Relationships, constraints and Joins

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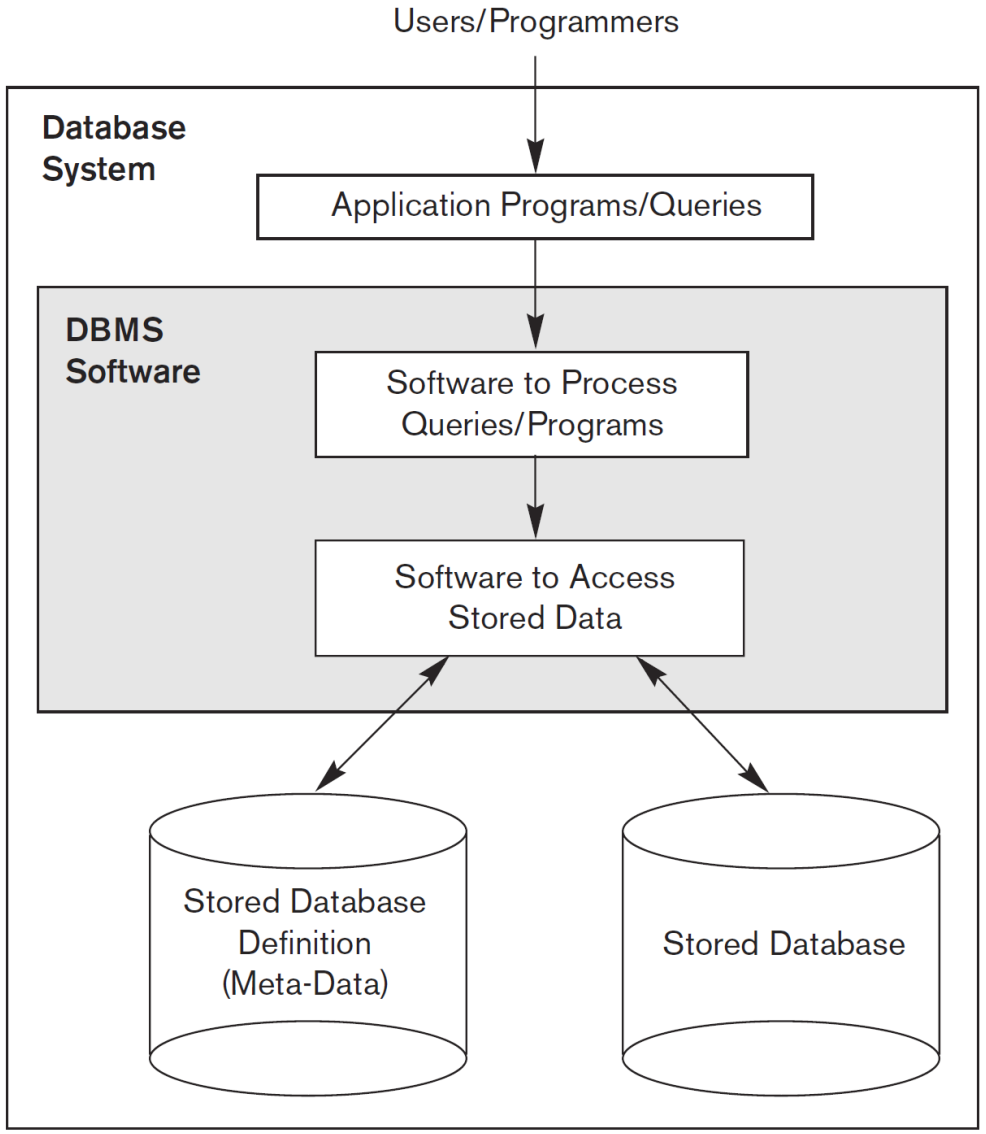
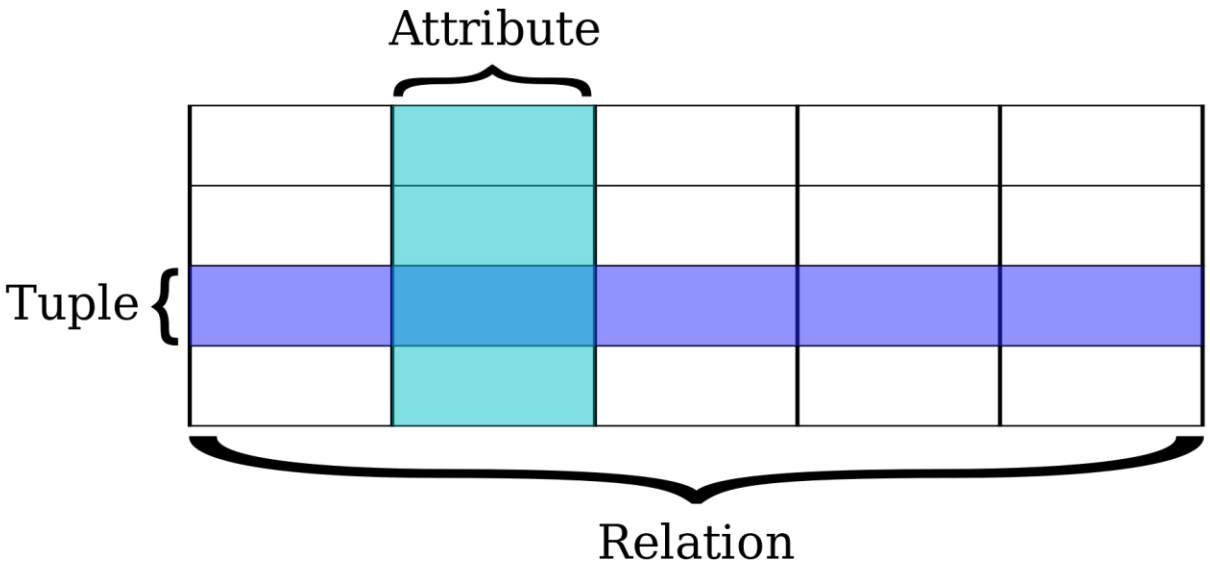


