



Politecnico  
di Torino

# Introduzione alle Applicazioni Web

# Database

Juan Pablo Sáenz

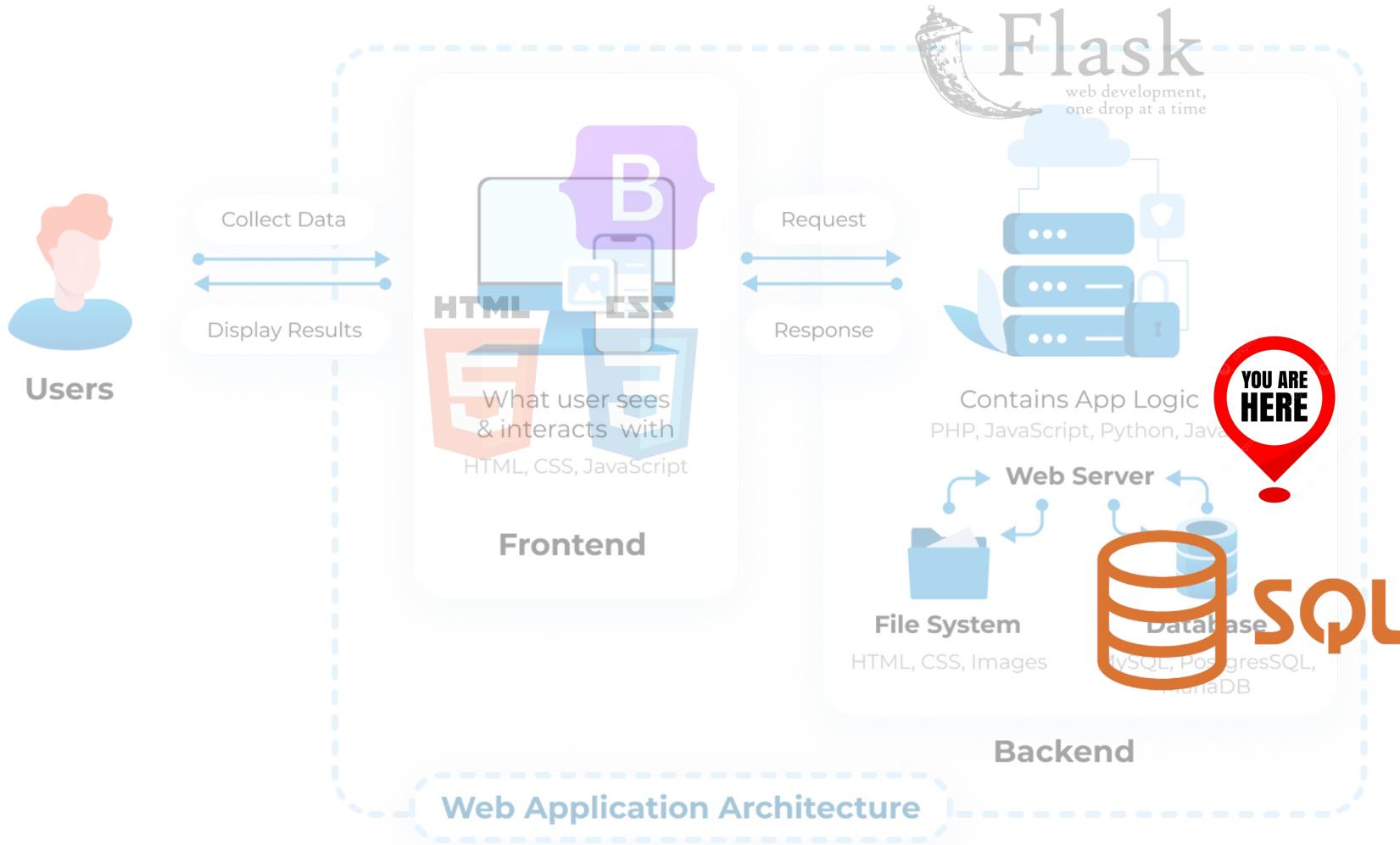


# Goals

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- Understand how to make **data persistent** across application restarts
- Learn how to manage large datasets **beyond in-memory storage**
- Use **SQL** to work with complex data and **perform advanced queries**

