CS307
Principles of Database Systems

Chapter 11 View

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Most contents are from Stéphane Faroult's slides

11.1 View

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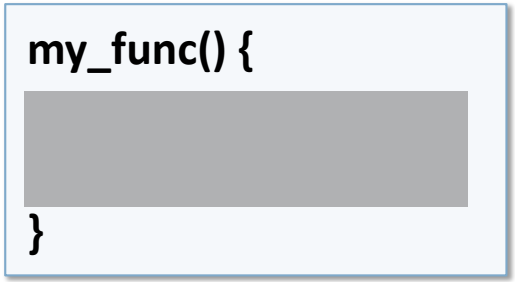


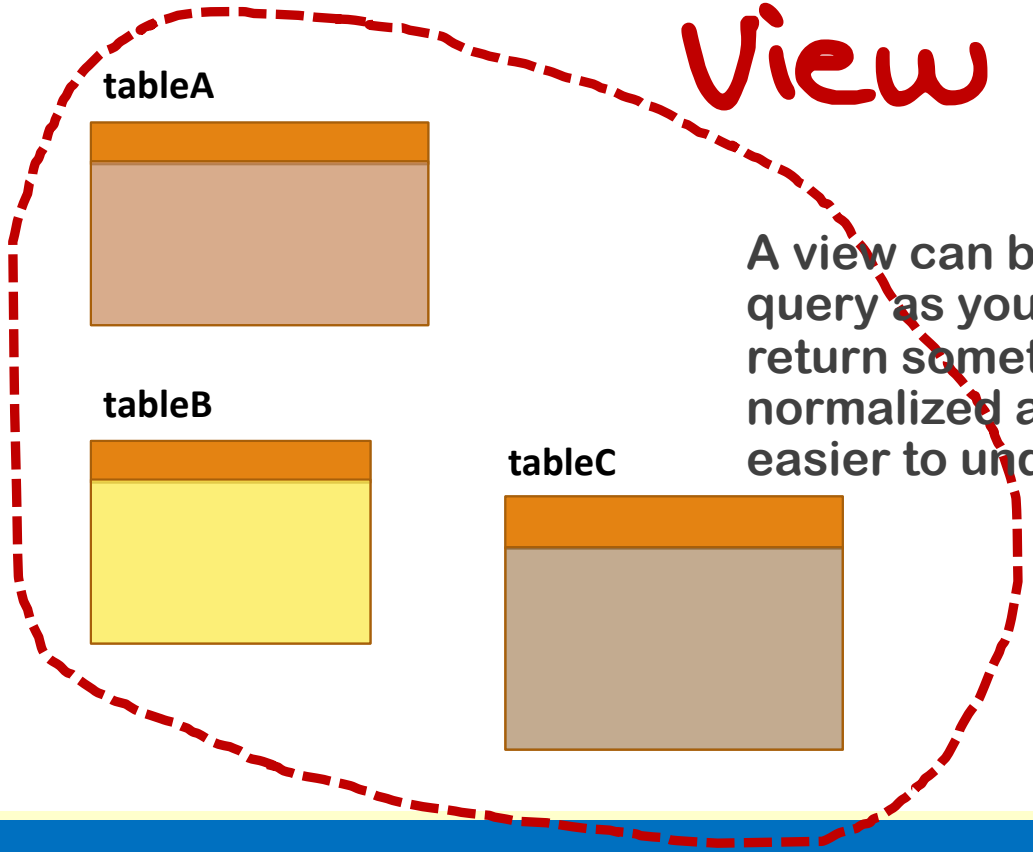
We have seen stored functions, but these functions are just returning numbers, strings or dates. Can we have relational functions, allowing to **reuse relational operations** as we would reuse code in a program?


It's possible, and a "recorded relational operation" is called a
VIEW
Flickr: René Ehrhardt

```
create view viewname (col1,…,coln)
as
select ...
```

In practice (theory is a bit more complicated) there isn't much to a view: it's basically a named query. If the query is correct, it should return a valid relation, so why not consider it as if it were a table? You can optionally rename columns after the view name (if you don't, the view uses column names from the query result)

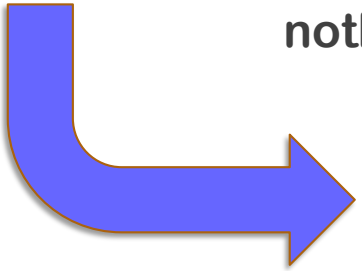
View



A view can be as a complicated query as you want, and will usually return something that isn't as normalized as your tables, but easier to understand.

