Databases

PostgreSQL

Week 6

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What is a database?

An answer: A database can be described as “a structured set of data held in a computer, especially one that is accessible in various ways.”

How does a relational database differ from a spreadsheet?

Spreadsheet

member_id	fname	lname	phone	email	dvd_id	dvd_title
1	Jane	Smith	02071231234	jane@gmail.com	3	Captain Marvel
2	Ann	Smith	02071231234	anne@gmail.com	1	Avengers
3	Mike	Jones	02071231234	mike@gmail.com	2	Dumbo

A relational database management system (RDBMS)

member

member_id	fname	lname	phone	email
1	Jane	Smith	02071231234	jane@gmail.com
2	Ann	Smith	02071231234	anne@gmail.com
3	Mike	Jones	02071231234	mike@gmail.com

dvd

dvd_id	dvd_title
1	Captain Marvel
2	Avengers
3	Dumbo

A relational database management system (RDBMS)

- This model organises data into one or more tables (or "relations") of columns and rows, with a unique key identifying each row. This unique key is called a Primary Key (PK).

- Rows are also called records or tuples.

- Columns are also called attributes.

- Generally, each table/relation represents one "entity type" (such as member, dvd, etc.).

- The rows represent “instances” of that type of entity (such as "Jane") and the columns representing values attributed to that “instance” (such as name, phone and email).

Primary keys

- Each row in a table has its own unique key called a Primary Key
- Can you point out the Primary keys?

member

member_id	fname	lname	phone	email
1	Jane	Smith	02071231234	jane@gmail.com
2	Ann	Smith	02071231234	anne@gmail.com
3	Mike	Jones	02071231234	mike@gmail.com

dvd

dvd_id	dvd_title
1	Captain Marvel
2	Avengers
3	Dumbo

booking

booking_id	member_id	dvd_id
1	1	3
2	2	1
3	3	2

Foreign keys

- Rows in a table can be linked to rows in other tables by adding a column for the unique key of the linked row (such columns are known as foreign keys).
- Can you point out the Foreign keys?
- When a Primary Key (PK) is duplicated in another table, it becomes a foreign key in the other table.

member

member_id	fname	lname	phone	email
1	Jane	Smith	02071231234	jane@gmail.com
2	Ann	Smith	02071231234	anne@gmail.com
3	Mike	Jones	02071231234	mike@gmail.com

dvd

dvd_id	dvd_title
1	Captain Marvel
2	Avengers
3	Dumbo

booking

booking_id	member_id	dvd_id
1	1	3
2	2	1
3	3	2

What is the difference between a primary key and a foreign key?

member

member_id	fname	lname	phone	email
1	Jane	Smith	02071231234	jane@gmail.com
2	Ann	Smith	02071231234	anne@gmail.com
3	Mike	Jones	02071231234	mike@gmail.com