Definitions ½ - Recap

- → Database Management System (DBMS) – A system that enables users to create and maintain a database.
- → Database – A collection of related data. A collection of random data is not a database. Often the word database also, incorrectly, refers to a DBMS.
- → Data – Known facts that can be recorded that has implicit meaning.
- → Mini-World / Universe of Discourse – a database that represents some aspect of the real world. (Mostly here as the book refers to it)
- → Meta data – Data about data, or data that gives context to other data.
- → Schema – A definition of table structures and their relationships.
- → SQL – Structured Query Language – A language to extract data from a database.

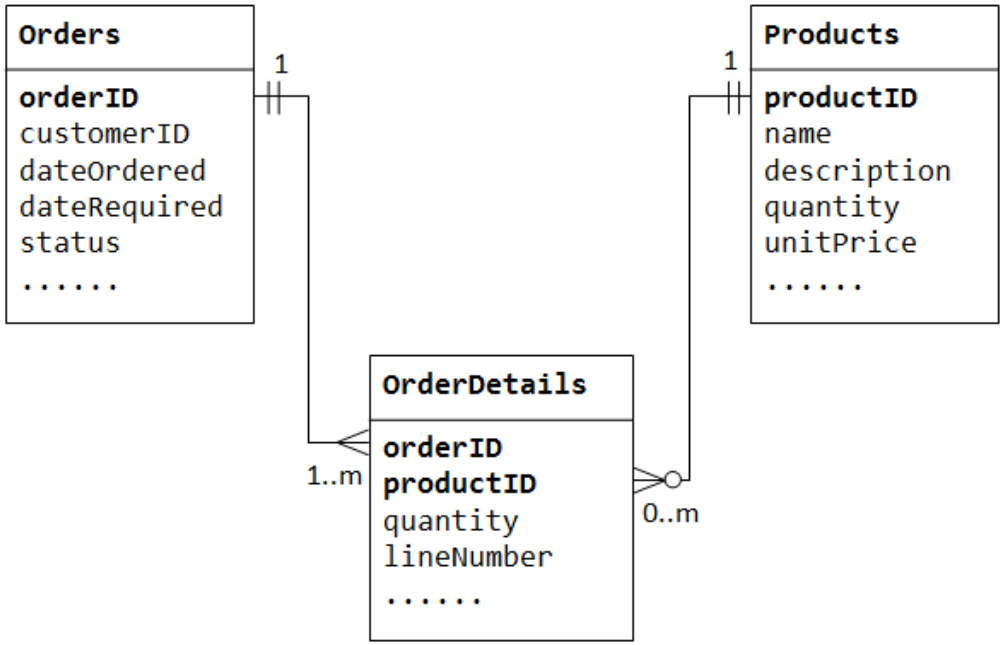
Source: Fundamentals of DB Systems, by Elmasri and Navathe

