

# Database roles and access control

DATABASE DESIGN

SQL

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# Granting and revoking access to a view

GRANT privilege(s) or REVOKE privilege(s)

ON object

TO role or FROM role

- **Privileges:** SELECT , INSERT , UPDATE , DELETE , etc.
- **Objects:** table, view, schema, etc.
- **Roles:** a database user or a group of database users

```
GRANT UPDATE ON ratings TO PUBLIC;  
REVOKE INSERT ON films FROM db_user;
```

# Database roles

- Manage database access permissions
- A database role is an entity that contains information that:
  - Define the role's privileges
    - Can you login?
    - Can you create databases?
    - Can you write to tables?
  - Interact with the client authentication system
    - Password
- Roles can be assigned to one or more users
- Roles are global across a database cluster installation

# Create a role

- Empty role

```
CREATE ROLE data_analyst;
```

- Roles with some attributes set

```
CREATE ROLE intern WITH PASSWORD 'PasswordForIntern' VALID UNTIL '2020-01-01';
```

```
CREATE ROLE admin CREATEDB;
```

```
ALTER ROLE admin CREATEROLE;
```

<sup>1</sup> [http://bit.ly/postgresql\\_attributes](http://bit.ly/postgresql_attributes)

# GRANT and REVOKE privileges from roles

```
GRANT UPDATE ON ratings TO data_analyst;
```

```
REVOKE UPDATE ON ratings FROM data_analyst;
```

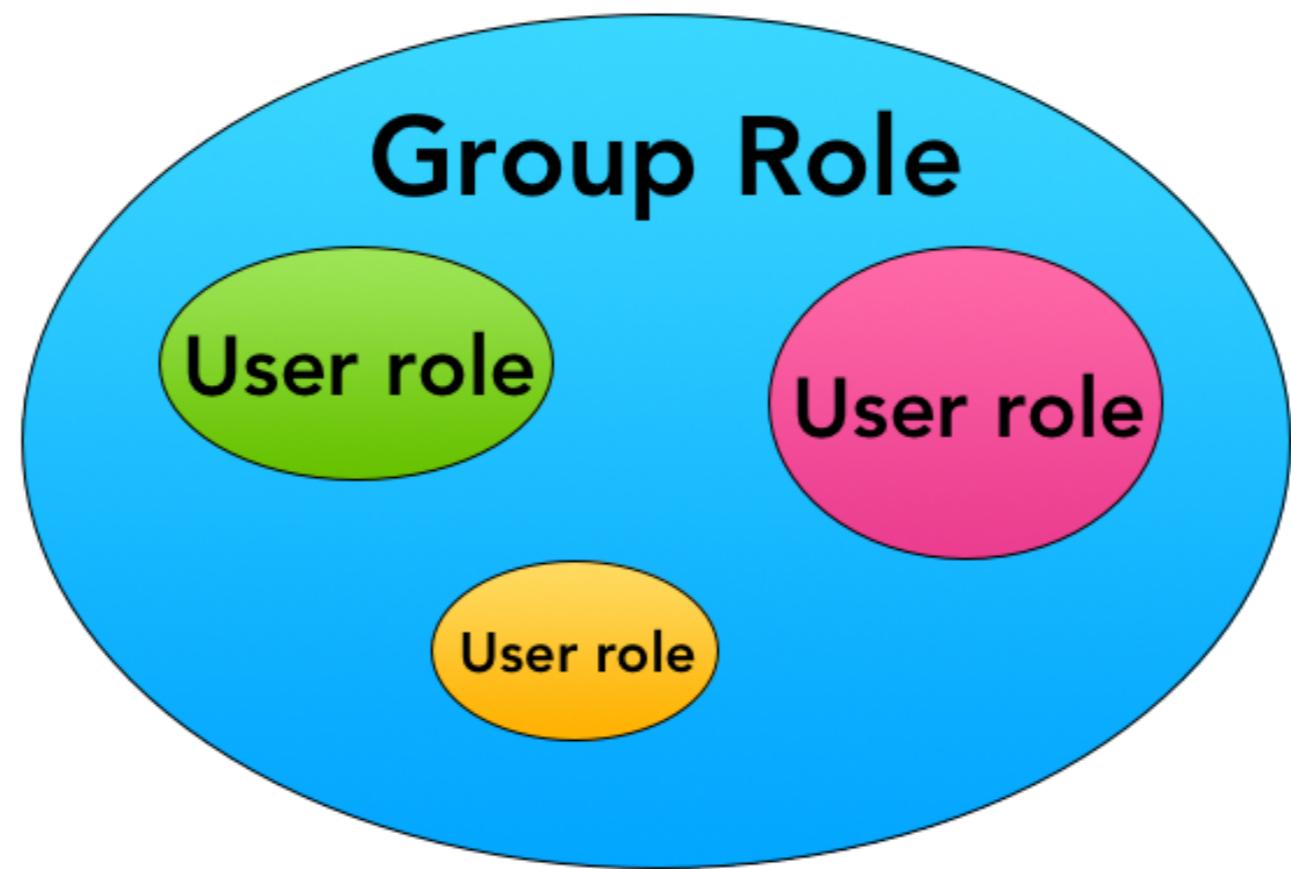
The available privileges in PostgreSQL are:

- `SELECT` , `INSERT` , `UPDATE` , `DELETE` , `TRUNCATE` , `REFERENCES` , `TRIGGER` , `CREATE` , `CONNECT` ,  
`TEMPORARY` , `EXECUTE` , and `USAGE`

<sup>1</sup> [http://bit.ly/postgresql\\_privileges](http://bit.ly/postgresql_privileges)

# Users and groups (are both roles)

- A role is an entity that can function as a user and/or a group
  - User roles
  - Group roles



# Users and groups (are both roles)

## Group role

```
CREATE ROLE data_analyst;
```

## User role

```
CREATE ROLE intern WITH PASSWORD 'PasswordForIntern' VALID UNTIL '2020-01-01';
```

# Users and groups (are both roles)

## Group role

```
CREATE ROLE data_analyst;
```

## User role

```
CREATE ROLE alex WITH PASSWORD 'PasswordForIntern' VALID UNTIL '2020-01-01';
```

---

```
GRANT data_analyst TO alex;
```

```
REVOKE data_analyst FROM alex;
```

# Common PostgreSQL roles

| Role                 | Allowed access  |
|----------------------|---|
| pg_read_all_settings | Read all configuration variables, even those normally visible only to superusers.                                       |
| pg_read_all_stats    | Read all pg_stat_* views and use various statistics related extensions, even those normally visible only to superusers. |
| pg_signal_backend    | Send signals to other backends (eg: cancel query, terminate).   |
| More...              | More...   |

<sup>1</sup> [http://bit.ly/default\\_roles\\_postgresql](http://bit.ly/default_roles_postgresql)

# Benefits and pitfalls of roles

## Benefits

- Roles live on after users are deleted
- Roles can be created before user accounts
- Save DBAs time

## Pitfalls

- Sometimes a role gives a specific user too much access
  - You need to pay attention

# **Let's practice!**

## **DATABASE DESIGN**

# Table partitioning

DATABASE DESIGN



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# Why partition?

*Tables grow (100s Gb / Tb)*

**Problem:** queries/updates become slower

**Because:** e.g., indices don't fit memory

**Solution:** split table into smaller parts (= **partitioning**)



# Data modeling refresher

## 1. Conceptual data model

## 2. Logical data model

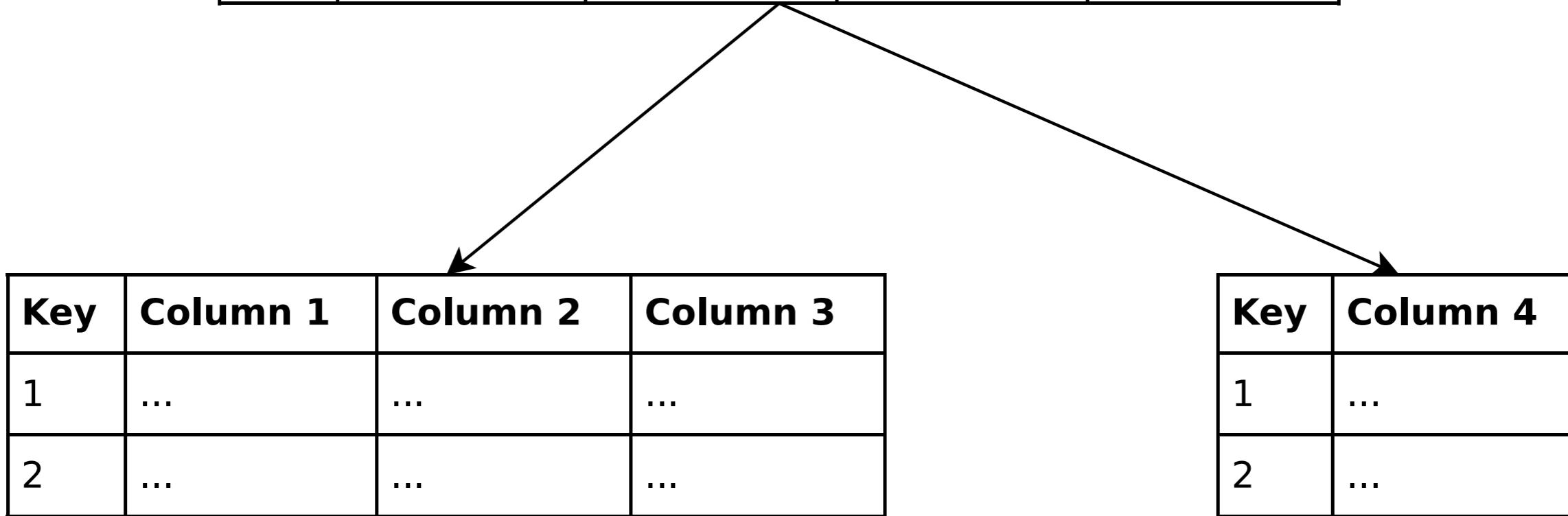
*For partitioning, logical data model is the same*

## 3. Physical data model

Partitioning is part of physical data model

# Vertical partitioning

| Key | Column 1 | Column 2 | Column 3 | Column 4 |
|-----|----------|----------|----------|----------|
| 1   | ...      | ...      | ...      | ...      |
| 2   | ...      | ...      | ...      | ...      |



*Split table even when fully normalized*

# Vertical partitioning: an example

| <b>id</b> | <b>name</b>    | <b>short_description</b>    | <b>price</b> | <b>long_descriptio</b> |
|-----------|----------------|-----------------------------|--------------|------------------------|
| 1         | Sunglasses     | Cool sunglasses             | \$25         | When you put on        |
| 2         | Leather wallet | Leather wallet with writing | \$127        | The wallet says 'B     |

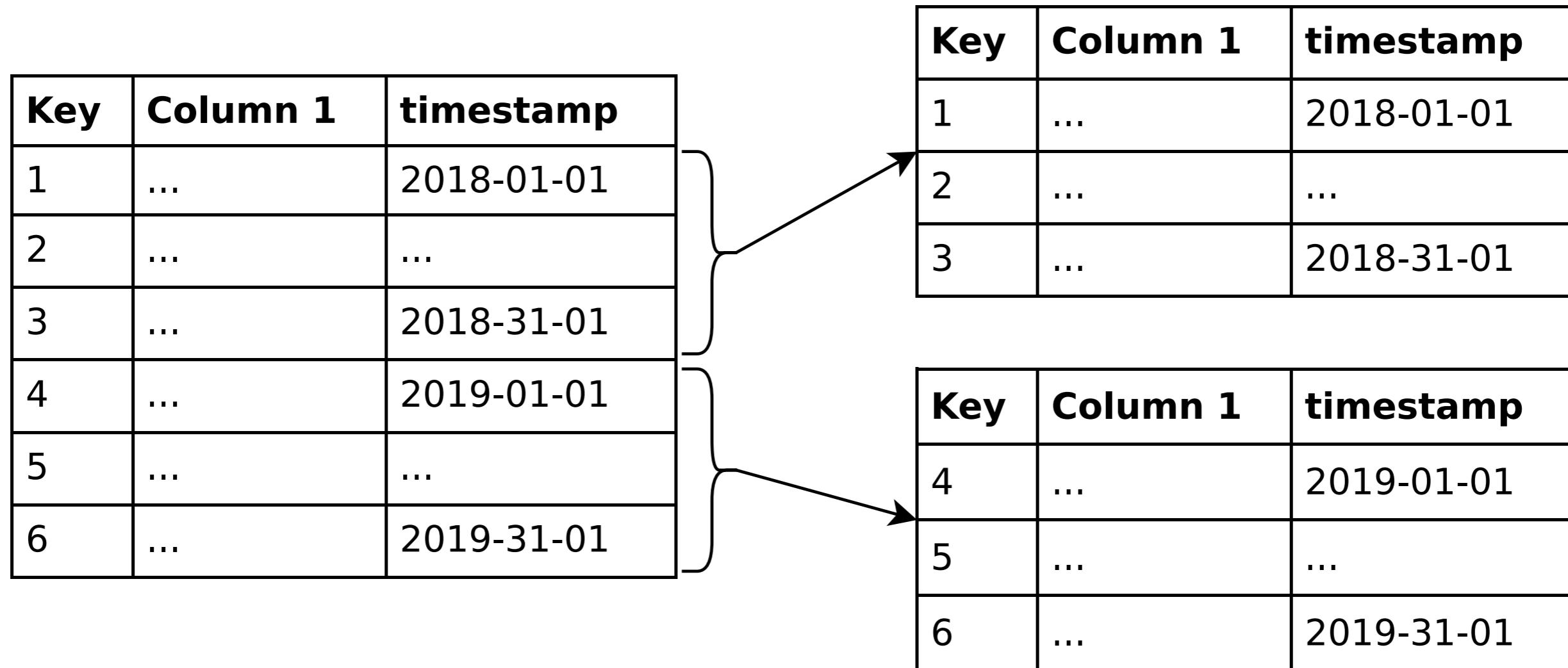
The diagram illustrates the process of vertical partitioning. At the top, there is a large table containing five columns: id, name, short\_description, price, and long\_description. Two arrows originate from the rightmost column, long\_description, and point downwards to two separate tables below. The left arrow points to a table with four columns: id, name, short\_description, and price. The right arrow points to a table with two columns: id and long\_description.