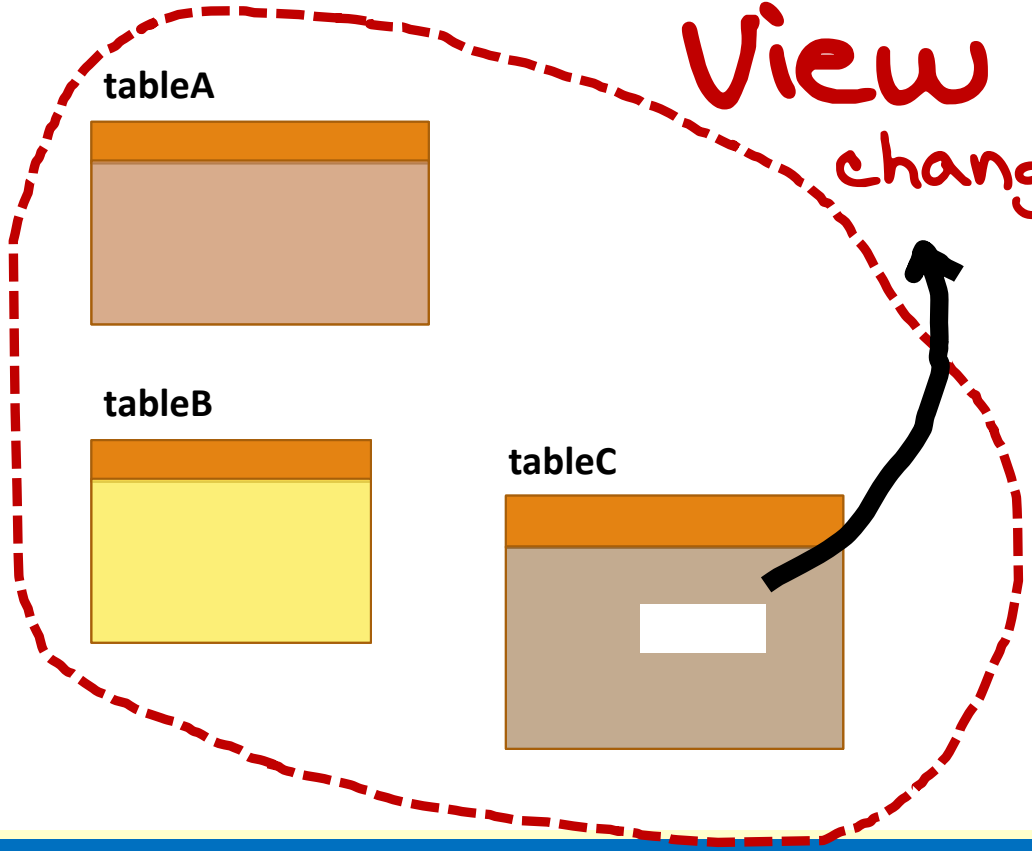
Tables = variables

rows



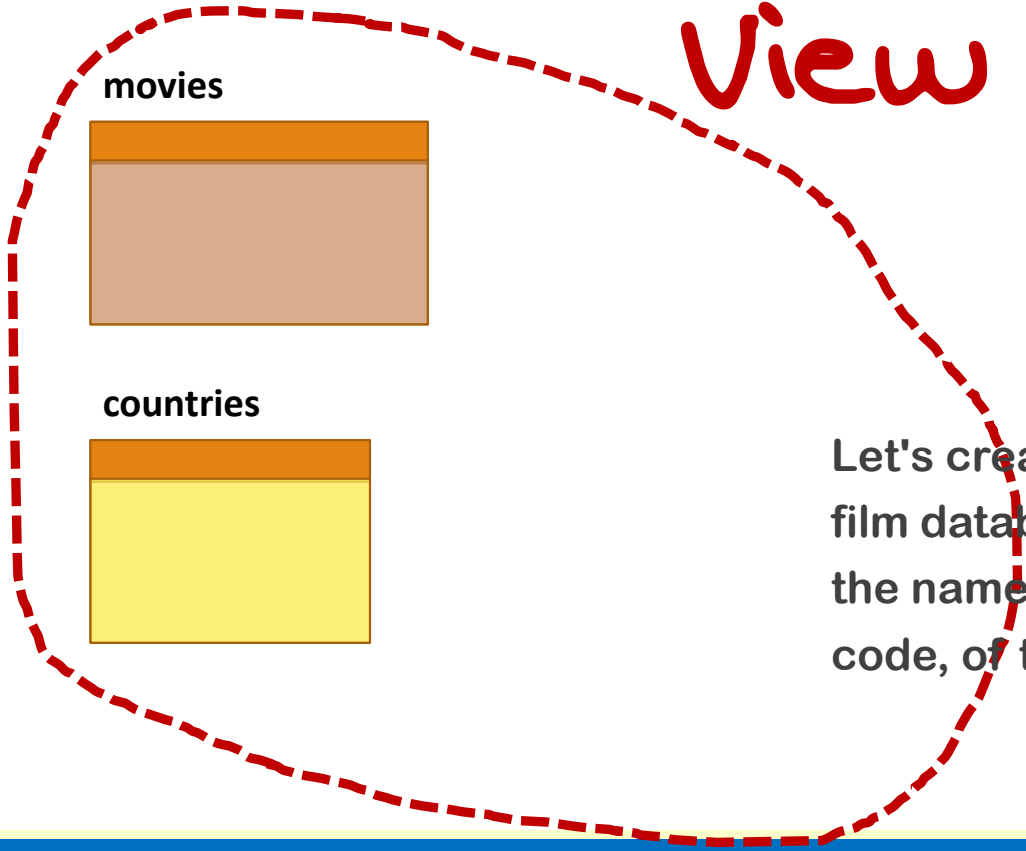
Remember that tables are relational variables, and that the rows they contain are nothing more than their "value"

values



In the same way that you get a different result from a function when you change the values of variables that you pass to it, when you change something in a table you change its value and it's reflected in the view, that takes a different value too.

View



Let's create a view in the film database that shows the name, rather than the code, of the country.

```
create view vmovies
as select m.movieid,
          m.title,
          m.year_released,
          c.country_name
    from movies m
        inner join countries c
          on c.country_code = m.country
```

```
select *
from vmovies
where country_name = 'Italy'
```

Once the view is created, I can query the view exactly as if it were a table; nothing says that it's a view, except the name that *I* have chosen. I like to give a special name to views to make it clear that it's a view (discussion about practical differences between views and tables comes soon) but I could have masked a change in table design to allow old programs to run by having a changed table T renamed T_V2 and creating a view T rendering the old version.

Result-wise, the previous query is strictly equivalent to this one.

```
select *
from (select m.movieid,
             m.title,
             m.year_released,
             c.country_name
        from movies m
            inner join countries c
              on c.country_code = m.country)
            vmovies
where country_name = 'Italy'
```

Some optimizers are able to push the condition up into the view.

However, there is far more than this to views. As I have said earlier, views are just the relational equivalent of functions: the ability to store (and reuse) a relational expression, in other words something that **returns a relation** and not simply a value like what you usually do with a stored function.

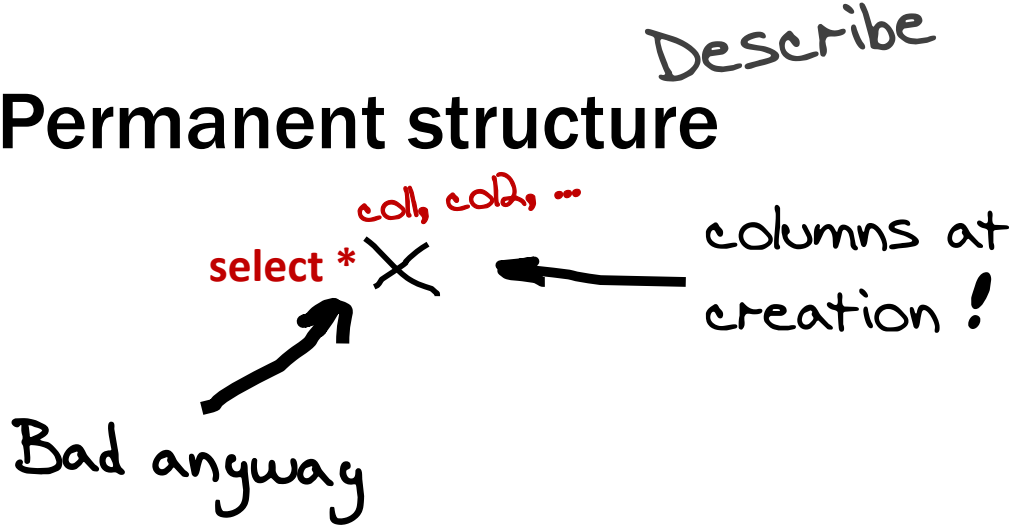
If we step back to design issues, you remember that modelling a database is basically distributing data between normalized tables, and there are often ways of organizing data that are more suitable for a given application. In some respect, views provide a way of **creating an "alternate model"**.

