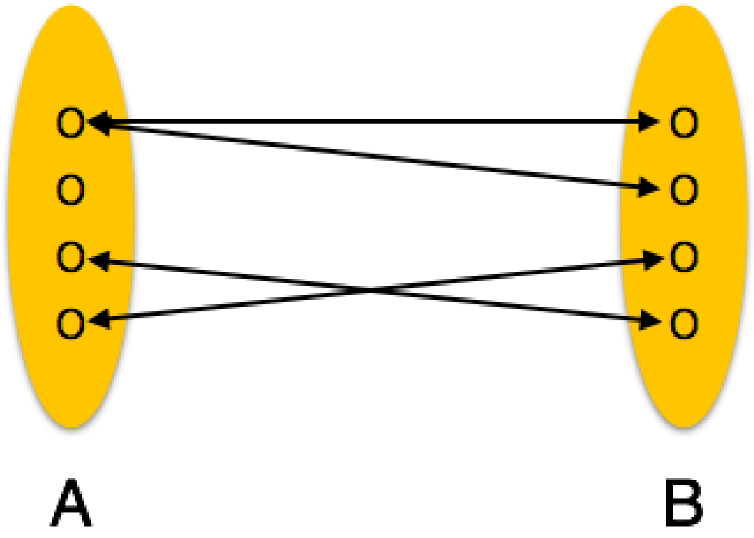
Relationships

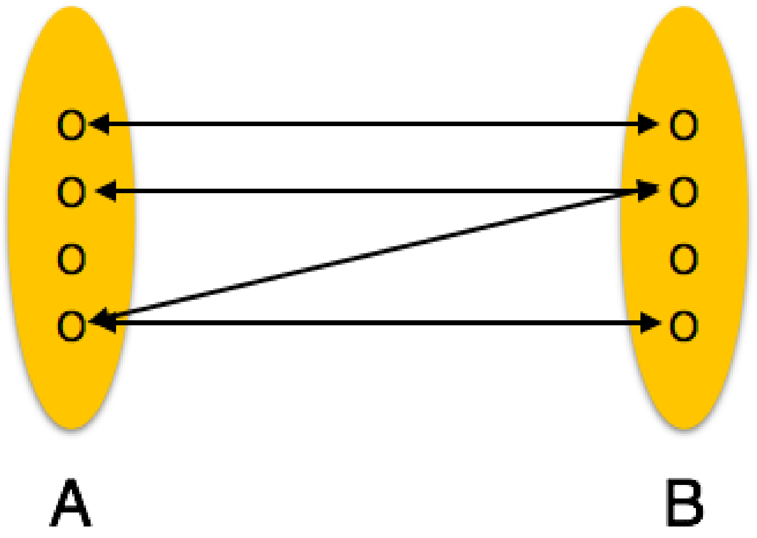
- Defines association between entities/tables
    - Eg. A TV program and the episodes



