

Data structures

UNDERSTANDING DATA ENGINEERING



Hadrien Lacroix

Content Developer at DataCamp

Structured data

- Easy to search and organize
- Consistent model, rows and columns
- Defined types
- Can be grouped to form relations
- Stored in relational databases
- About 20% of the data is structured
- Created and queried using SQL

Employee table

| index | last_name | first_name | role | team | full_time | office |
|-------|------------|------------|--------------------|------------------|-----------|----------------|
| 0 | Thien | Vivian | Data Engineer | Data Science | 1 | Belgium |
| 1 | Huong | Julian | Data Scientist | Data Science | 1 | Belgium |
| 2 | Duplantier | Norbert | Software Developer | Infrastructure | 1 | United Kingdom |
| 3 | McColgan | Jeff | Business Developer | Sales | 1 | United States |
| 4 | Sanchez | Rick | Support Agent | Customer Service | 0 | United States |

Relational database

| office | address | number | city | zipcode |
|---------|----------------|--------|----------|----------|
| Belgium | Martelarenlaan | 38 | Leuven | 3010 |
| UK | Old Street | 207 | London | EC1V 9NR |
| USA | 5th Ave | 350 | New York | 10118 |

Relational database

| index | last_name | first_name | office | address | number | city | zipcode |
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| 0 | Thien | Vivian | Belgium | Martelarenlaan | 38 | Leuven | 3010 |
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Semi-structured data

- Relatively easy to search and organize
- Consistent model, less-rigid implementation: different observations have different sizes
- Different types
- Can be grouped, but needs more work
- NoSQL databases: JSON, XML, YAML

Favorite artists JSON file

```
{  
  {"user_1645156":  
    "last_name": "Lacroix",  
    "first_name": "Hadrien",  
    "favorite_artists": ["Fools in Deed", "Gojira", "Pain", "Nanowar of Steel"]},  
  {"user_5913764":  
    "last_name": "Billen",  
    "first_name": "Sara",  
    "favorite_artists": ["Tamino", "Taylor Swift"]},  
  {"user_8436791":  
    "last_name": "Sulmont",  
    "first_name": "Lis",  
    "favorite_artists": ["Arctic Monkeys", "Rihanna", "Nina Simone"]},  
  ...  
}
```

Unstructured data

- Does not follow a model, can't be contained in rows and columns
- Difficult to search and organize
- Usually text, sound, pictures or videos
- Usually stored in data lakes, can appear in data warehouses or databases
- Most of the data is unstructured
- Can be extremely valuable

Una mattina mi son alzato
O bella ciao, bella ciao, bella ciao, ciao, ciao
Una mattina mi son alzato
E ho trovato l'invasor