dvd

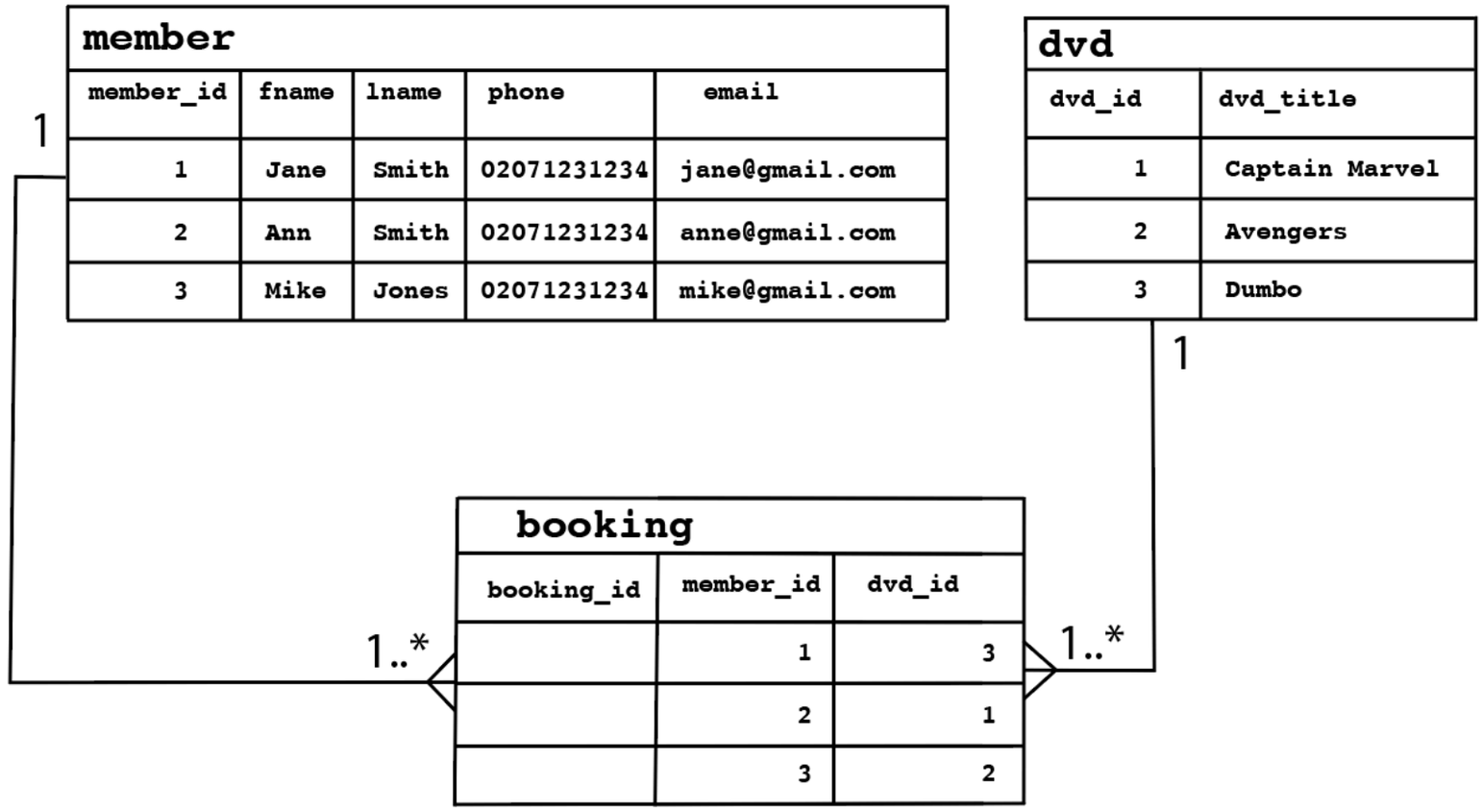
dvd_id	dvd_title
1	Captain Marvel
2	Avengers
3	Dumbo