Relationship Cardinality





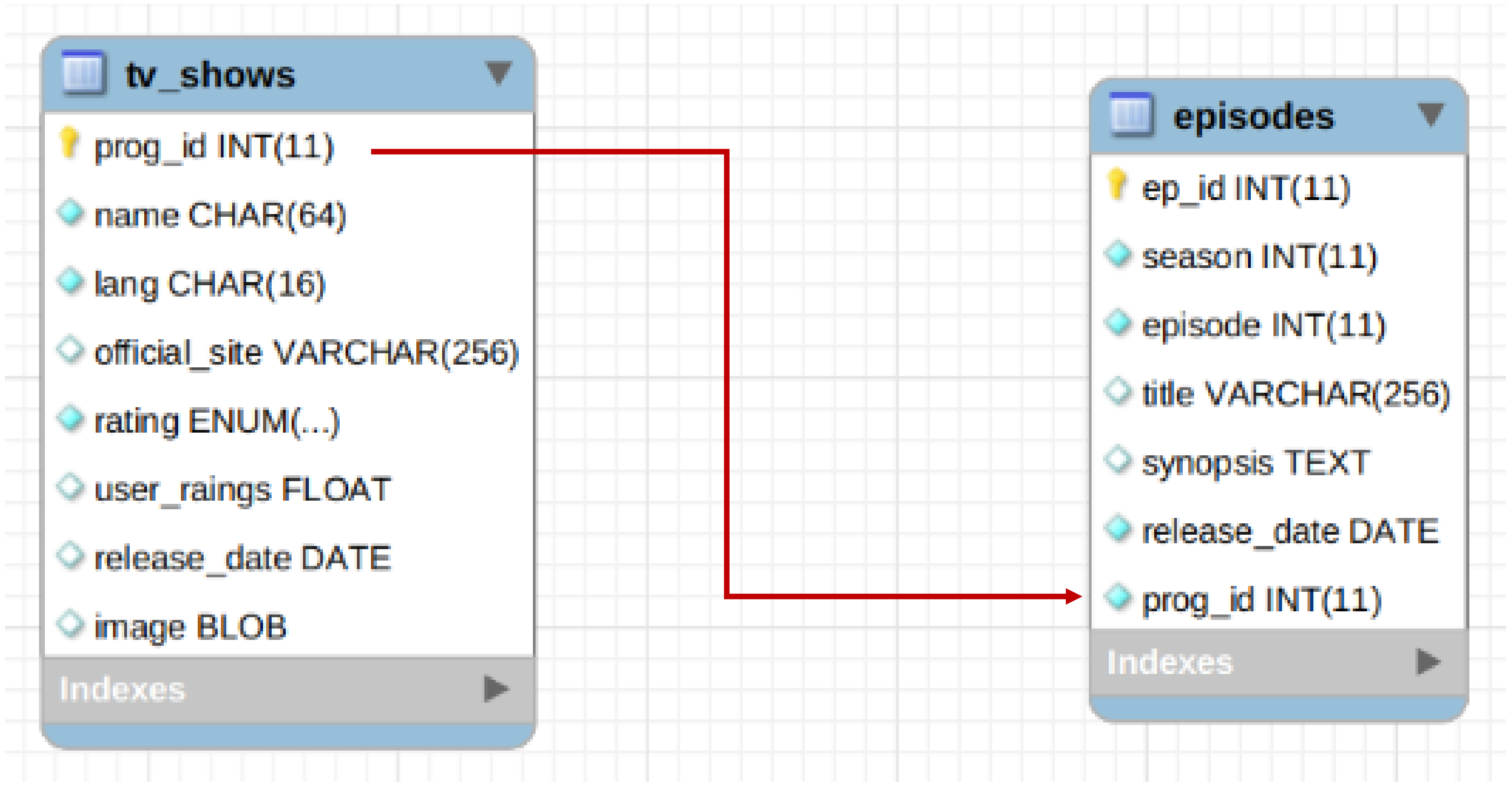


One to one

One to Many/
Many to one

Many to many

Relating Tables



Relate tables by embedding the primary key of one table into another

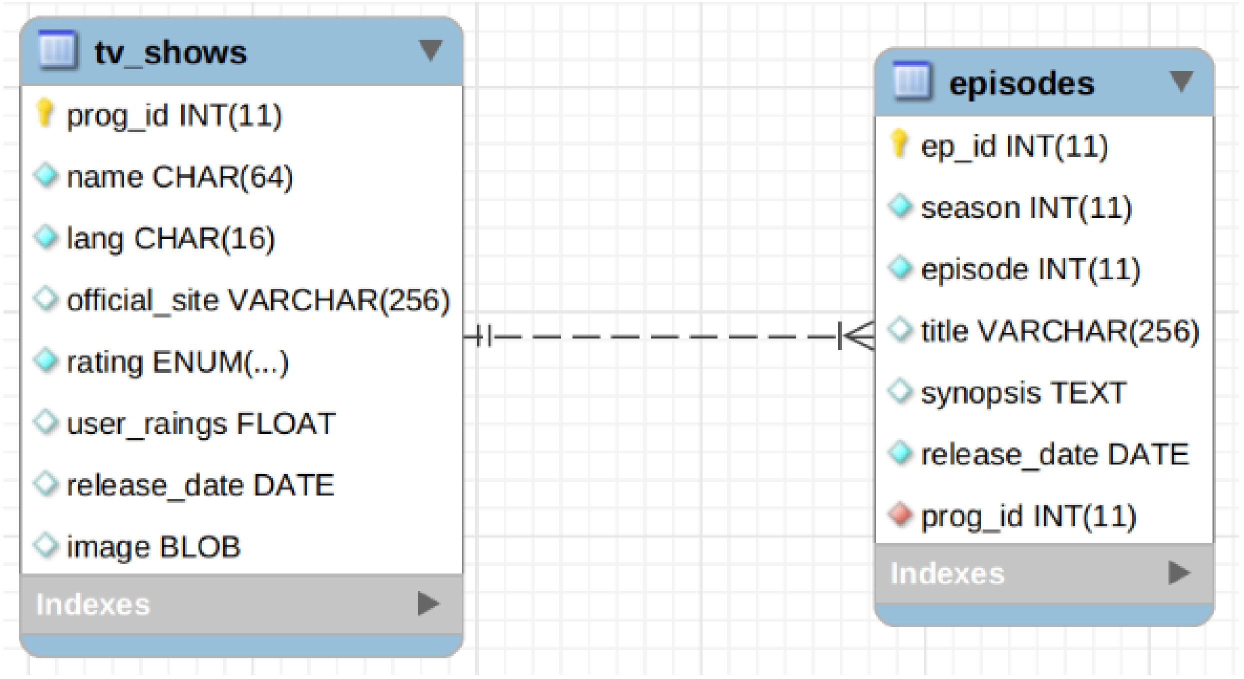
Foreign Key

- A field in a table that references the primary key of another table
  - The foreign key field stores only values found in the primary key field
  - Called the foreign key constraint
- Referential integrity - foreign key constraint
  - Cannot delete a record if there are foreign keys referencing it
  - Cannot insert values in a foreign key field that are not present in the referencing primary key field
- Foreign key field
  - Do not have to be unique
  - Can be null even if the primary key field that it references is not

Table with Foreign Key

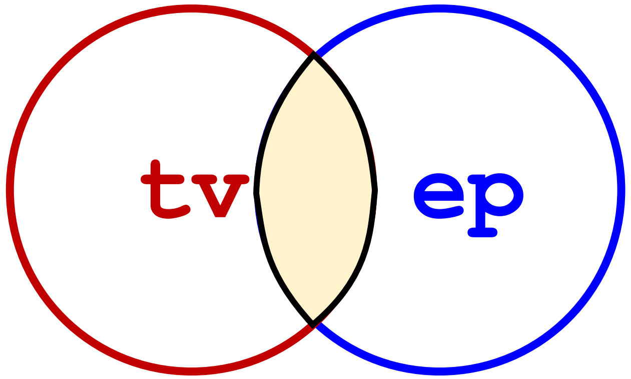
```
create table episodes (
   ep_id            int(11) auto_increment,
   season           int not null,
   episode          int not null,
   title            varchar(256),
   synopsis         text,
   release_date     date not null,
   prog_id          int  not null,

   primary key(ep_id),
   constraint fk_prog_id
        foreign key(prog_id)
        references tv_shows(progs_id)
);
```



'Link' `prog_id` field in `episodes` table to the `prog_id` column in `tv_shows` table

