


```
SELECT  
  'amazing_features'  
FROM  
  "postgresql"
```







Postgres 95



PostgreSQL v1



PostgreSQL v6...



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Gitlab Heroes



Open Source Contributor





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



What comes after DevOps?

1970s+

JIT
Manufacturing

1980s+

Business
Process
Reengineering

1990s+

Change
management

2000s+

Agile, Lean Six
Sigma

2010s+

DevOps

2020+

DPE

Developer Productivity Engineering



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

by Peter Drucker

DEVELOCITY Podcast-Server :backend:jib Jan 19 2024 05:06:49 CET Build Scans Sign in

29 tasks, 0 transforms executed in 5 projects in **1m 8.206s**, with 5 avoided tasks saving 2m 8.748s

Order: Execution | Ungrouped | Grouped by type

Task	Start	End	Duration	Cache	Source
:build-plugin-database:checkKotlinGradlePluginConfigurationErrors	11.376s	0.059s	org.jetbrains.kotlin.gradle.plugin.diagnostics.CheckKotlinGradlePluginConfigurationErrors	T	
:build-plugin-docker-images:checkKotlinGradlePluginConfigurationErrors	11.376s	0.061s	org.jetbrains.kotlin.gradle.plugin.diagnostics.CheckKotlinGradlePluginConfigurationErrors	T	
:build-plugin-database:compileKotlin	11.454s	0.568s	org.jetbrains.kotlin.gradle.tasks.KotlinCompile	T	
:build-plugin-docker-images:compileKotlin	11.459s	0.564s	org.jetbrains.kotlin.gradle.tasks.KotlinCompile	T	FROM-CACHE
:build-plugin-database:compileJava	12.025s	0.012s	org.gradle.api.tasks.compile.JavaCompile	T	NO-SOURCE
:build-plugin-docker-images:compileJava	12.033s	0.005s	org.gradle.api.tasks.compile.JavaCompile	T	NO-SOURCE
:build-plugin-database:pluginDescriptors			org.gradle.plugin.devel.tasks.GeneratePluginDescriptors	T	
:build-plugin-docker-images:pluginDescriptors			org.gradle.plugin.devel.tasks.GeneratePluginDescriptors	T	
:build-plugin-database:processResources			org.gradle.process.resources.Main	T	
:build-plugin-docker-images:processResources			org.gradle.process.resources.Main	T	
:build-plugin-database:classes			org.gradle.api.tasks.compile.JavaCompile	T	
:build-plugin-docker-images:classes			org.gradle.api.tasks.compile.JavaCompile	T	
:build-plugin-database:jar			org.gradle.api.tasks.bundling.Jar	T	
:build-plugin-docker-images:jar			org.gradle.api.tasks.bundling.Jar	T	
:backend-lib-youtubed:compileJava			org.gradle.api.tasks.compile.JavaCompile	T	FROM-CACHE
:backend:checkKotlinGradlePluginConfigurationErrors			org.jetbrains.kotlin.gradle.plugin.diagnostics.CheckKotlinGradlePluginConfigurationErrors	T	
:backend-lib-database:compileJava			org.gradle.api.tasks.compile.JavaCompile	T	FROM-CACHE
:backend:generateGitProperties			org.gradle.groovy.tasks.GenerateGitProperties	T	
:backend-lib-youtubed:processResources			org.gradle.process.resources.Main	T	
:backend-lib-youtubed:classes			org.gradle.api.tasks.compile.JavaCompile	T	UP-TO-DATE
:backend-lib-youtubed:jar			org.gradle.api.tasks.bundling.Jar	T	
:backend-lib-database:processResources			org.gradle.process.resources.Main	T	
:backend-lib-database:classes			org.gradle.api.tasks.compile.JavaCompile	T	UP-TO-DATE
:backend-lib-database:jar			org.gradle.api.tasks.bundling.Jar	T	
:backend:compileKotlin			org.jetbrains.kotlin.gradle.tasks.KotlinCompile	T	FROM-CACHE
:backend:compileJava			org.gradle.api.tasks.compile.JavaCompile	T	NO-SOURCE

Details Predecessors Successors

Kind: TASK
Path: :build-plugin-database:pluginDescriptors
Type: org.gradle.plugin.devel.tasks.GeneratePluginDescriptors

This task is not on the critical path.

Started after: 12.039s
Duration: 0.012s

This task was not up-to-date because there was no task history available.

Cache key: 0e96cd44a0f07adf9be5f07f1b6301a7
Not cacheable: Not worth caching.