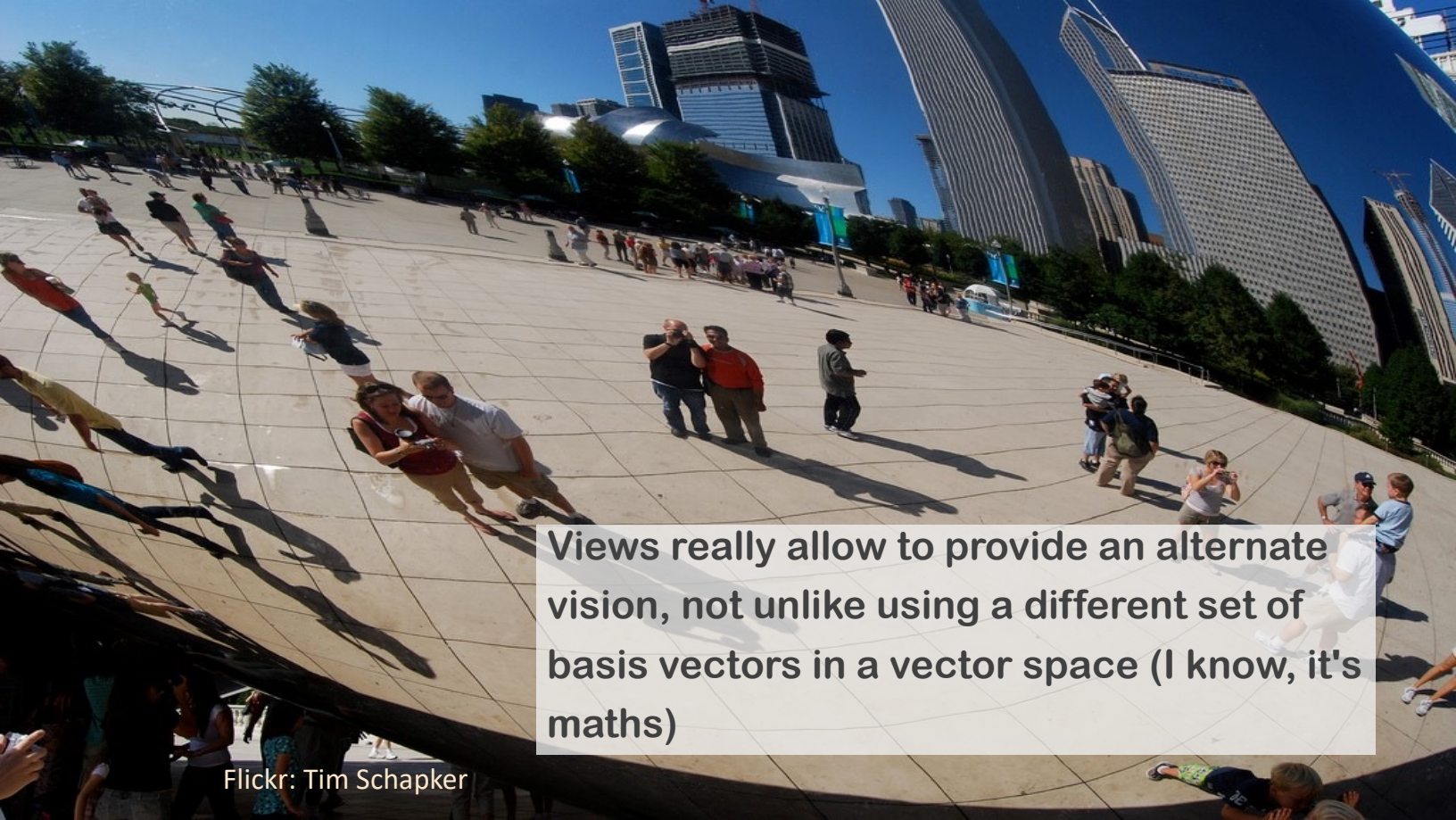
What is important is that views are permanent objects in the database - needless to say, their content will change with the data in the underlying tables, but the structure will remain constant and can be described in the same way as the structure of a table can be described: columns are typed.

Beware that columns are the one in tables when the view was created. Columns added later to tables in the view won't be added even if the view was created with SELECT * (bad practice)

Permanent object

Permanent structure





Views really allow to provide an alternate vision, not unlike using a different set of basis vectors in a vector space (I know, it's maths)