Joins



Inner Join

- Combining 2 or more tables to produce a new table
  - Typically based on some common fields between the 2 tables
  - Eg. tables are related with a foreign key
- Default joins are inner join

```
select tv.name, tv.lang, ep.season, ep.episode, ep.title,
   from tv_shows as tv
   inner join episodes as ep
   on tv.tv_id = ep.tv_id;
```

Inner Join Examples

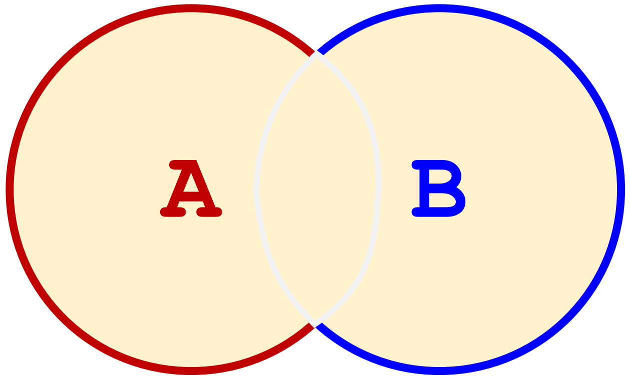
```
select tv.name, tv.lang, ep.season, ep.episode, ep.title,
  from tv_shows as tv
  join episodes as ep
  on tv.tv_id = ep.tv_id
  where tv.name like “%New%”
```

List all episodes from TV programs with the word **New** in its title

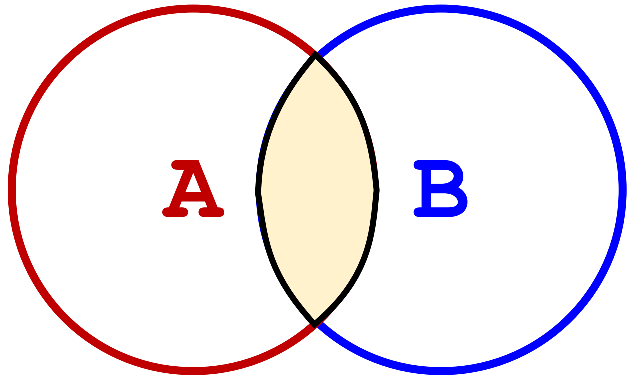
```
select tv.name, count(distinct ep.season)
  from tv_shows as tv
  join episodes as ep
  on tv.tv_id = ep.tv_id
  group by tv.name
```

Count the number of seasons aired for each TV program

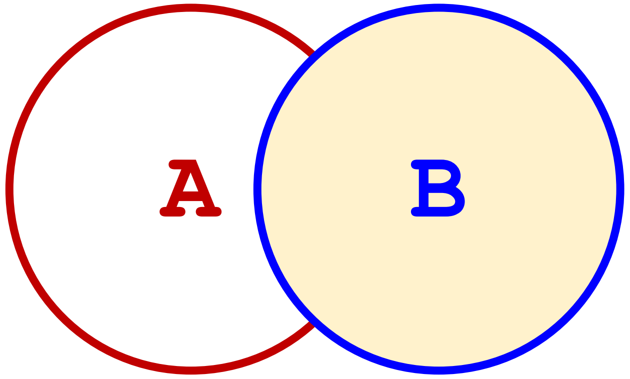
Types of Joins



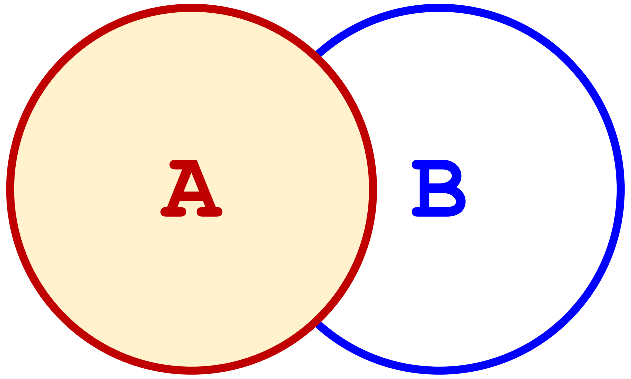
Full Join



Inner Join



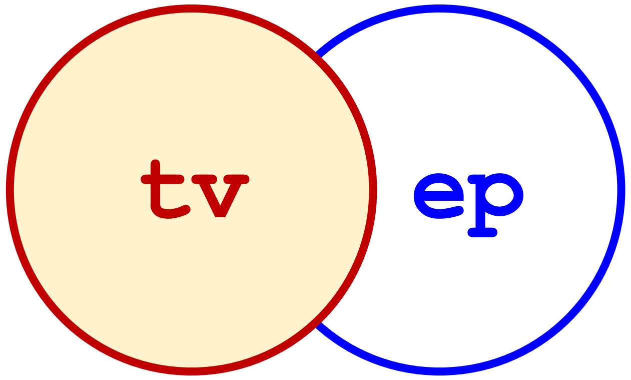
Right Join



Left Join

Left Join

Return rows from the left table even if there are no matches in the right table

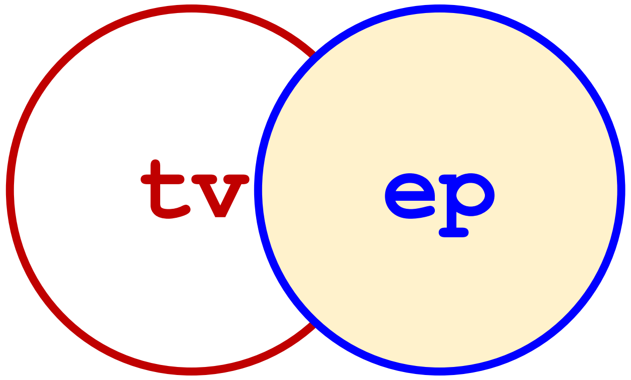


Left Join

```
select tv.name, tv.lang, ep.season, ep.episode, ep.title,
  from tv_shows as tv
  left join episodes as ep
  on tv.tv_id = ep.tv_id
  where tv.name like "%New%"
```