| <b>id</b> | <b>name</b>    | <b>short_description</b>    | <b>price</b> |
|-----------|----------------|-----------------------------|--------------|
| 1         | Sunglasses     | Cool sunglasses             | \$25         |
| 2         | Leather wallet | Leather wallet with writing | \$127        |

| <b>id</b> | <b>long_descri</b>        |
|-----------|---------------------------|
| 1         | When you put on these ... |
| 2         | The wallet says 'Bad ...  |

E.g., store `long_description` on slower medium

# Horizontal partitioning



# Horizontal partitioning: an example

| <b>id</b> | <b>product_id</b> | <b>amount</b> | <b>total_price</b> | <b>timestamp</b> |
|-----------|-------------------|---------------|--------------------|------------------|
| 1         | 123               | 1             | \$102              | 2019-04-0        |
| 2         | 101               | 7             | \$21               | 2019-23-0        |
| 3         | 18202             | 1             | \$499              | 2019-30-0        |
| 4         | 1762              | 15            | \$1500             | 2019-21-0        |
| 5         | 10                | 1             | \$5                | 2019-30-0        |
| 6         | 123               | 1             | \$102              | 2019-29-0        |

# Horizontal partitioning: an example

| <b>id</b> | <b>product_id</b> | <b>amount</b> | <b>total_price</b> | <b>timestamp</b> |                 |
|-----------|-------------------|---------------|--------------------|------------------|-----------------|
| 1         | 123               | 1             | \$102              | 2019-04-01       | Q1<br>partition |
| 2         | 101               | 7             | \$21               | 2019-23-01       | Q2<br>partition |
| 3         | 18202             | 1             | \$499              | 2019-30-01       | Q3<br>partition |
| 4         | 1762              | 15            | \$1500             | 2019-21-01       | Q4<br>partition |
| 5         | 10                | 1             | \$5                | 2019-30-01       |                 |
| 6         | 123               | 1             | \$102              | 2019-29-01       |                 |

```
CREATE TABLE sales (
    ...
    timestamp DATE NOT NULL
)
PARTITION BY RANGE (timestamp);

CREATE TABLE sales_2019_q1 PARTITION OF sales
    FOR VALUES FROM ('2019-01-01') TO ('2019-03-31');
...

CREATE TABLE sales_2019_q4 PARTITION OF sales
    FOR VALUES FROM ('2019-09-01') TO ('2019-12-31');

CREATE INDEX ON sales ('timestamp');
```

# Pros/cons of horizontal partitioning

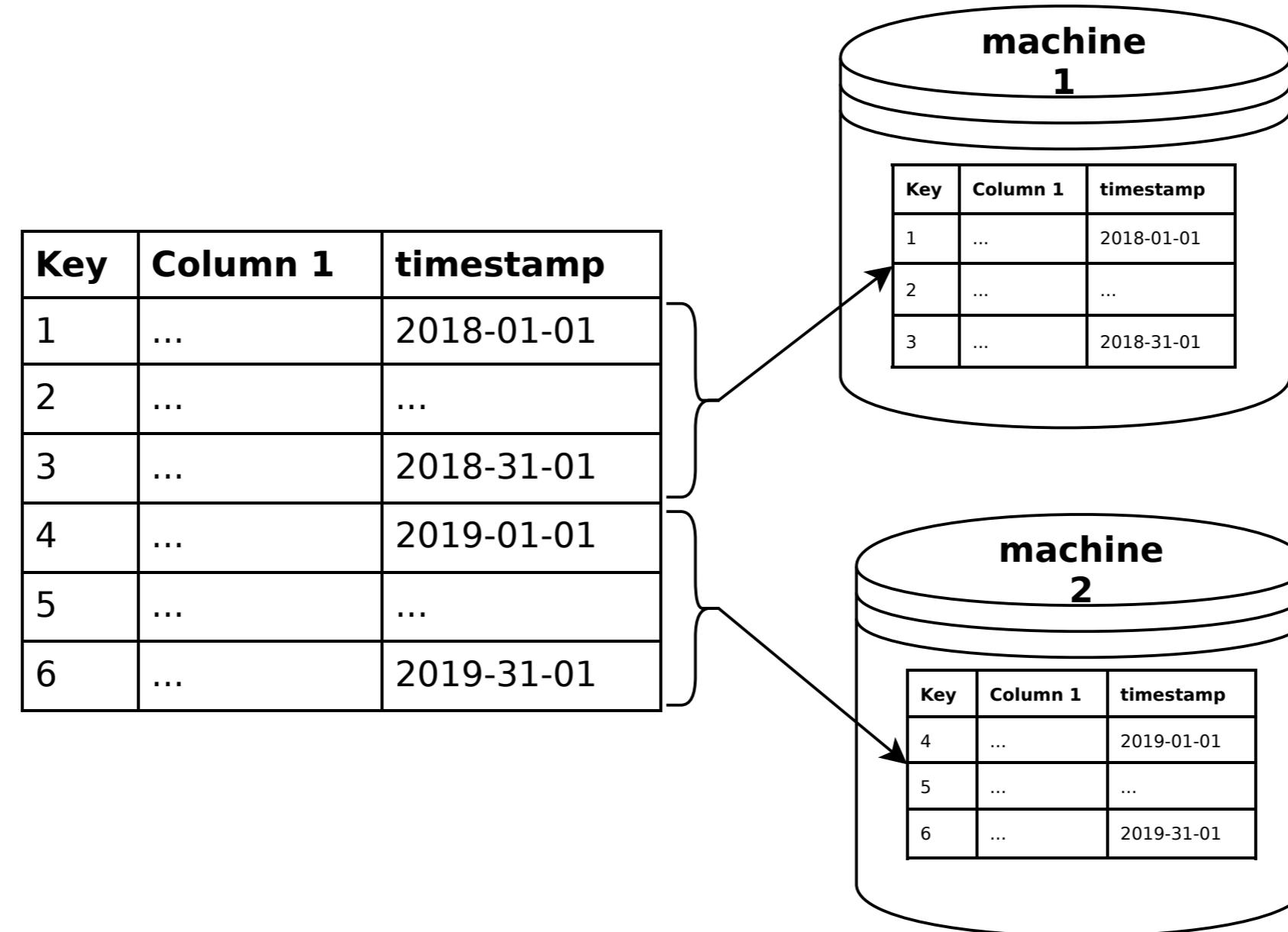
## Pros

- Indices of **heavily-used partitions** fit in memory
- Move to **specific medium**: slower vs. faster
- Used for both OLAP as OLTP

## Cons

- Partitioning **existing table** can be a hassle
- Some **constraints** can not be set

# Relation to sharding



# **Let's practice!**

## **DATABASE DESIGN**

# Data integration

DATABASE DESIGN

SQL

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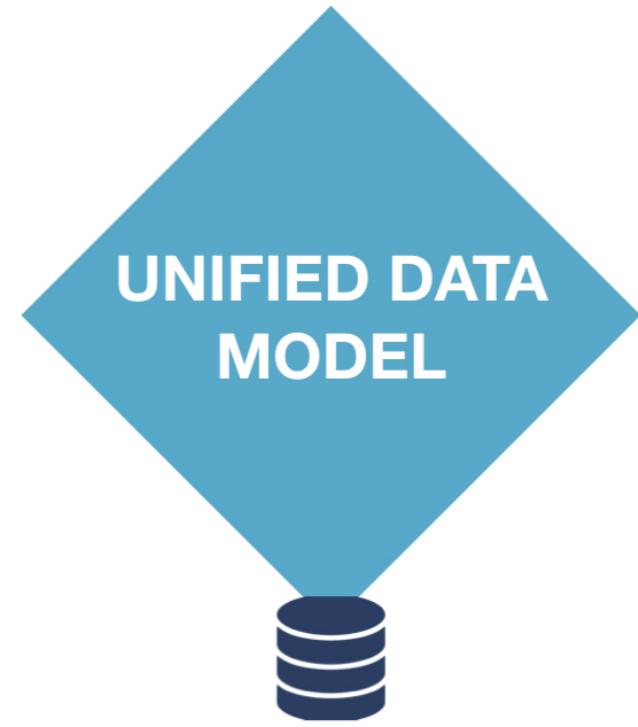
# What is data integration

**Data Integration combines data from different sources, formats, technologies to provide users with a translated and unified view of that data.**