Definitions 2/2 - Recap



- → Table – A collection of rows and columns that contains Cells.
- → Row, Tuple, or Record – A collection of cells that together form a set of data that has a concrete Relation to each other. Shown as the horizontal line to the left.
- → Column, Attribute, or Field – A collection of Cells that that are all the same type. They are a part of multiple Rows.
- → Cell – A specific Rows Column. Ergo the intersection.
- → Relation – The relationship between data in a Row.
- → Value – The information saved in the specific Cell.
- → View / Result Set – The table that is created in memory and sent to the client as a result of a query.

What is a relational database? - Recap



- → Has a Schema that defines the Tables
- → Uses multiple tables to store data
- → Uses the notion of Primary Keys and Foreign keys to relate table content to each other.
- → Uses SQL which makes CRUD (Create, Read, Update, Delete) operations on Schemas, Tables, and Rows.

Contraint types

→ PRIMARY KEY – The unique identifier for the current row, which is always NOT NULL

→ REFERENCES (FOREIGN KEY) – A key that refers to a primary key in a different table, signifying their relationship to each other

→ UNIQUE – Two cells in this Column cannot be the same

→ NOT NULL – This attribute HAS to be specified

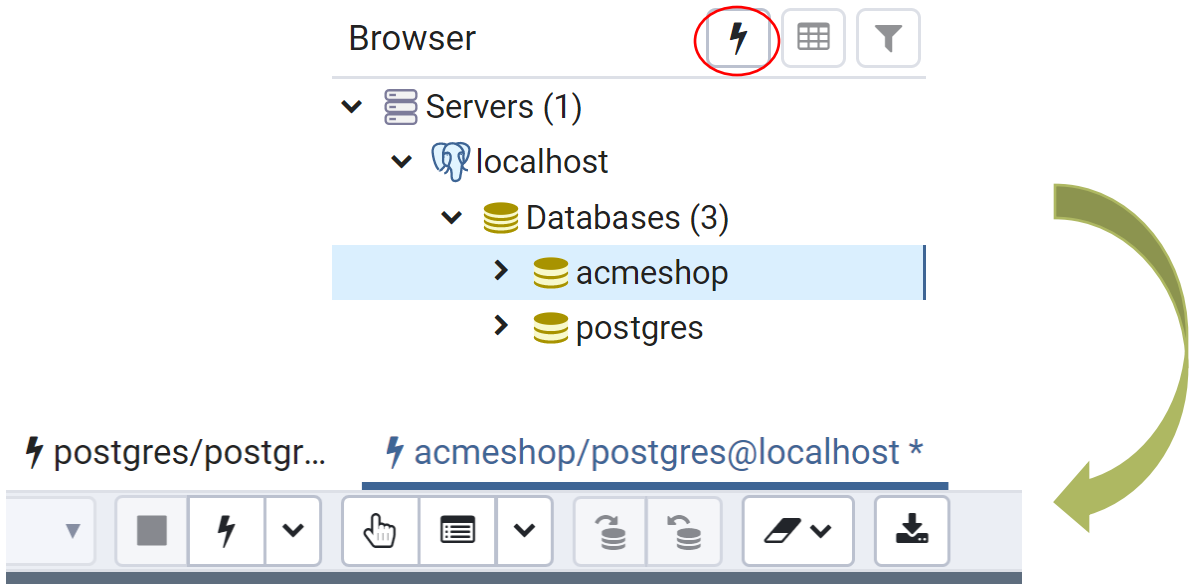
Constraints and Data types in SQL

```
CREATE TABLE account(
   user_id serial PRIMARY KEY,
   username VARCHAR (50) UNIQUE NOT NULL,
   password VARCHAR (50) NOT NULL,
   email VARCHAR (355) UNIQUE NOT NULL,
   created_on TIMESTAMP NOT NULL,
   last_login TIMESTAMP
);
```