Right Join

Return rows from the right table even if there are no matches in the left table

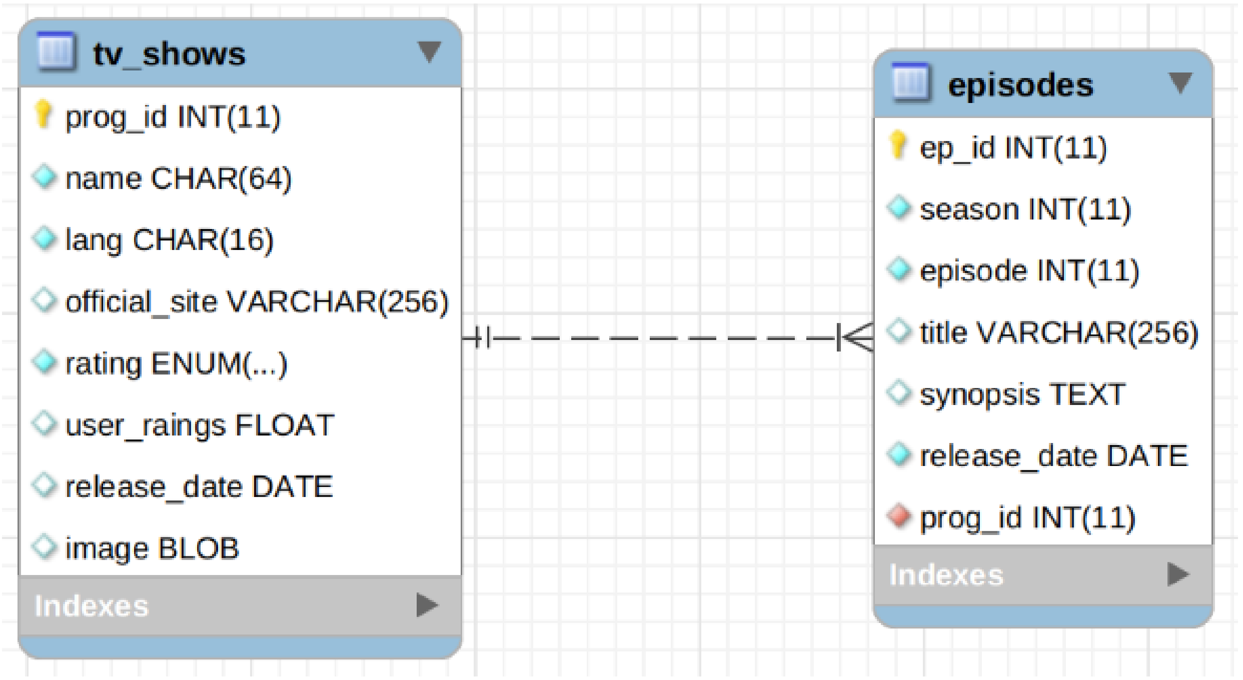


Right Join

```
select tv.name, tv.lang, ep.season, ep.episode, ep.title,
  from tv_shows as tv
  right join episodes as ep
  on tv.tv_id = ep.tv_id
  where tv.name like "%New%"
```

Relationship and Joins

- Foreign keys are constraints to enforce referential integrity
- If you based a join on between 2 tables on their foreign key, then the foreign key provide some guarantees that there will always be result
  - Eg. `tv_shows` will always return `episodes`



Referential Integrity

- Foreign keys constraint prevents a parent key from being delete or update
  - Eg. Delete a record in `tv_program` table where there are references from `episodes`
  - Eg. Update/change the `prog_id` in `tv_program` table where there are references from `episodes` table
  - Default behaviour

```
constraint fk_prog_id
  foreign key(prog_id)
  references tv_shows(prog_id)
  on delete restrict
  on update restrict
```

Default behaviour can be omitted

Foreign Key Behaviour

- Cascade - apply the action to all records that references the primary key as foreign key
    - Eg. delete all records that references the parent key when the parent key is delete

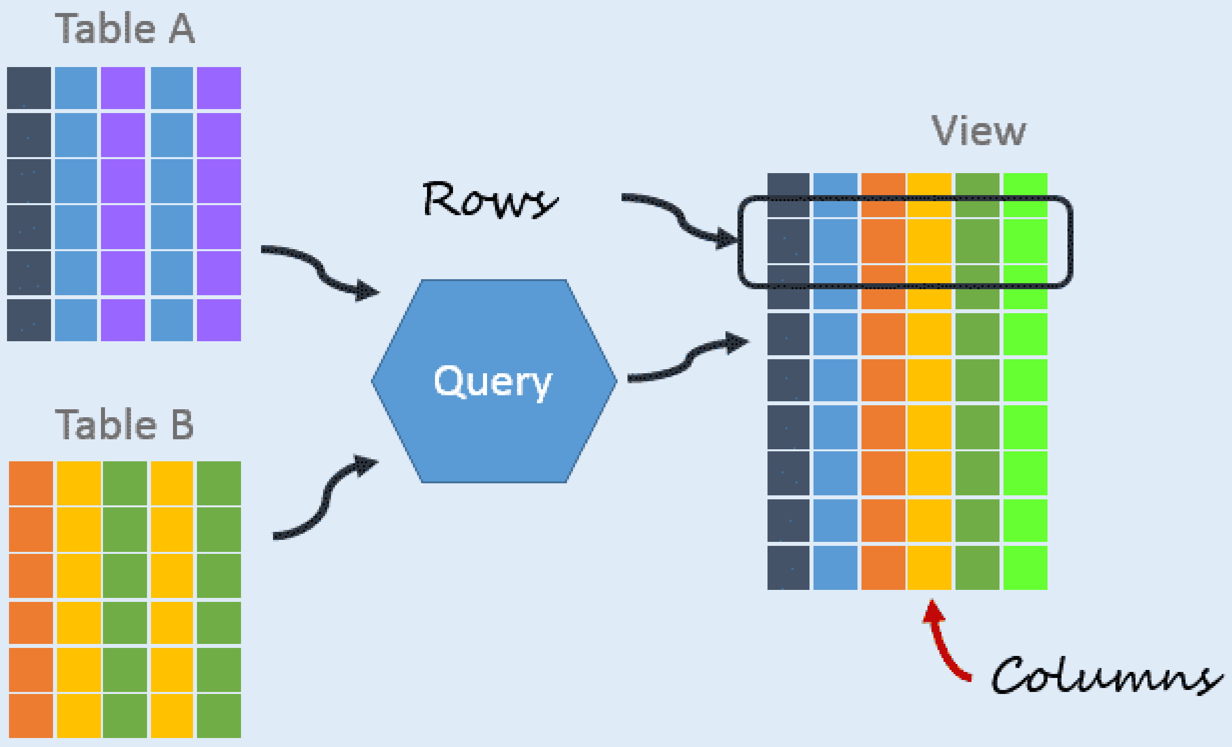
```
constraint fk_prog_id
   foreign key(prog_id)
   references tv_shows(prog_id)
   on delete cascade
   on update restrict
```

