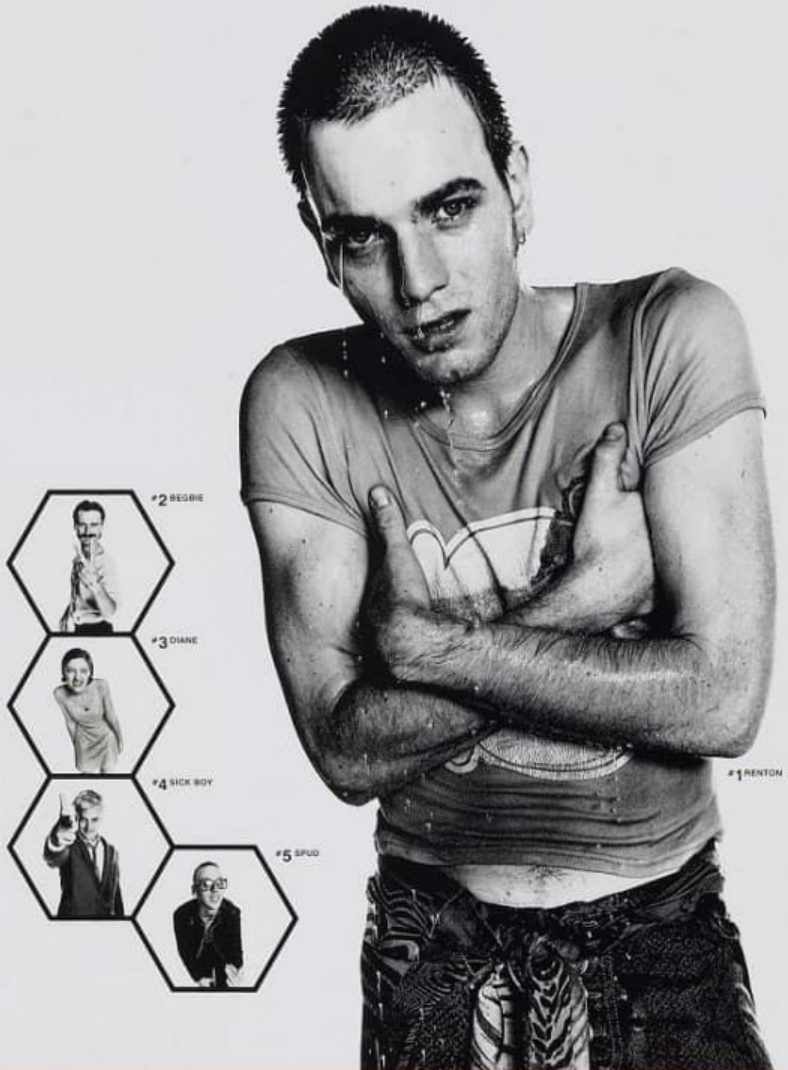

SELECT
'amazing_features'
FROM
"postgresql"

Postgres **95**

PostgreSQL **v1**



PostgreSQL **v6...**

Kevin DAVIN

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Google Developer Expert
on **Google Cloud** & **Kotlin**

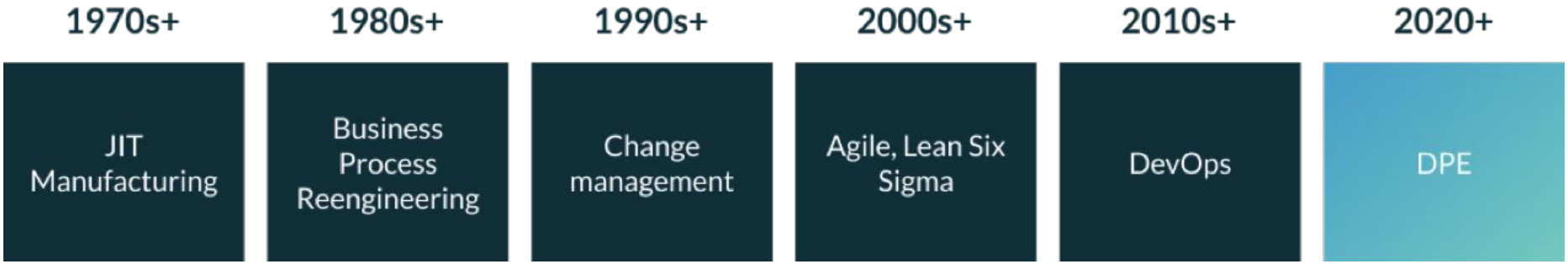
Gitlab Heroes

Open Source Contributor


Gradle

Our mission at **Gradle** is to **accelerate developer productivity** and **make developers happier**

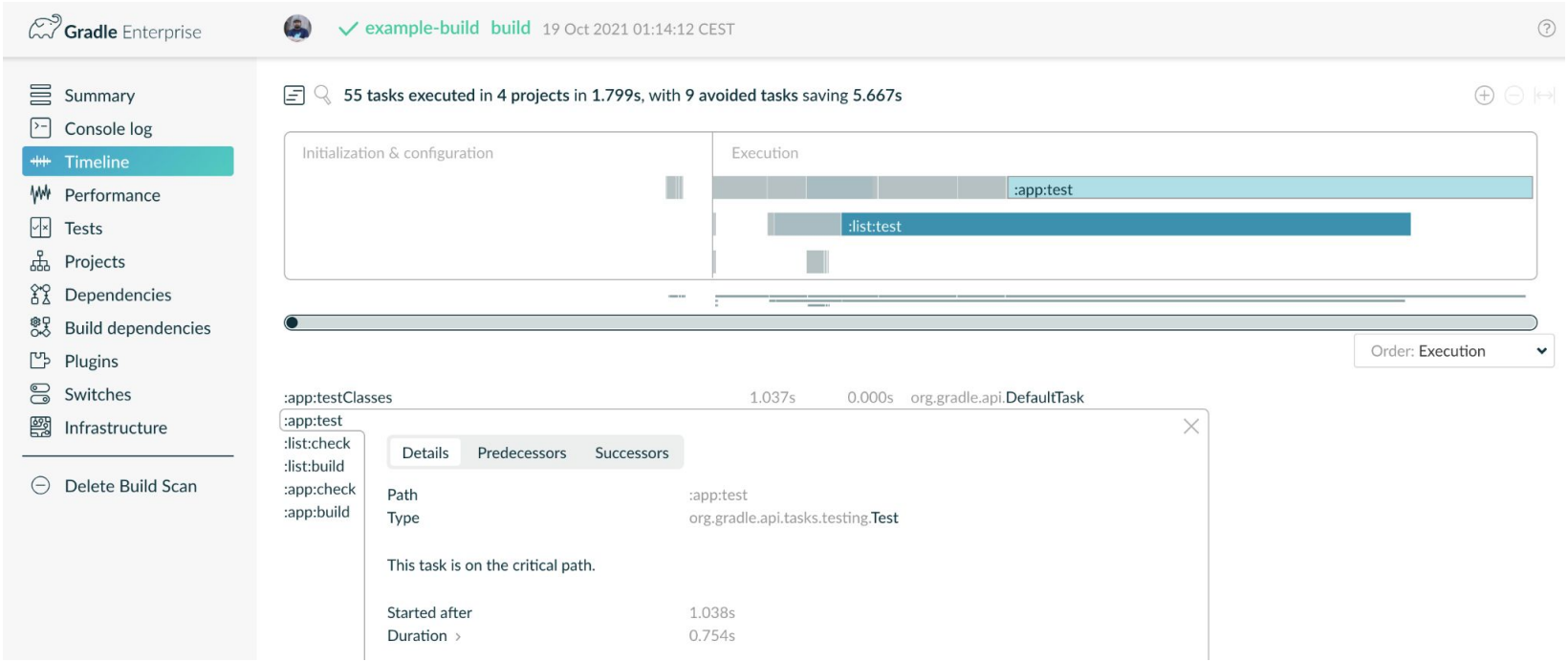
What comes after DevOps?



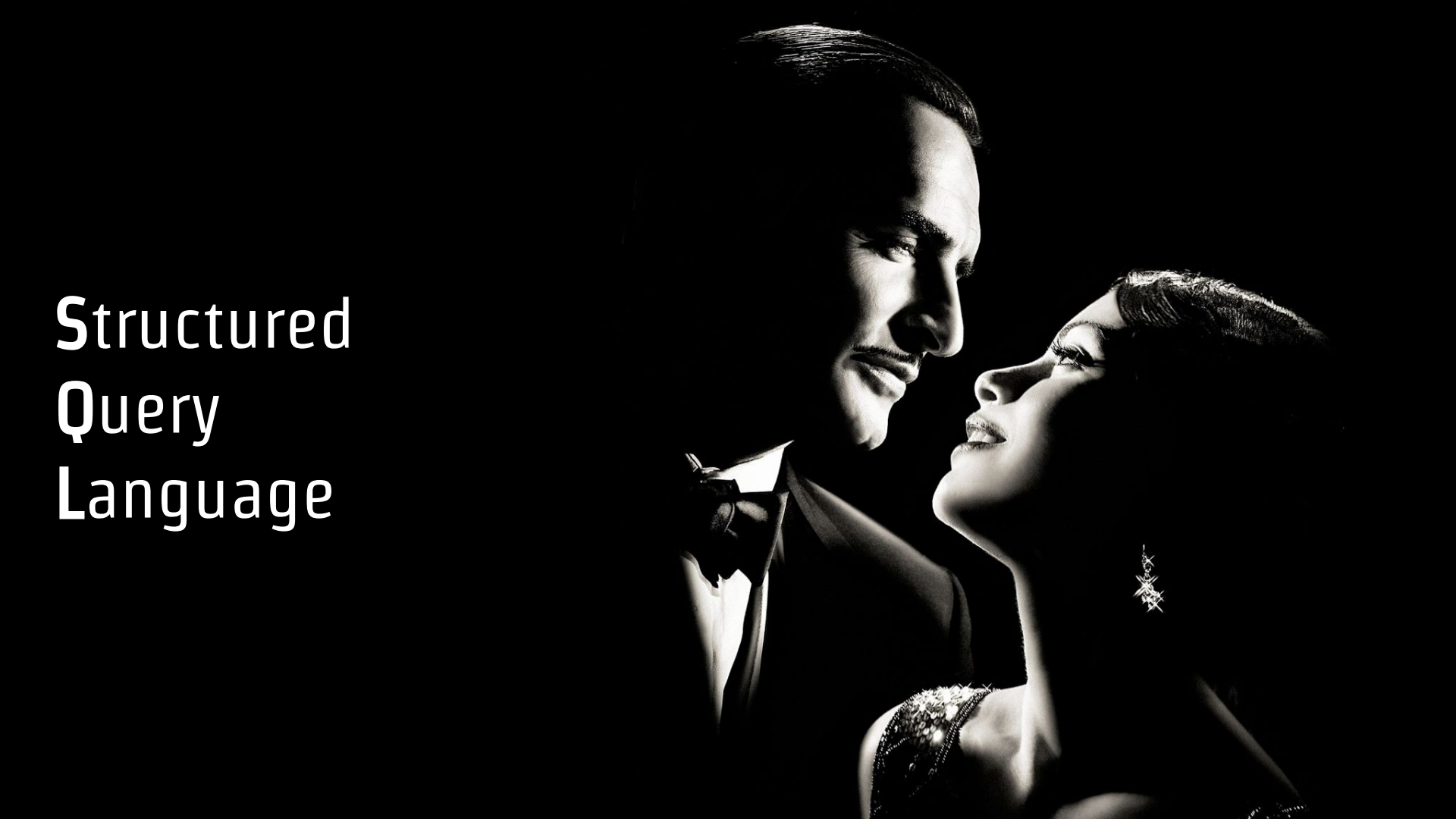
Developer **P**roductivity **E**ngineering