Creating a Database

- → PostgreSQL only allows connections to one database at a time, and does not allow switching between them.
- → This is not normal, and usually you can “use database” to attach to another database.
- → Because of this restriction, run the command, pick the newly created database, and start a new SQL window.

```
-- creating a database
create database AcmeShop;
```



Deleting a Database

```
drop database AcmeShop;
```

Active connections to a database will block a deletion attempt!

Tables and relationships

Customers Table

	id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	1	John	myPassW0rd	john@acme.com	2020-02-13 10:40:41.660572	[null]
2	2	Anne	SomePassword	anne@acme.com	2020-02-13 10:40:41.660572	[null]

Products Table

	id [PK] integer	name character varying (150)	price real
1	1	Samsung Galaxy S20	7799.95
2	2	Samsung Galaxy S20 - Leathe…	799.95
3	3	iPhone 11 Pro	8899
4	4	iPhone 11 Pro - Leather Cover	399.5
5	5	Huawai P30 Lite	1664.5
6	6	Huawai P30 - Leather Cover	1664.5

Orders Table

	id [PK] integer	order_number character (10)	customer_id integer
1	1	DA-0001234	1
2	2	DA-0001235	1
3	3	DE-0001236	2
4	4	DE-0001237	2

Order_Lines Table

	id [PK] integer	order_id integer	product_id integer	amount integer
1	1	1	1	2
2	2	1	2	2
3	3	1	5	1
4	4	3	3	2
5	5	3	4	1
6	6	4	1	1

Creating Tables with Relationships

```
CREATE TABLE account(
   id serial PRIMARY KEY,
   username VARCHAR (50) UNIQUE NOT NULL,
   password VARCHAR (50) NOT NULL,
   email VARCHAR (355) UNIQUE NOT NULL,
   created_on TIMESTAMP NOT NULL,
   last_login TIMESTAMP
);

CREATE TABLE blog_entries(
    id serial PRIMARY KEY,
    header varchar(255) NOT NULL,
    body TEXT NOT NULL,
    created_by integer NOT NULL REFERENCES account(id)
);
```

Constraint Enforcement

```sql
INSERT INTO account (username, password, email, created_on)
VALUES ('John', 'myPassW0rd', 'john@acme.com', NOW()); -- becomes user 1
```

```sql
INSERT INTO blog_entries (header, body, created_by)
VALUES ('My article', 'my body text', 1); -- works!
```

```sql
INSERT INTO blog_entries (header, body, created_by)
VALUES ('My article', 'my body text', 6); -- ERROR!
```

```
ERROR:  insert or update on table "blog_entries" violates foreign key constraint "blog_entries_created_by_fkey"
DETAIL:  Key (created_by)=(6) is not present in table "account".
SQL state: 23503
```

Deleting tables, and tables with constraints

```
CREATE TABLE account(
   id serial PRIMARY KEY,
   username VARCHAR (50) UNIQUE NOT NULL,
   password VARCHAR (50) NOT NULL,
   email VARCHAR (355) UNIQUE NOT NULL,
   created_on TIMESTAMP NOT NULL,
   last_login TIMESTAMP
);

CREATE TABLE blog_entries(
    id serial PRIMARY KEY,
    header varchar(255) NOT NULL,
    body TEXT NOT NULL,
    created_by integer NOT NULL REFERENCES account(id)
);

drop table account;
```