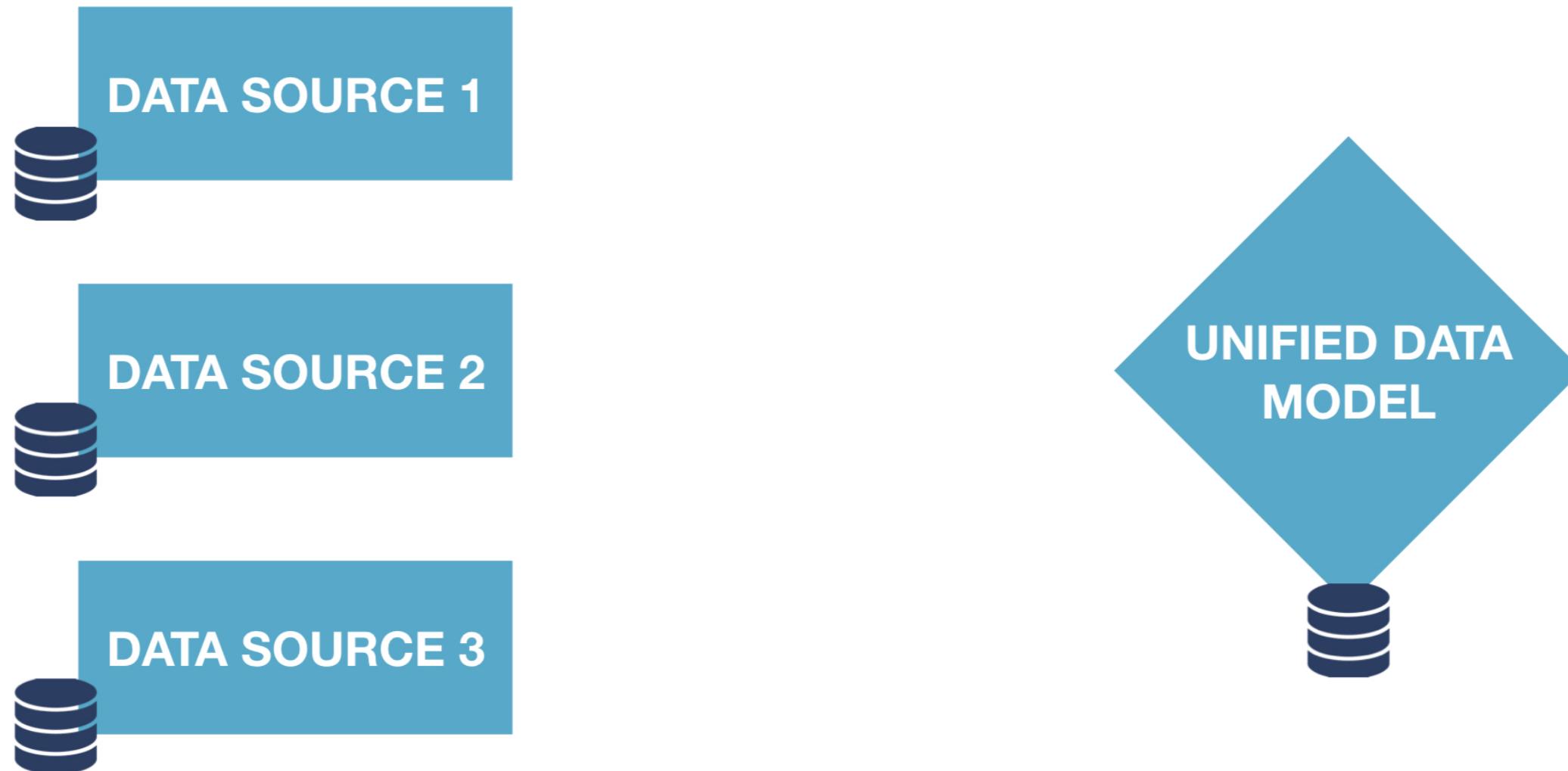
# Business case examples

- 360-degree customer view
- Acquisition
- Legacy systems

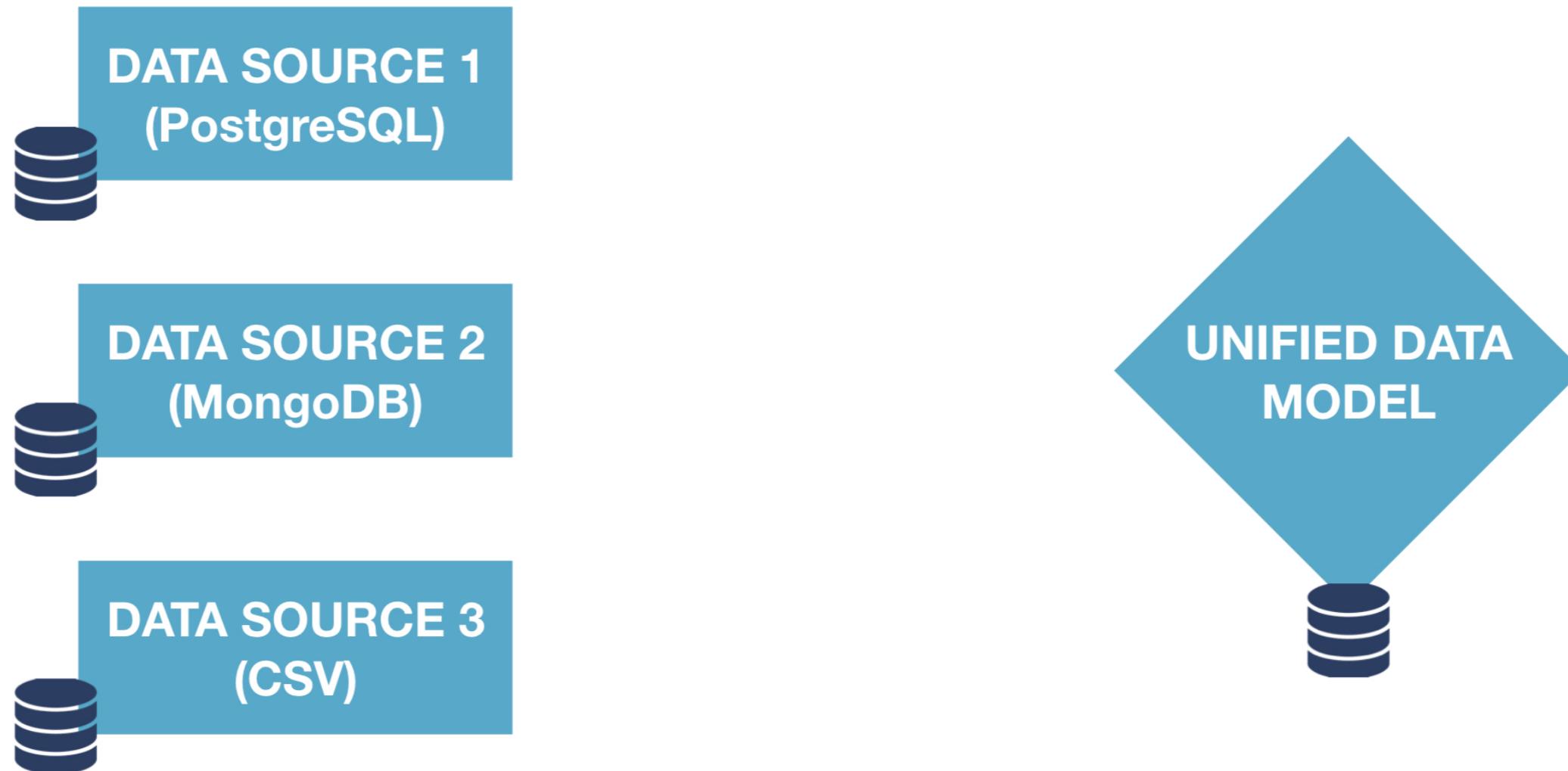
# Unified data model



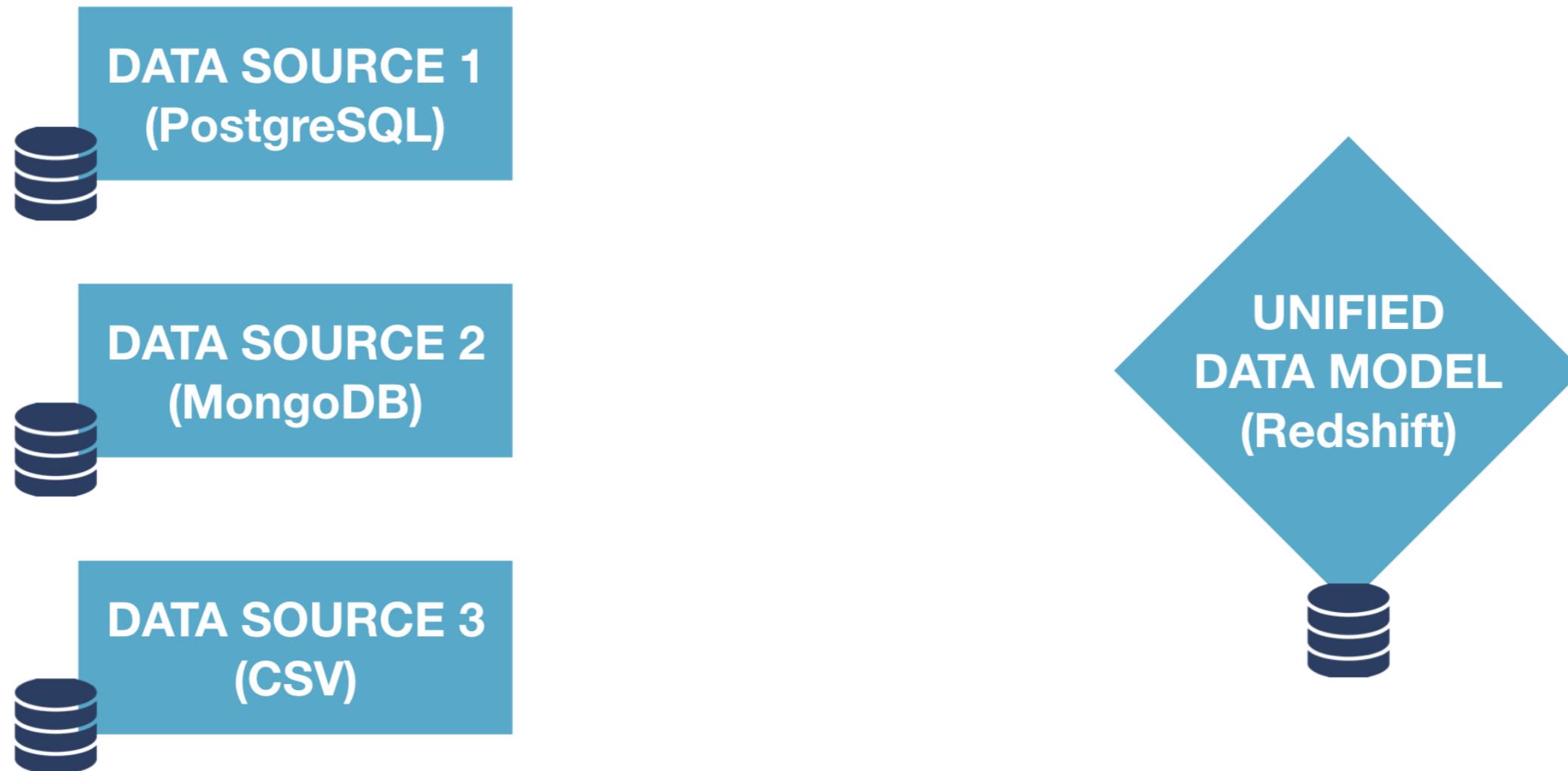