# Database: where are we?

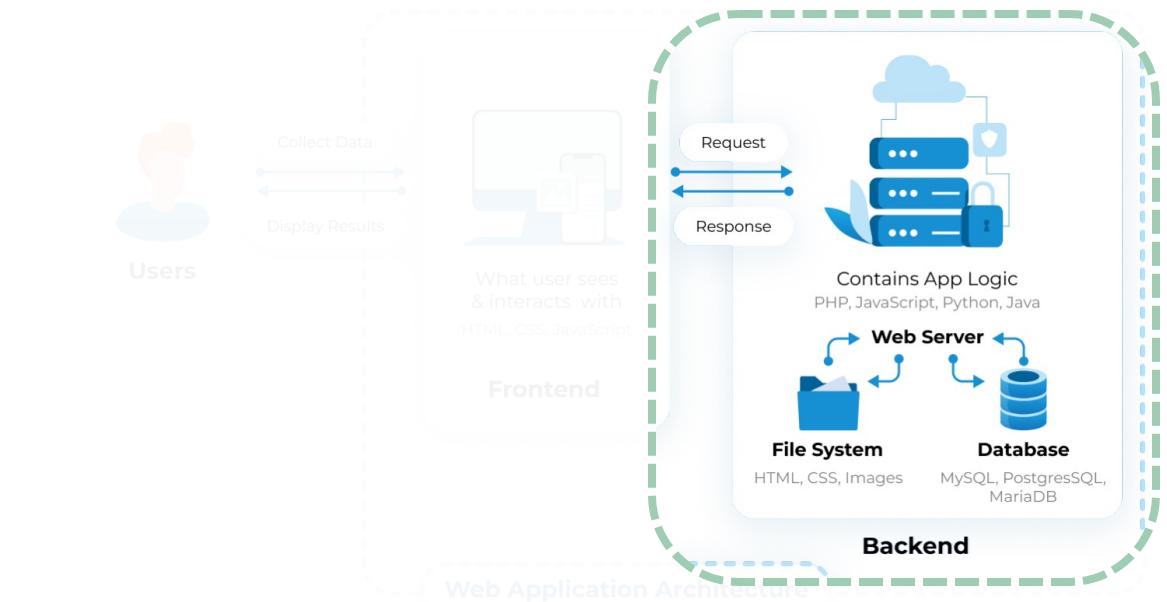




# Web architecture components: Backend

**Database:** a system that **stores and organizes data**, making it easy to retrieve, manage, and update.

- It ensures data integrity, security, and performance, often structured in **tables, rows, and columns**.
- **SQL (Structured Query Language)** is the language used to **interact with databases**, allowing users to search, insert, update, and delete data.



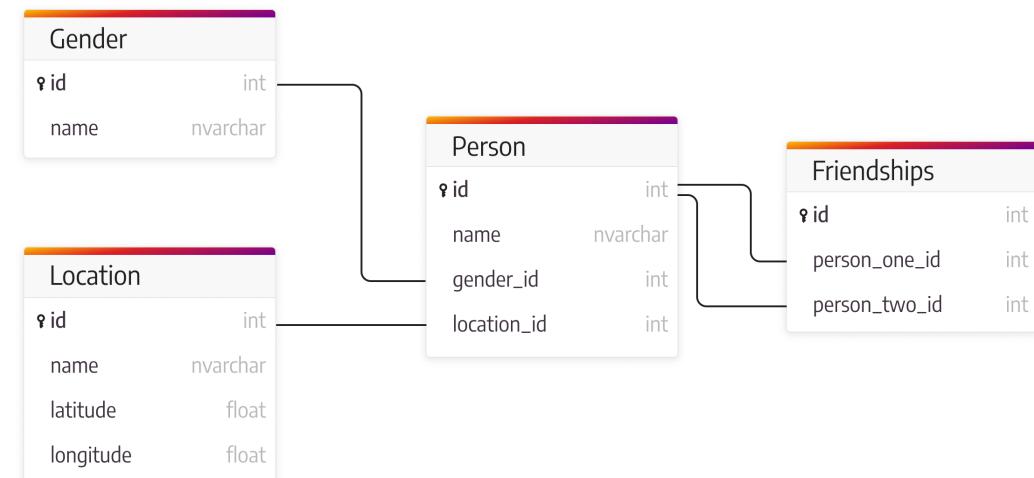
# Relational databases

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A **structured** way to store data in **tables** (**rows** and **columns**)

Each **table** represents a specific **entity** (e.g., users, products)