→ Delete in order, where non of a tables attributes has a constraint from another table

```
ERROR:  cannot drop table account because other objects depend on it
DETAIL:  constraint blog_entries_created_by_fkey on table blog_entries depends on table account
HINT:  Use DROP ... CASCADE to drop the dependent objects too.
SQL state: 2BP01
```

Altering tables and deleting them

```
-- creating and altering tables
CREATE TABLE my_table(
   id serial PRIMARY KEY,
   my_attribute VARCHAR (50) UNIQUE NOT NULL
);

ALTER TABLE my_table ADD COLUMN my_new_coulmn TIMESTAMP;

ALTER TABLE my_table ALTER COLUMN my_new_coulmn TYPE varchar(50);

ALTER TABLE my_table DROP COLUMN my_new_coulmn;

DROP TABLE my_table;
```

Inserts (CRUD)

```
INSERT INTO account (username, password, email, created_on)
VALUES ('John', 'myPassW0rd', 'john@acme.com', NOW());

INSERT INTO account (username, password, email, created_on)
VALUES ('Anne', 'myPassW0rd', 'anne@acme.com', NOW());
```

	user_id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	4	John	myPassW0rd	john@acme.com	2020-02-06 11:43:44.158522	[null]
2	5	Anne	myPassW0rd	anne@acme.com	2020-02-06 11:43:44.158522	[null]

Selects (CRUD)

```sql
SELECT * FROM account;

SELECT username, created_on FROM account WHERE email = 'john@acme.com';

SELECT username, created_on FROM account WHERE email LIKE '%anne%';
```

	user_id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	1	John	myPassW0rd	john@acme.com	2020-02-06 11:41:11.729203	[null]

Updates (CRUD)

```
UPDATE account SET password = 'newPassW0rd' WHERE username = 'Anne';
```

	user_id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	1	John	myPassW0rd	john@acme.com	2020-02-06 11:41:11.729203	[null]
2	2	Anne	newPassW0rd	anne@acme.com	2020-02-06 11:42:13.27506	[null]

Delete (CRU**D**)

```
DELETE FROM account WHERE email = 'john@acme.com';
```

	user_id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	5	Anne	myPassW0rd	anne@acme.com	2020-02-06 11:43:44.158522	[null]

BEWARE of doing this: `DELETE FROM account;`

Querying Your Result Set - Nested Queries

```
CREATE TABLE account(
   id serial PRIMARY KEY,
   username VARCHAR (50) UNIQUE NOT NULL,
   password VARCHAR (50) NOT NULL,
   email VARCHAR (355) UNIQUE NOT NULL,
   created_on TIMESTAMP NOT NULL,
   last_login TIMESTAMP
);

CREATE TABLE blog_entries(
    id serial PRIMARY KEY,
    header varchar(255) NOT NULL,
    body TEXT NOT NULL,
    created_by integer NOT NULL REFERENCES account(id)
);
```

```
select * from account, blog_entries
where blog_entries.created_by = account.id;
```

	id integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp witho
1	1	John	myPassW0rd	john@acme.com	2020-02-13 11:55:37.125376	[null]
2	1	John	myPassW0rd	john@acme.com	2020-02-13 11:55:37.125376	[null]
3	1	John	myPassW0rd	john@acme.com	2020-02-13 11:55:37.125376	[null]
4	2	Anne	SomePassword	anne@acme.com	2020-02-13 11:55:42.35475	[null]
5	1	John	myPassW0rd	john@acme.com	2020-02-13 11:55:37.125376	[null]

```
select username, email, created_by from (
    select * from account, blog_entries
    where blog_entries.created_by = account.id
) as result_set where created_by = 2;
```

	username character varying (50)	email character varying (355)	created_by integer
1	Anne	anne@acme.com	2