# Data sources



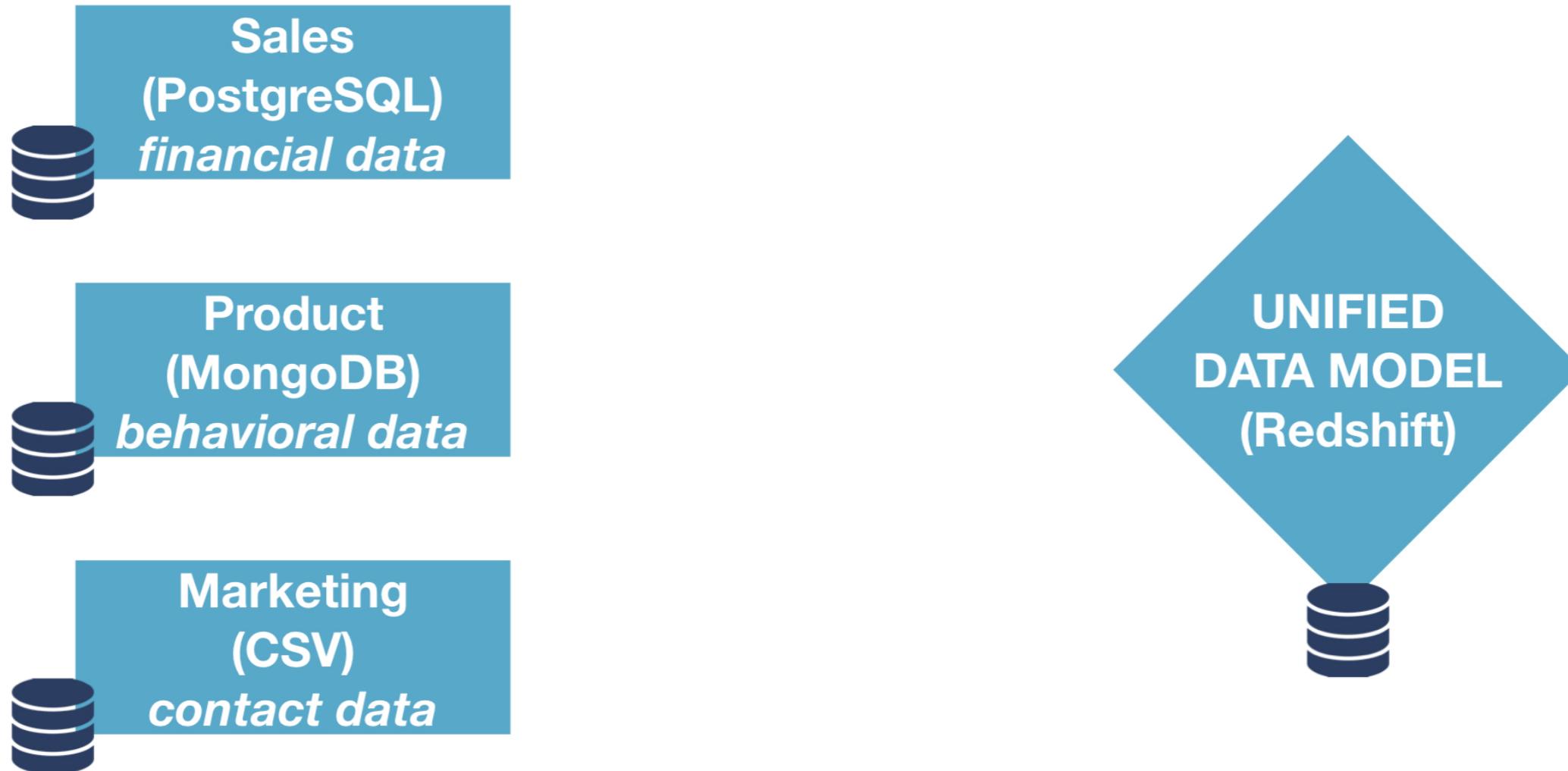
# Data sources format



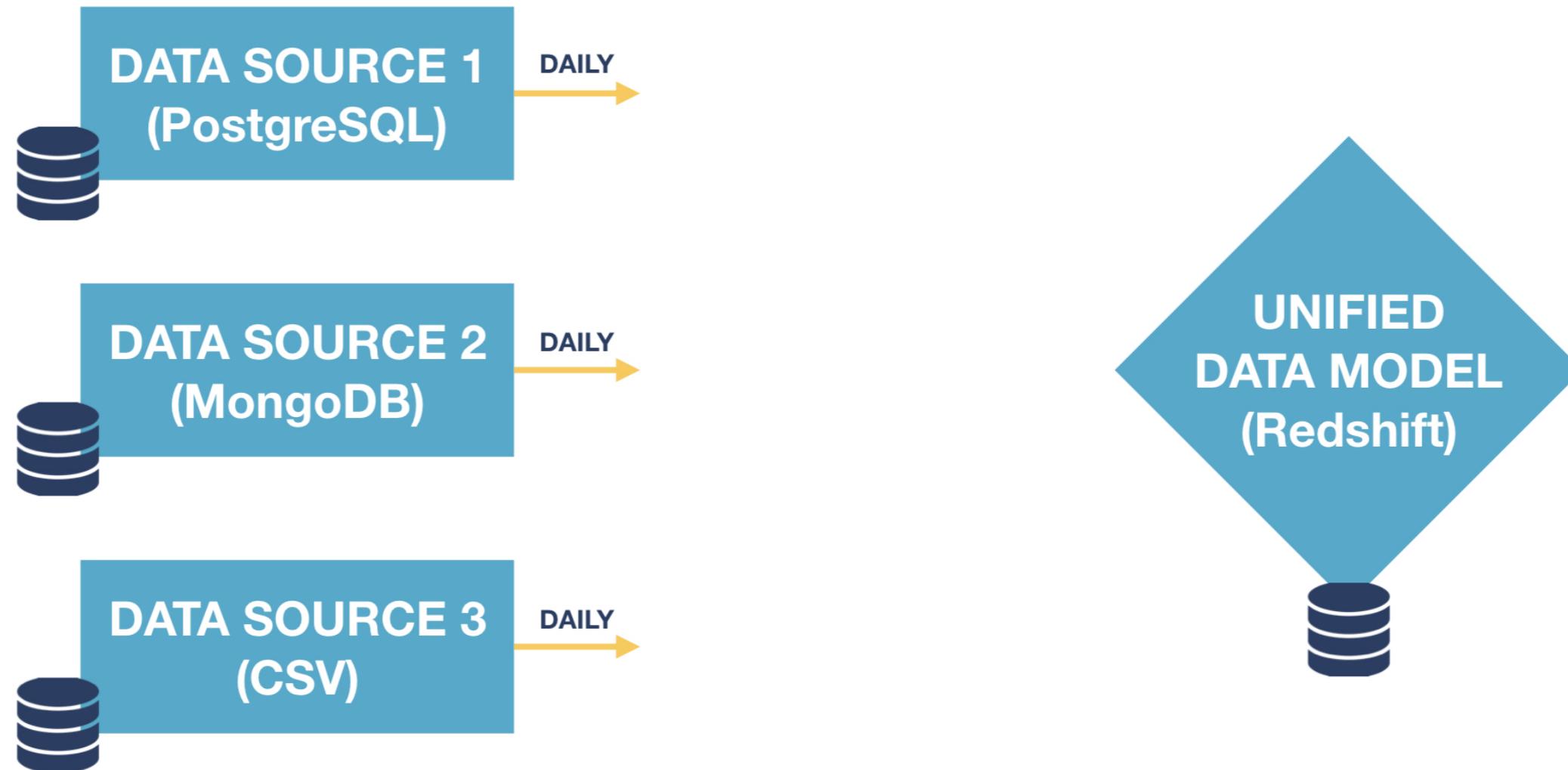
# Unified data model format



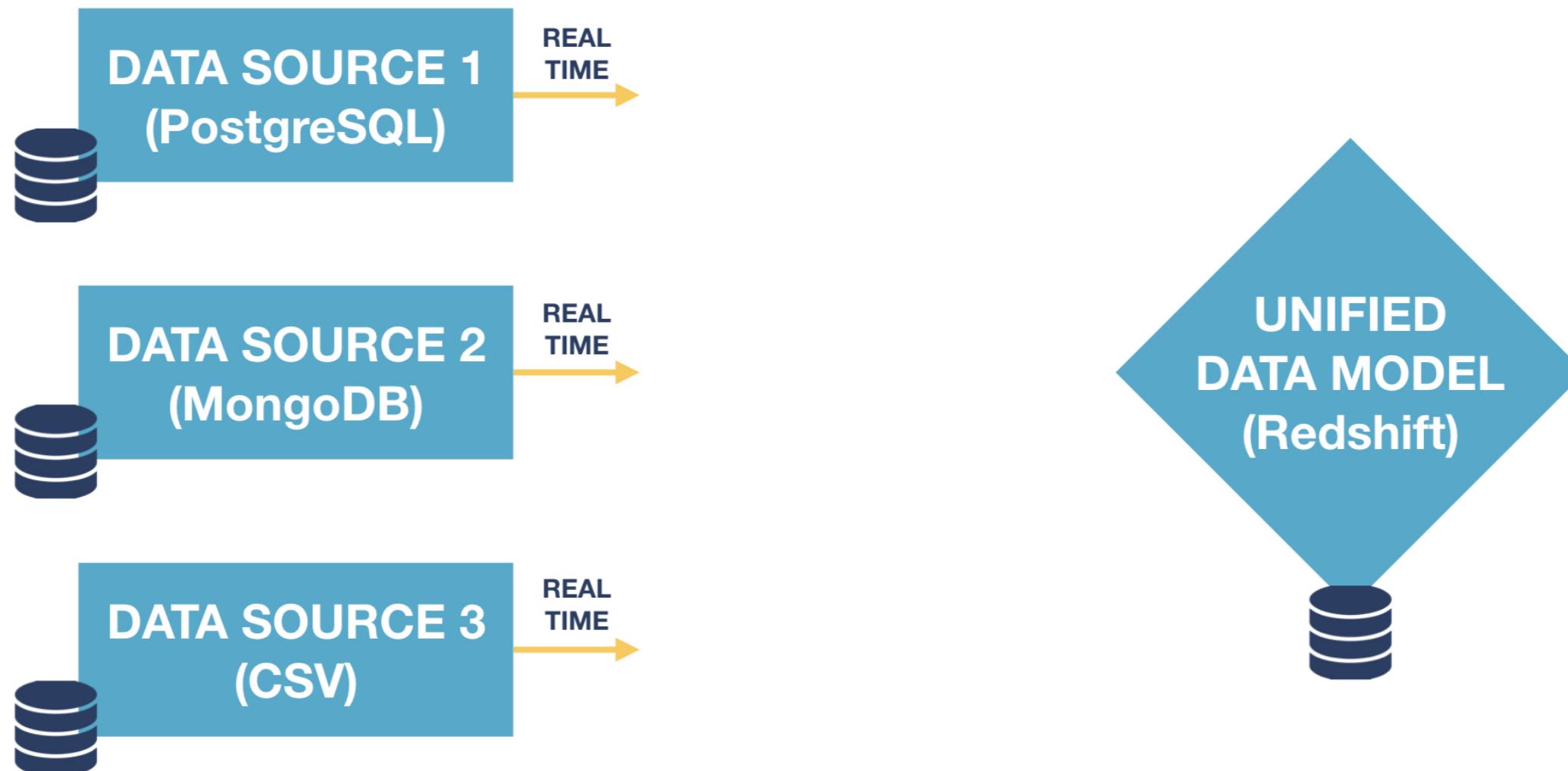
# Example: DataCamp



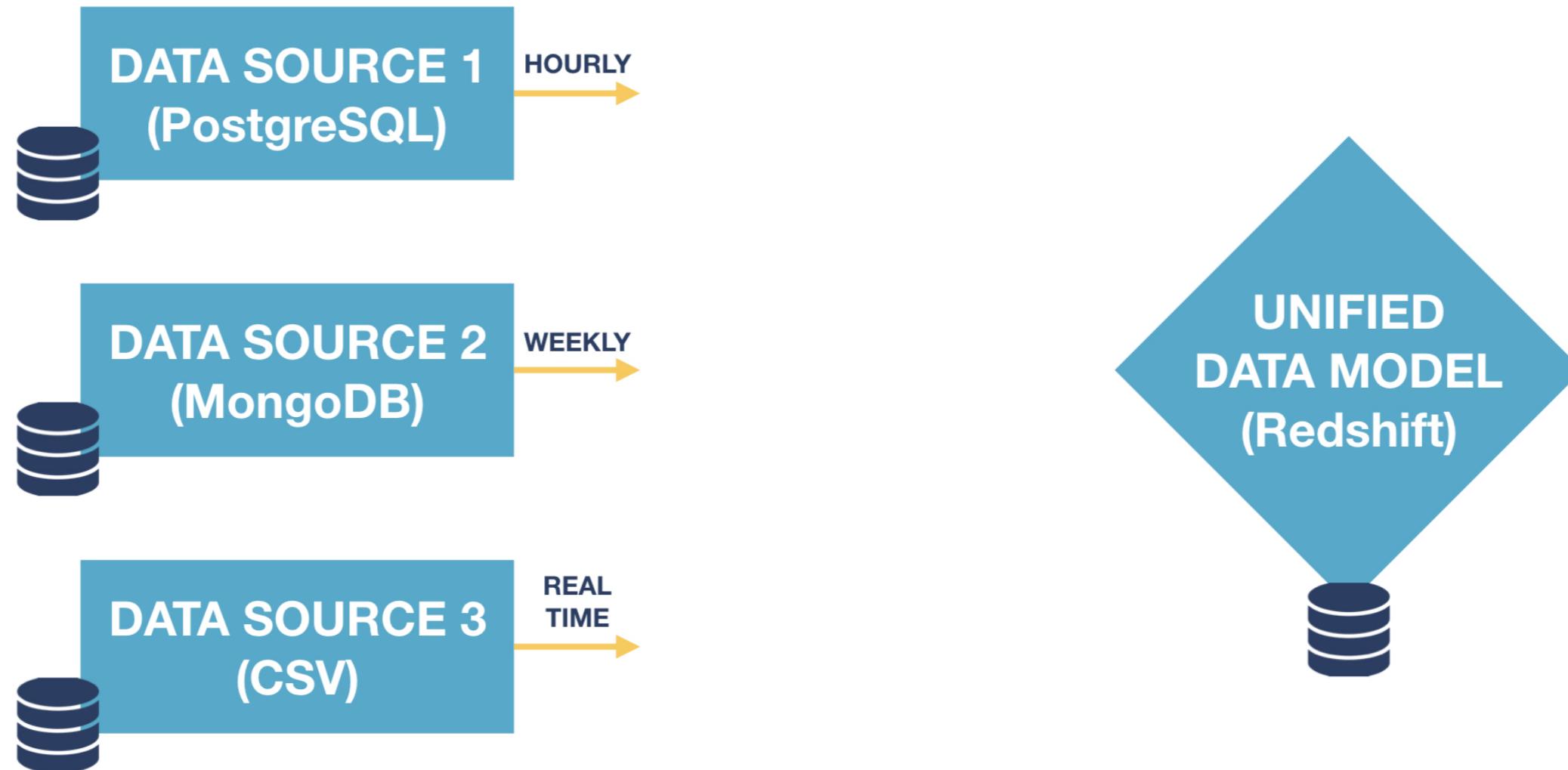