“If you can’t measure it, you can’t improve it!”

by Peter Drucker



Structured
Query
Language



Standard

ISO/IEC **9075-1**

Never
Forget
The order...

From
Join

Where

Group by

Aggregate
Functions

Having

Window
Functions

Select

Distinct

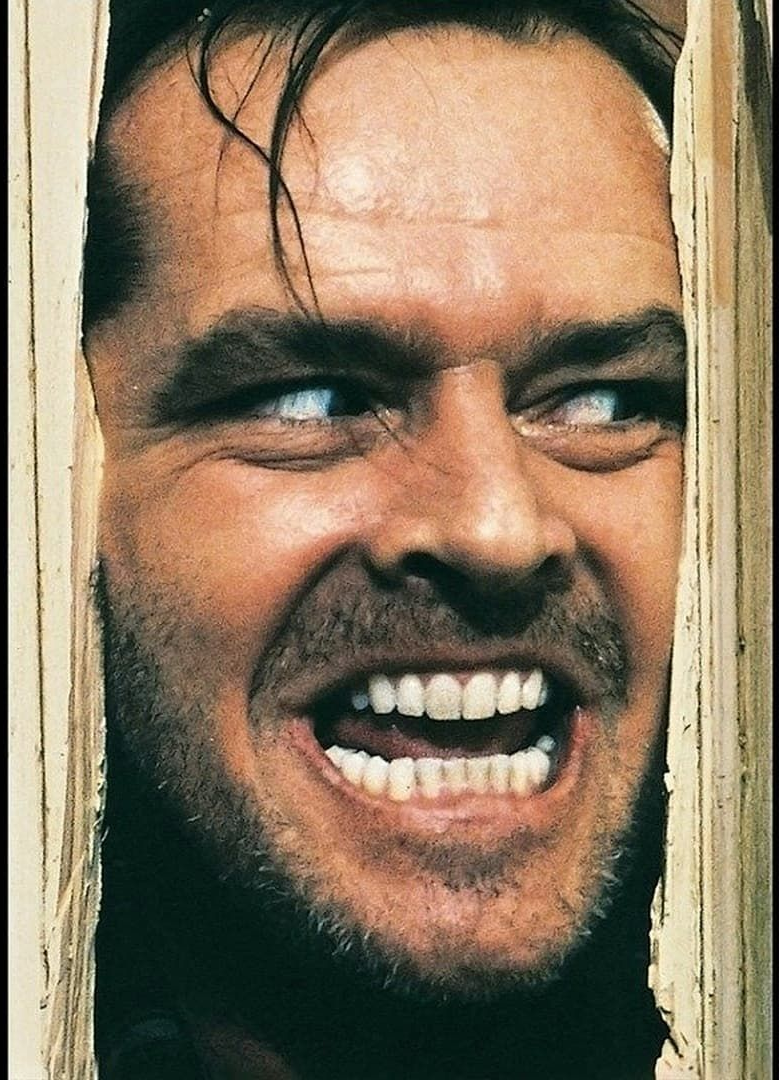
Union
Intersect
Except