[View task in console log](#) [Focus on task in timeline](#)

Structured Query Language



Standard ISO/IEC 9075-1



SQL:1986





SQL:2023

**Never
Forget
The order...**



From
Join

Where

Group by

Aggregate
Functions

Having

Window
Functions

Select

Distinct

Union
Intersect
Except

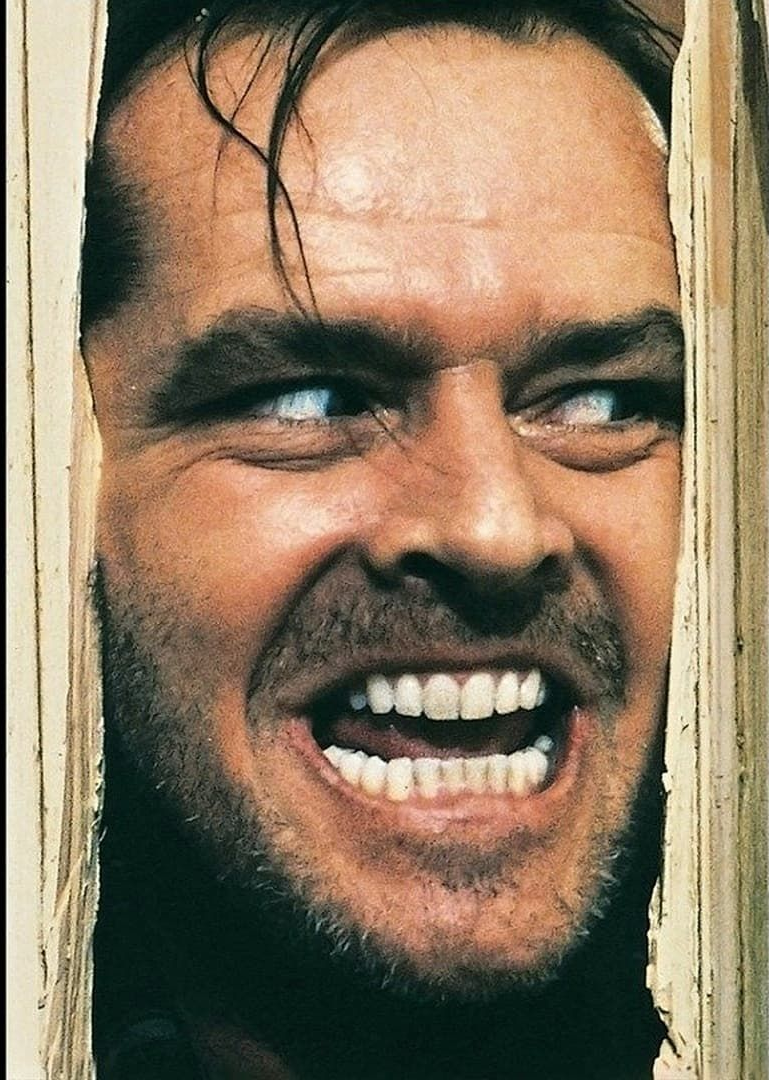
Order by

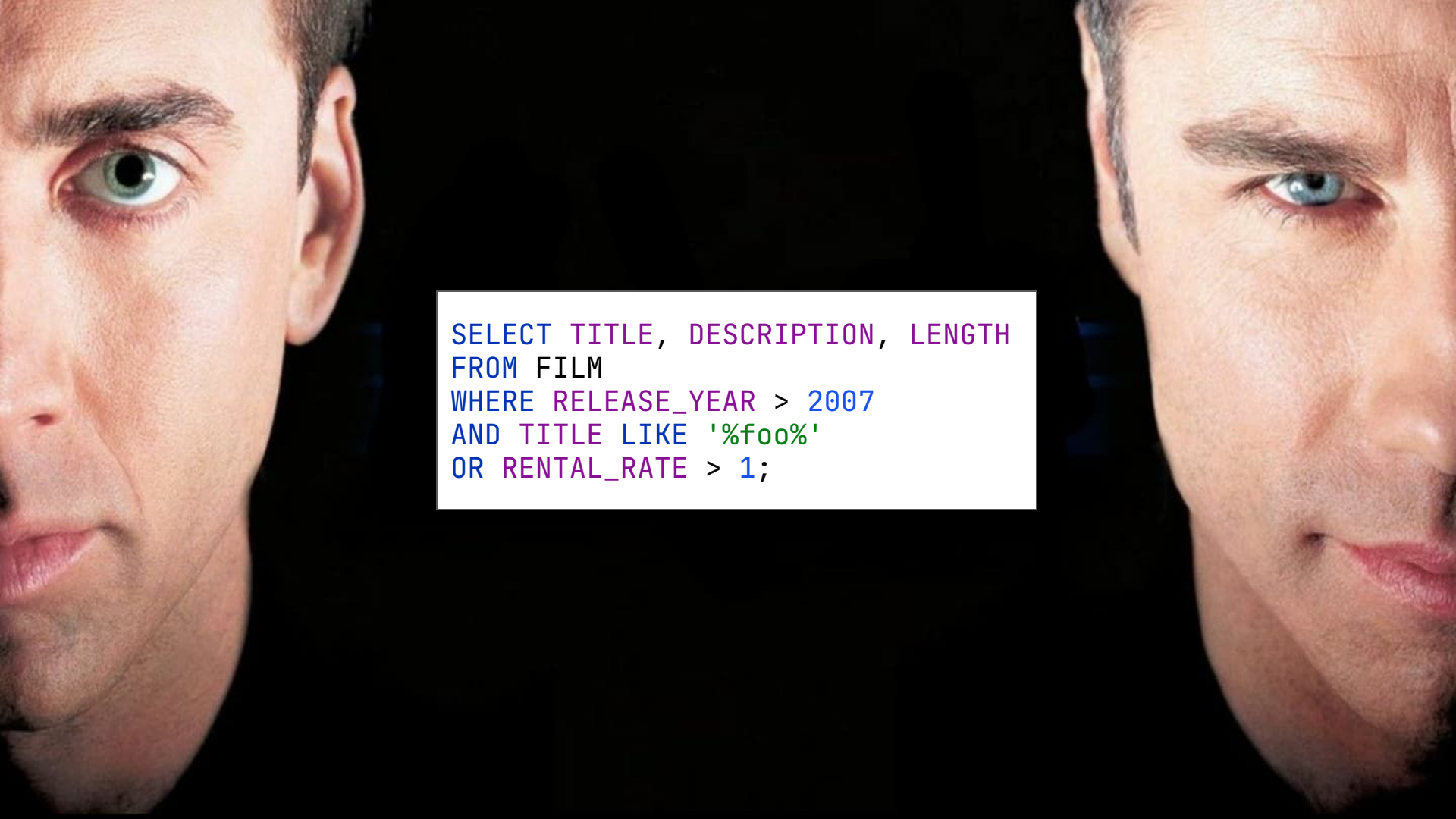
Offset

Limit
Fetch
Top

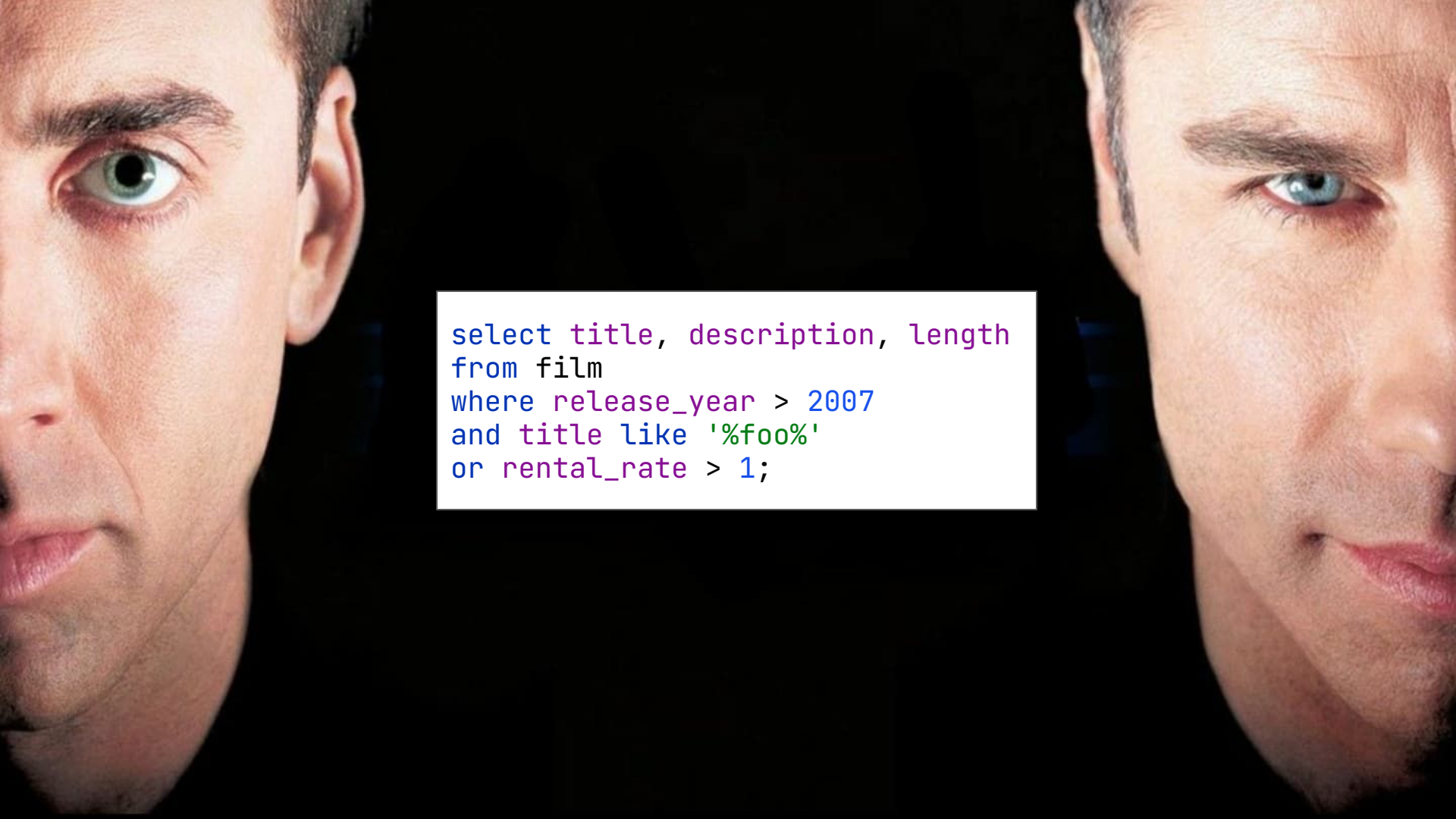


Don't need to