- ! Tables are named in **PLURAL** (e.g., users, orders) to reflect collections



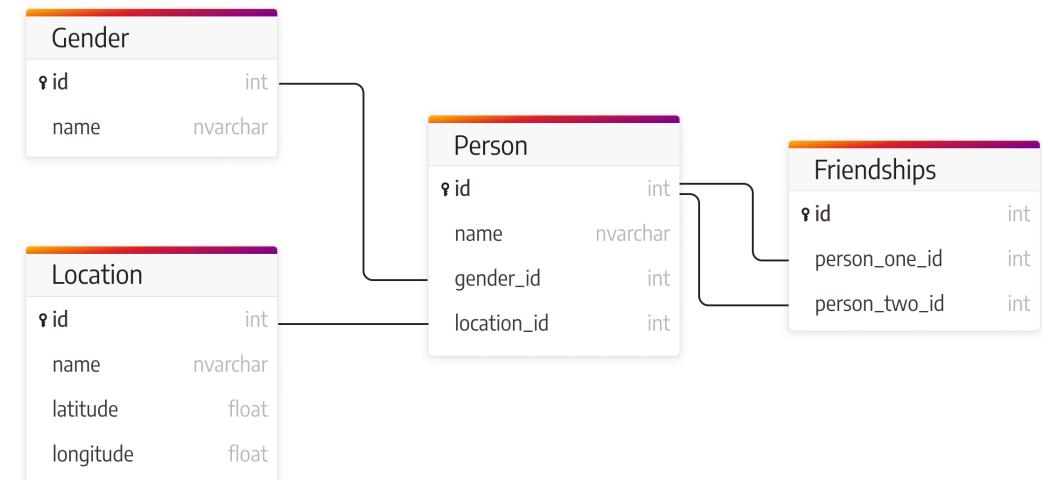
<https://memgraph.com/blog/graph-database-vs-relational-database>

# Relational databases

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Tables can be linked through **relationships** (e.g., foreign keys)

Enables **powerful querying using SQL** (Structured Query Language)



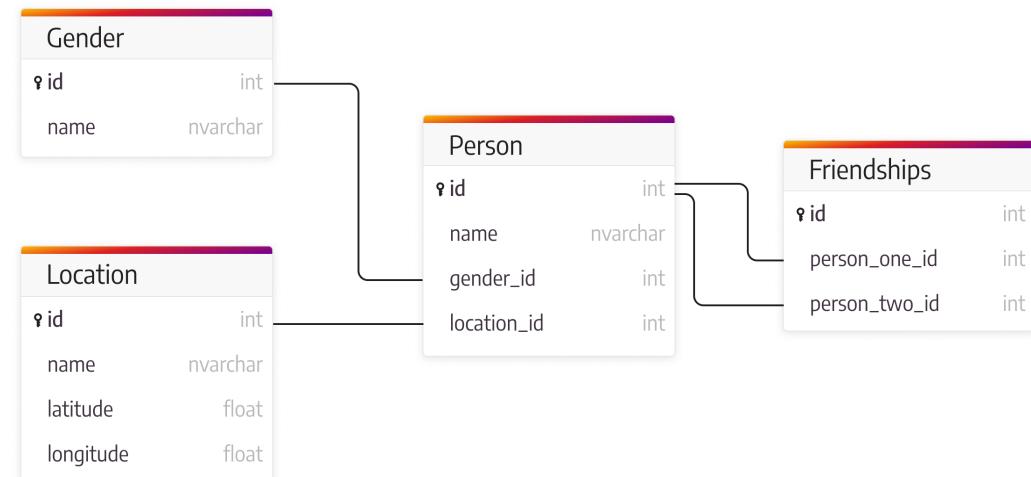
<https://memgraph.com/blog/graph-database-vs-relational-database>

# Relational databases

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Ensures data integrity through **ACID** properties:

- **Atomicity:** All or nothing: a transaction must **fully happen or not at all**
- **Consistency:** **Data must stay correct** before and after a transaction
- **Isolation:** **Transactions don't mess with each other**, even if run at the same time
- **Durability:** Once saved, **data won't be lost** – even if the system crashes



<https://memgraph.com/blog/graph-database-vs-relational-database>

# Non-relational databases

Also known as **NoSQL** databases

Store data in **flexible formats** like:

- Documents (e.g., MongoDB)
- Key-value pairs (e.g., Redis)
- Graphs (e.g., Neo4j)