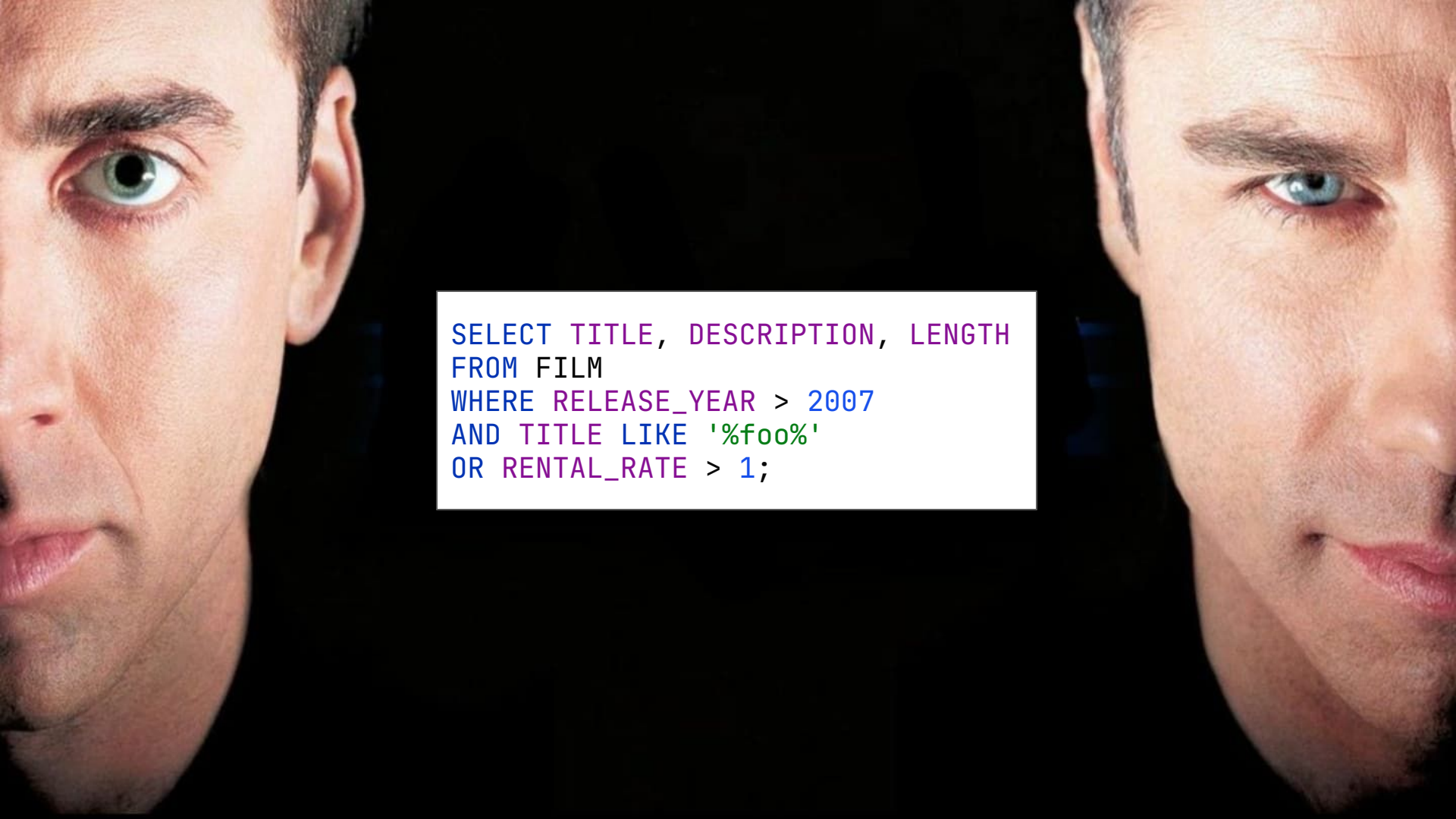
Order by

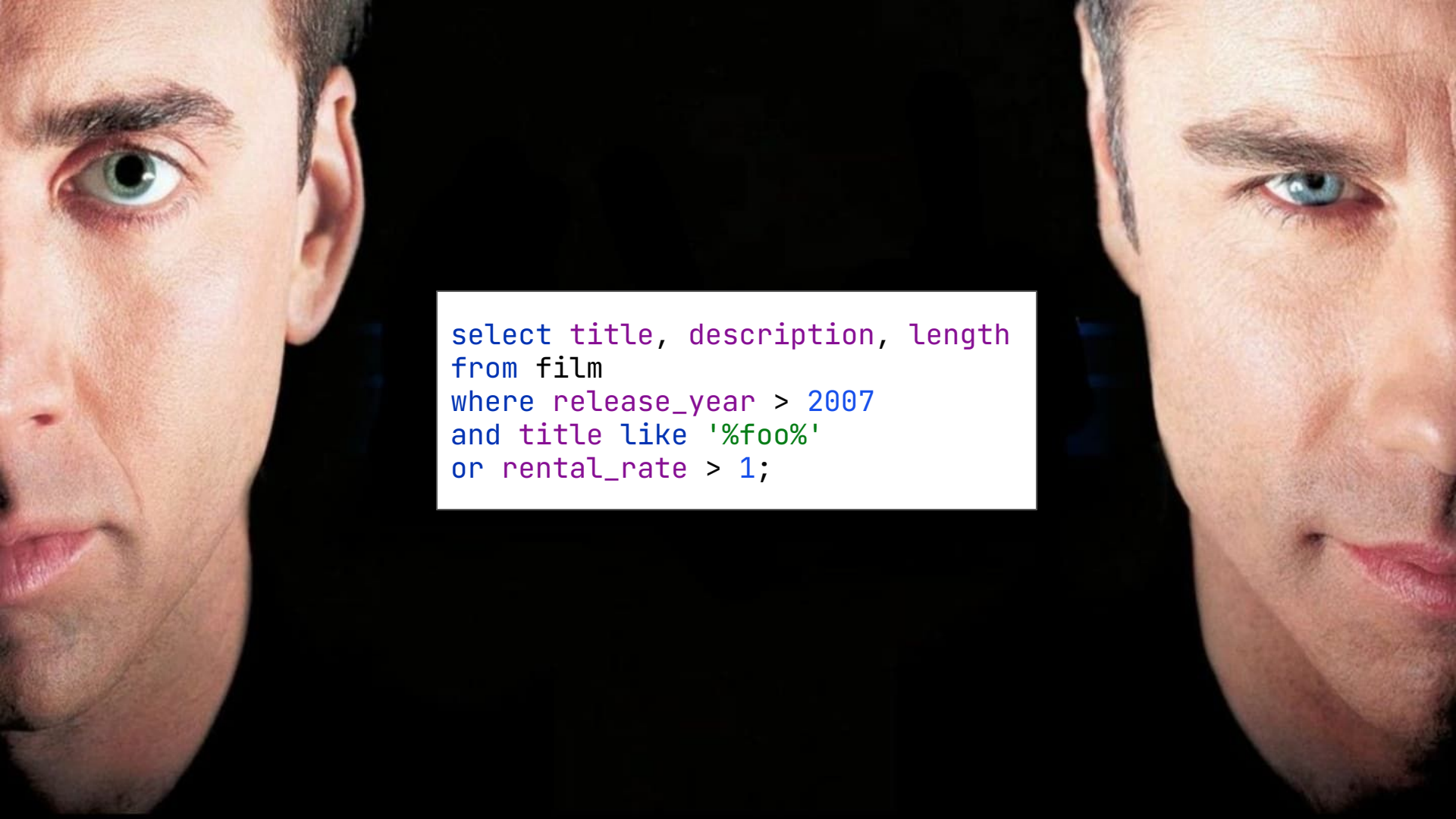
Offset

Limit
Fetch
Top

Don’t need to shout…

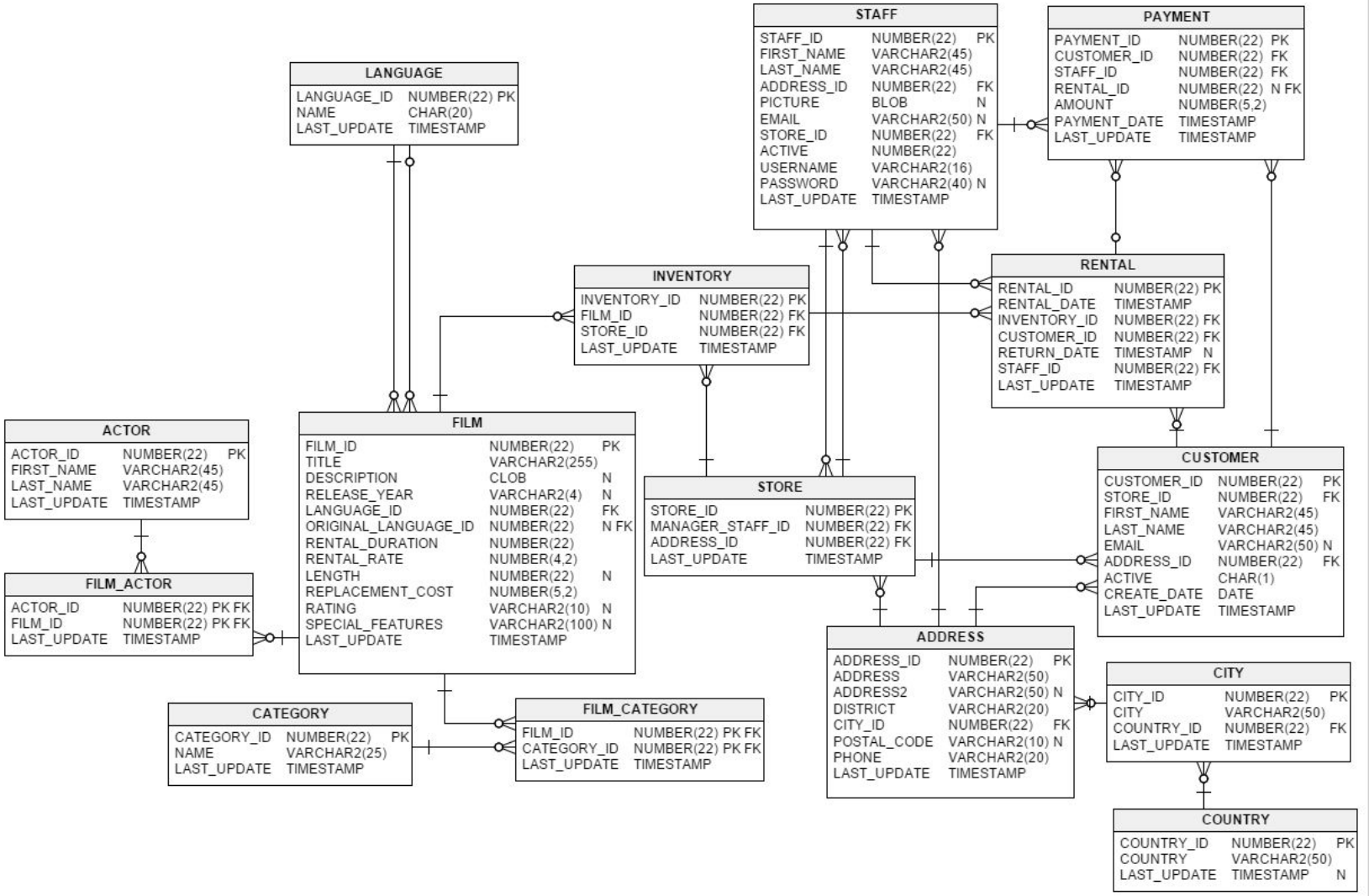


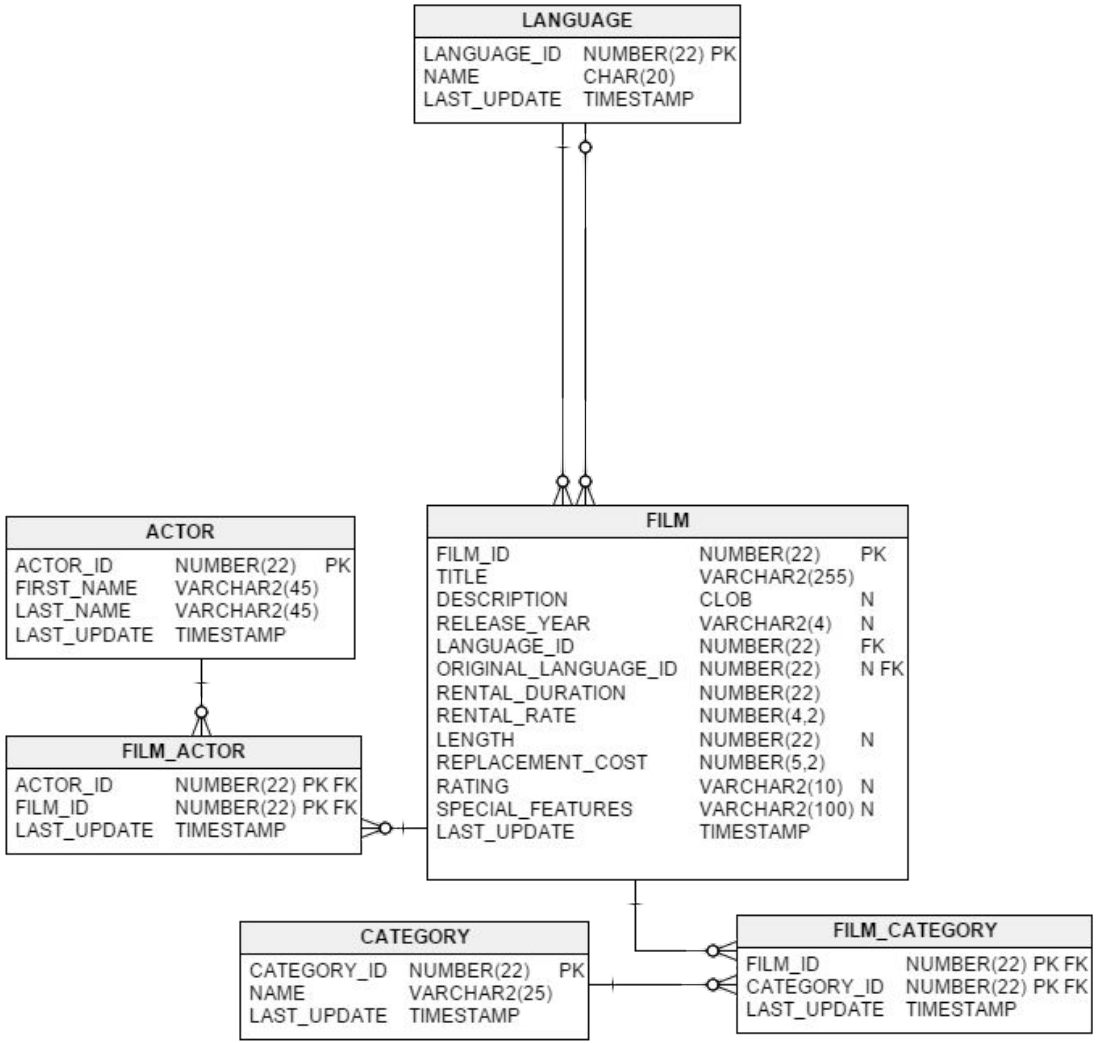

SELECT TITLE, DESCRIPTION, LENGTH
FROM FILM
WHERE RELEASE_YEAR > 2007
AND TITLE LIKE '%foo%'
OR RENTAL_RATE > 1;