Flickr: Tim Schapker

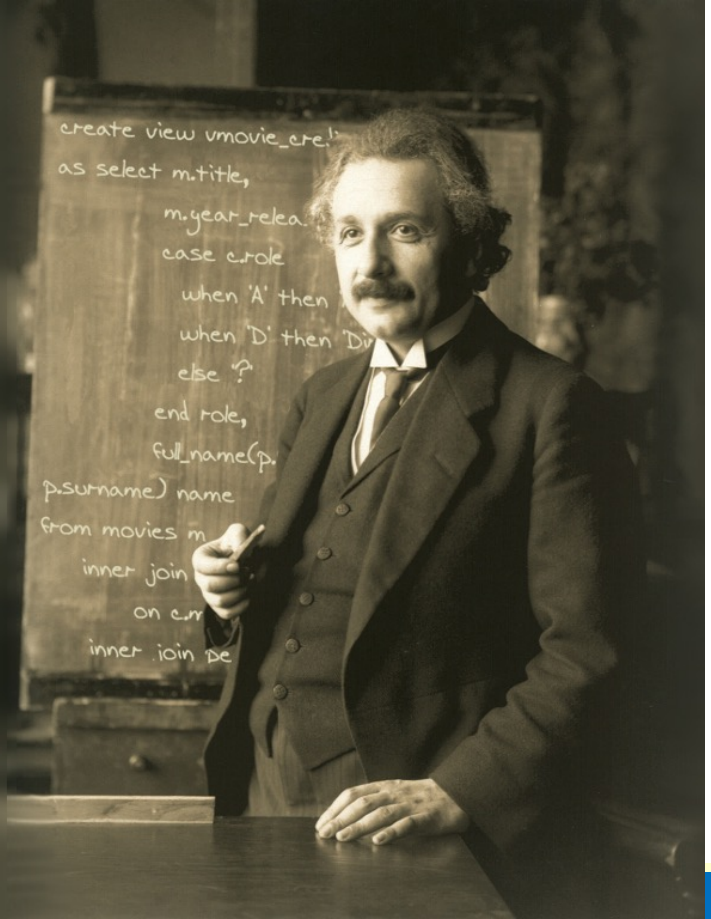
In real life, views are much used for simplifying queries. Many business reports are based on the same set of hairy joins, with just variations on the columns that you aggregate or order by.

Somehow, views allow to come back to that old fancy of the early days of SQL, having something that anybody can query with simple commands, without having to master the intricacies of the querying language.

Simplify queries

Make the sharp guys write the hard stuff, then use cheap code-monkeys to wrap some basic things around... That's more or less the idea (but it's rarely presented like this).

Leverage the skills of THE BEST SQL CODERS



```
select *
from vmovies
where country_name = 'Italy'
```

This is something that a cheap beginner completely ignorant of databases should be able to write after having been briefed for about three minutes.

Looks like a table

Tastes like a table

But

It's again an area where theory is bruised by practice.

■ ■ ■

11.2 Deeper in Views

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Most contents are from Stéphane Faroult's slides

```
create view vmovie_credits
as select m.title,
          m.year_released release,
          case c.credited_as
            when 'A' then 'Actor'
            when 'D' then 'Director'
            else '?'
          end duty,
          full_name(p.first_name, p.surname) name
from movies m
    inner join credits c
        on c.movieid = m.movieid
     inner join people p
        on p.peopleid = c.peopleid
```

Let's say that we have this view, which nicely displays film credits, including people names like 'Erich von Stroheim' as they should appear.

vmovie_credits

title	release	duty	name
Casablanca	1942	Director	Michael Curtiz
Casablanca	1942	Actor	Humphrey Bogart
Casablanca	1942	Actor	Ingrid Bergman
Casablanca	1942	Actor	Conrad Veidt
Casablanca	1942	Actor	Claude Rains
...	...	...	...

When we query the view, it looks really good and user-friendly. Well, it actually depend on HOW we query it, and on which column. Querying by title will be fine.

```
create view vmovie_credits
as select m.title,
        m.year_released release,
        case c.credited_as
          when 'A' then 'Actor'
          when 'D' then 'Director'
          else '?'
        end duty,
        full_name(p.first_name, p.surname) name
from movies m
   inner join credits c
      on c.movieid = m.movieid
    inner join people p
      on p.peopleid = c.peopleid
```

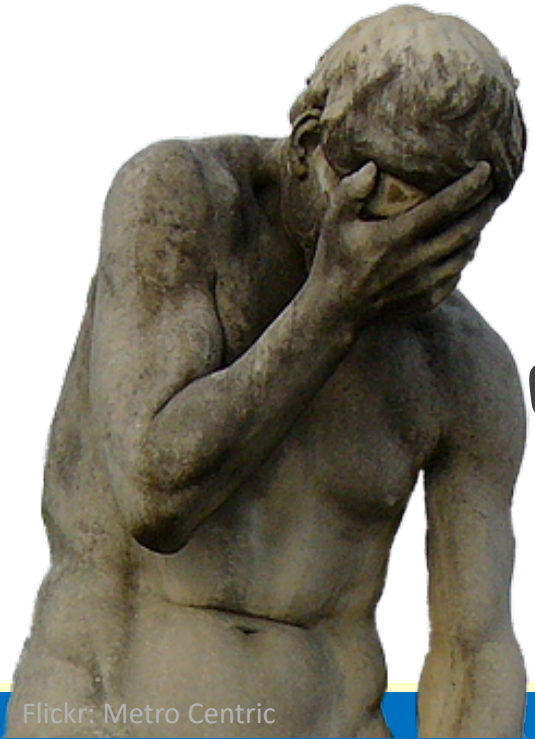
There are times, though, when all the benevolence of the optimizer cannot do anything for you. You may remember how awful function full_name() is

```
select *
from vmovie_credits
where name = 'Humphrey Bogart'
```

无法用索引检索
linear scan.

If you are writing something like this, what looks like a column (NAME) is in fact the result of a function. There is no way the index on (SURNAME, FIRST_NAME) can be used. We'll have to scan the full table, compute the function, and compare its result to the constant. Unless you do some tricky stuff to index in a way or the other the result of the function (not always possible).

```
select *
from vmovie_credits
where name = 'Humphrey Bogart'
```



Indexes?

Flickr: Metro Centric

VIEWS

Hide complexity

The problem with views is that as long as you haven't seen how they have been defined, you have no idea how complex they may be. They may be fairly innocuous, or they may be queries of death (they often are)

```
select distinct title
from vmovie_credits
```

Difficulties usually increase sharply as a young developer gets with time more confident, not to say bold, with SQL. Being so accustomed to working with this convenient "table", VMOVIES_CREDITS (it may not bear a name that makes it obvious it's a view), the developer may think of this as a way to return all the different titles in the database. Technically speaking, it will return the desired result, and it may even do it reasonably fast.

```
select distinct title
from
  (select m.title,
          m.year_released release,
          case c.credited_as
            when 'A' then 'Actor'
            when 'D' then 'Director'
            else '?'
          end duty,
          full_name(p.first_name, p.surname) name
from movies m
   inner join credits c
       on c.movieid = m.movieid
    inner join people p
       on p.peopleid = c.peopleid) vmovie_credits
```

Lot of useless work for what we want

Do we really want the join?