booking

booking_id	member_id	dvd_id
1	1	3
2	2	1
3	3	2

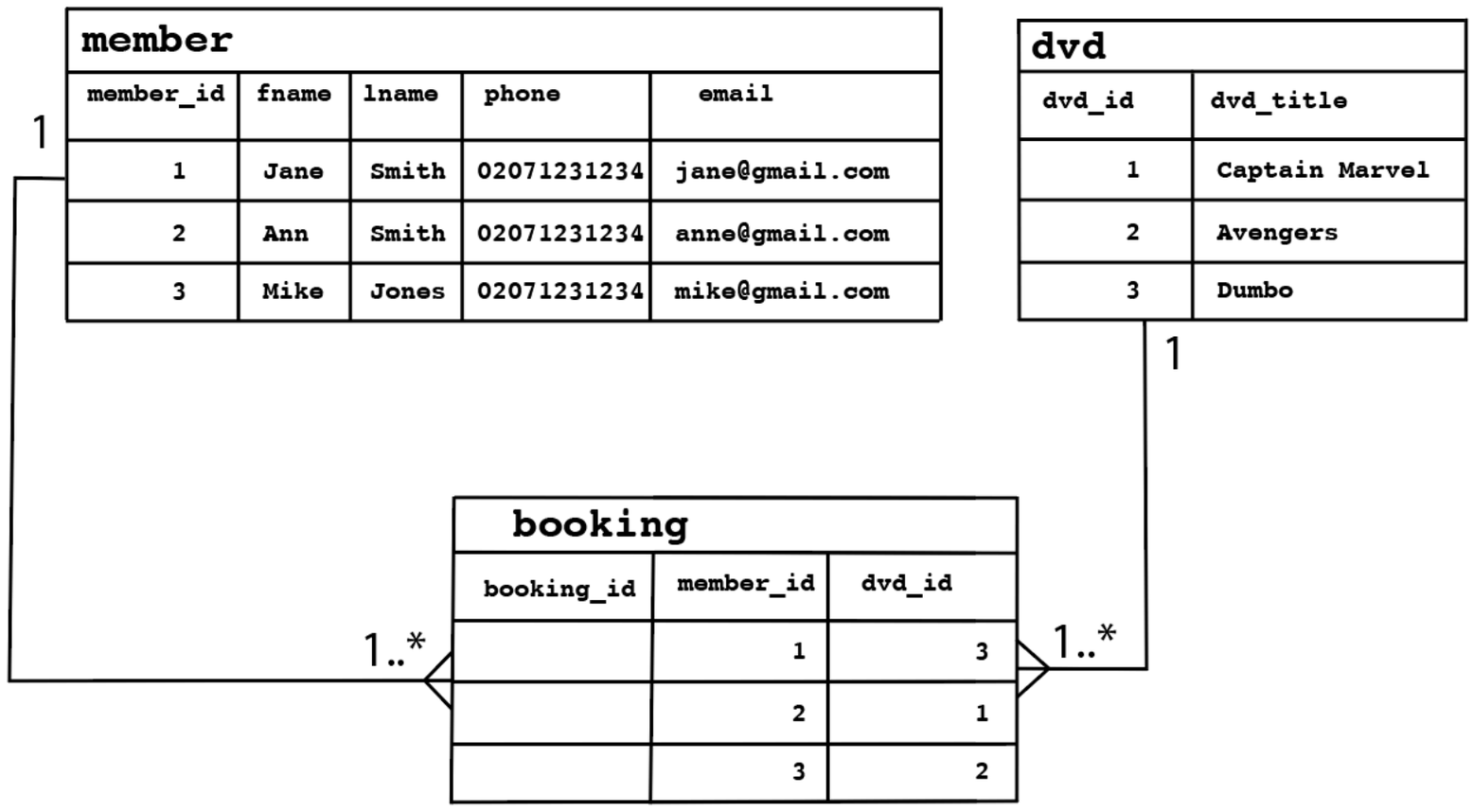
Schema diagrams are used for planning table relationships

- What type of relationships are represented here?



One-to-many (bridging table)

- Most relational database designs resolve many-to-many relationships by creating an additional table that contains the Primary Keys (PKs) from both of the other entity tables.



A.C.I.D

- ACID (Atomicity, Consistency, Isolation, Durability) is a set of properties of database transactions intended to guarantee valid data even in the event of errors, power failures, etc.

Important database concepts

- In order for a database management system (DBMS) to operate efficiently and accurately, it must use ACID transactions.

A.C.I.D. transaction example: a document sent to a printer

- atomicity - printer prints 2 pages of a document or none
- consistency - printer prints half page and the page gets stuck. The printer restarts itself and prints 2 pages with all content
- isolation - while there were too many print outs in progress - printer prints the right content of the document
- durability - while printing, there was a power cut- printer again prints documents without any errors

PostgreSQL 🐘

pronounced “post-gres”

PostgreSQL info

- PostgreSQL is a relational database management system (RDBMS).
- It is an Object-relational database management system (RDBMS)
- It’s free and Open source
- It is Platform independent (Mac, Window, Linux)
- Its SQL queries comply to ANSI-standard SQL (American National Standard Institute)
- Forums: reddit.com, dba.stackexchange.com

Workshop PostgreSQL Setup

- Work with someone who has the same platform (Mac, Window, Linux) as there are separate instructions for each.

- You will be installing POSTgreSQL, the Database management system.

What is psql?

- **psql** is a terminal-based front-end to PostgreSQL.

- **pgcli** (stands for postgres command line interface). pgcli is a command line interface for Postgres with auto-completion and syntax highlighting.

- psql and pgcli enable you to type in SQL queries interactively, issue them to PostgreSQL, and see the SQL query results. Alternatively, SQL can be run from a file.