shout...





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

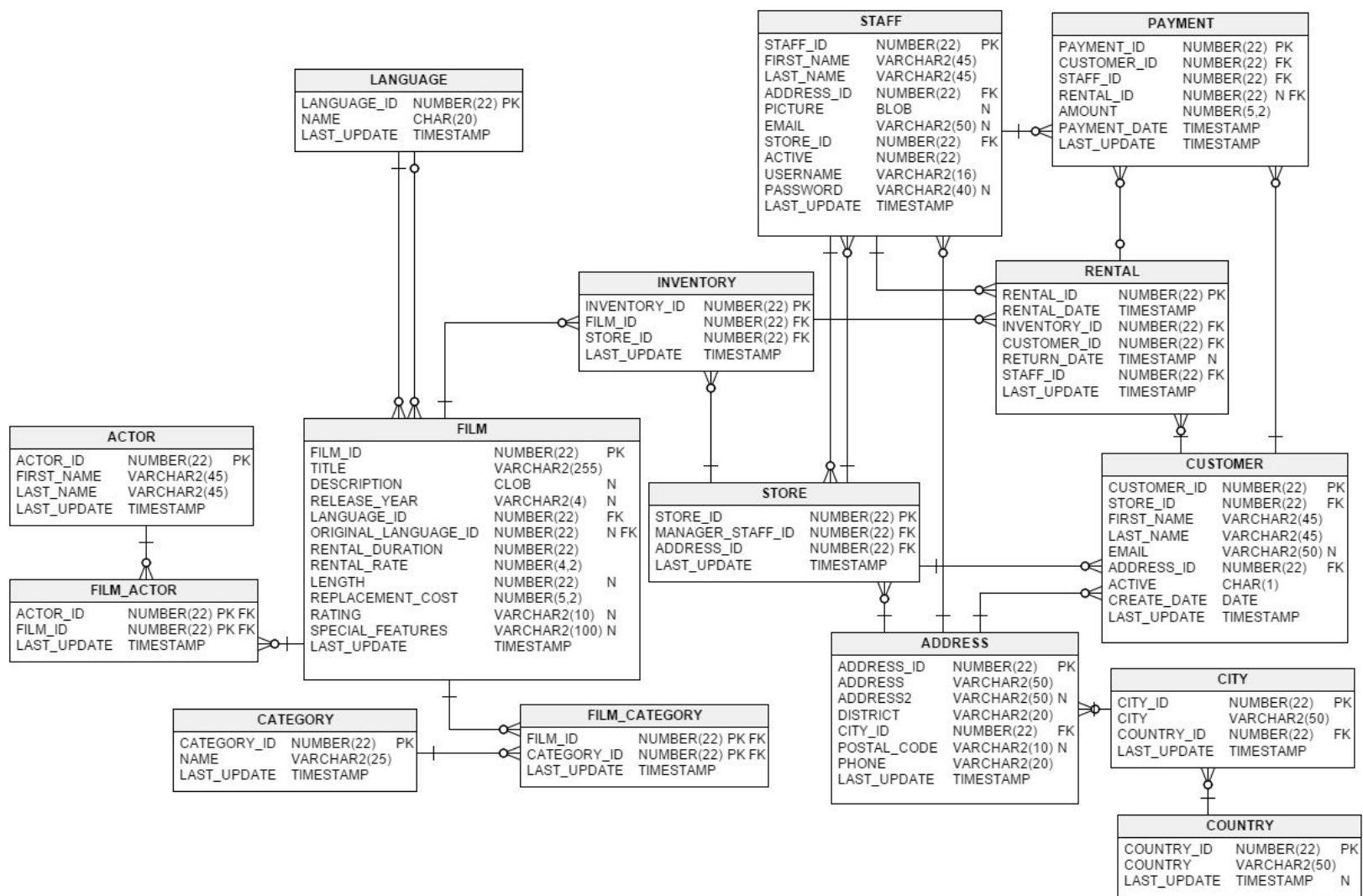


```
select title, description, length
from film
where release_year > 2007
and title like '%foo%'
or rental_rate > 1;
```