# Update cadence - sales



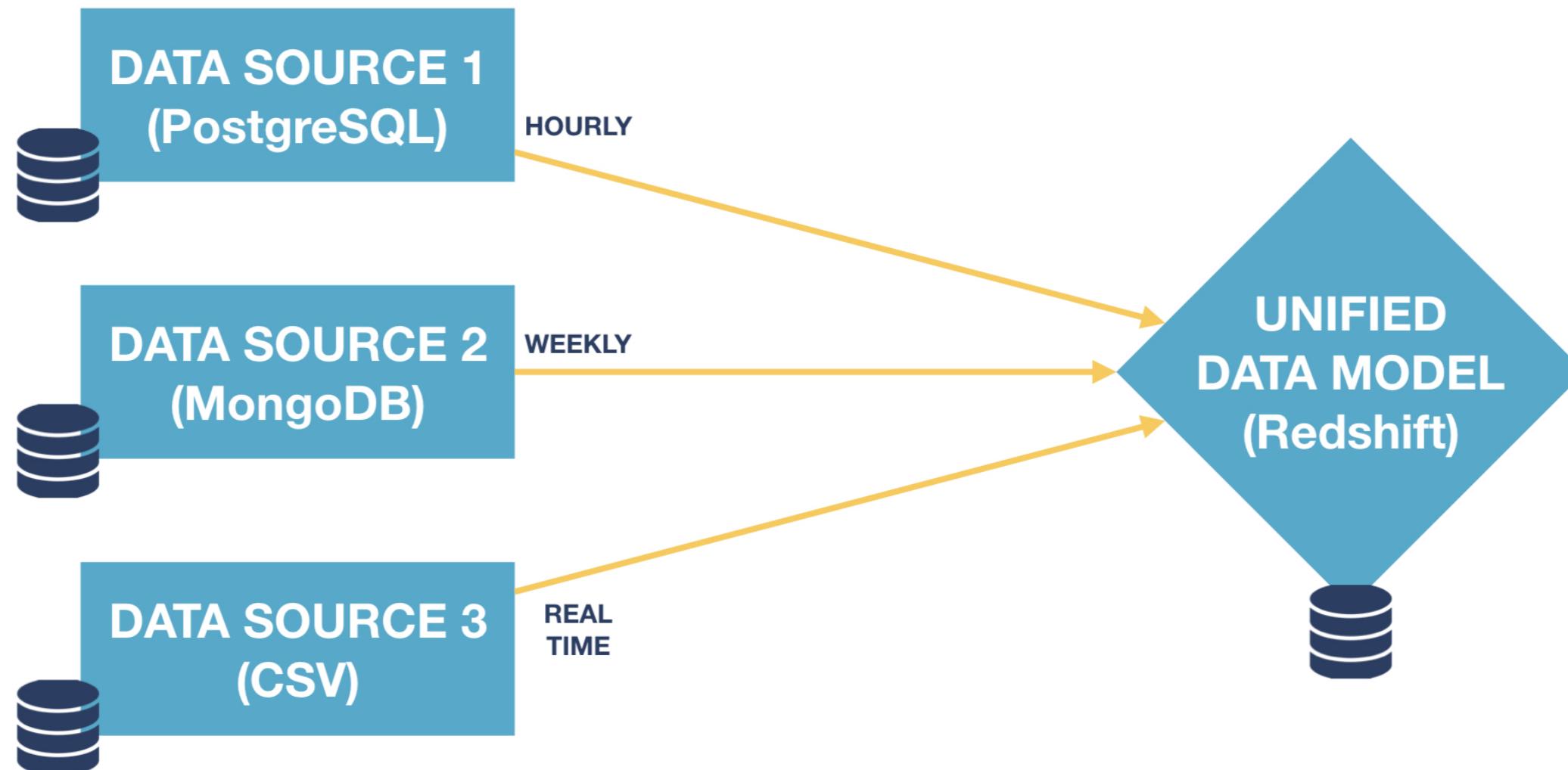
# Update cadence - air traffic



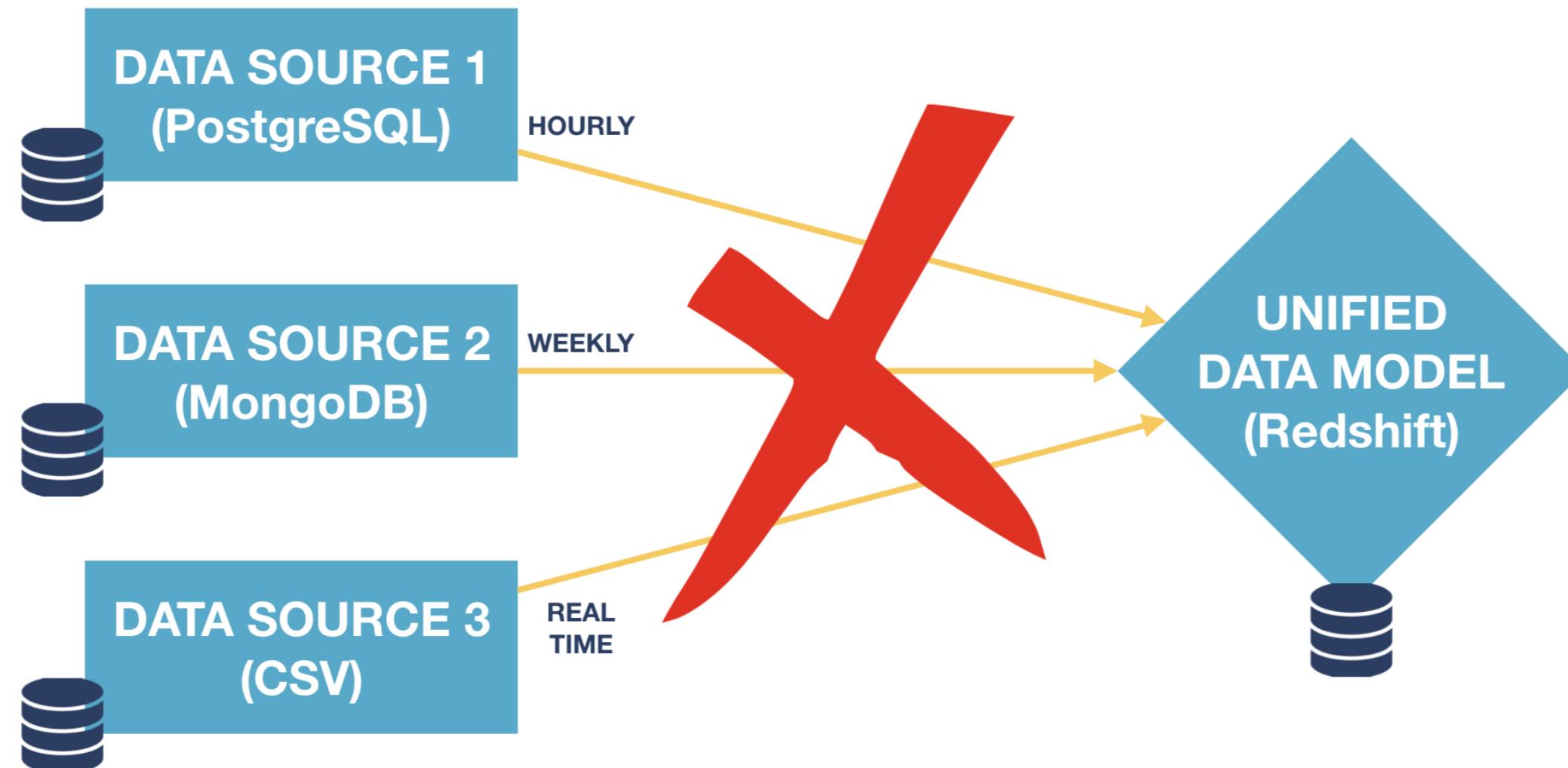
# Different update cadences



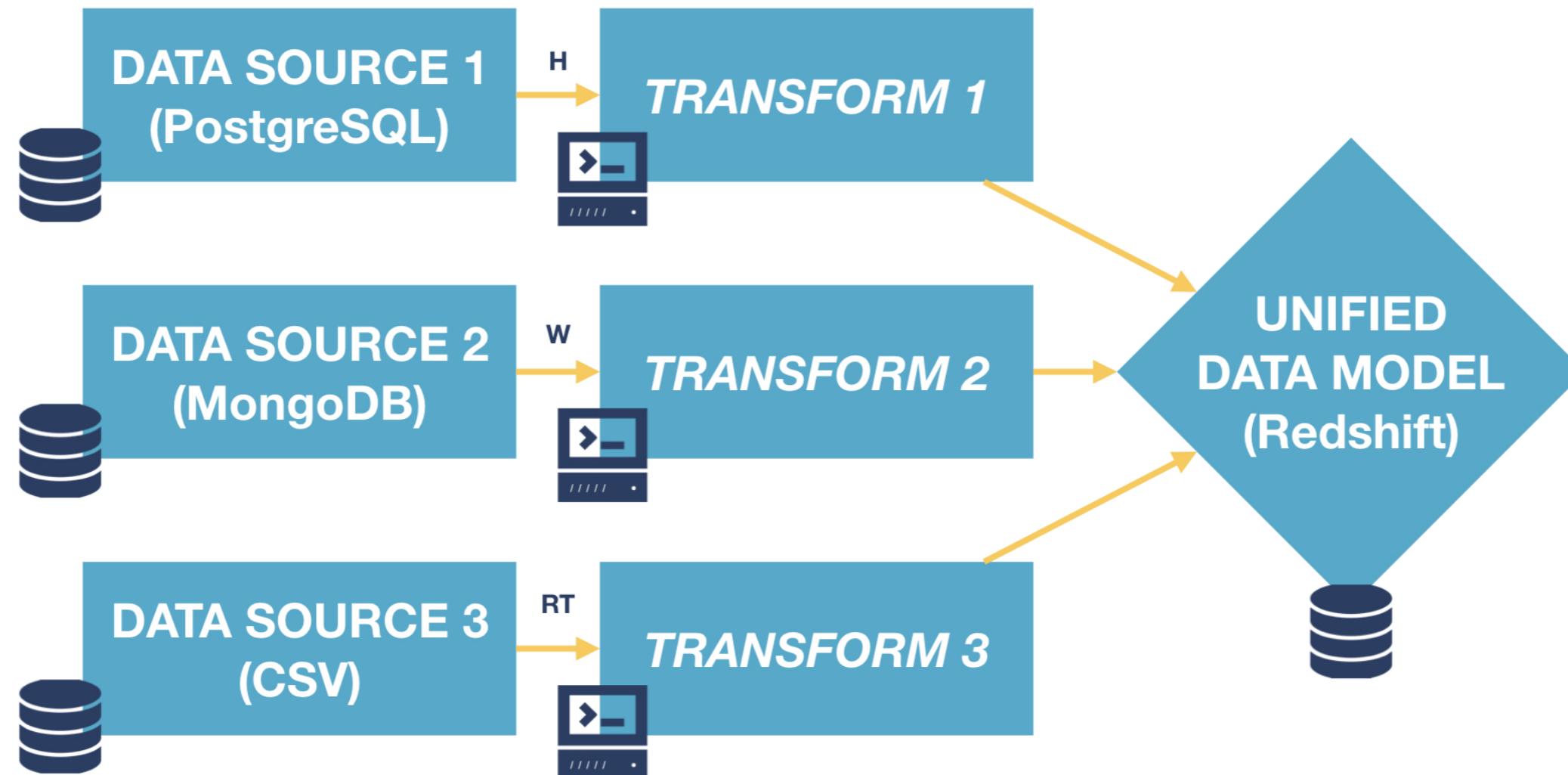
# So simple?