Scalability

And here we are coming to one of the great issues with databases and information systems generally speaking, namely the ability to deliver response times that remain acceptable when the number of users, data volumes, or both, sharply increase.

The computer system of any retailer must survive Black Friday in the US or 11/11 in China.

Computing power is always

And the problem is that it doesn't matter how big and powerful your computers are, computing power will always be a limited resource.

Slower query to retrieve the same data

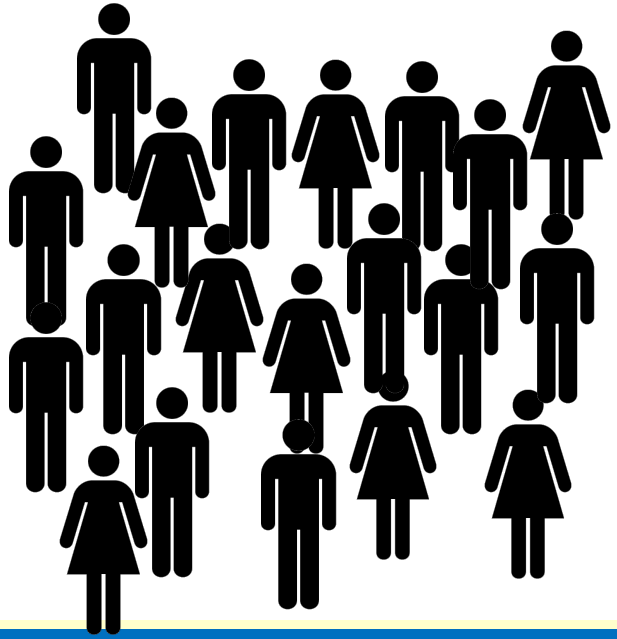
Fewer simultaneous users served

You will only be able to serve *that* many users simultaneously.

You don't want to see everything crawl during peak time.

Query table

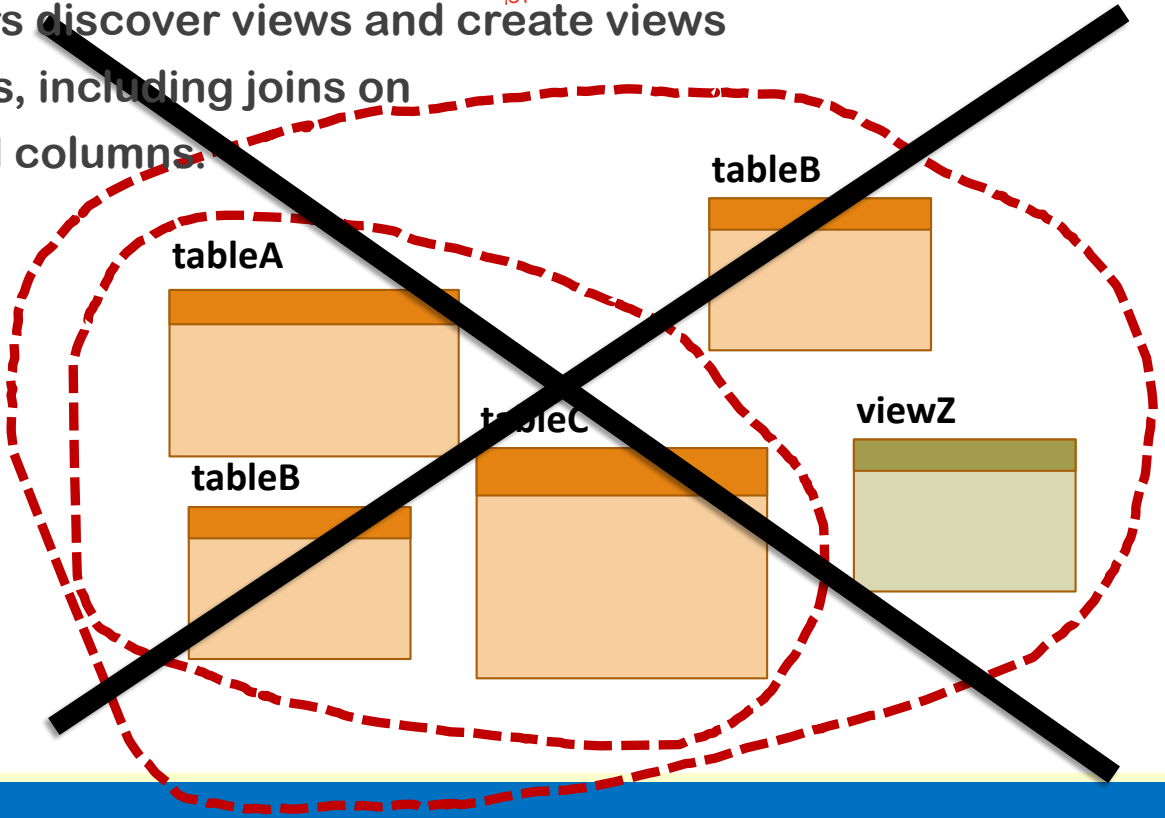
Query view



If querying the view takes 4 times as long as querying the table, you'll only be able to serve 25% of users..

Demand, though, isn't something that you control. So as many users will probably query the database at the same time whether you query views or tables. With complex views, more requests will be queued and will wait.

Performance issues are usually compounded when developers discover views and create views over views, including joins on computed columns.



DON'T

create views on complex views

11.3 Security

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Good for:
Reports
User Interface
SECURITY

Nevertheless, there are three areas where views are very useful. the third area is security.

How is security managed?

Before we see how views can help, we need to review how security is managed in a database.

To access a database, you must be authenticated, which often means entering a username and a password.

There are other means of authentication, and for some products database authentication is tied to operating system authentication, but in any case the database knows who you are.

Database Account RIGHTS

So you end up being connected to a database account, and this account as a set of rights.