- Set null - set the foreign key column to null when the parent key is deleted

```
constraint fk_prog_id
   foreign key(prog_id)
   references tv_shows(prog_id)
   on delete set null
   on update restrict
```

Database Views

Anatomy of a View



Characteristics

- One or more source tables make up a view
- Query follows "SELECT STATEMENT" format
- Views generally read-only
- Views don't require additional storage

Database Views

- View is a table that is defined from one or more queries
- The table is computed when it is accessed
  - No data are stored
- Use cases
  - Providing a conditional view of a table
    - Eg. this months orders
  - Aggregated results from a join
    - Eg. list of all inventories with warehouse location and quantities

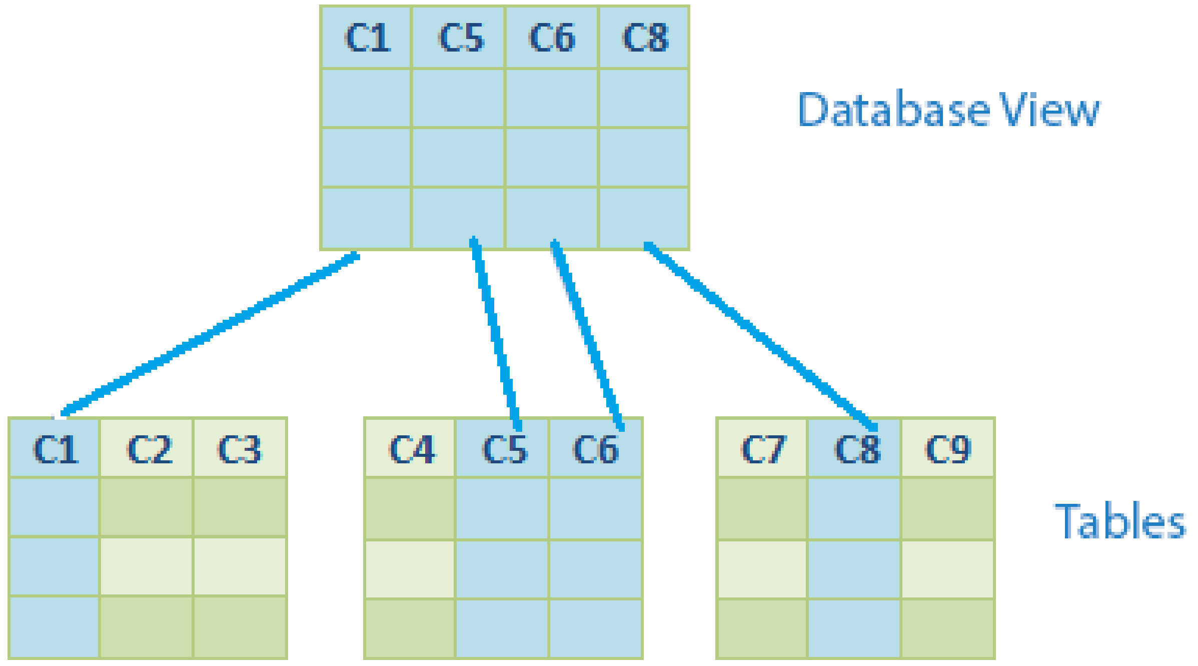


Image from http://www.w3webtutorial.com/mysql/mysql-views-tutorial.php

Views Example

View's name

Query that defines the view

Query

```
create view aug_shows as
  select * from tv_shows tv
    where tv.release_date > '2019-08-01'
```

Query

```
create view shows_episodes as
  select ep.ep_id, as id, tv.name as name,
        ep.season as season, ep.episode as episode,
        ep.title as title
    from tv_shows tv
    join episodes ep
    on tv_shows.prog_id = ep.prog_id
```

Good practice to provide names to columns from a view

Modifying Views

- Views derived from a single query can be modified

```
create view shows_general as
  select * from tv_shows tv
    where tv.rating like ‘G’
```

Single query

```
insert into shows_general(prog_id, name, ...)
  values (100, ‘SpongeBob SquarePants‘ ...)
```

- View derived from joins or aggregation cannot be modified

```
create view episodes_per_season as
  select tv.name as name,
    ep.season as season, count(ep.episode) as episodes
    from tv_shows tv join episodes as ep
    on tv.prog_id = ep.prog_id
    group by tv.name, ep.season
```