Join types

- → INNER JOIN
  - → For each row R1 of T1, the joined table has a row for each row in T2 that satisfies the join condition with R1.
- → LEFT OUTER JOIN
  - → First, an inner join is performed. Then, for each row in T1 that does not satisfy the join condition with any row in T2, a joined row is added with null values in columns of T2. Thus, the joined table always has at least one row for each row in T1.
- → RIGHT OUTER JOIN
  - → First, an inner join is performed. Then, for each row in T2 that does not satisfy the join condition with any row in T1, a joined row is added with null values in columns of T1. This is the converse of a left join: the result table will always have a row for each row in T2.
- → FULL OUTER JOIN
  - → First, an inner join is performed. Then, for each row in T1 that does not satisfy the join condition with any row in T2, a joined row is added with null values in columns of T2. Also, for each row of T2 that does not satisfy the join condition with any row in T1, a joined row with null values in the columns of T1 is added.
- → Source: https://www.postgresql.org/docs/9.2/queries-table-expressions.html

Inner Join

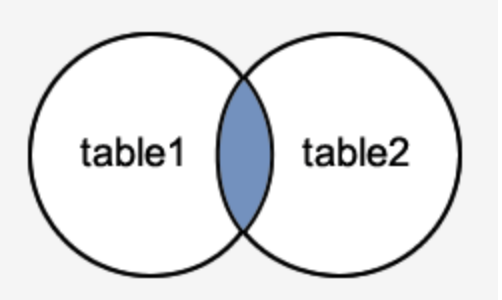
```
SELECT * FROM t1 INNER JOIN t2 ON t1.num = t2.num;
```

```
SELECT * FROM t1,t2 WHERE t1.num = t2.num;
```

num integer	name character varying (10)	num integer	value character varying (10)
1	a	1	xxx
3	c	3	yyy

```
SELECT * FROM t1 INNER JOIN t2 USING (num);
```

num integer	name character varying (10)	value character varying (10)
1	a	xxx
3	c	yyy



T1 table

num integer	name character varying (10)
1	a
2	b
3	c

T2 table

num integer	value character varying (10)
1	xxx
3	yyy
5	zzz

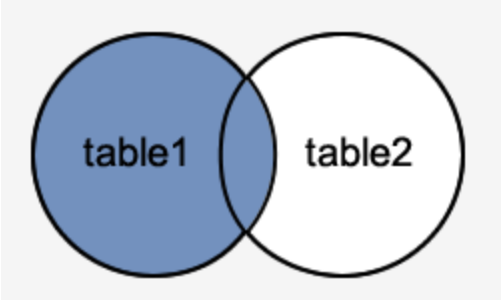
Left Outer Join

```
SELECT * FROM t1 LEFT JOIN t2 ON t1.num = t2.num;
```

num integer	name character varying (10)	num integer	value character varying (10)
1	a	1	xxx
2	b	[null]	[null]
3	c	3	yyy

```
SELECT * FROM t1 LEFT JOIN t2 USING (num);
```

num integer	name character varying (10)	value character varying (10)
1	a	xxx
2	b	[null]
3	c	yyy



T1 table

num integer	name character varying (10)
1	a
2	b
3	c

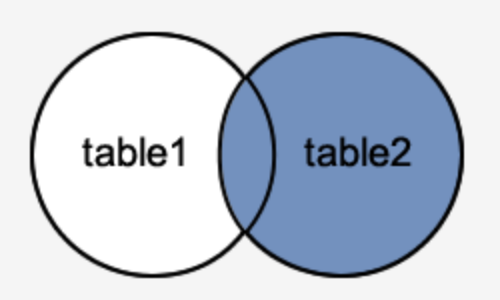
T2 table

num integer	value character varying (10)
1	xxx
3	yyy
5	zzz

Right Outer Join

```
SELECT * FROM t1 RIGHT JOIN t2 ON t1.num = t2.num;
```

num integer	name character varying (10)	num integer	value character varying (10)
1	a	1	xxx
3	c	3	yyy
[null]	[null]	5	zzz