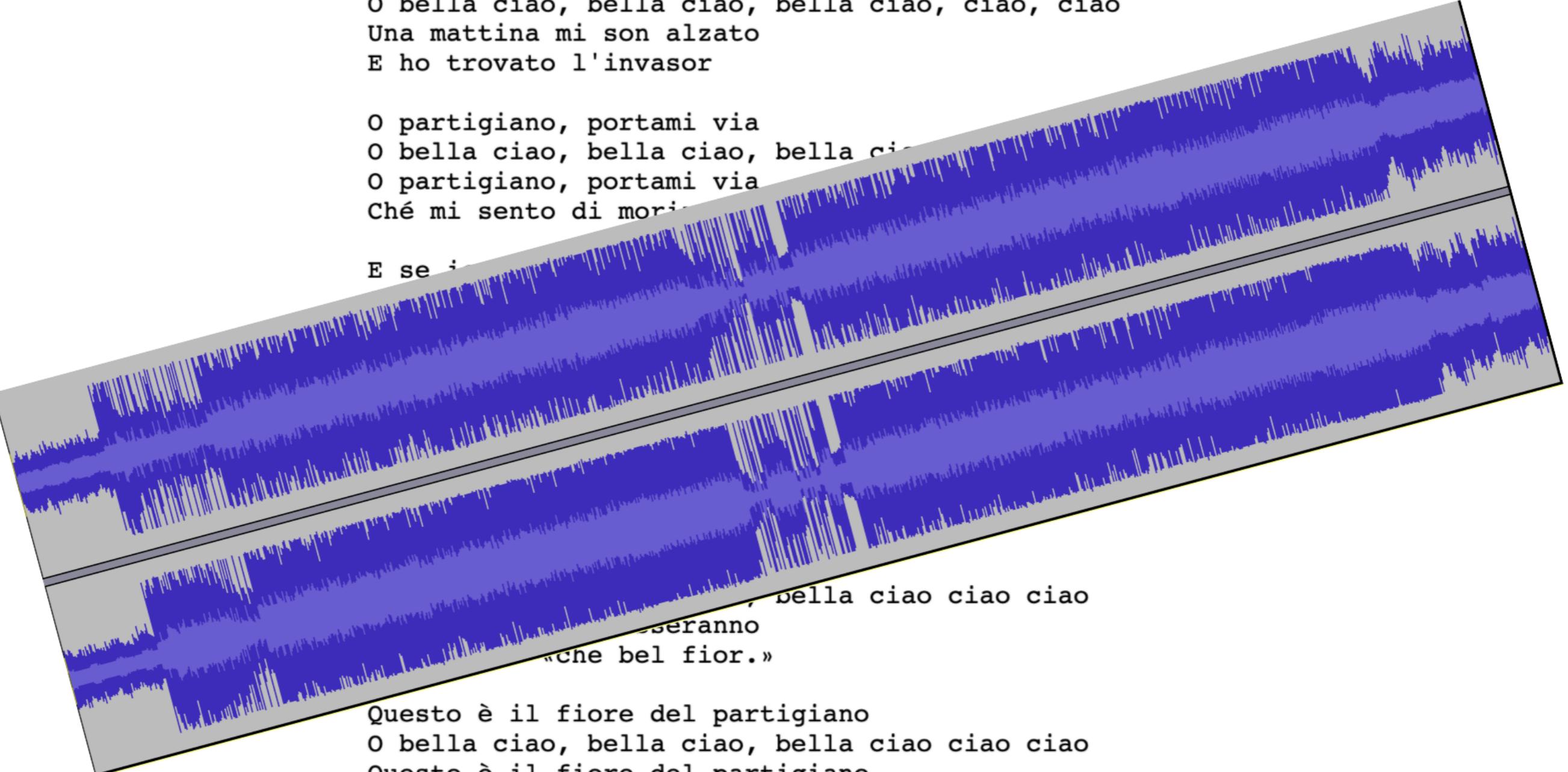
O partigiano, portami via
O bella ciao, bella ciao, bella ciao, ciao, ciao
O partigiano, portami via
Ché mi sento di morir

E se io muoio da partigiano
O bella ciao, bella ciao, bella ciao, ciao, ciao
E se io muoio da partigiano
Tu mi devi seppellir

E seppellire lassù in montagna
O bella ciao, bella ciao, bella ciao, ciao, ciao
E seppellire lassù in montagna
Sotto l'ombra di un bel fior

E le genti che passeranno
O bella ciao, bella ciao, bella ciao ciao ciao
E le genti che passeranno
Mi diranno «che bel fior.»

Questo è il fiore del partigiano
O bella ciao, bella ciao, bella ciao ciao ciao
Questo è il fiore del partigiano
Morto per la libertà



Una mattina mi son alzato
O bella ciao, bella ciao, bella ciao, ciao, ciao
Una mattina mi son alzato
E ho trovato l'invasor

O partigiano, portami via
O bella ciao, bella ciao, bella ciao
O partigiano, portami via
Ché mi sento di morir

E se :

, bella ciao ciao ciao
seranno
"che bel fior."

Questo è il fiore del partigiano
O bella ciao, bella ciao, bella ciao ciao ciao
Questo è il fiore del partigiano
Morto per la libertà

Una mattina mi son alzato
O bella ciao, bella ciao, bella ciao, ciao, ciao

Una mattina mi son alzato
E ho tro

O parti
O bella
O part
Ché mi

E se

Questo è il fiore dei partigiani
O bella ciao, bella ciao, bella ciao
Questo è il fiore del partigiano
Morto per la libertà





Adding some structure

- Use AI to search and organize unstructured data
- Add information to make it semi-structured

Summary

- Structured data
- Semi-structured data
- Unstructured data
- Differences between the three
- Give examples

Let's practice!