In fact those rights are called "privileges", so that you understand that getting them is a favor.
Privileges

A privilege is given to a user account using this command:

grant *<right>* **to** *<account>*

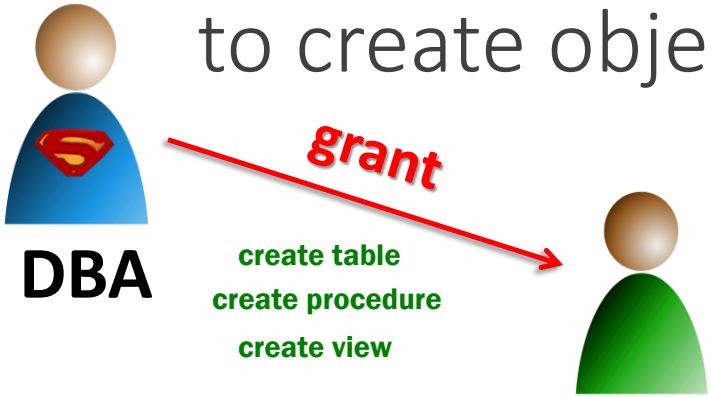
and can be taken back using this one:

revoke *<right>* **to** *<account>*

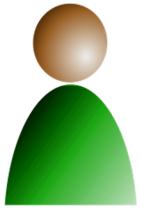
GRANT and REVOKE are the two pillars of what is sometimes called DCL, Data Control Language.

System rights

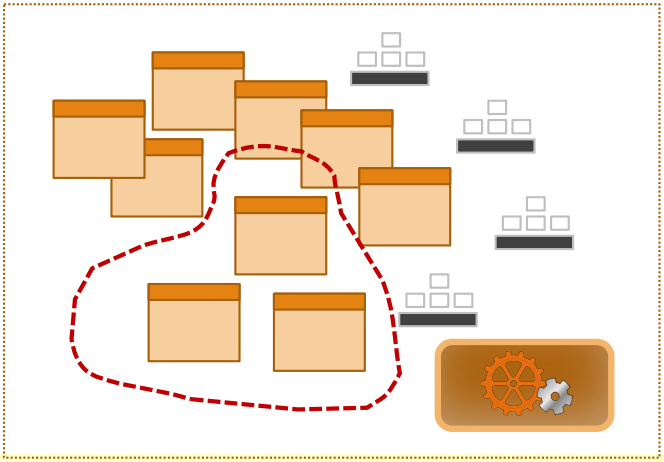
Rights to create objects



Privileges fall into two categories: system rights give users the right to issue DDL commands and change the structure of the database. Not many people get them.



Schema



A user who has these (or some of these) privileges will be able to create objects in a SCHEMA, which is usually a set of database objects required by one application.

The other category of privileges is composed of privileges to access and change the data. Everybody who accesses the database must have some privileges of that category, otherwise there would be no point in accessing the database ...

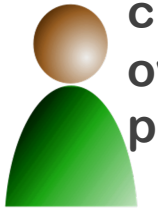
Table rights

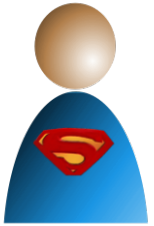
Rights

to access the data

Some people can only access some of the data, some can modify "current" data but not reference tables, some data administrators may have the right to modify any table ... but not necessarily to create even a view!

When accounts have been created by a DBA, the schema owner can grant them specific privileges.



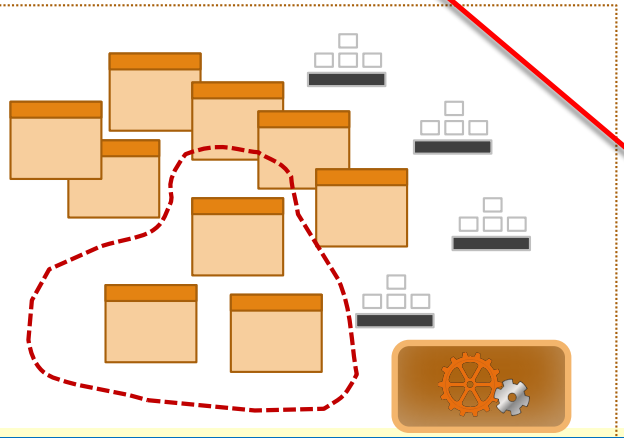


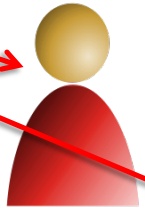
DBA

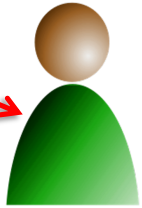
grant

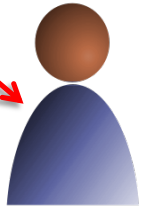
execute
delete
update
insert
select

Schema









grant select on *tablename* to *accountname*

grant insert on *tablename* to *accountname*

grant update on *tablename* to *accountname*

grant delete on *tablename* to *accountname*

grant select, insert on *tablename* to *accountname*

GRANT commands to give privileges on a table look like this. You can give one or several privileges at once. Sometimes you can give privileges over all the tables in a schema, existing tables and tables still to be created. The UPDATE privilege can also be restricted to some columns only. Some products may require special additional rights (with PostgreSQL "usage" on a schema)

For users who have been naughty:

```
revoke privilege on tablename
from accountname
```

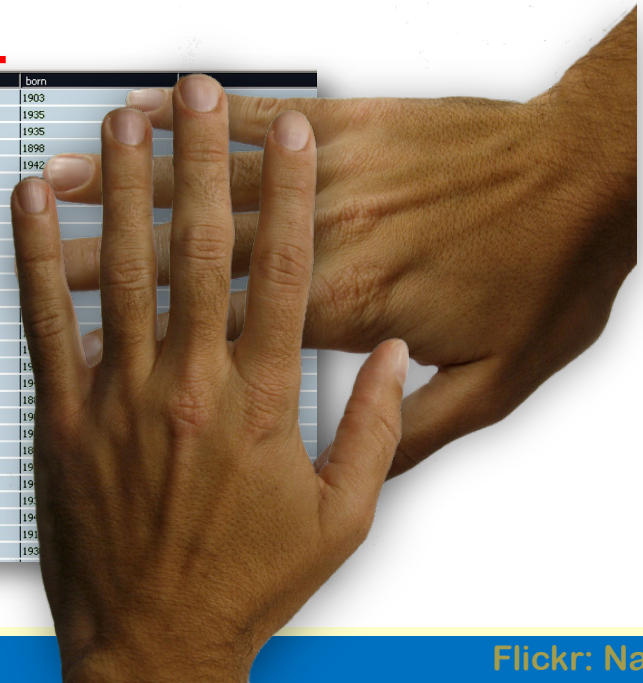
How can views help?