Normalization

- The process of eliminating redundancy from the database
- It is a series of steps performed on one or more tables to ensure that every field in a row of record can be found by just the primary key
  - Non-key column is directly dependent on the primary key
- The result is eliminating redundancies
  - Fewer or no data anomalies since you only have to update the data once
  - More efficient updates

First Normal Form - 1NF

- Every row must be unique
  - Table must have primary key
  - Can create table without primary key
- No repeating same group of attributes viz. should not have multiple columns with the same attribute
  - Eg. multiple columns for different email addresses

```
create table supplier (
   supplier_id char(10) primary key,
   name varchar(255) non null,
   products varchar(255)
);
```

"mouse, keyboard, USB cable"

```
create table supplier (
   supplier_id char(10) primary key,
   name varchar(255) non null,
   product0 varchar(32),
   product1  varchar(32),
   product2  varchar(32)
);
```

"mouse"

"keyboard"

"USB cable"

First Normal Form - 1NF

supplier_id	name	prod_name
acme	ACME Corp	Jet Propelled Unicycle
orsbone	Orsbone Corp	Globlin Sparks, Bat Hoverboard
acme	ACME Corp	Triple-Strength Fortified Leg Muscle Vitamins

Column with repeating values

First Normal Form - 1NF

```
create table supplier (
  supplier_id char(10) primary key,
  name varchar(255) non null
);
```

supplier_id	name
acme	ACME Corp
orsbone	Orsbone Corp

```
create table product (
  product_id char(10) primary key,
  name varchar(255) non null,
  supplier_id char(10) non null,
  constraint fk_supplier_id
    foreign key(supplier_id)
    references supplier(supplier_id)
);
```

product_id	name	supplier_id
0	Globlin Sparks	orsbone
1	Bat Hoverboard	orsbone
2	Jet Propelled Unicycle	acme
3	Triple-Strength Fortified Leg Muscle Vitamins	acme

Second Normal Form - 2NF

- Must be in 1NF
- If the non primary key fields are dependent on the primary key(s)
  - Primary key(s) - may be composite

warehouse_id	product_id	location	quantity
tuas	1	Tuas	100
woodlands	1	Woodlands	100
tuas	2	Tuas	100

$\underbrace{\texttt{warehouse\_id} \quad \texttt{product\_id}}_{\text{Composite primary key}}$

Composite primary key

`location` field is dependent only on `warehouse_id` not on `product_id`

Second Normal Form - 2NF

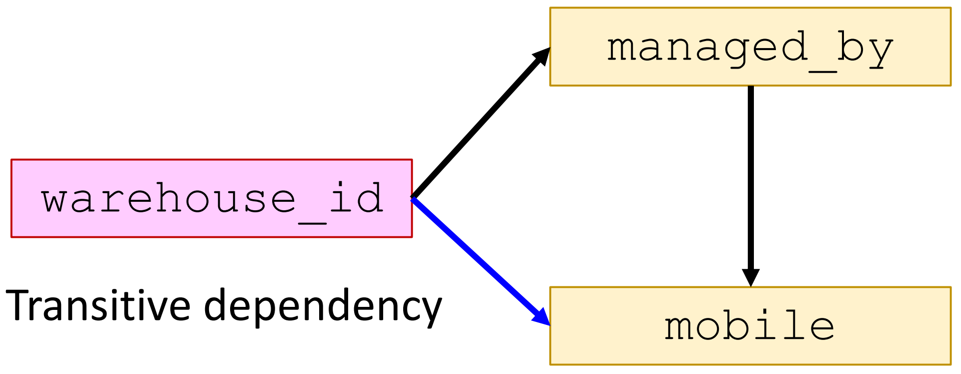
warehouse_id	location
tuas	Tuas
woodlands	Woodlands

Primary key

warehouse_id	product_id	quantity
tuas	1	100
woodlands	1	100
tuas	2	100

Composite primary key

Third Normal Form - 3NF



- Must be in 2NF
- Has no transitive dependencies
  - The non primary key fields must be dependent on only the primary key(s)
  - Changing one field may cause changes to another field

warehouse_id	location	managed_by	mobile
tuas	Tuas	Alfred	555-1234
woodlands	Woodlands	Jeeves	555-6789

Primary key

We know that Tuas is managed by Alfred whose phone number is 555-1234.
So we can infer the `mobile` number from `managed_by` which is not a primary key