UNDERSTANDING DATA ENGINEERING

SQL databases

UNDERSTANDING DATA ENGINEERING



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SQL

- Structured Query Language
- Industry standard for Relational Database Management System (RDBMS)
- Allows you to access many records at once, and group, filter or aggregate them
- Close to written English, easy to write and understand
- Data engineers use SQL to create and maintain databases
- Data scientists use SQL to query (request information from) databases

Remember the employees table

| index | last_name | first_name | role | team | full_time | office |
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SQL for data engineers

- Data engineers use SQL to create, maintain and update tables.

```
CREATE TABLE employees (
    employee_id INT,
    first_name VARCHAR(255),
    last_name VARCHAR(255),
    role VARCHAR(255),
    team VARCHAR(255),
    full_time BOOLEAN,
    office VARCHAR(255)
);
```

SQL for data scientists

- Data scientist use SQL to query, filter, group and aggregate data in tables.

```
SELECT first_name, last_name  
FROM employees  
WHERE role LIKE '%Data%'
```

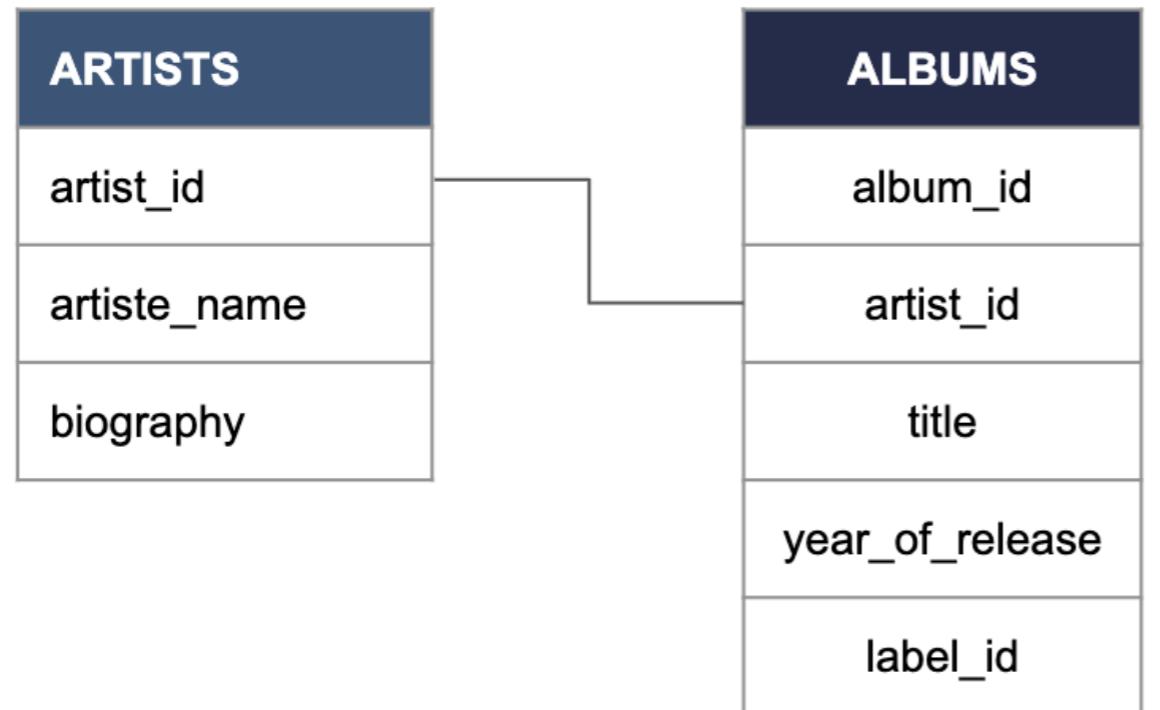
Database schema

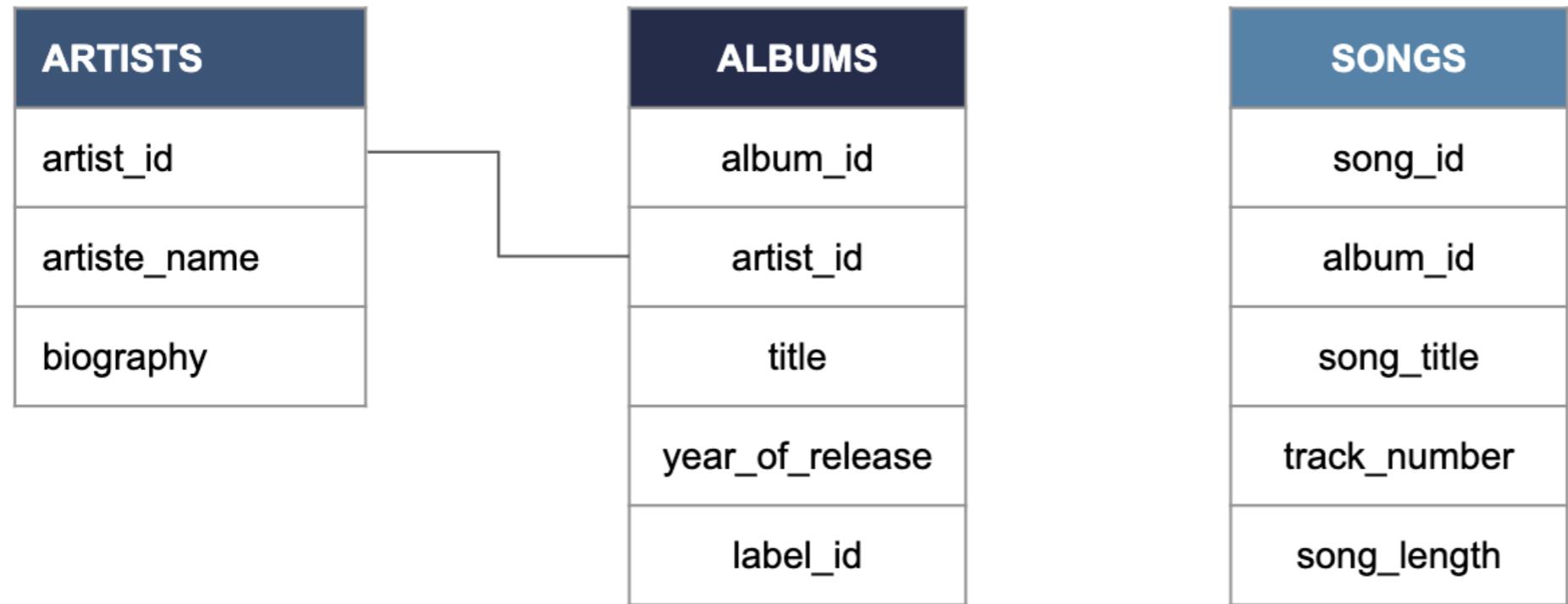
- Databases are made of tables
- The database schema governs how tables are related