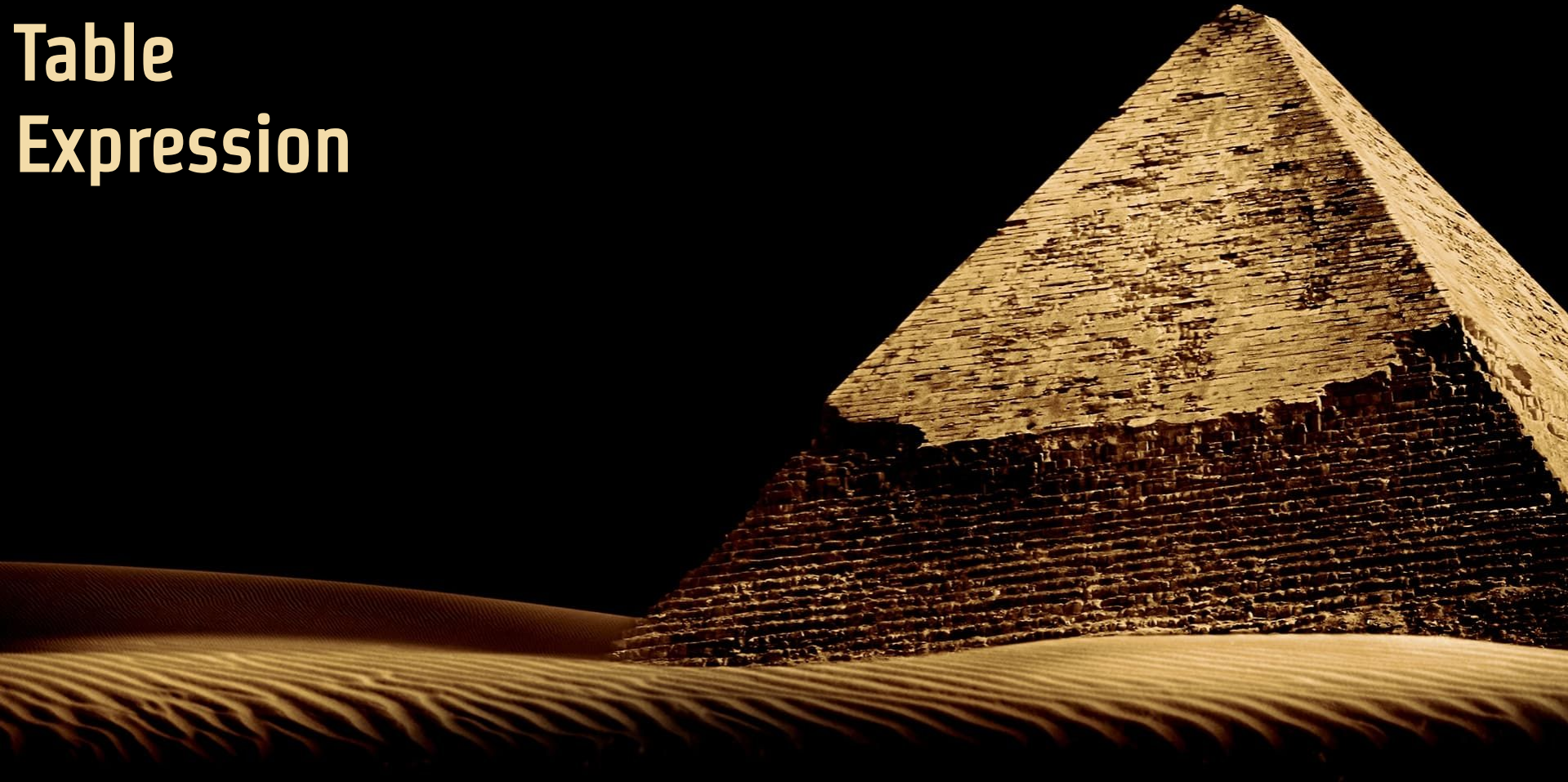


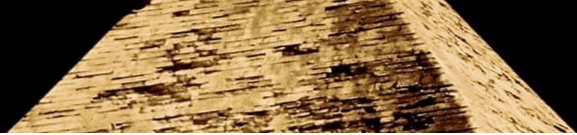
Sakila Database



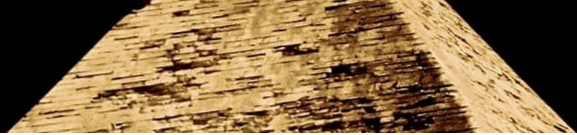


Common Table Expression

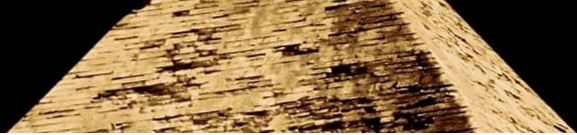




```
select
  c.first_name || ' ' || c.last_name,
  sum(amount)
from
  customer c
  join (
    select r.customer_id
    from rental r
      inner join inventory i on r.inventory_id = i.inventory_id
      inner join film f on i.film_id = f.film_id
      inner join film_category fc on f.film_id = fc.film_id
      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



```
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

```
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



```
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

```
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