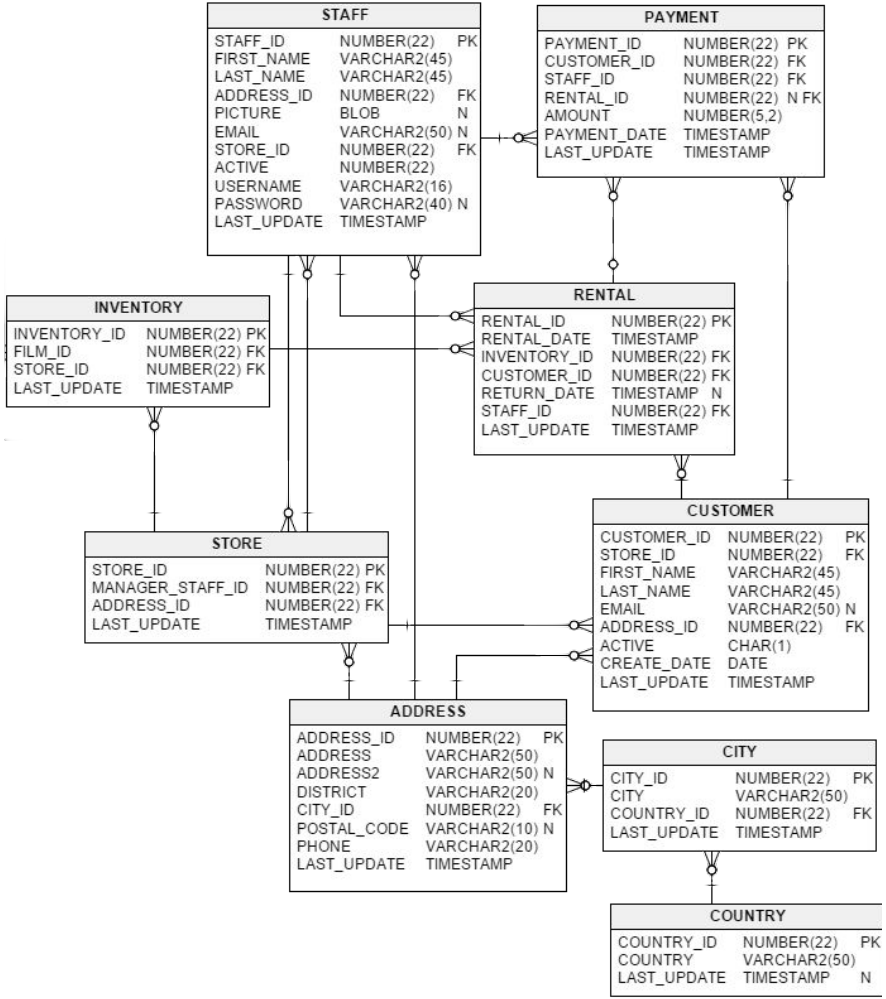


```sql
select title, description, length
from film
where release_year > 2007
and title like '%foo%'
or rental_rate > 1;
```

Sakila Database

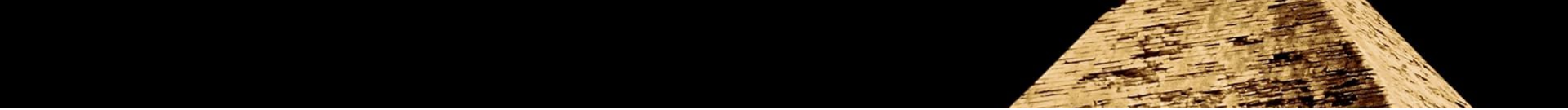

STAFF
STAFF_ID NUMBER(22) PK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
ADDRESS_ID NUMBER(22) FK
PICTURE BLOB N
EMAIL VARCHAR2(50) N
STORE_ID NUMBER(22) FK
ACTIVE NUMBER(22)
USERNAME VARCHAR2(16)
PASSWORD VARCHAR2(40) N
LAST_UPDATE TIMESTAMP
PAYMENT
PAYMENT_ID NUMBER(22) PK
CUSTOMER_ID NUMBER(22) FK
STAFF_ID NUMBER(22) FK
RENTAL_ID NUMBER(22) N FK
AMOUNT NUMBER(5,2)
PAYMENT_DATE TIMESTAMP
LAST_UPDATE TIMESTAMP
LANGUAGE
LANGUAGE_ID NUMBER(22) PK
NAME CHAR(20)
LAST_UPDATE TIMESTAMP
INVENTORY
INVENTORY_ID NUMBER(22) PK
FILM_ID NUMBER(22) FK
STORE_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
RENTAL
RENTAL_ID NUMBER(22) PK
RENTAL_DATE TIMESTAMP
INVENTORY_ID NUMBER(22) FK
CUSTOMER_ID NUMBER(22) FK
RETURN_DATE TIMESTAMP N
STAFF_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
ACTOR
ACTOR_ID NUMBER(22) PK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
LAST_UPDATE TIMESTAMP
FILM
FILM_ID NUMBER(22) PK
TITLE VARCHAR2(255)
DESCRIPTION CLOB N
RELEASE_YEAR VARCHAR2(4) N
LANGUAGE_ID NUMBER(22) FK
ORIGINAL_LANGUAGE_ID NUMBER(22) N FK
RENTAL_DURATION NUMBER(22)
RENTAL_RATE NUMBER(4,2)
LENGTH NUMBER(22) N
REPLACEMENT_COST NUMBER(5,2)
RATING VARCHAR2(10) N
SPECIAL_FEATURES VARCHAR2(100) N
LAST_UPDATE TIMESTAMP
STORE
STORE_ID NUMBER(22) PK
MANAGER_STAFF_ID NUMBER(22) FK
ADDRESS_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
CUSTOMER
CUSTOMER_ID NUMBER(22) PK
STORE_ID NUMBER(22) FK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
EMAIL VARCHAR2(50) N
ADDRESS_ID NUMBER(22) FK
ACTIVE CHAR(1)
CREATE_DATE DATE
LAST_UPDATE TIMESTAMP
FILM_ACTOR
ACTOR_ID NUMBER(22) PK FK
FILM_ID NUMBER(22) PK FK
LAST_UPDATE TIMESTAMP
ADDRESS
ADDRESS_ID NUMBER(22) PK
ADDRESS VARCHAR2(50)
ADDRESS2 VARCHAR2(50) N
DISTRICT VARCHAR2(20)
CITY_ID NUMBER(22) FK
POSTAL_CODE VARCHAR2(10) N
PHONE VARCHAR2(20)
LAST_UPDATE TIMESTAMP
CITY
CITY_ID NUMBER(22) PK
CITY VARCHAR2(50)
COUNTRY_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
CATEGORY
CATEGORY_ID NUMBER(22) PK
NAME VARCHAR2(25)
LAST_UPDATE TIMESTAMP
FILM_CATEGORY
FILM_ID NUMBER(22) PK FK
CATEGORY_ID NUMBER(22) PK FK
LAST_UPDATE TIMESTAMP
COUNTRY
COUNTRY_ID NUMBER(22) PK
COUNTRY VARCHAR2(50)
LAST_UPDATE TIMESTAMP N


LANGUAGE
LANGUAGE_ID NUMBER(22) PK
NAME CHAR(20)
LAST_UPDATE TIMESTAMP
ACTOR
ACTOR_ID NUMBER(22) PK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
LAST_UPDATE TIMESTAMP
FILM
FILM_ID NUMBER(22) PK
TITLE VARCHAR2(255)
DESCRIPTION CLOB N
RELEASE_YEAR VARCHAR2(4) N
LANGUAGE_ID NUMBER(22) FK
ORIGINAL_LANGUAGE_ID NUMBER(22) N FK
RENTAL_DURATION NUMBER(22)
RENTAL_RATE NUMBER(4,2)
LENGTH NUMBER(22) N
REPLACEMENT_COST NUMBER(5,2)
RATING VARCHAR2(10) N
SPECIAL_FEATURES VARCHAR2(100) N
LAST_UPDATE TIMESTAMP
FILM_ACTOR
ACTOR_ID NUMBER(22) PK FK
FILM_ID NUMBER(22) PK FK
LAST_UPDATE TIMESTAMP
CATEGORY
CATEGORY_ID NUMBER(22) PK
NAME VARCHAR2(25)
LAST_UPDATE TIMESTAMP
FILM_CATEGORY
FILM_ID NUMBER(22) PK FK
CATEGORY_ID NUMBER(22) PK FK
LAST_UPDATE TIMESTAMP

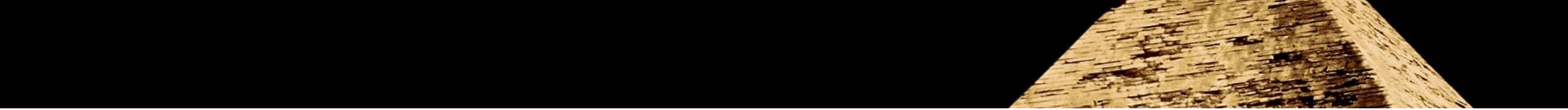

STAFF
STAFF_ID NUMBER(22) PK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
ADDRESS_ID NUMBER(22) FK
PICTURE BLOB N
EMAIL VARCHAR2(50) N
STORE_ID NUMBER(22) FK
ACTIVE NUMBER(22)
USERNAME VARCHAR2(16)
PASSWORD VARCHAR2(40) N
LAST_UPDATE TIMESTAMP
PAYMENT
PAYMENT_ID NUMBER(22) PK
CUSTOMER_ID NUMBER(22) FK
STAFF_ID NUMBER(22) FK
RENTAL_ID NUMBER(22) N FK
AMOUNT NUMBER(5,2)
PAYMENT_DATE TIMESTAMP
LAST_UPDATE TIMESTAMP
INVENTORY
INVENTORY_ID NUMBER(22) PK
FILM_ID NUMBER(22) FK
STORE_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
RENTAL
RENTAL_ID NUMBER(22) PK
RENTAL_DATE TIMESTAMP
INVENTORY_ID NUMBER(22) FK
CUSTOMER_ID NUMBER(22) FK
RETURN_DATE TIMESTAMP N
STAFF_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
CUSTOMER
CUSTOMER_ID NUMBER(22) PK
STORE_ID NUMBER(22) FK
FIRST_NAME VARCHAR2(45)
LAST_NAME VARCHAR2(45)
EMAIL VARCHAR2(50) N
ADDRESS_ID NUMBER(22) FK
ACTIVE CHAR(1)
CREATE_DATE DATE
LAST_UPDATE TIMESTAMP
STORE
STORE_ID NUMBER(22) PK
MANAGER_STAFF_ID NUMBER(22) FK
ADDRESS_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
ADDRESS
ADDRESS_ID NUMBER(22) PK
ADDRESS VARCHAR2(50)
ADDRESS2 VARCHAR2(50) N
DISTRICT VARCHAR2(20)
CITY_ID NUMBER(22) FK
POSTAL_CODE VARCHAR2(10) N
PHONE VARCHAR2(20)
LAST_UPDATE TIMESTAMP
CITY
CITY_ID NUMBER(22) PK
CITY VARCHAR2(50)
COUNTRY_ID NUMBER(22) FK
LAST_UPDATE TIMESTAMP
COUNTRY
COUNTRY_ID NUMBER(22) PK
COUNTRY VARCHAR2(50)
LAST_UPDATE TIMESTAMP N