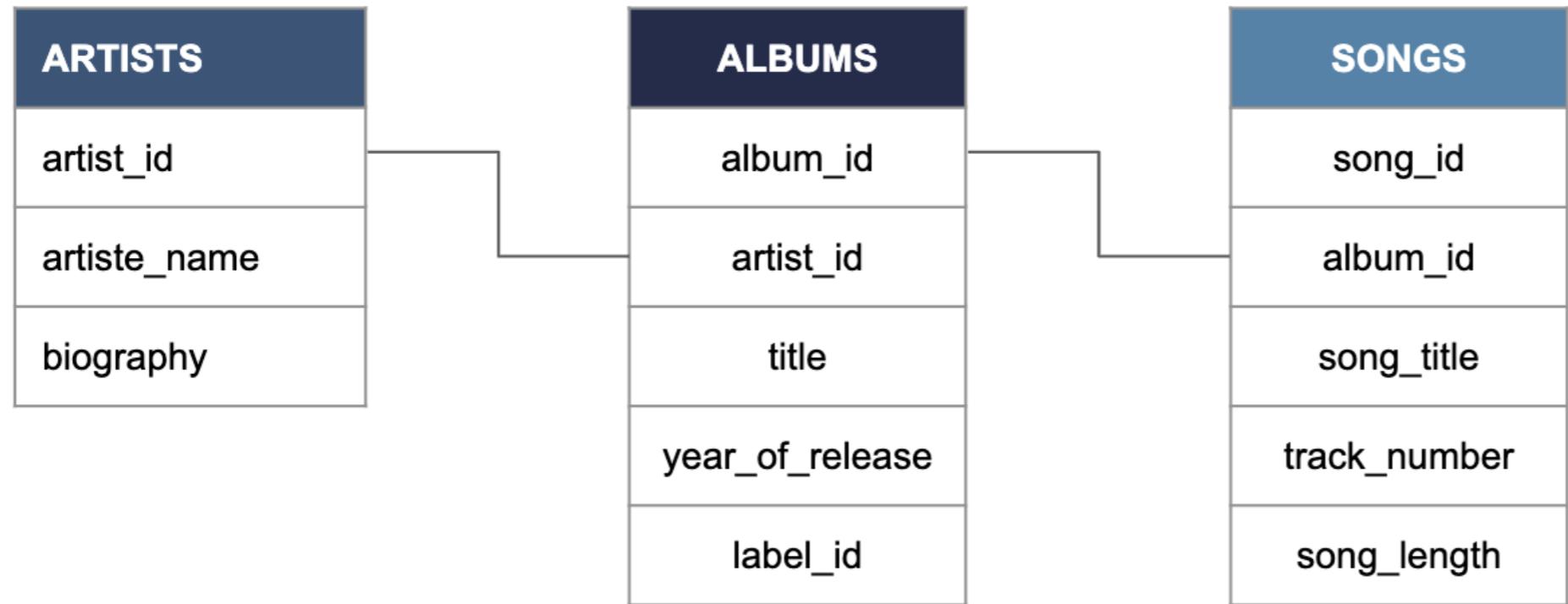
| ALBUMS |
|-----------------|
| album_id |
| artist_id |
| title |
| year_of_release |
| label_id |

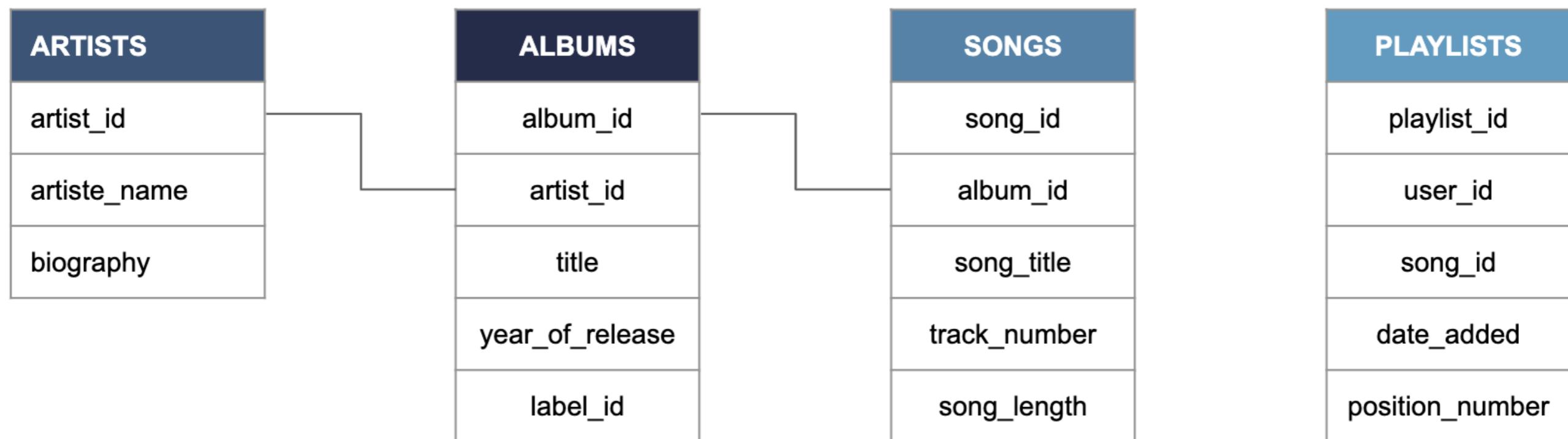
| ARTISTS |
|--------------|
| artist_id |
| artiste_name |
| biography |