T1 table

num integer	name character varying (10)
1	a
2	b
3	c

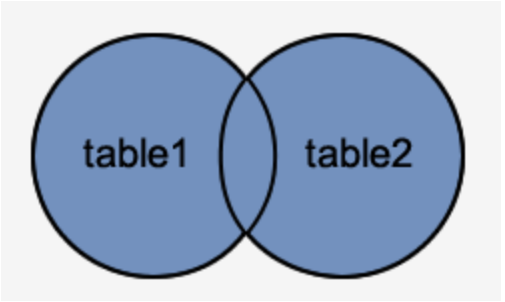
T2 table

num integer	value character varying (10)
1	xxx
3	yyy
5	zzz

Full Outer Join

```
SELECT * FROM t1 FULL JOIN t2 ON t1.num = t2.num;
```

num integer	name character varying (10)	num integer	value character varying (10)
1	a	1	xxx
2	b	[null]	[null]
3	c	3	yyy
[null]	[null]	5	zzz



T1 table

num integer	name character varying (10)
1	a
2	b
3	c

T2 table

num integer	value character varying (10)
1	xxx
3	yyy
5	zzz

Views – Creating Virtual Tables

```
CREATE VIEW MyCustomView AS
    SELECT email, username FROM account, blog_entries
    WHERE blog_entries.created_by = account.id;

SELECT * FROM MyCustomView;
```

Query defining the view content

	email character varying (355)	username character varying (50)
1	john@acme.com	John
2	john@acme.com	John
3	john@acme.com	John
4	anne@acme.com	Anne
5	john@acme.com	John

- Can join and simplify multiple tables into a view.
- Result of the query in the view is dynamically updated, when new database content id added.
- Can hide complexity of data
- Takes very little space as only the query is stored

Feedback on the book!

01

How is the reading experience compared to the book from the curriculum?

02

Does the book help you better prepare for class?

03

What could be better with the book?

04

How well does the book align with the content taught in class?

05

Any thoughts on the open-source approach to the book? (Everyone can contribute, public issue tracking and more)

Live Demo

Pay attention, and don't try to replicate what I do right now!

You will have time to do that afterwards.

Exercises

- → Make sure you have access to Discord now!
- → Make sure PostgreSQL works! Ask instructors for help! It will be close to impossible to complete the course without doing the exercises.
- → Create a database using pgAdmin/DataGrip.
- → Create the tables from the next page WITH constraints in the new database.
- → Create the content for all of the tables.
- → Create the following queries:
  - → Add another column to the Product Table called Manufacturer as a VARCHAR(250) using the ALTER TABLE command.
  - → Query all orders with the products bought, and the amount bought for each product, as well as the order_number and customer email.
    - → Explore the different types of joins, Inner, left outer, right outer and full outer.
- → Create a view with the query from above.
- → Query the new view but look for a specific order number.

Create these tables with the same values

Customers Table

	id [PK] integer	username character varying (50)	password character varying (50)	email character varying (355)	created_on timestamp without time zone	last_login timestamp without time zone
1	1	John	myPassW0rd	john@acme.com	2020-02-13 10:40:41.660572	[null]
2	2	Anne	SomePassword	anne@acme.com	2020-02-13 10:40:41.660572	[null]

Products Table

	id [PK] integer	name character varying (150)	price real
1	1	Samsung Galaxy S20	7799.95
2	2	Samsung Galaxy S20 - Leathe…	799.95
3	3	iPhone 11 Pro	8899
4	4	iPhone 11 Pro - Leather Cover	399.5
5	5	Huawai P30 Lite	1664.5
6	6	Huawai P30 - Leather Cover	1664.5

Orders Table

	id [PK] integer	order_number character (10)	customer_id integer
1	1	DA-0001234	1
2	2	DA-0001235	1
3	3	DE-0001236	2
4	4	DE-0001237	2

Order_Lines Table

	id [PK] integer	order_id integer	product_id integer	amount integer
1	1	1	1	2
2	2	1	2	2
3	3	1	5	1
4	4	3	3	2
5	5	3	4	1
6	6	4	1	1