Common Table Expression

```sql
select
    c.first_name || ' ' || c.last_name,
    sum(amount)
from
    customer c
        join (
            select r.customer_id
            from rental r
                inner join inventory i on r.inventory_id = i.inventory_id
                inner join film f on i.film_id = f.film_id
                inner join film_category fc on f.film_id = fc.film_id
                inner join category cat on cat.category_id = fc.category_id
            where cat.name = 'Documentary'
            group by r.customer_id
        ) r on c.customer_id = r.customer_id
        join payment ps on c.customer_id = ps.customer_id
group by c.first_name, c.last_name
order by 2 desc;
```



```
var result = foo(bar(baz(1, foo(2,3)), really(4, tooMuch(5,6))), 7);
```



```
var first = tooMuch(5, 6);
var second = foo(2, 3);
var third = really(4, first);
var fourth = baz(1, second);
var last = bar(fourth, third);
var result = foo(last, 7);
```

Better readability

Better readability

```
with documentary_rentals as (
    select r.customer_id
    from rental r
             inner join inventory i on r.inventory_id = i.inventory_id
             inner join film f on i.film_id = f.film_id
             inner join film_category fc on f.film_id = fc.film_id
             inner join category cat on cat.category_id = fc.category_id
    where cat.name = 'Documentary'
    group by r.customer_id
)
select
    c.first_name || ' ' || c.last_name,
    sum(ps.amount)
from
    customer c
        join documentary_rentals r on c.customer_id = r.customer_id
        join payment ps on c.customer_id = ps.customer_id
group by c.first_name, c.last_name
order by 2 desc
```

Naming
is **important**

Naming is **important**

```sql
with documentary_rentals as (
    select r.customer_id
    from rental r
             inner join inventory i on r.inventory_id = i.inventory_id
             inner join film f on i.film_id = f.film_id
             inner join film_category fc on f.film_id = fc.film_id
             inner join category cat on cat.category_id = fc.category_id
    where cat.name = 'Documentary'
    group by r.customer_id
)
select
    c.first_name || ' ' || c.last_name,
    sum(ps.amount)
from
    customer c
        join documentary_rentals r on c.customer_id = r.customer_id
        join payment ps on c.customer_id = ps.customer_id
group by c.first_name, c.last_name
order by 2 desc
```

Faster Execution

Faster Execution

```
with
  first_cte as (…),
  second_cte as (…),
  third_cte as (…)
select
   c.first_name || ' ' || c.last_name,
   sum(ps.amount)
from
   …
group by c.first_name, c.last_name
order by 2 desc
```


Window Functions

From
Join

Where

Group by

Aggregate
Functions

Having

**Window
Functions**

Select

Distinct

Union
Intersect
Except

Order by

Offset

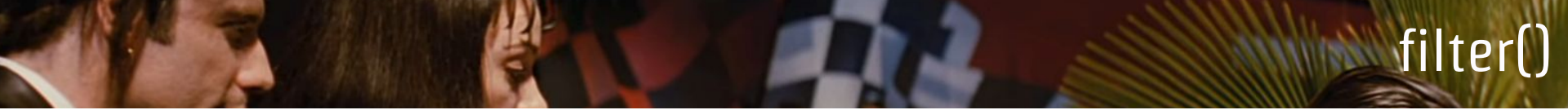
Limit
Fetch
Top

Window Functions

```sql
select rating, count(*) as "number of movie"
from film
group by rating;
```

rating	number of movie
PG	194
G	178
NC-17	210
PG-13	223
R	195

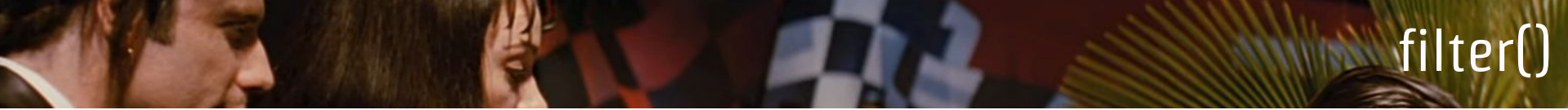

filter()



filter()

```sql
select
    count(*) as "all",
    count(*) filter ( where rating = 'PG' ) as "PG",
    count(*) filter ( where rating = 'G' ) as "G",
    count(*) filter ( where rating = 'NC-17' ) as "NC-17",
    count(*) filter ( where rating = 'PG-13' ) as "PG-13",
    count(*) filter ( where rating = 'R' ) as "R"
from film;
```

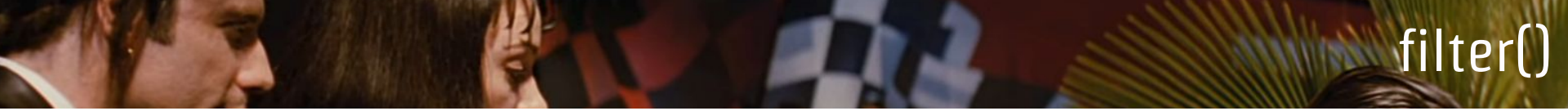
```
 all  | PG  |  G  | NC-17 | PG-13 |  R
------+-----+-----+-------+-------+-----
 1000 | 194 | 178 |   210 |   223 | 195
```



filter()

```
select

   count(*) filter ( where length > 30 ) as "> 30m",
   count(*) filter ( where length > 60 ) as "> 60m",
   count(*) filter ( where length > 90 ) as "> 90m",
   count(*) filter ( where length > 120 ) as "> 120m",
   count(*) filter ( where length > 180 ) as "> 180m"
from film;
```

```
 > 30m | > 60m | > 90m | > 120m | > 180m
-------+-------+-------+--------+--------
  1000 |   896 |   675 |    457 |     39
```



filter()

```
select
   count(*) as "all",
   count(*) filter ( where rating = 'PG' ) as "PG",
   count(*) filter ( where rating = 'G' ) as "G",
   count(*) filter ( where rating = 'NC-17' ) as "NC-17",
   count(*) filter ( where rating = 'PG-13' ) as "PG-13",
   count(*) filter ( where rating = 'R' ) as "R",
   count(*) filter ( where length > 30 ) as "> 30m",
   count(*) filter ( where length > 60 ) as "> 60m",
   count(*) filter ( where length > 90 ) as "> 90m",
   count(*) filter ( where length > 120 ) as "> 120m",
   count(*) filter ( where length > 180 ) as "> 180m"
from film
```

all	PG	G	NC-17	PG-13	R	> 30m	> 60m	> 90m	> 120m	> 180m
1000	194	178	210	223	195	1000	896	675	457	39

row_number()

row_number()

```
create table film_with_duplicate (
   film_id integer default nextval('film_film_id_seq'::regclass) not null,
   title character varying(255) not null
);


insert into film_with_duplicate (title)
   -- all original films are inserted
   (select title from film)
union all
   -- and we insert 40 random films from the same list
   (select title from film order by random() limit 40);
```

row_number()

```
select count(*) as "number of films"
from film_with_duplicate;
```

number of films
1040

row_number()

```
select title, film_id
from film_with_duplicate
order by title;
```

title	film_id
ACADEMY DINOSAUR	1074
ACE GOLDFINGER	1747
ADAPTATION HOLES	**1986**
ADAPTATION HOLES	**2034**
AFFAIR PREJUDICE	1614
AFRICAN EGG	1047

row_number()

```
select title, film_id
       row_number() over (partition by title) as duplication_times,
from film_with_duplicate
```

title	duplication_times	film_id
ACADEMY DINOSAUR	1	1074
ACE GOLDFINGER	1	1747
ADAPTATION HOLES	1	1986
ADAPTATION HOLES	**2**	**2034**
AFFAIR PREJUDICE	1	1614
AFRICAN EGG	1	1047

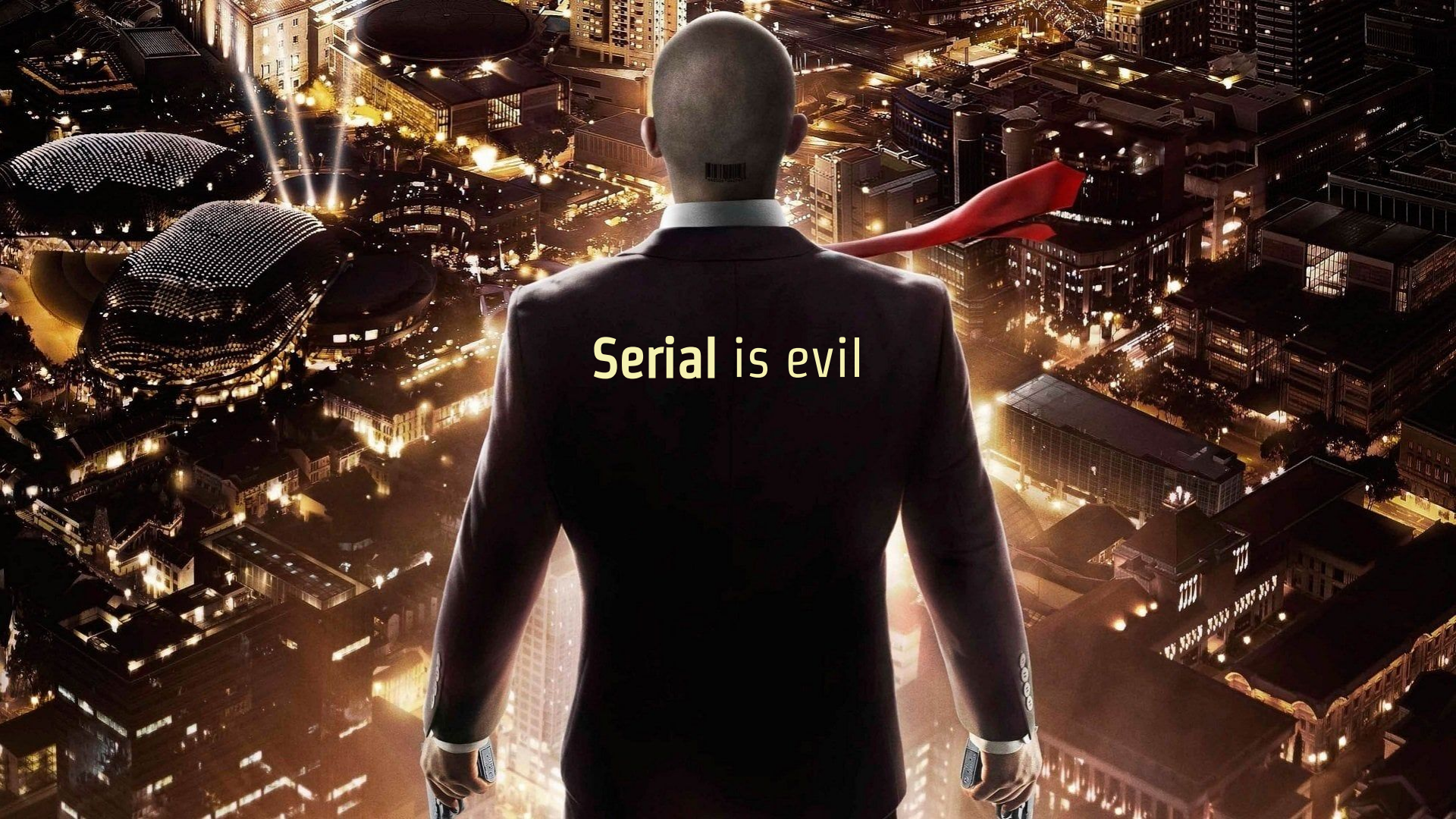
row_number()

```
with iteration_of_each_film_entry as (
    select title, film_id,
           row_number() over (partition by title) as duplication_times
    from film_with_duplicate
)
delete from film_with_duplicate
where film_id IN (
    select distinct film_id
    from iteration_of_each_film_entry
    where duplication_times > 1
);
```