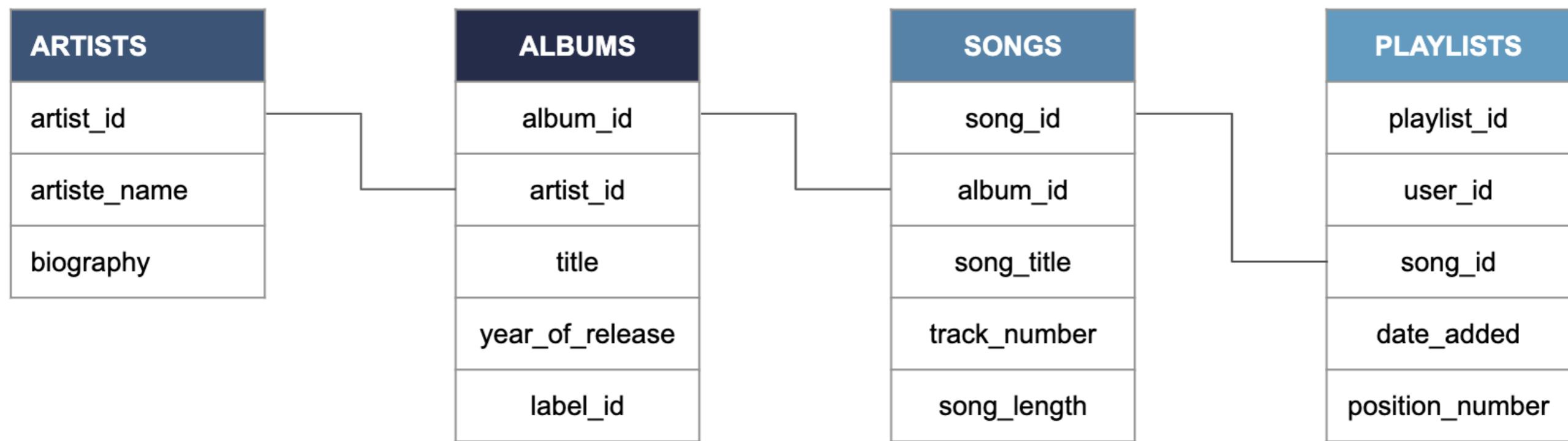
| ALBUMS |
|-----------------|
| album_id |
| artist_id |
| title |
| year_of_release |
| label_id |











Several implementations

- SQLite
- MySQL
- PostgreSQL
- Oracle SQL
- SQL Server

Summary

- SQL = industry standard
- Explain how Data engineers and Data scientists use it differently
- Database schema
- SQL implementations

Let's practice!