Third Normal Form - 3NF

warehouse_id	location	manager_id
tuas	Tuas	1
woodlands	Woodlands	2

Primary key

manager_id	name	mobile
1	Alfred	555-1234
2	Jeeves	555-6789

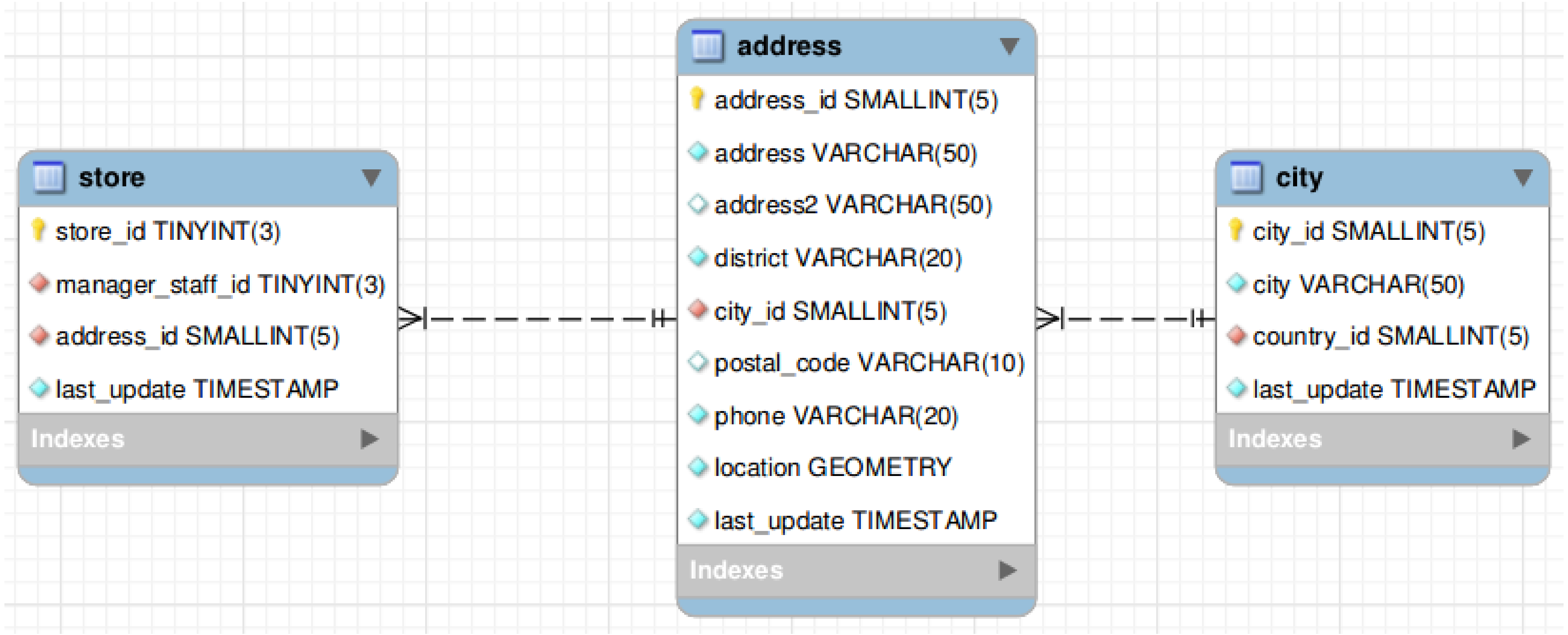
Appendix

Sub Queries

- Queries within a query
    - To be used by the outer query
- The inner query must be a select statement enclosed in parenthesis
- The inner query can return
    - A single value viz. single row, single column
    - A single row, viz. multiple row, single columns
    - A table viz. multiple rows, multiple columns
        - Temporary table

Example - Single Value

Find all the store from a particular city eg. Lethbridge



Example - Single Value

```
select city.city_id
   from city
   where city.city = ‘Lethbridge’
```

Returns a single value

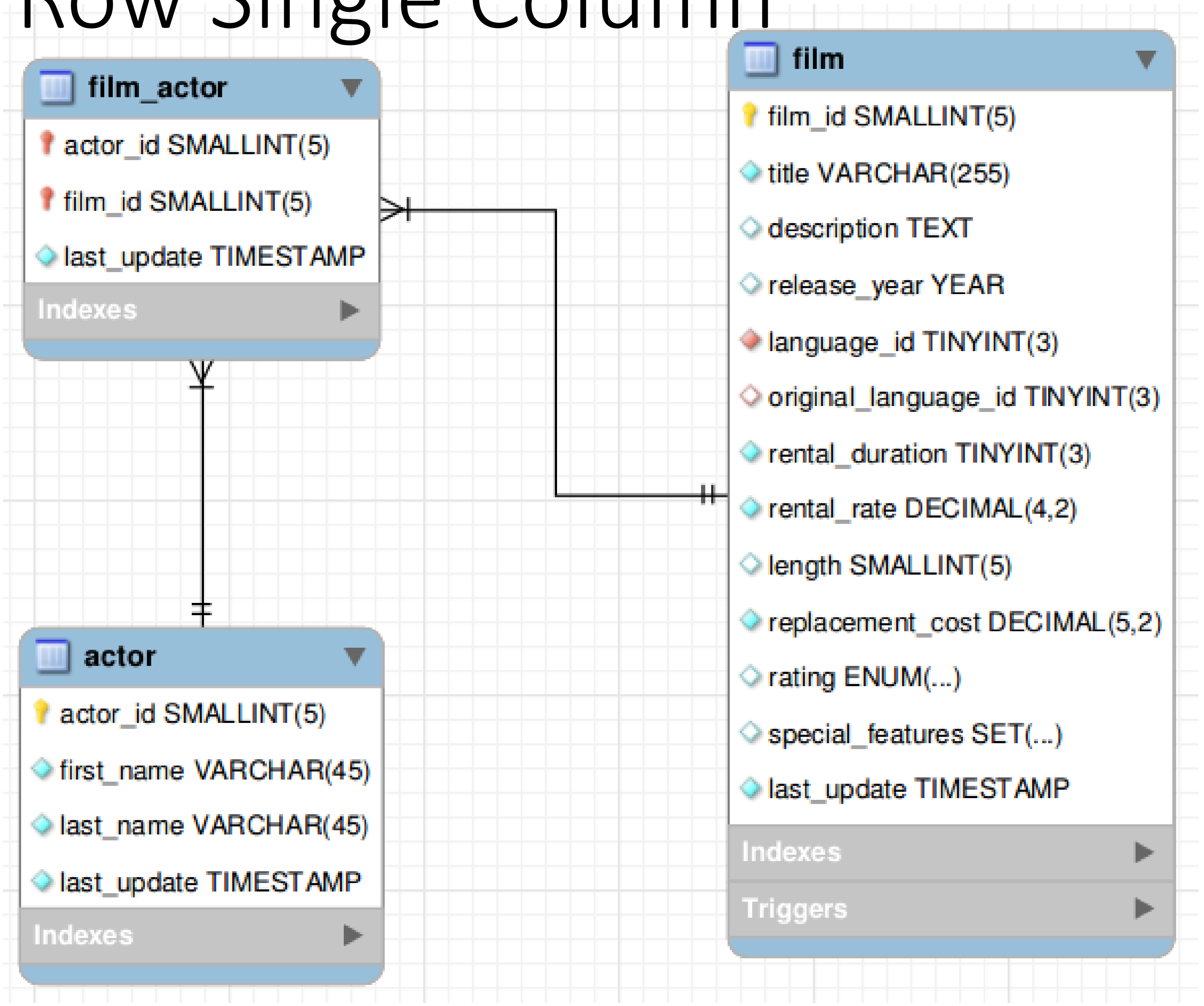
```
select *
   from store
   left join address
   where address.city_id = (
      select city.city_id
         from city
         where city.city = ‘Lethbridge’
   )
```