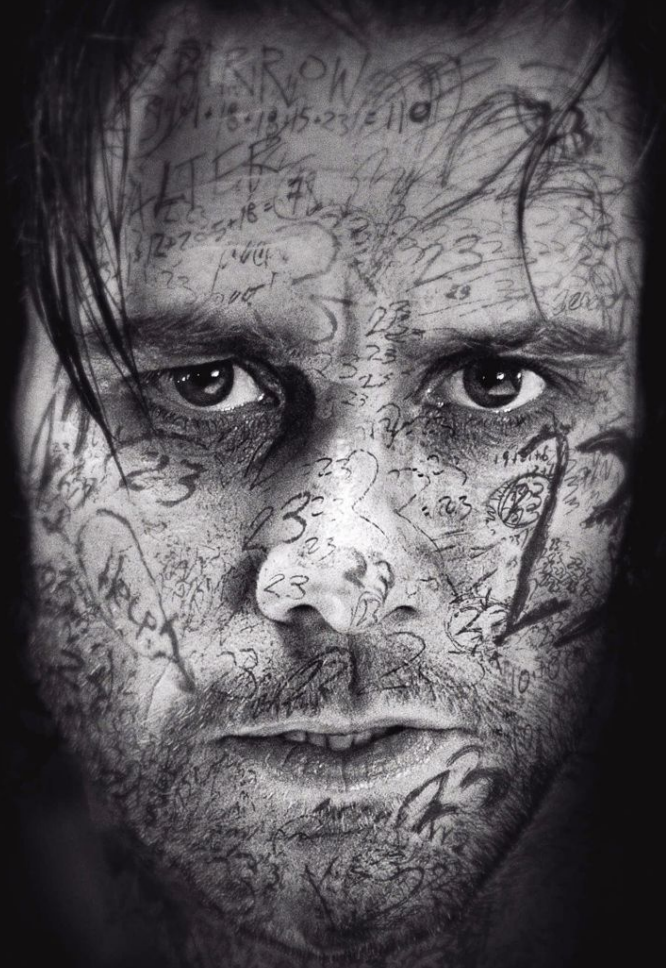
```

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 serial primary key,  
    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

Join Lateral



Join Lateral

```
select f.title, rental_date,  
       row_number() over (partition by f.title order by rental_date desc)  
from film f  
join inventory i on f.film_id = i.film_id  
join rental r on i.inventory_id = r.inventory_id  
order by title, rental_date desc
```

title	rental_date	row_number
ACADEMY DINOSAUR	2005-08-23 01:01:01	1
ACADEMY DINOSAUR	2005-08-22 23:56:37	2
ACADEMY DINOSAUR	2005-08-22 00:44:08	3
ACADEMY DINOSAUR	2005-08-21 21:27:43	4
ACADEMY DINOSAUR	2005-08-21 18:32:42	5
ACADEMY DINOSAUR	2005-08-21 00:30:32	6
ACADEMY DINOSAUR	2005-08-18 18:36:16	7
ACADEMY DINOSAUR	2005-08-02 20:13:10	8
...		