title	duplication_times	film_id
ACADEMY DINOSAUR	1	1074
ACE GOLDFINGER	1	1747
ADAPTATION HOLES	1	1986
ADAPTATION HOLES	**2**	**2034**
AFFAIR PREJUDICE	1	1614
AFRICAN EGG	1	1047

row_number()

```
40 rows affected in 18 ms
```


Serial is evil


```sql
create table film_serial (
    id serial primary key,
    title character varying(255) not null
);


insert into film_serial (title)
values
    ('Matrix'),
    ('Matrix Reloaded'),
    ('Matrix Revolutions'),
    ('Matrix Resurrections')
returning id, title;
```


```
id |         title
---+-----------------------
 1 | Matrix
 2 | Matrix Reloaded
 3 | Matrix Revolutions
 4 | Matrix Resurrections
```

```
select currval('film_serial_id_seq'::regclass);
```

UUID is better!

UUID is better!

```
create extension "uuid-ossp";
create table if not exists film_uuid (
   id uuid primary key default uuid_generate_v4(),
   title character varying(255) not null
);
```

```
insert into film_uuid (title)
values ('Matrix'),
       ('Matrix Reloaded'),
       ('Matrix Revolutions'),
       ('Matrix Resurrections')
returning id, title;
```

UUID is better!

```
                  id                  |        title
--------------------------------------+----------------------
60b8a533-2680-4eaa-a75e-128aa0c67df9 | Matrix
45d3f3c9-cbbe-450f-8d14-cbdfd30c1109 | Matrix Reloaded
d1687d3e-3d75-4620-8ade-f26c6e8fd8ae | Matrix Revolutions
16f8daf5-2bd5-4816-ac6d-79042ab3b584 | Matrix Resurrections
```

UUID is better!

```
insert into film_uuid (id, title)
values
  ('4339890d-706f-4950-a862-542f288dca2e'::uuid, 'Matrix'),
  ('b4774c08-8be9-44a4-90aa-8b9af26a5c13'::uuid, 'Matrix Reloaded'),
  ('3f09a064-2f32-41b9-be24-94cc0b068a40'::uuid, 'Matrix Revolutions'),
  ('fae647ab-7c60-4e7c-b4a5-2188b3845f83'::uuid, 'Matrix Resurrections')
-- returning id, title;
```


Constraints

Constraints

```
create table film_with_isan (
 film_id integer default nextval('film_film_id_seq'::regclass) NOT NULL,
 title character varying(255) not null,
 isan character varying(255)




);
```

Constraints

```
create table film_with_isan (
 film_id integer default nextval('film_film_id_seq'::regclass) NOT NULL,
 title character varying(255) not null,
 isan character varying(255),

 constraint has_valid_isan check (
  isan is null or
  isan ~* 'ISAN [0-9a-f]{4}-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-z]-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-z]'
   --       ISAN     0000   -    0001   -    8947   -    0000   -       8-    0000   -    0000   -       D
 )

);
```

Constraints

```
create table film_with_isan (
 film_id integer default nextval('film_film_id_seq'::regclass) NOT NULL,
 title character varying(255) not null,
 isan character varying(255),

 constraint has_valid_isan check (
  isan is null or
  isan ~* 'ISAN [0-9a-f]{4}-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-z]-[0-9a-f]{4}-[0-9a-f]{4}-[0-9a-z]'
   --       ISAN     0000   -    0001   -    8947   -    0000   -       8-    0000   -    0000   -       D
 ),
 constraint isan_is_unique unique (isan)
);
```

Constraints

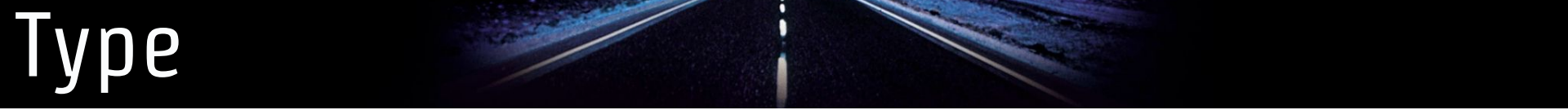
```
sakila.public> insert into film_with_isan (title, isan)
               values ('INVALID_ISAN','63998367-c0c9-4fe0-82fc-ba4c96890ee1');

[2023-03-25 17:04:37] [23514] ERROR: new row for relation "film_with_isan" violates check constraint "has_valid_isan"
[2023-03-25 17:04:37] Detail: Failing row contains (2042, INVALID_ISAN, 63998367-c0c9-4fe0-82fc-ba4c96890ee1).
```

Constraints

```
sakila.public> insert into film_with_isan (title, isan)
               values ('REAL_ISAN', 'ISAN 0000-0001-68EC-0000-X-0000-0000-C');

[2023-03-25 17:07:47] 1 row affected in 13 ms

sakila.public> insert into film_with_isan (title, isan)
               values ('REAL_ISAN', 'ISAN 0000-0001-68EC-0000-X-0000-0000-C');

[2023-03-25 17:08:21] [23505] ERROR: duplicate key value violates unique constraint "isan_is_unique"
[2023-03-25 17:08:21] Detail: Key (isan)=(ISAN 0000-0001-68EC-0000-X-0000-0000-C) already exists.
```

Type

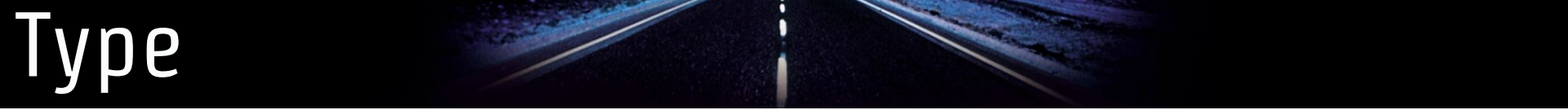
Type



```
create type isan_type as (
   block_1 varchar(4), block_2 varchar(4), block_3 varchar(4), block_4 varchar(4),
   block_5 varchar(1), block_6 varchar(4), block_7 varchar(4), block_8 varchar(1)
);
```

```
create domain isan as isan_type check (
       (value).block_1 is not null and (value).block_1 ~* '[0-9a-f]{4}'
   and (value).block_2 is not null and (value).block_2 ~* '[0-9a-f]{4}'
   and (value).block_3 is not null and (value).block_3 ~* '[0-9a-f]{4}'
   and (value).block_4 is not null and (value).block_4 ~* '[0-9a-f]{4}'
   and (value).block_5 is not null and (value).block_5 ~* '[0-9a-f]'
   and (value).block_6 is not null and (value).block_6 ~* '[0-9a-f]{4}'
   and (value).block_7 is not null and (value).block_7 ~* '[0-9a-f]{4}'
   and (value).block_8 is not null and (value).block_8 ~* '[0-9a-f]'
);
```

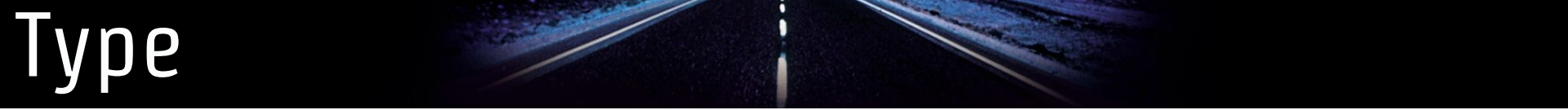
Type



```
select ('0000', '0001', '68ec', '0000', 'a', '0000', '0000', 'c')::isan;
```

```
                isan
-------------------------------------
(0000,0001,68ec,0000,a,0000,0000,c)
```

Type



```
select (null, '0001', '68ec', '0000', 'a', '0000', '0000', 'c')::isan;
```

```
[2023-03-29 21:15:46] [23514] ERROR: value for domain isan violates check
constraint "isan_check"
```

Type

```
create function isan_to_text(isan) … $$
create function text_to_isan(isan) … $$
create function isan_exception(text) … $$
create function isan_equals(isan) … $$
create function isan_not_equals(isan) … $$
```

```
select
   isan_equals(
     text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C'),
     text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C')
   ) as isan_equality,

   isan_not_equals(
       ('0000', '0001', '68ec', '0000', 'a', '0000', '0000', 'c')::isan,
       text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C')
   ) as isan_different
;
```