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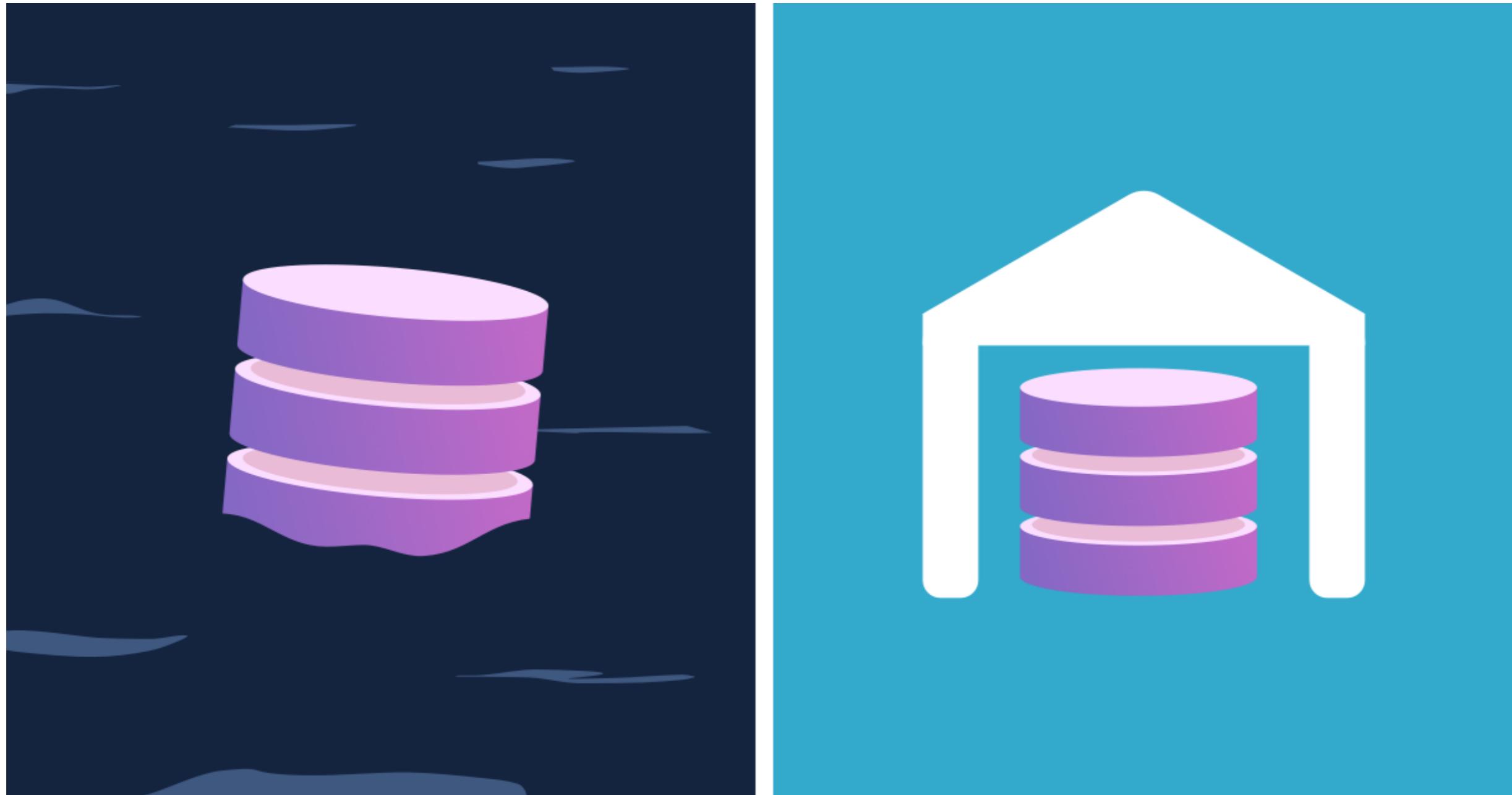
Data warehouses and data lakes