Do **not require a fixed schema**, making them ideal for **unstructured** or **evolving** data

Common in real-time applications

⚠ **Out of scope** for this course

Difference between Relational and Non-Relational databases				
Relational				Non-Relational
student				
id	name	surname	age	student.json file body:
1	John	Brown	19	[ { "id": 1, "name": "John", "surname": "Brown", "age": 19 }, { "id": 2, "name": "Emma", "surname": "Carly", "age": 23 } ]
2	Emma	Carly	23	

# Relational databases: SQLite

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A **lightweight, serverless** relational database

Stores data in a **single file** on disk

Commonly used in **mobile applications**, embedded systems, and for **rapid prototyping**

💡 **Zero Configuration:** No separate server or complex setup required



# Step-by-Step Guide to Using SQLite

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## Step 1: Importing SQLite

Since Python 2.5, **SQLite** has been included by default via the **sqlite3** module

```
# app.py  
import sqlite3
```

# Step-by-Step Guide to Using SQLite

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## Step 2: Query definition

- Use a regular SQL query stored in a **string**
- If your query includes variable parameters, use **placeholders (?)**
- **⚠ NEVER** build SQL queries by joining strings
- **📌** Use SQL templates with **placeholders** instead of inserting values directly
- **📌** Pass the actual values using **.execute()**

```
sql = "SELECT id, original,  
modified FROM translation»  
  
sql = "INSERT INTO translation  
(original, modified) VALUES (?, ?)"
```

# Step-by-Step Guide to Using SQLite

## Step 2: Query definition

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```
sql = "SELECT id, original,  
modified FROM translation"  
  
sql = "INSERT INTO translation  
(original, modified) VALUES (?, ?)"  
  
# Define the query with a  
placeholder  
sql = "SELECT id, email FROM users  
WHERE name = ?"
```

# Step-by-Step Guide to Using SQLite

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## Step 3: Database connection

- Establishes a connection to a **SQLite database file** named **example.db**
- If the file does not exist, **SQLite will automatically create it**
- **conn** is a connection object used to:

Create a **cursor** for executing SQL commands

**Commit** changes

**Close** the connection

```
conn =  
sqlite3.connect('example.db')
```

# Step-by-Step Guide to Using SQLite

## Step 4: Query execution

- Get a **cursor** from the connection
- Execute a SQL query: **.execute()**
- Use **placeholders** to pass parameters safely
- Query parameters are given as a '**tuple**' argument

⚠ One-element tuples require trailing ,

```
cursor.execute(sql, (txtid,))
```

```
sql = "INSERT INTO translation  
(original, modified) VALUES (?, ?)"  
# Create a cursor object to execute  
SQL commands  
cursor = conn.cursor()  
  
# Insert a row using placeholders  
(note the ? symbols)  
cursor.execute(sql, ("Hello",  
"Hola"))
```

# Step-by-Step Guide to Using SQLite

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## Step 4: Query execution

- If the query was a **SELECT**

**cursor.fetchone()**: retrieves the next result

**cursor.fetchall()**: retrieves all remaining results

Both methods return tuples, representing the selected columns

<https://www.python.org/dev/peps/pep-0249/#cursor-methods>

```
# Fetch and print the results
rows = cursor.fetchall()
for row in rows:
    print(row)
```

# Step-by-Step Guide to Using SQLite

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## Step 4: Query execution

- For **INSERT**, **UPDATE**, or **DELETE** there is no result
- The changes are not immediately applied to the database; they need to be '**committed**' first
- **⚠ Don't forget to commit**, or you might lose your data!
- This must be called before **conn.close()**

```
# Save (commit) the changes
conn.commit()

# Always close the connection when
done
conn.close()
```

# Step-by-Step Guide to Using SQLite

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## Step 5: Closing the cursor and the connection

- When you're done with the cursor, call **cursor.close()**
- Also, close the connection, this frees up resources on the database server: **conn.close()**

```
# Close the cursor
cursor.close()

# Always close the connection when
done
conn.close()
```

# Minimal example

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```
conn = sqlite3.connect('example.db')

sql_insert = "INSERT INTO translation (original, modified) VALUES (?, ?)"

cursor = conn.cursor()

cursor.execute(sql_insert, ("Hello", "Hola"))

conn.commit()

cursor.close()
conn.close()
```



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