Type


```
create operator = (
 leftarg = isan,
 rightarg = isan,
 procedure = isan_equals,
 commutator = =,
 negator = ≠,
 hashes,
 merges
);
```

```
create operator ≠ (
 leftarg = isan,
 rightarg = isan,
 function = isan_not_equals,
 commutator = ≠,
 negator = =,
 hashes,
 merges
);
```

```
select
  text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C') = text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C'),
  text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C') ≠ text_to_isan('ISAN 0000-0001-68EC-0000-A-0000-0000-C');
```

Listen | Notify

Listen | Notify

```
create or replace function notify_new_film()
returns trigger
language plpgsql
as $$
declare
 channel text := TG_ARGV[0];
begin
 perform (
    with payload as (select NEW.film_id as id, NEW.title as title)
    select pg_notify(channel, row_to_json(payload)::text) from payload
 );
 return null;
end;
$$;
```

```
create trigger notify_clients
after insert on film_with_notification
for each row execute procedure notify_new_film('film.add');
```

Listen | Notify

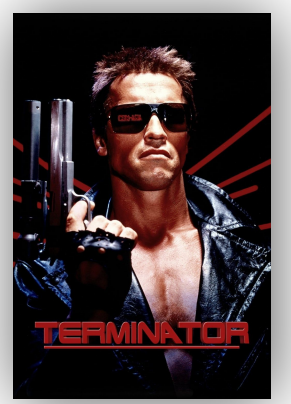
```
listen "film.add";
```

```
Asynchronous notification "film.add" with payload
"{"id":1010,"title":"Speed"}" received from server
process with PID 161.

Asynchronous notification "film.add" with payload
"{"id":1011,"title":"John Wick"}" received from server
process with PID 161.

Asynchronous notification "film.add" with payload
"{"id":1012,"title":"Point Break"}" received from server
process with PID 161.

Asynchronous notification "film.add" with payload
"{"id":1013,"title":"The Devil's Advocate"}" received
from server process with PID 161.

Asynchronous notification "film.add" with payload
"{"id":1014,"title":"The Lake House"}" received from
server process with PID 161.
```

```
insert into film_with_notification(title)
values
   ('Speed'), ('John Wick'), ('Point Break'),
   ('The Devil''s Advocate'), ('The Lake House');
```

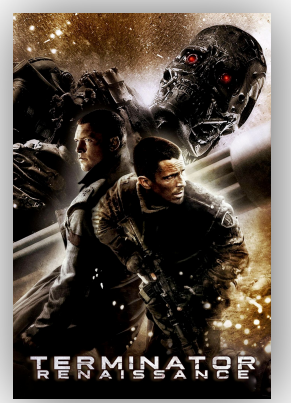
ltree & more

Itree & more


TERMINATOR


SCHWARZENEGGER
TERMINATOR 2
LE JUGEMENT DERNIER


TERMINATOR 3
LE SOULÈVEMENT DES MACHINES

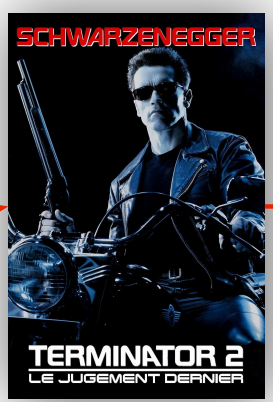

TERMINATOR
RENAISSANCE


TERMINATOR
GENISYS
LA MENACE A CHANGÉ.


TERMINATOR
DARK FATE

Itree & more


TERMINATOR


SCHWARZENEGGER
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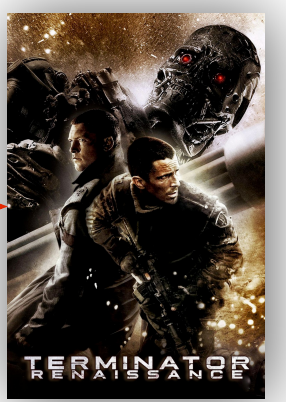

TERMINATOR
RENAISSANCE


TERMINATOR
GENISYS
LA MENACE A CHANGÉ.


TERMINATOR
DARK FATE

ltree & more

```
create extension ltree;

create table film_with_saga_order (
   film_id integer default nextval('film_film_id_seq'::regclass) NOT NULL,
   title character varying(255) not null,
   saga_order ltree
);
```

```
insert into film_with_saga_order (film_id, title, saga_order)
values
   (1, 'Terminator', '1'),
   (2, 'Terminator 2: Judgment Day', '1.2'),
   (3, 'Terminator 3: Rise of the Machines', '1.2.3'),
   (4, 'Terminator Salvation', '1.2.3.4'),
   (5, 'Terminator Genisys', '1.5'),
   (6, 'Terminator: Dark Fate', '1.2.6');
```

ltree & more

```sql
with selected_movie as (
   select saga_order
   from film_with_saga_order
   where film_id = 6
)
select *
from film_with_saga_order
where saga_order @> (select saga_order from selected_movie);
-- @> means '[left ltree] is ancestor of [right ltree]
```

```
film_id |           title            | saga_order
--------+----------------------------+------------
      1 | Terminator                 | 1
      2 | Terminator 2: Judgment Day | 1.2
      6 | Terminator: Dark Fate      | 1.2.6
```

Itree & **more**

ltree & more

```
create table film_with_previous (
   film_id integer default nextval('film_film_id_seq'::regclass) NOT NULL,
   title character varying(255) not null,

   previous integer
);
```

```
insert into film_with_previous (film_id, title, previous)
values
   (1, 'Terminator', null),
   (2, 'Terminator 2: Judgment Day', 1),
   (3, 'Terminator 3: Rise of the Machines', 2),
   (4, 'Terminator Salvation', 3),
   (5, 'Terminator Genisys', 1),
   (6, 'Terminator: Dark Fate', 2);
```

ltree & more

```
with recursive saga as (
       select f.film_id, f.title, f.previous
       from film_with_previous f
       where f.film_id = 6
   union all
       select f.film_id, f.title, f.previous
       from film_with_previous f
       inner join saga s on s.previous = f.film_id
)
select title
from saga
order by film_id;
```

```
film_id |           title             | previous
--------+-----------------------------+----------
      1 | Terminator                  |
      2 | Terminator 2: Judgment Day  |        1
      6 | Terminator: Dark Fate       |        2
```


AUSTIN

Foreign Data Wrapper

Foreign Data Wrapper

```
create extension file_fdw;
create server file_server foreign data wrapper file_fdw;

create foreign table passwd (
   username text,
   pass text,
   uid int4,
   gid int4,
   gecos text,
   home text,
   shell text
) server file_server
options (format 'text', filename '/etc/passwd', delimiter ':', null '');
```

Foreign Data Wrapper

```sql
select *
from passwd
where shell ~* '.*bash.*';
```

```
username | uid | gid |        home         |   shell
---------+-----+-----+---------------------+-----------
root     |   0 |   0 | /root               | /bin/bash
postgres | 999 | 999 | /var/lib/postgresql | /bin/bash
```

Foreign Data Wrapper

```
create foreign table fs (
   inode text,
   block text,
   permission text,
   hard_link text,
   owner text,
   "group" text,
   size int,
   last_modification text,
   pathname text
) server file_server
options (format 'text', program '/list-all-files.sh', delimiter '|', null '');

select pathname, owner, "group", size
from fs
where permission ~ '.......rwx'
order by size desc;
```

pathname	owner	group	size
/etc/alternatives/CREATE_TEXT_SEARCH_CONFIGURATION.7.gz	root	root	71
/etc/alternatives/ALTER_TEXT_SEARCH_CONFIGURATION.7.gz	root	root	70
/etc/alternatives/DROP_TEXT_SEARCH_CONFIGURATION.7.gz	root	root	69
/etc/alternatives/CREATE_TEXT_SEARCH_DICTIONARY.7.gz	root	root	68
/etc/alternatives/ALTER_TEXT_SEARCH_DICTIONARY.7.gz	root	root	67

Foreign Data Wrapper

Foreign Data Wrapper

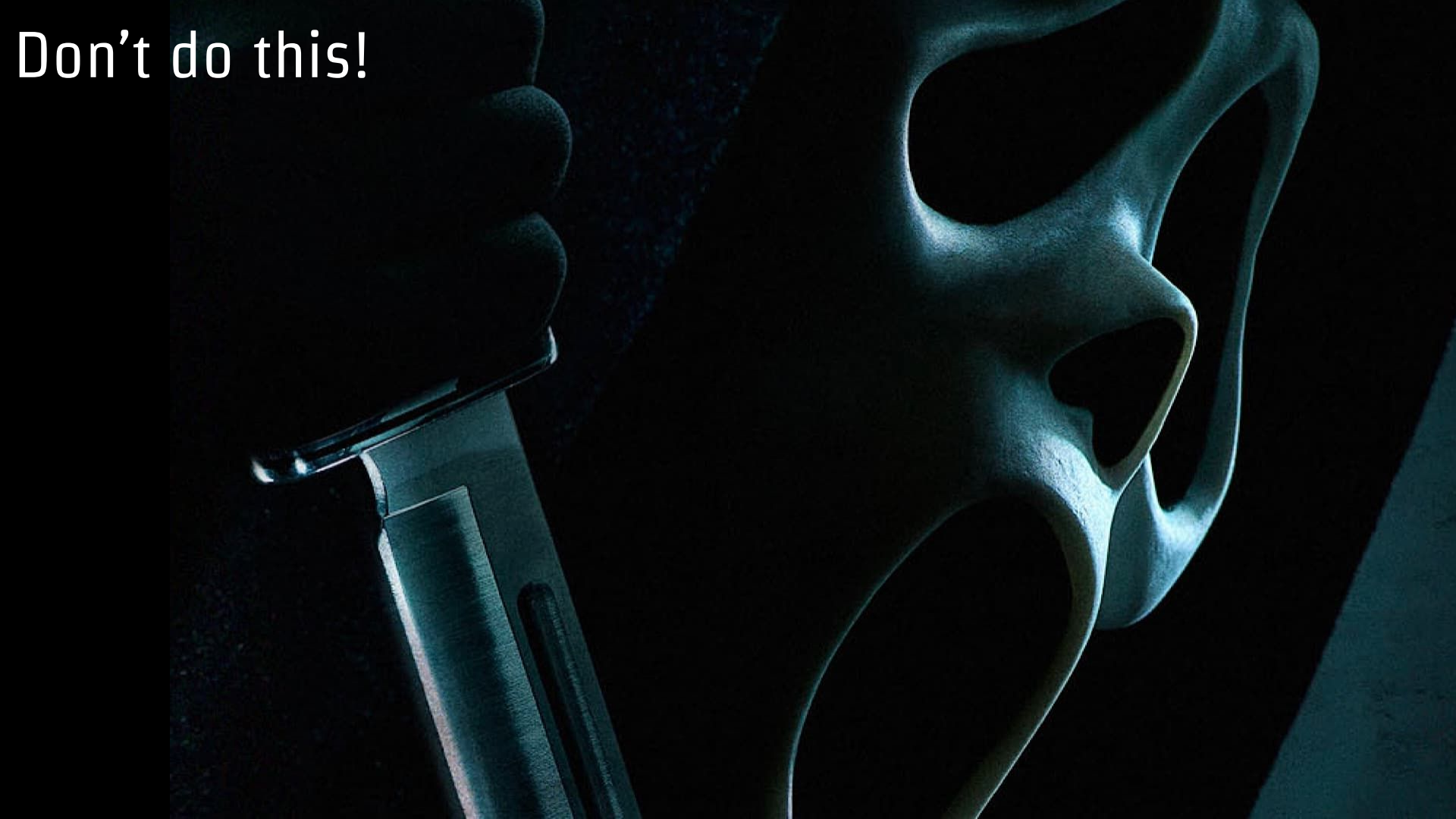
```
create extension postgres_fdw;

create server sakila
foreign data wrapper postgres_fdw
options (host 'amazing-pg', port '5432', dbname 'sakila');

create user mapping for postgres
server sakila
options (user 'postgres', password 'gjITg2bOO33DlbYju27wK2WoOlI2');
```