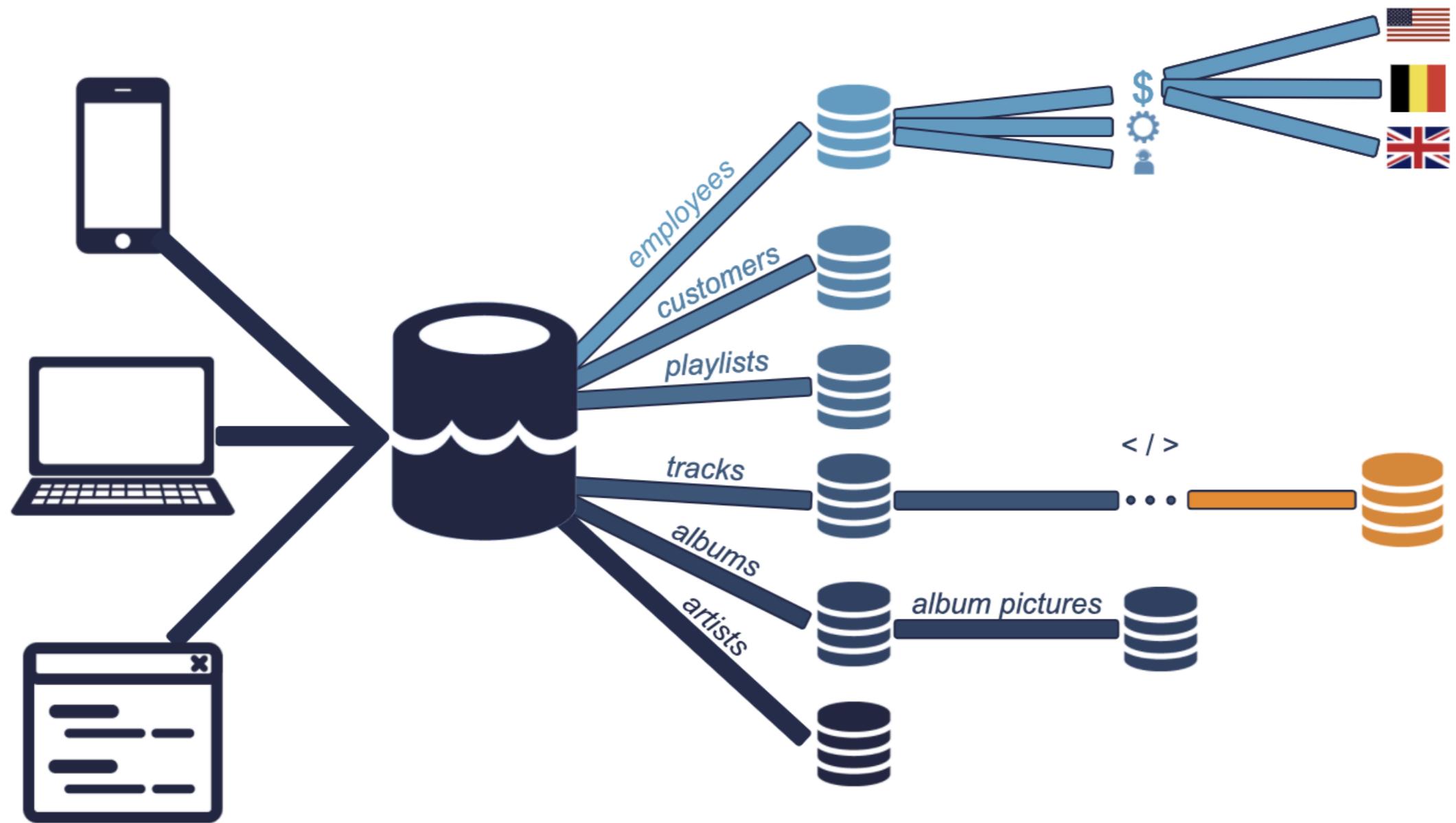
UNDERSTANDING DATA ENGINEERING



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Warehouses with stunning view on the lake





Data lakes and data warehouses

Data lake

- Stores all the raw data
- Can be petabytes (1 million GBs)
- Stores all data structures
- Cost-effective
- Difficult to analyze
- Requires an up-to-date data catalog
- Used by data scientists
- Big data, real-time analytics

Data warehouse

- Specific data for specific use
- Relatively small
- Stores mainly structured data
- More costly to update
- Optimized for data analysis
- Also used by data analysts and business analysts
- Ad-hoc, read-only queries

Data catalog for data lakes

- What is the source of this data?
- Where is this data used?
- Who is the owner of the data?
- How often is this data updated?
- Good practice in terms of data governance
- Ensures reproducibility
- No catalog --> data swamp
- **Good practice for any data storage solution**
 - Reliability
 - Autonomy
 - Scalability
 - Speed

Database vs. data warehouse

- Database:
 - General term
 - Loosely defined as *organized data stored and accessed on a computer*
- Data warehouse is a type of database

Summary

- Data lakes
- Data warehouses
- Databases
- Data catalog

Let's practice!

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