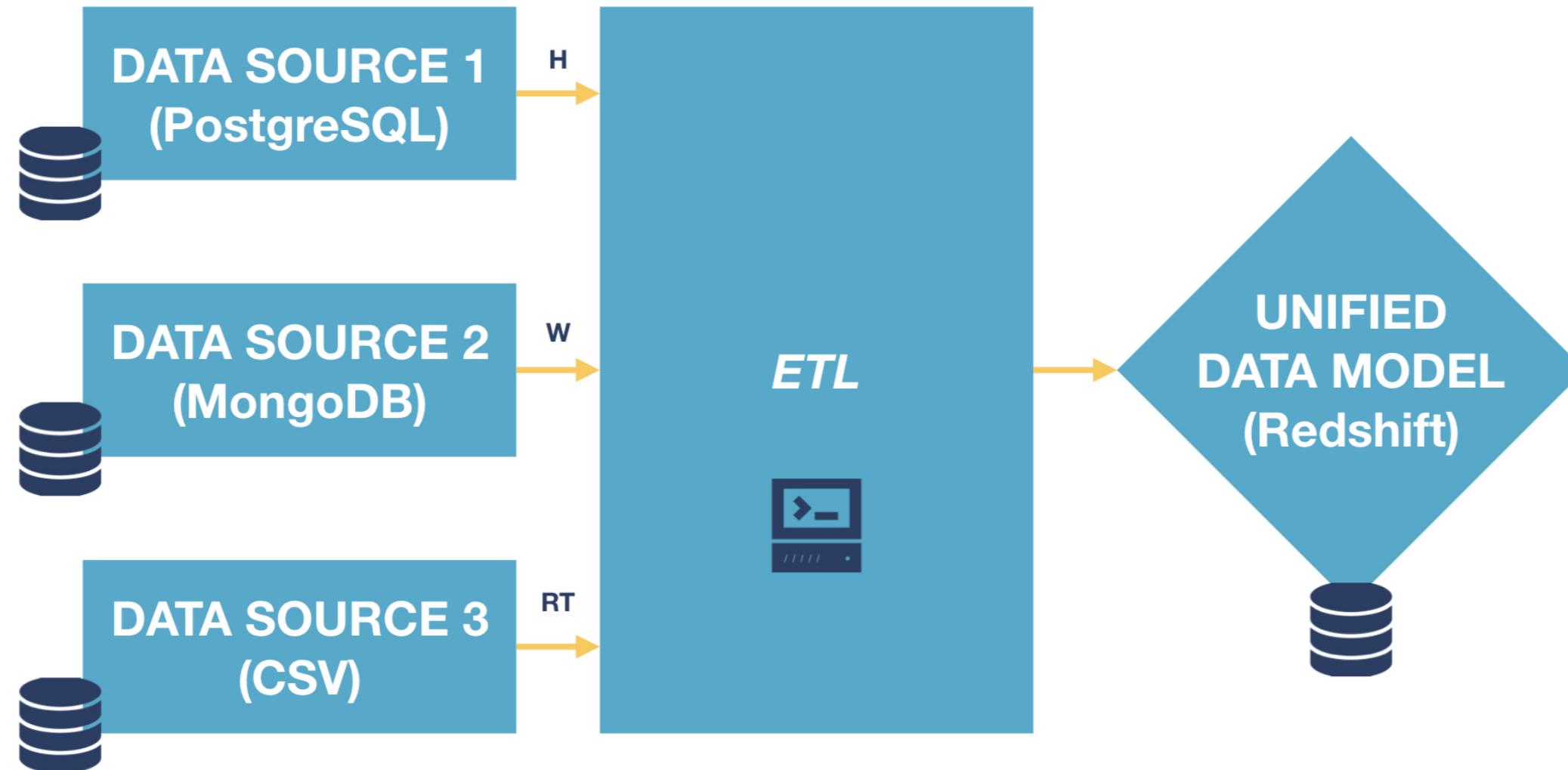
# Not really



# Transformations



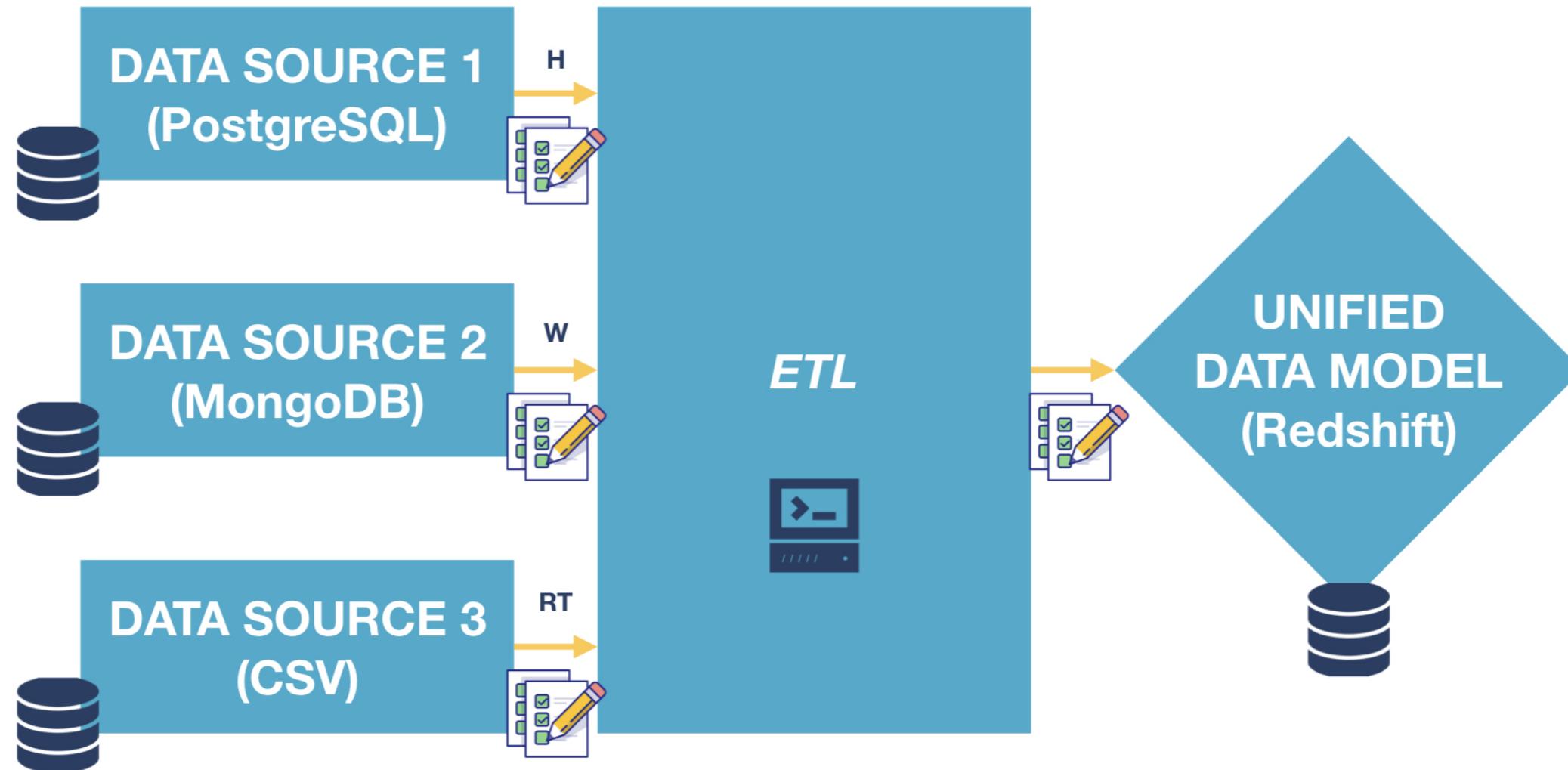
# Transformation - tools



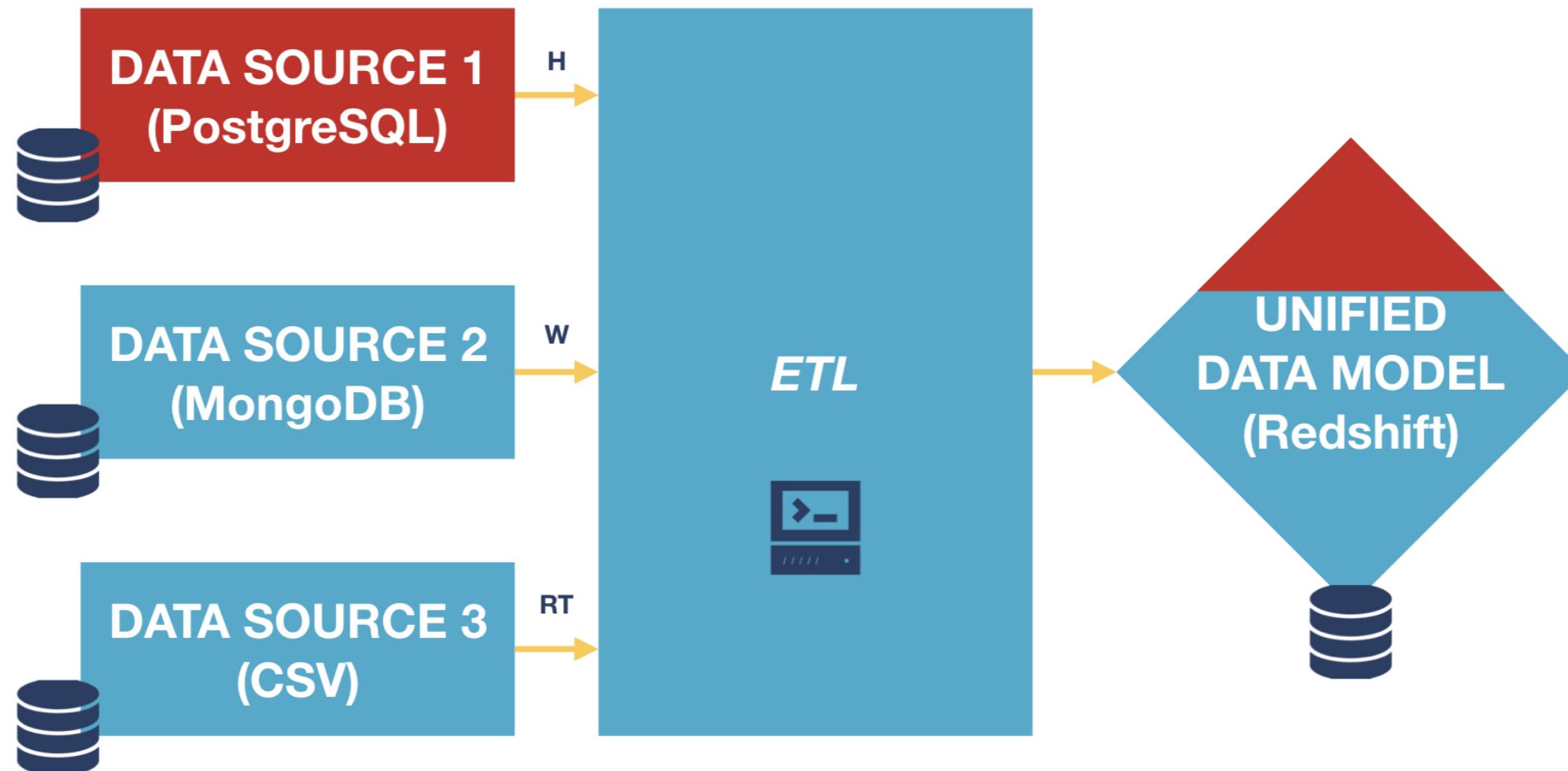
# Choosing a data integration tool

- Flexible
- Reliable
- Scalable

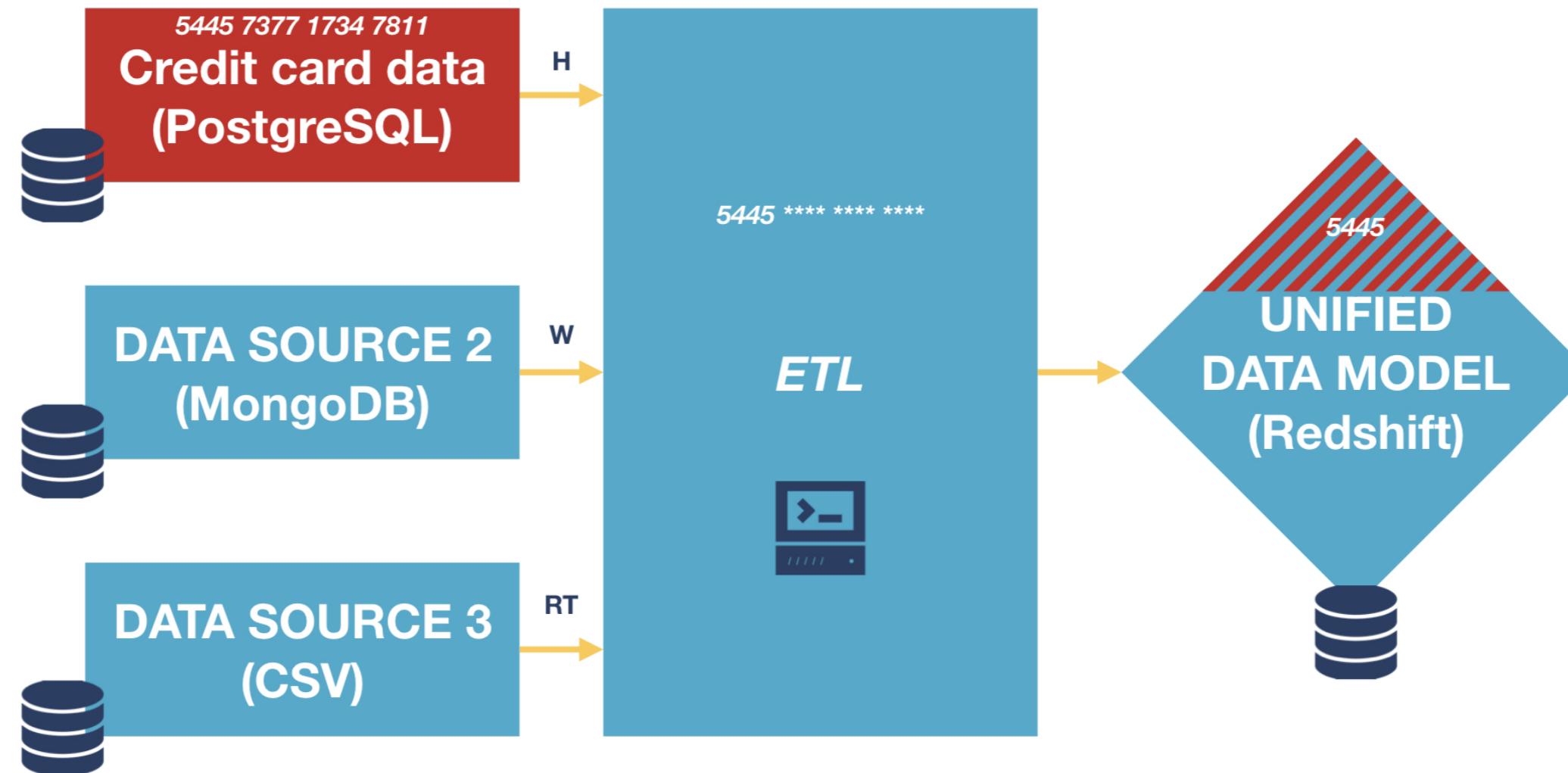
# Automated testing and proactive alerts