The trick is to use a view that only shows what people are supposed to see, and grant SELECT on the view and not on the table..

grant select on view

people

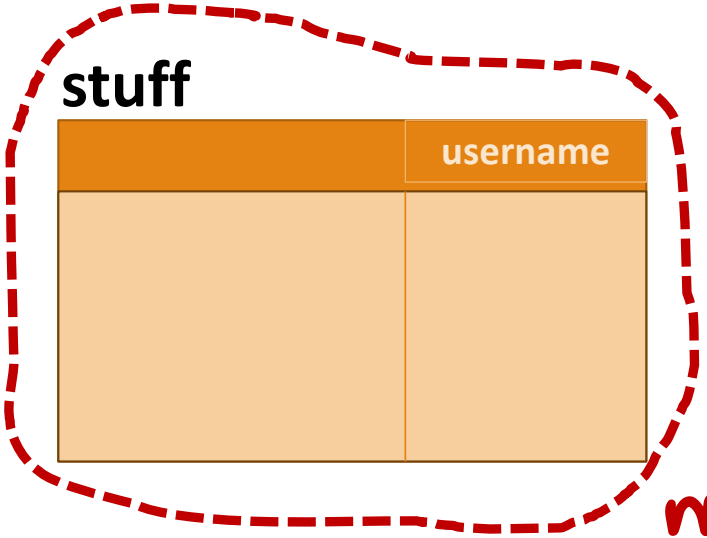
peopleid	first_name	surname	born
1	Grigori	Aleksandrov	1903
2	Woody	Allen	1935
3	Julie	Andrews	1935
4		Arletty	1898
5	Amitabh	Bachchan	1942
6	Kanu	Bannerjee	
7	Karuna	Bannerjee	
8	Ingmar	Bergman	
9	Ingrid	Bergman	
10	Luc	Besson	
11	Gunnar	Björnstrand	
12	Orlando	Bloom	
13	Humphrey	Bogart	
14	Marlon	Brando	
15	Marcel	Carné	
16	Leslie	Cheung	
17	Yun-Fat	Chow	
18	Julie	Christie	
19	Jean	Cocteau	
20	Joseph	Cotten	
21	Alain	Cuny	
22	Michael	Curtiz	
23	Josette	Day	
24	Robert	De Niro	
25		Dharmendra	
26	Richard	Dreyfuss	
27	Marie	Déa	
28	Clint	Eastwood	



You can hide sensitive columns

Flickr: Nate Steiner

```
create view my_stuff
as
select * from stuff
where username = user
```

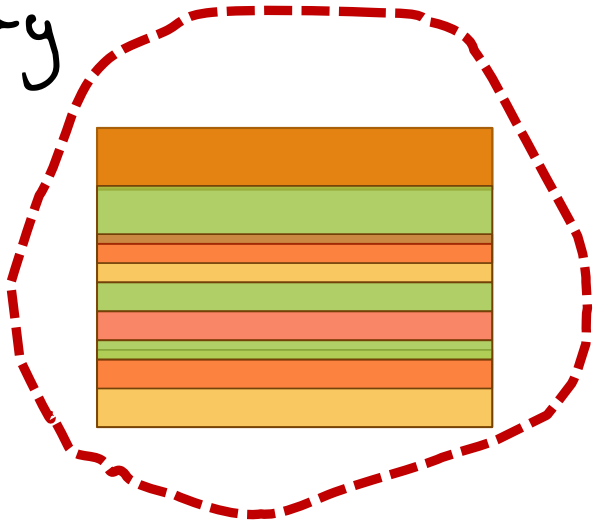


ORACLE

PostgreSQL

You can even hide rows by only returning rows "owned" by the user currently connected.

Same query



With such a view exactly the same query run by different users will return different rows.

Beware when you

MODIFY

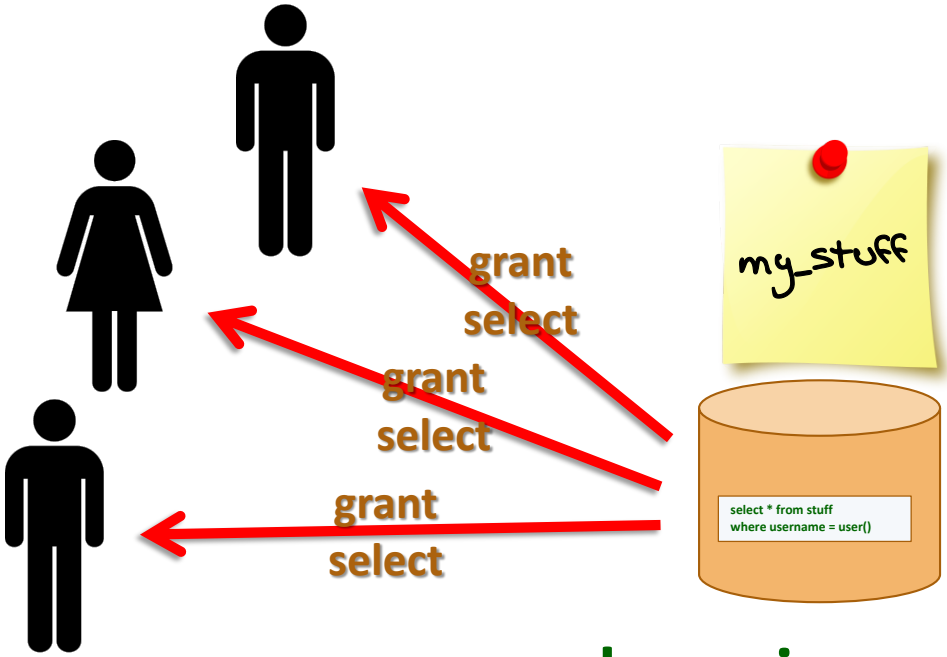
the definition of a view

Beware when you modify the definition of a view:

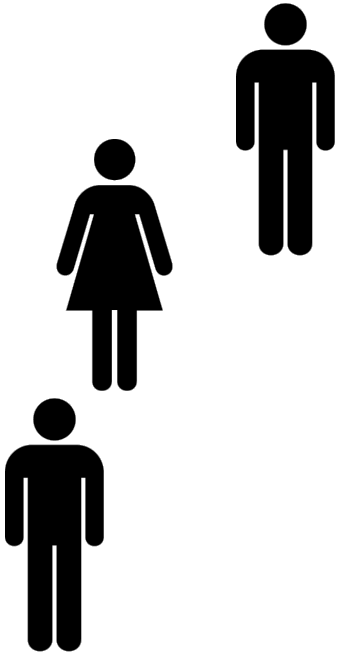
If you simply drop and recreate it, you lose the privileges.