Foreign Data Wrapper

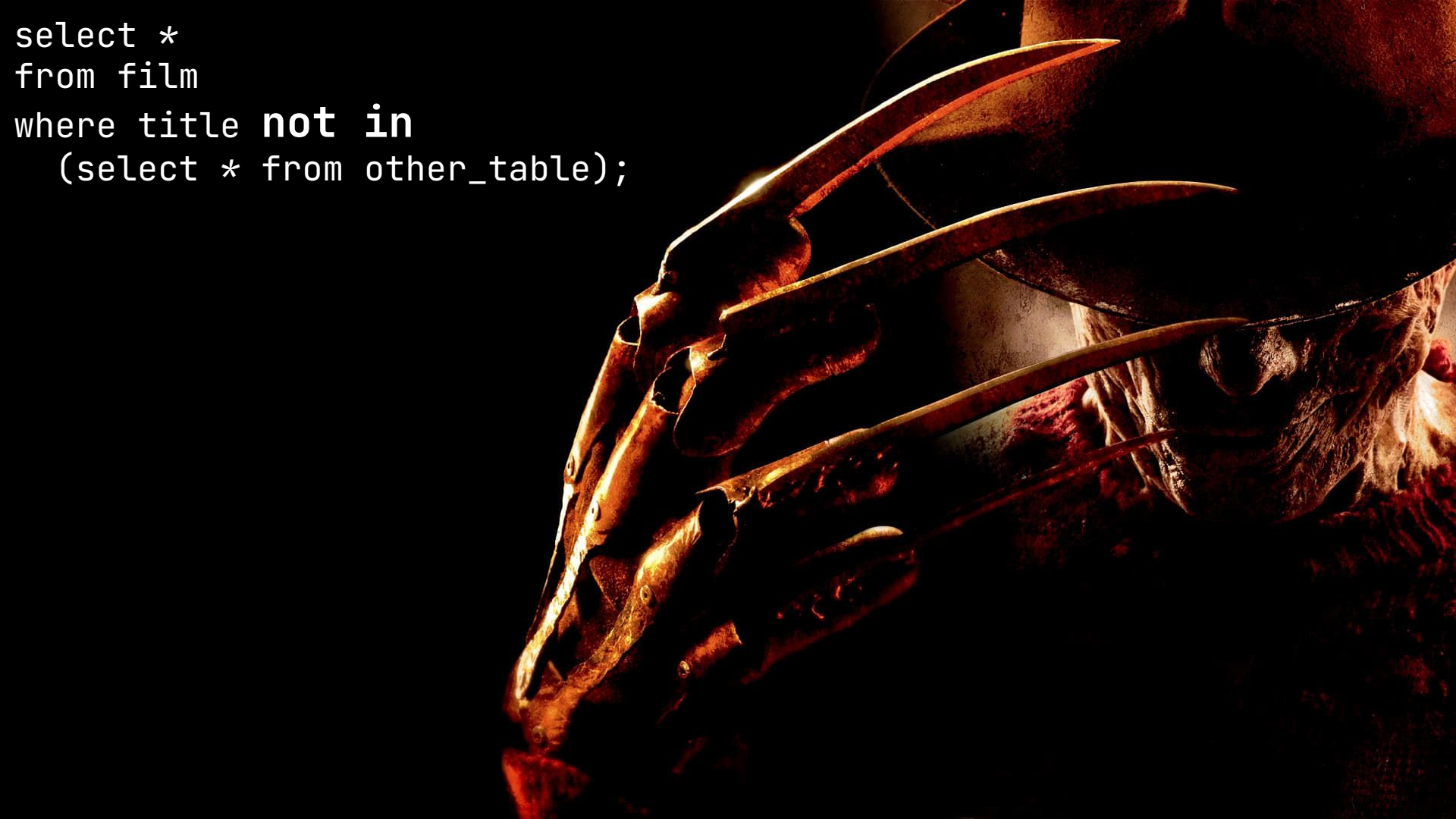
```
create foreign table remote_film (
   film_id integer not null,
   title character varying(255) not null
)
server sakila
options (schema_name 'public', table_name 'film');

select *
from remote_film;
```

```
   id    |      title
---------+------------------
       1 | ACADEMY DINOSAUR
       2 | ACE GOLDFINGER
       3 | ADAPTATION HOLES
       4 | AFFAIR PREJUDICE
       5 | AFRICAN EGG
```

Don’t do this!



```
select *
from film
where title not in
  (select * from other_table);
```




create table xyz (
…
) inherits (film)

```
create table xyz (
 date timestamp
)
```

But use them...

```
create table xyz (
   id uuid not null default uuid_generate_v4(),
   title text not null,
   fts_title tsvector generated always as (to_tsvector('english', title)) stored
)
```

```
-- Use PostGIS for geo-queries
create extension postgis;
```

```
create table xyz (
    json_data jsonb default '{}'
)
```


PostgREST
GRAPHJIN

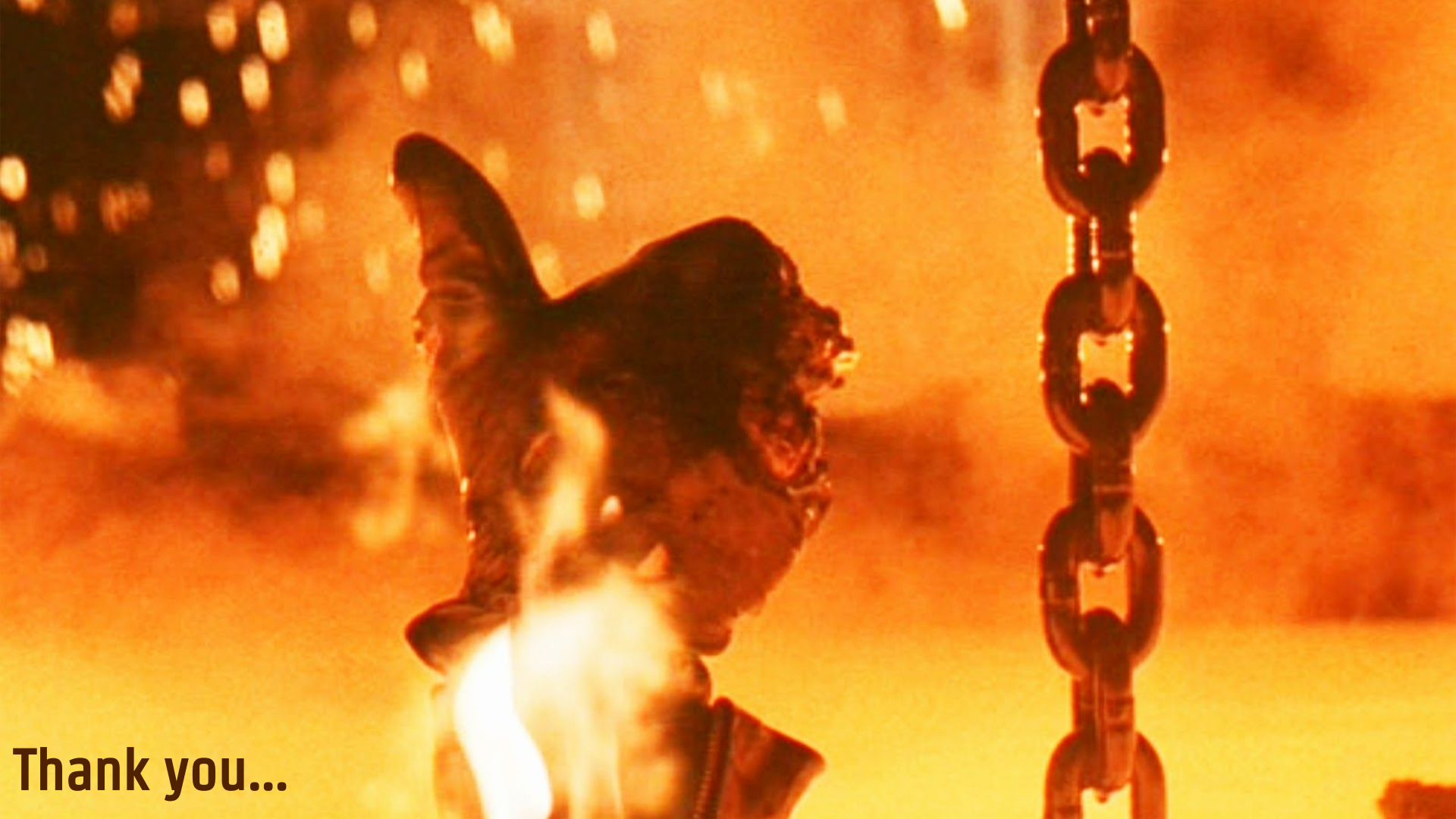
Everywhere!


In any server...

In Kubernetes with...


aws


Infinite possibilities...


Thank you...

Questions?

Gradle @ DevoxxFR