Inner query returns a single value which is used by the outer query in the where clause

Inner query inside a parenthesis

Example - Multiple Row Single Column

Get all the movies with actors whose last name is Davis



Example - Multiple Row Single Column

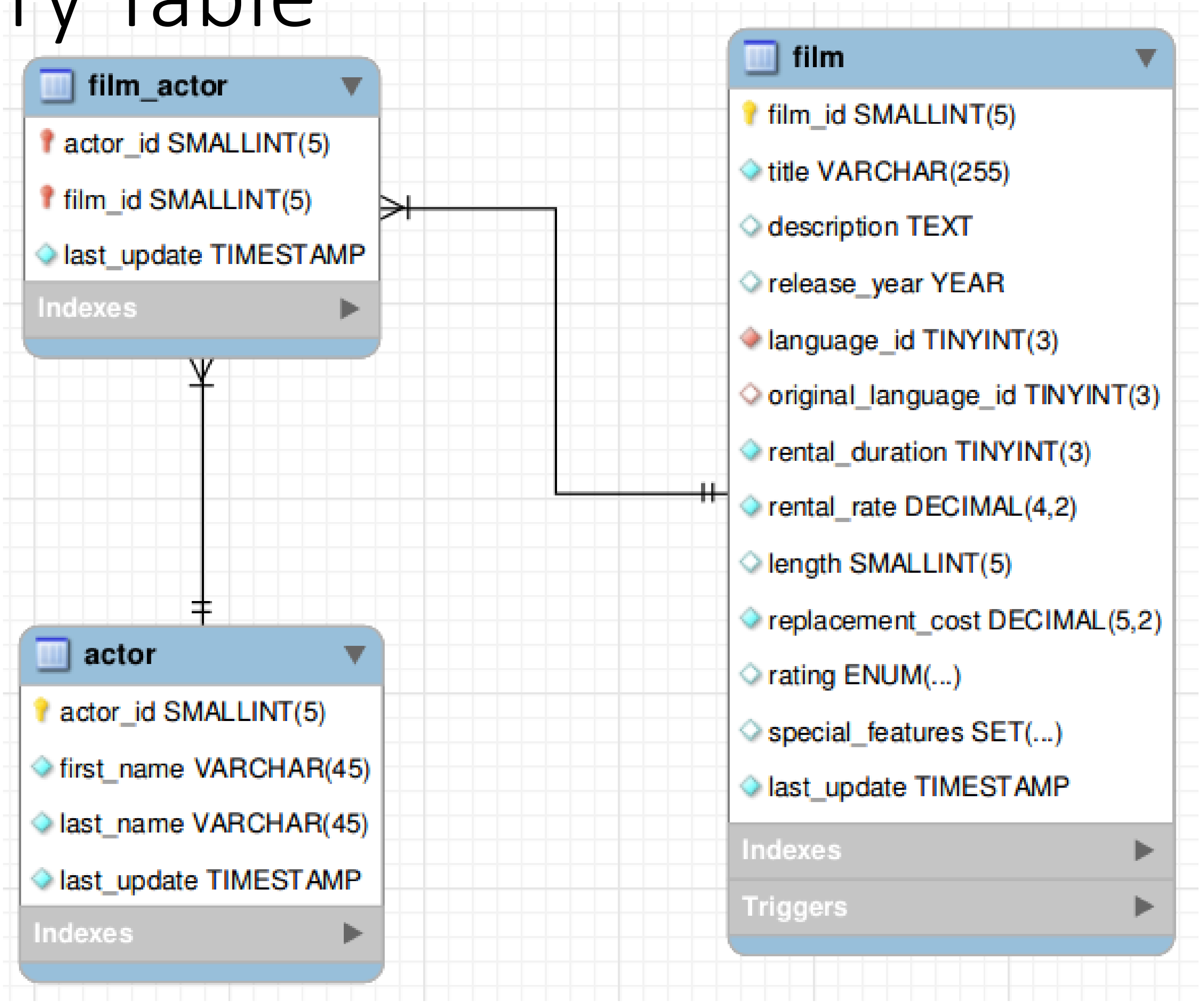
```
select distinct film_actor.film_id
  from actor
  right join film_actor
  on actor.actor_id = film_actor.actor_id
  where actor.last_name like 'Davis'
```

```
select film.title
  from film
  where film.film_id in (
    select distinct film_actor.film_id
      from actor
      right join film_actor
      on actor.actor_id = film_actor.actor_id
      where actor.last_name like 'Davis'
)
```

Inner query returns a single column which is used to check membership

Example - Temporary Table

Get all the actors who has appeared in more than 25 films



Example - Temporary Table

```
select film_count_tbl.firstname, film_count_tbl.lastname
  from (
    select actor.last_name as lastname,
      actor.first_name as first_name,
      count(film_actor.film_id) as film_count
        from actor
        left join film_actor
        on actor.actor_id = film_actor.actor_id
        group by lastname, firstname
    ) as film_count_tbl
  where film_count_tbl.film_count > 25
```

Inner query returns a temporary table. All components of the table must be aliased