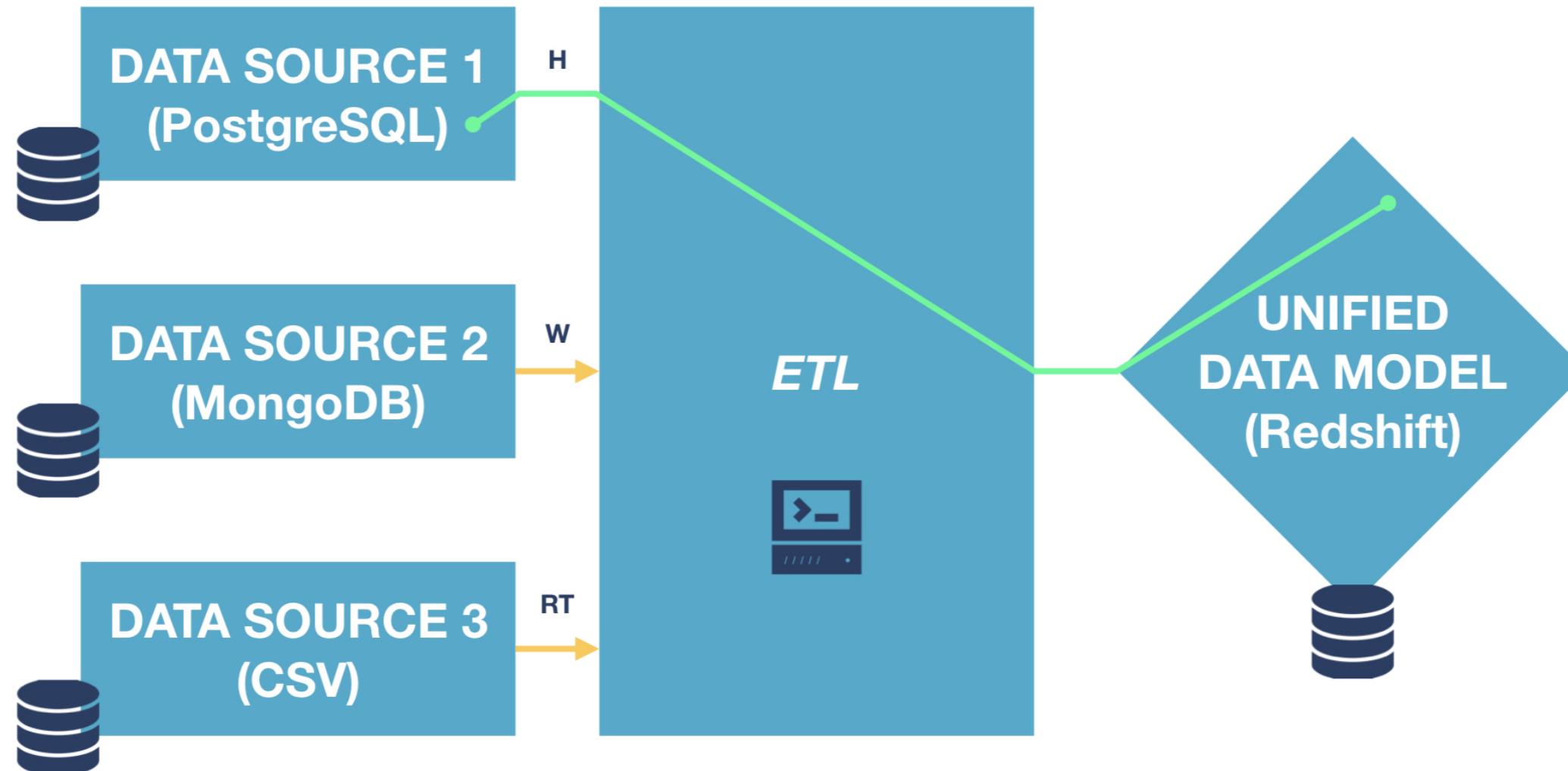
# Security



# Security - credit card anonymization



# Data governance - lineage



# **Let's practice!**

## **DATABASE DESIGN**

# Picking a Database Management System (DBMS)

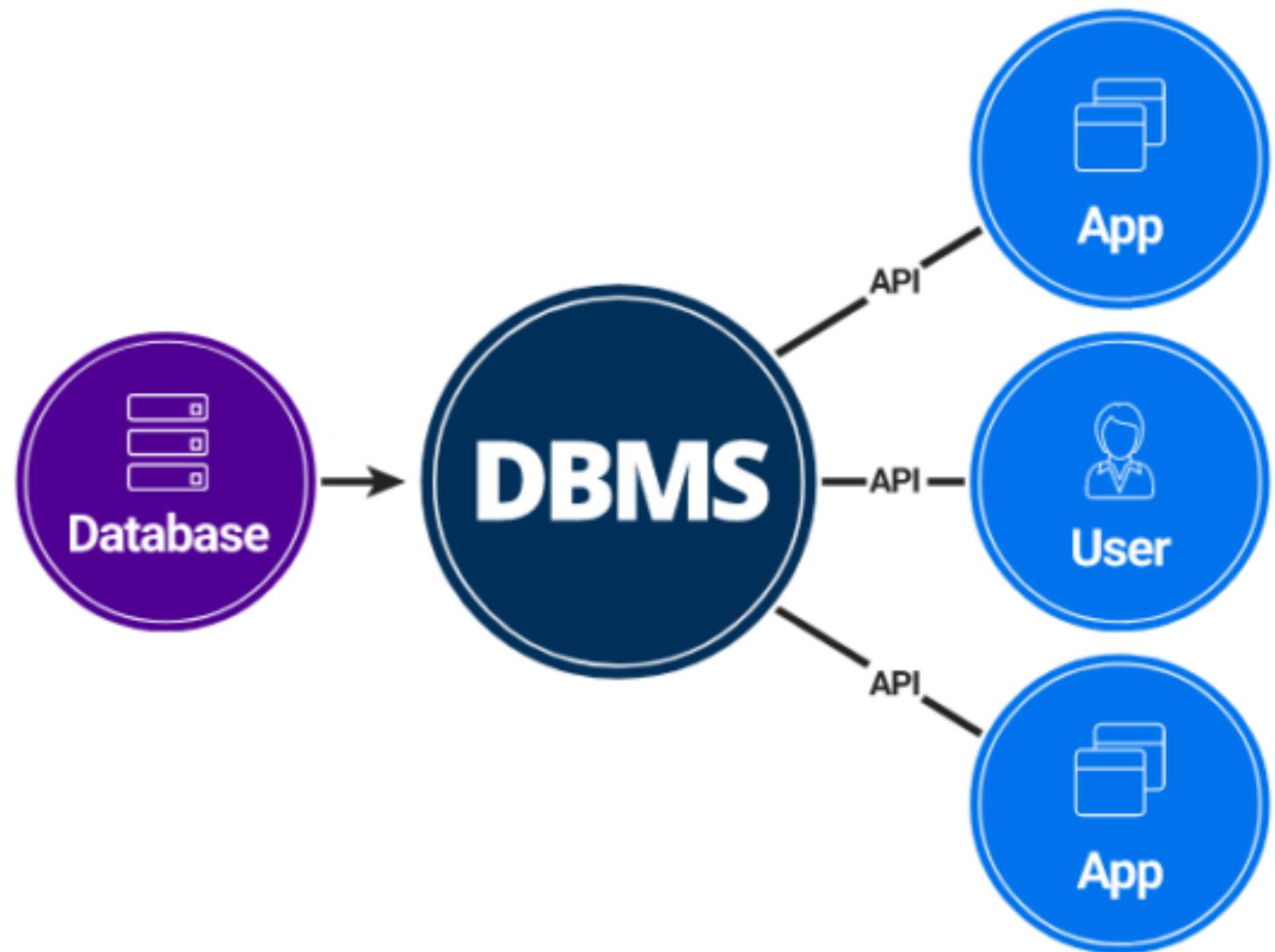
DATABASE DESIGN

A dark blue circular icon containing the white text "SQL".

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# DBMS

- **DBMS:** DataBase Management System
- Create and maintain databases
  - Data
  - Database schema
  - Database engine
- Interface between database and end users



# DBMS types

- Choice of DBMS depends on database type
- Two types:
  - **SQL DBMS**
  - **NoSQL DBMS**

# SQL DBMS

- Relational DataBase Management System (RDBMS)
- Based on the relational model of data
- Query language: SQL
- Best option when:
  - Data is structured and unchanging
  - Data must be consistent

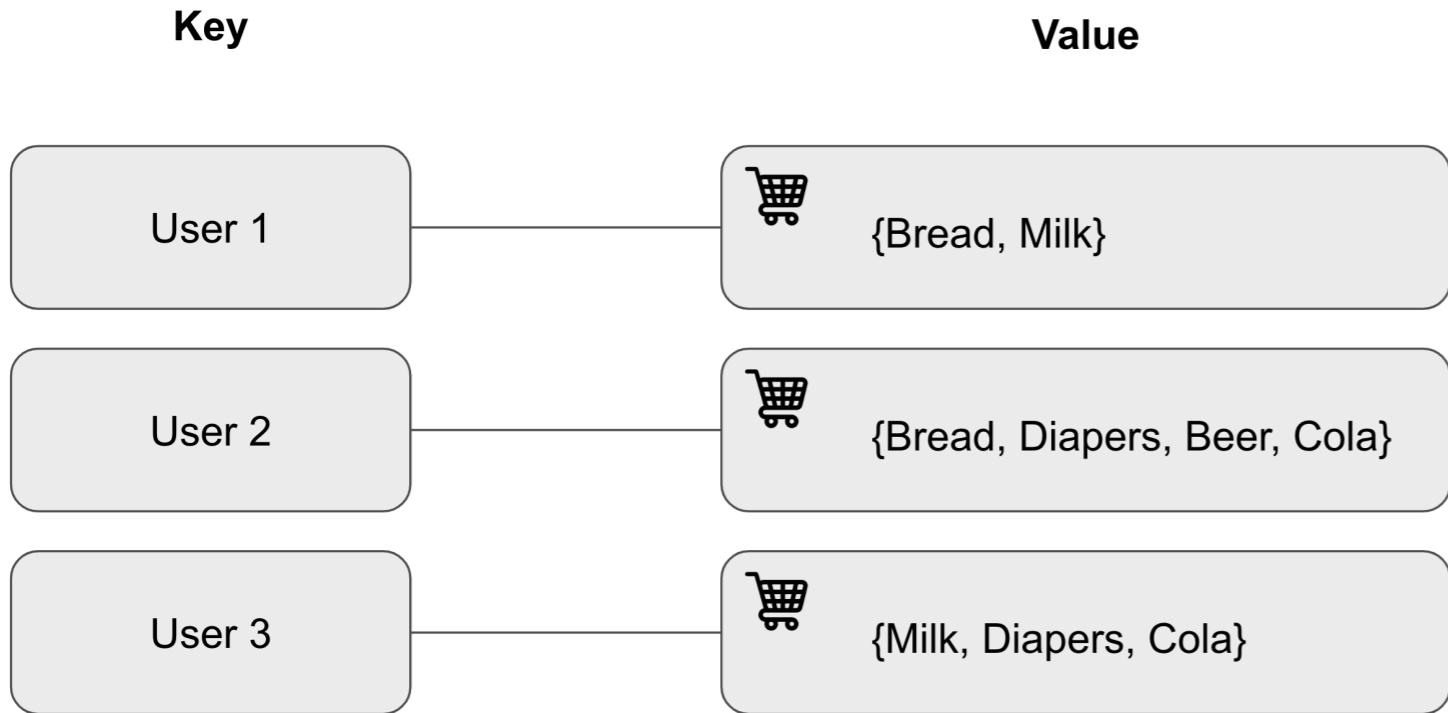


ORACLE

# NoSQL DBMS

- Less structured
- Document-centered rather than table-centered
- Data doesn't have to fit into well-defined rows and columns
- Best option when:
  - Rapid growth
  - No clear schema definitions
  - Large quantities of data
- Types: key-value store, document store, columnar database, graph database