Use CREATE OR REPLACE

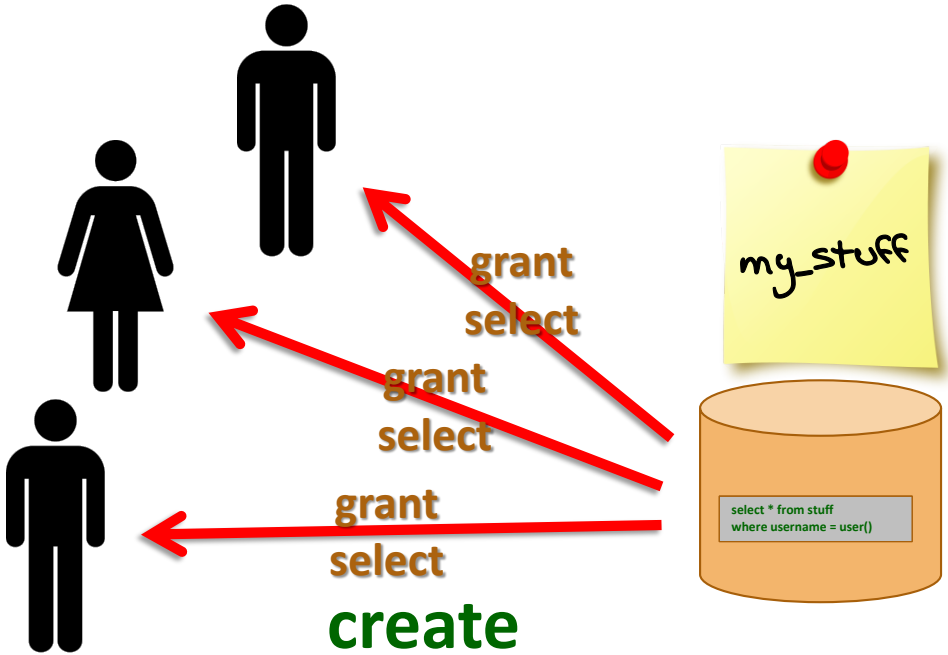
```
select * from stuff
where username = user
```


grant
select
grant
select
grant
select
my_stuff
select * from stuff
where username = user()

drop view



create view



create

or replace view

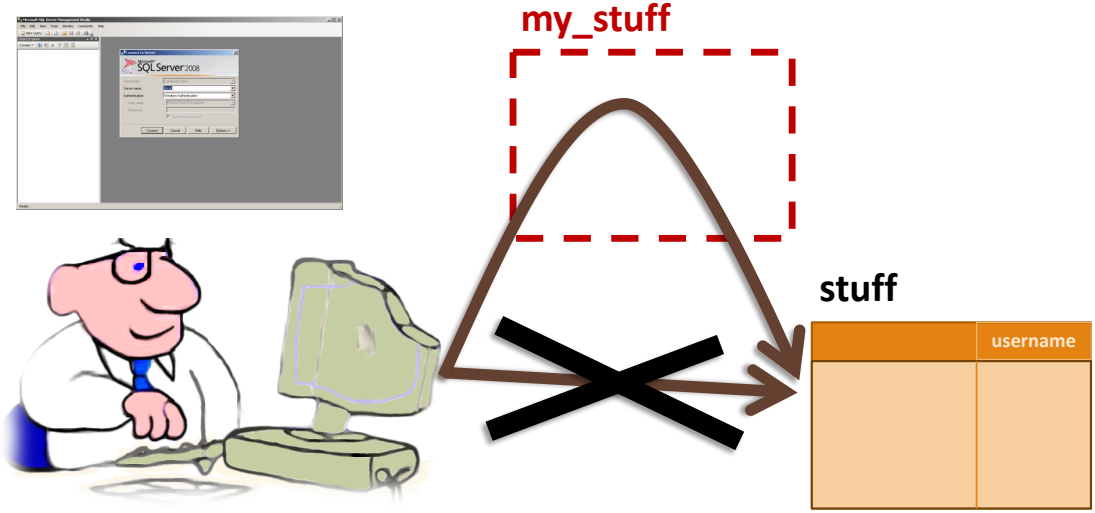
alter view

Microsoft SQL Server

MySQL

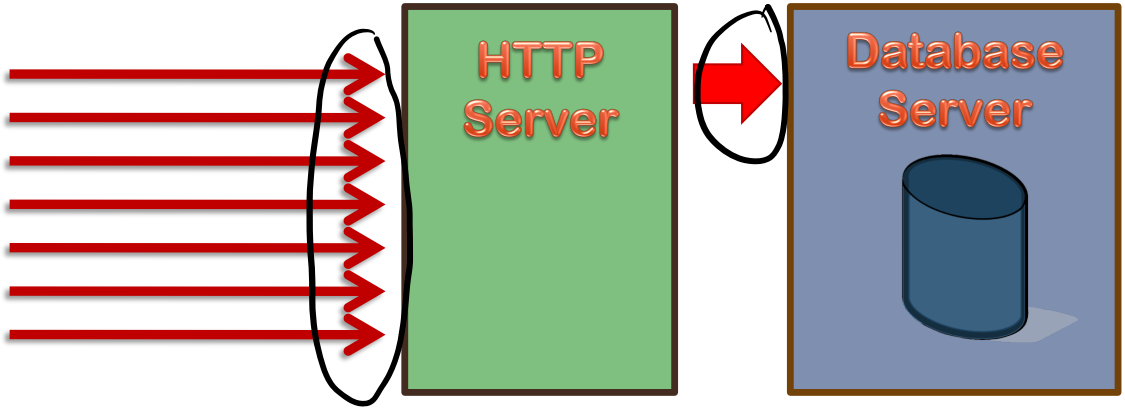
ORACLE

PostgreSQL



Now, the problem is that for security though a view, users need to be personally authenticated.

Requires PERSONAL account



When accesses are run through a single connection as happens on a web server, it's not really interesting to use views for security. They can, however, be quite interesting for development, as we'll soon see.