Join Lateral

```
with all_rentals (film, rental_date, iteration) as (  
  select f.title, rental_date,  
         row_number() over (partition by f.title order by rental_date desc)  
  from film f  
  join inventory i on f.film_id = i.film_id  
  join rental r on i.inventory_id = r.inventory_id  
  order by title, rental_date desc  
)  
select film, rental_date  
from all_rentals  
where iteration ≤ 3;
```

film	rental_date
ACADEMY DINOSAUR	2005-08-23 01:01:01
ACADEMY DINOSAUR	2005-08-22 23:56:37
ACADEMY DINOSAUR	2005-08-22 00:44:08
ACE GOLDFINGER	2006-02-14 15:16:03
ACE GOLDFINGER	2005-08-22 16:59:05
ACE GOLDFINGER	2005-08-17 09:33:02
ADAPTATION HOLES	2005-08-23 13:54:39
ADAPTATION HOLES	2005-08-22 03:52:21
...	

Do you know
for-each
?

```
select film.title, recently_rented.rental_date
from film
```

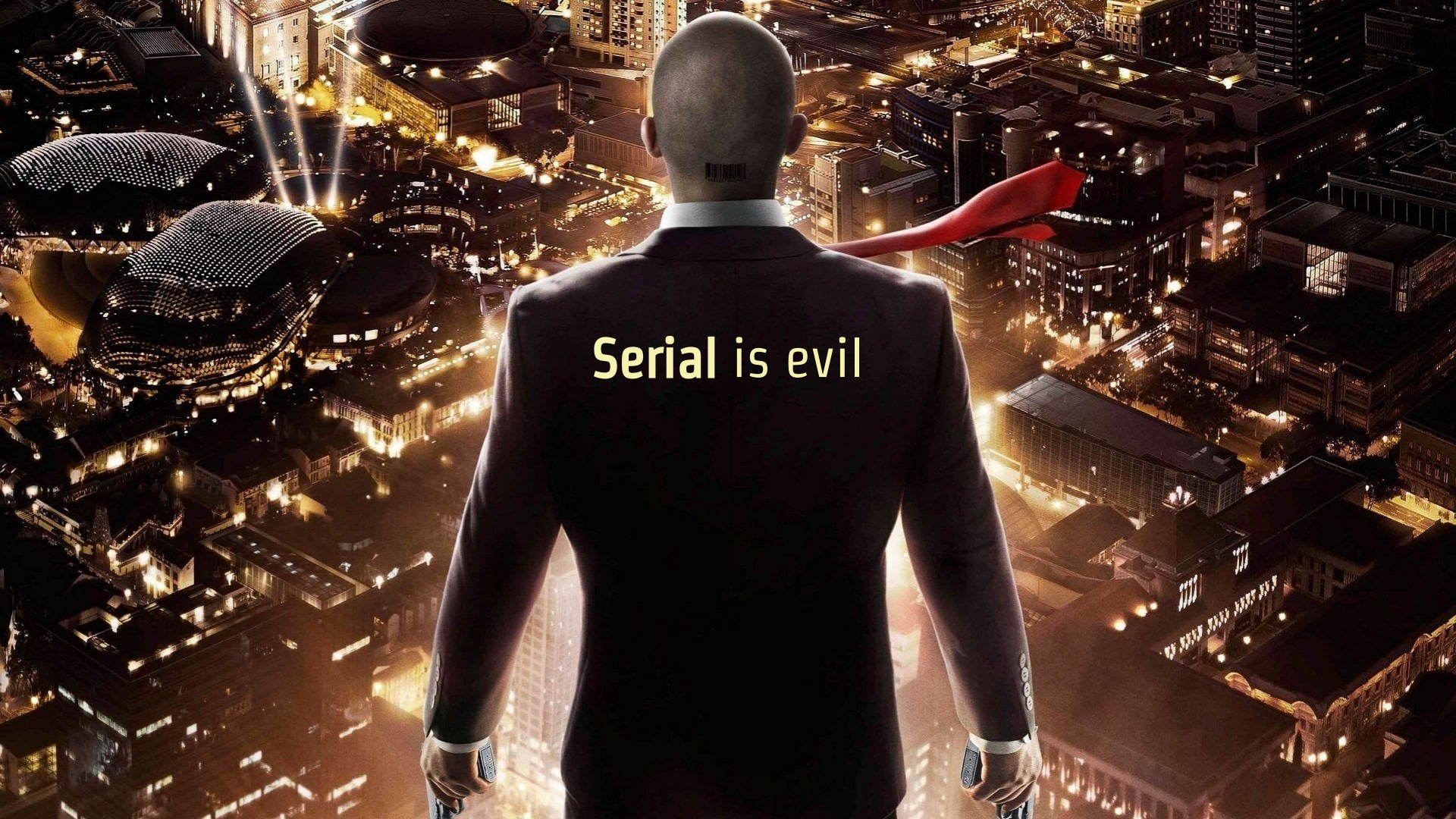
title

ACADEMY DINOSAUR
ACE GOLDFINGER
ADAPTATION HOLES
AFFAIR PREJUDICE
AFRICAN EGG
AGENT TRUMAN
AIRPLANE SIERRA
AIRPORT POLLOCK
...


Join Lateral

```
select film.title, recently_rented.rental_date
from film
left join lateral (
  select *
  from inventory i
  join rental r on i.inventory_id = r.inventory_id
  where i.film_id = film.film_id -- film from outer query
  order by rental_date desc
  limit 3
) as recently_rented on film.film_id = recently_rented.film_id
order by film.title;
```

title	rental_date
ACADEMY DINOSAUR	2005-08-23 01:01:01
ACADEMY DINOSAUR	2005-08-22 23:56:37
ACADEMY DINOSAUR	2005-08-22 00:44:08
ACE GOLDFINGER	2006-02-14 15:16:03
ACE GOLDFINGER	2005-08-22 16:59:05
ACE GOLDFINGER	2005-08-17 09:33:02
ADAPTATION HOLES	2005-08-23 13:54:39
ADAPTATION HOLES	2005-08-22 03:52:21
...	




Serial is evil



Serial

```
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;
```

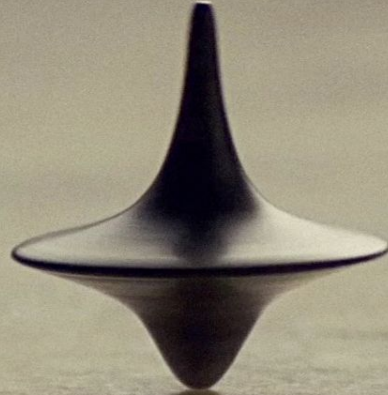



Serial

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-osspl";
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;
```





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Constraints



```
create table film_with_isan (  
  film_id serial primary key,  