PostgreSQL info

Schedule Day 1

- Morning: installing Postgres and then sql-commands intro workshop 11am - 1pm

- Afternoon: 2pm - 4.00pm: workshop on SQL commands and psql.

- 4.00pm - 6pm: biz dev and community outreach

SQL

structured query language
pronounced S.Q.L. or “sequel”

- SQL is a language designed for communicating with databases. It is not the database itself.
- SQL commands are known as queries.
- SQL queries include keywords to select or update, details of data from a database.
- Data types include: INTEGER, boolean, VARCHAR(n), text and many more.

https://www.w3schools.com/sql/sql_datatypes.asp

SQL

structured query language
pronounced S.Q.L. or “sequel”

- Some useful key words include:

SELECT, Columns or expression to query

WHERE, Row-level filter

LIKE, Search pattern with wildcard: %

IN, (value, value)

AS, Alias name for the returned columns

INSERT INTO

UPDATE

https://www.w3schools.com/sql/sql_datatypes.asp

SQL Commands intro
Blog database

- In this workshop you will clone a blog database containing the tables:
- blog_posts
- post_comments
- users

SQL Commands intro

- SELECT all the information from the users table

SELECT * FROM table name

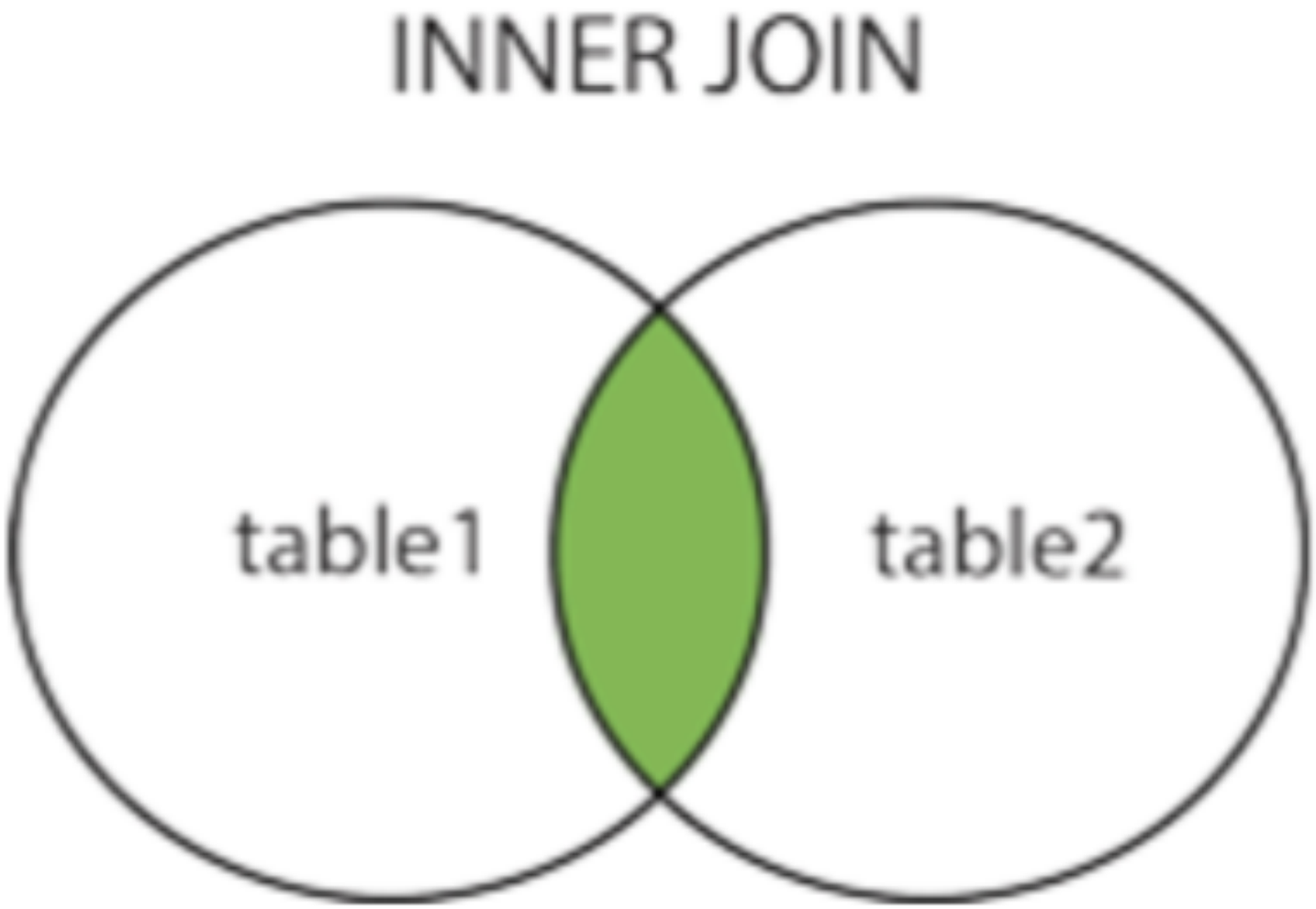
Tip: SQL command line: press Enter at the end of a line to break up a query.
press semicolon (;) to end the query not Enter.