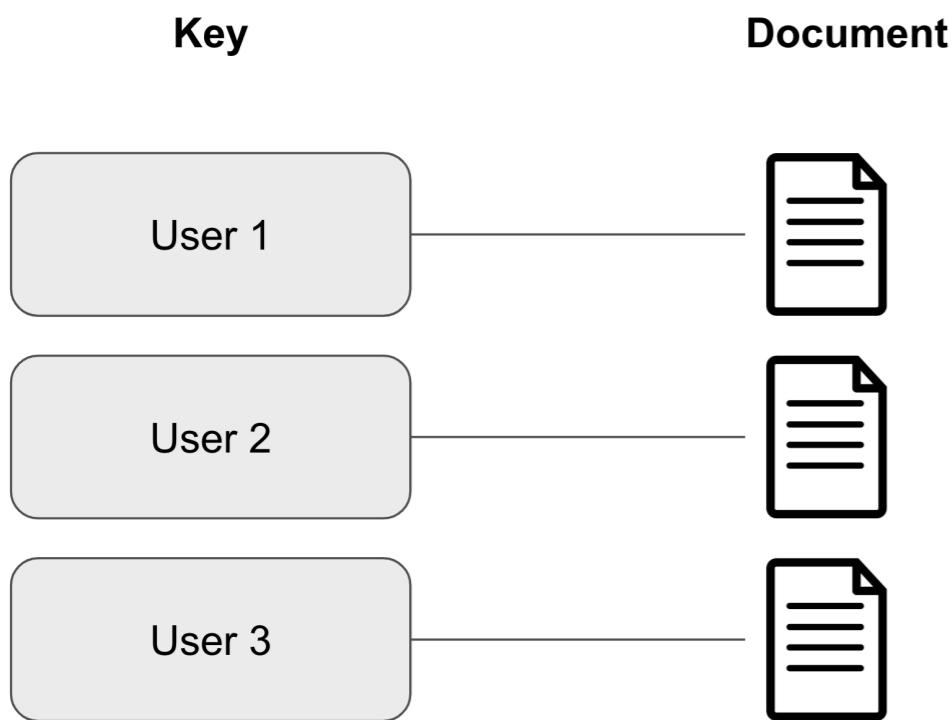
# NoSQL DBMS - key-value store



- Combinations of keys and values
  - Key: unique identifier
  - Value: anything
- **Use case:** managing the shopping cart for an on-line buyer
- Example:



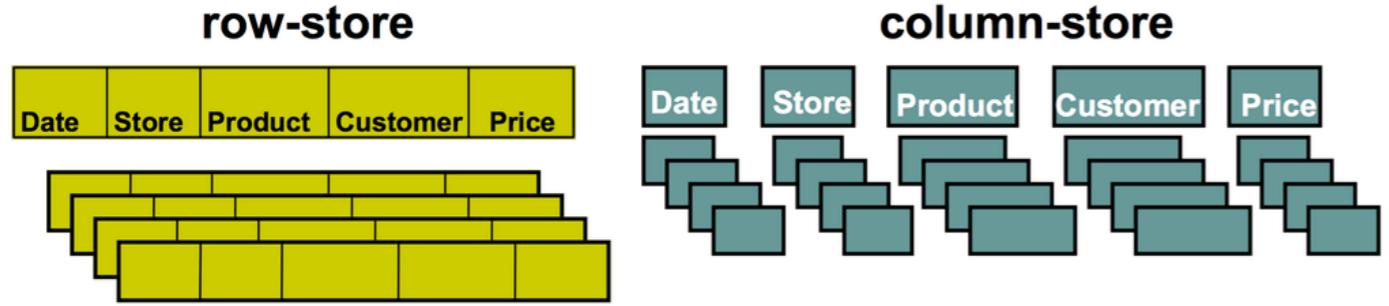
# NoSQL DBMS - document store



- Similar to key-value
- Values (= documents) are structured
- **Use case:** content management
- Example:



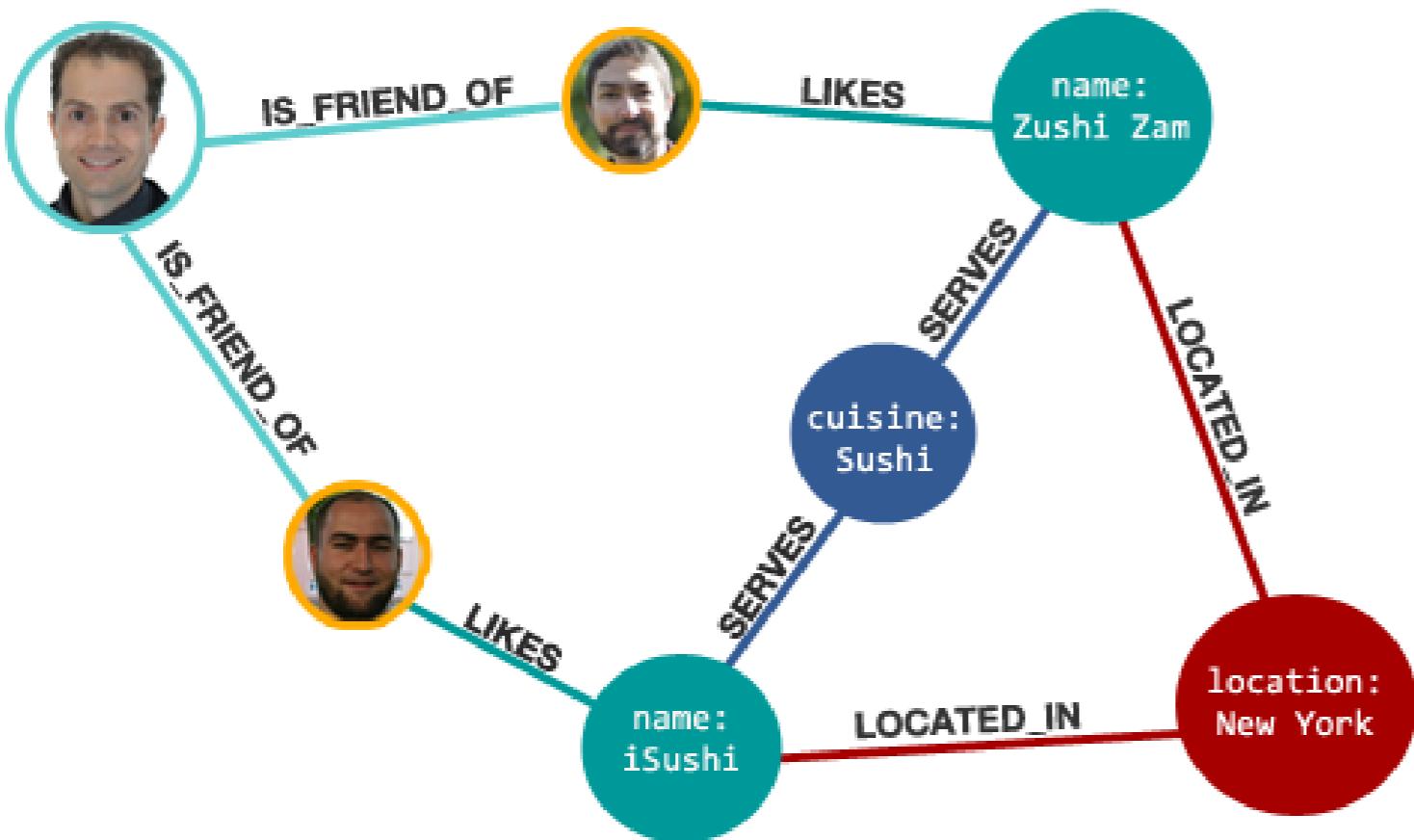
# NoSQL DBMS - columnar database



- Store data in columns
- Scalable
- **Use case:** big data analytics where speed is important
- Example:



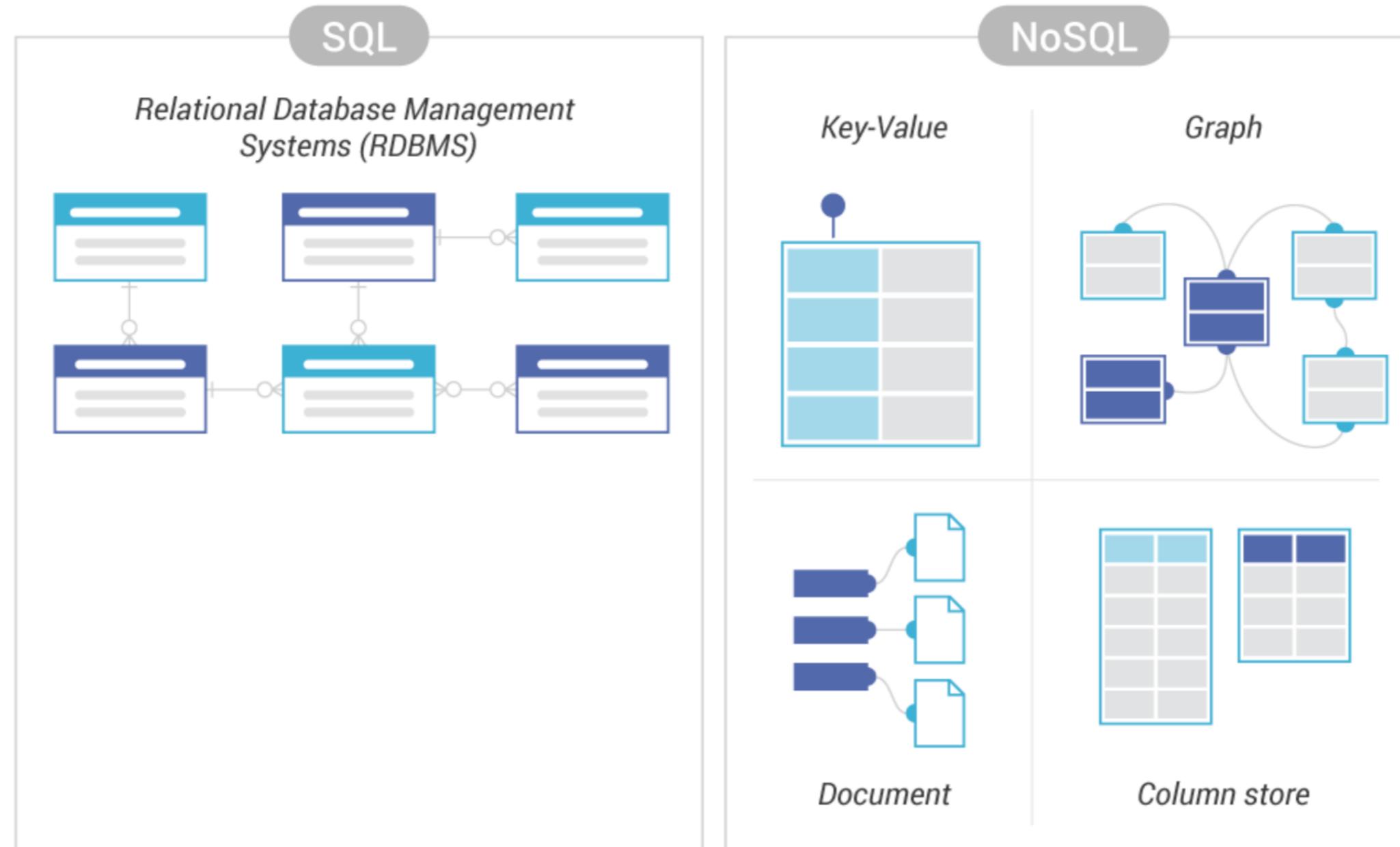
# NoSQL DBMS - graph database



- Data is interconnected and best represented as a graph
- **Use case:** social media data, recommendations
- Example:



# Choosing a DBMS



# **Let's practice!**

## **DATABASE DESIGN**