  title character varying(255) not null,  
  isan character varying(255)  
  
);
```


Constraints



```
create table film_with_isan (  
  film_id serial primary key,  
  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 - 0  
  )  
);
```

Constraints



```
create table film_with_isan (  
  film_id serial primary key,  
  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 - 0  
  ),  
  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

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');
```



A man and a woman are shown in profile, looking down. The man is on the left, wearing a dark shirt, and the woman is on the right, wearing a light-colored, textured top. The background is a gradient from dark on the left to light on the right. The text "Listen | Notify" is positioned in the bottom left corner.

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.

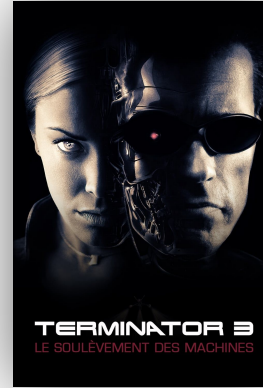
Asynchronous notification "film.add" with payload `{"id":1014,"title":"The Lake House"}` received from server process with PID 161.

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

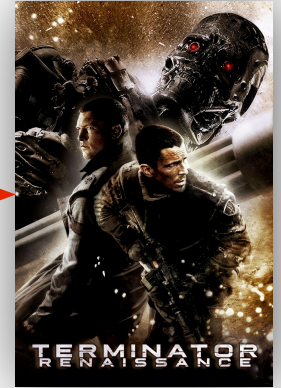
tree & more



Itree & more



Itree & more



ltree & more

```
create extension ltree;

create table film_with_saga_order (
    film_id serial primary key,
    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

```
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 serial primary key,  
    title character varying(255) not null,  
  
    previous integer references film_with_previous(film_id)  
);
```

```
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



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

```
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 'gjITg2b0033D1bYju27wK2Wo0LI2');
```

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!



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yugabyteDB







AlloyDB for PostgreSQL



Infinite possibilities...



Thank you...

Questions?

X
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E