-# I'm in the middle of a query
=# I'm ready to start the next query

```
=# SELECT publishers.name, books.name
-# FROM publishers
```

Commas are used to add more than one value.
Use table.column to select a column from a table.

SQL INNER JOIN and set theory



PostgreSQL Workshop

SQL INNER JOIN and set theory

books

id	name	release_date	publishe
1	Python Made Easy	1994-01-26	
2	SQL: Part 2	1979-06-01	
3	JavaScript: The Really Good Parts	1995-09-18	
4	Java in Japanese	1996-01-23	
5	Elm Street	2012-04-01	
6	CSS: Cansei	1994-10-10	
7	Ruby Gems	1996-12-25	
8	C++	2017-07-06	
9	CoffeeScript in Java	2009-12-24	
10	Swift in 10 Days	2014-06-02	

publisher

id	name
1	The Big Publishing House
2	McGraw-Hill
3	No Starch Press
4	Mega Corp Ltd

- Match values in each table on a primary key in books table and a foreign key in another table.
  (There are 2 matches within the publisher_id so both would be selected).

- Show any column from the 2 tables which are acting as a joined table.

INNER JOIN syntax

```
      name       |                name
-----------------+-------------------------------
 No Starch Press | Python Made Easy
 No Starch Press | JavaScript: The Really Good Parts
```

```
=# SELECT publishers.name, books.name FROM publishers
-# INNER JOIN books
-# ON books.publisher_id = publishers.id
-# WHERE publishers.name = 'No Starch Press';
```

pg-walkthrough
Code-along

Building a database

- Creating a build script in an `.sql` file
- Using the DROP and IF EXISTS commands, for use on a `test database`
- What cascade is for and when to use it
- Execute a transaction using BEGIN & COMMIT

Connecting to a database

- Connecting to a PostgreSQL server from a node server
- Running queries in Node
- Understanding what a connection pool is and how to initialise and configure one using pg
- Using pool.query with callbacks, to execute single queries to the database
- Using parameterised queries (to prevent SQL injection)
- Serving the query results to the front end

This exercise is designed to get you familiar with connecting to a database, querying it and viewing that information. We'll be using the npm module `pg` to connect our node server to a locally-hosted Postgres database.

Serves db to browser

pg-workshop

- In this workshop we'll be building on what we learnt in the pg walkthrough.
- This app currently contains static data: the users' name and location.
- We'll be setting up our own database connection so that the data can be retrieved from a table of "users" instead.
- We'll also be adding a form so names can be added to the database table via the form.

DATABASE CONCEPT

CRUD

Create, Read, Update, and Delete

Create, Read, Update, and Delete (CRUD) are the four basic functions of persistent storage.

In SQL this translates to:

CREATE in SQL is INSERT INTO

```
INSERT INTO <tablename> (column1)
VALUES(value1,value2,…. )
```

READ = SELECT

```
SELECT * FROM <TableName>
```

UPDATE

```
UPDATE <TableName>
SET Column1=Value1, Column2=Value2,…
WHERE <Expression>
```

DELETE

```
DELETE FROM <TableName>
WHERE <Expression>
```