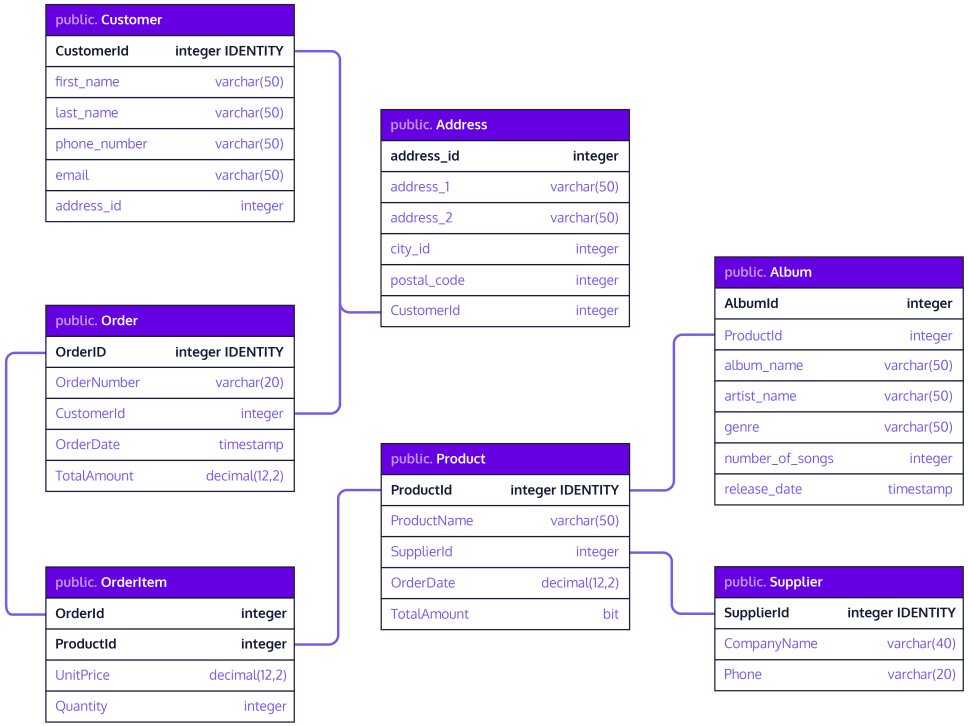
# Database Operations

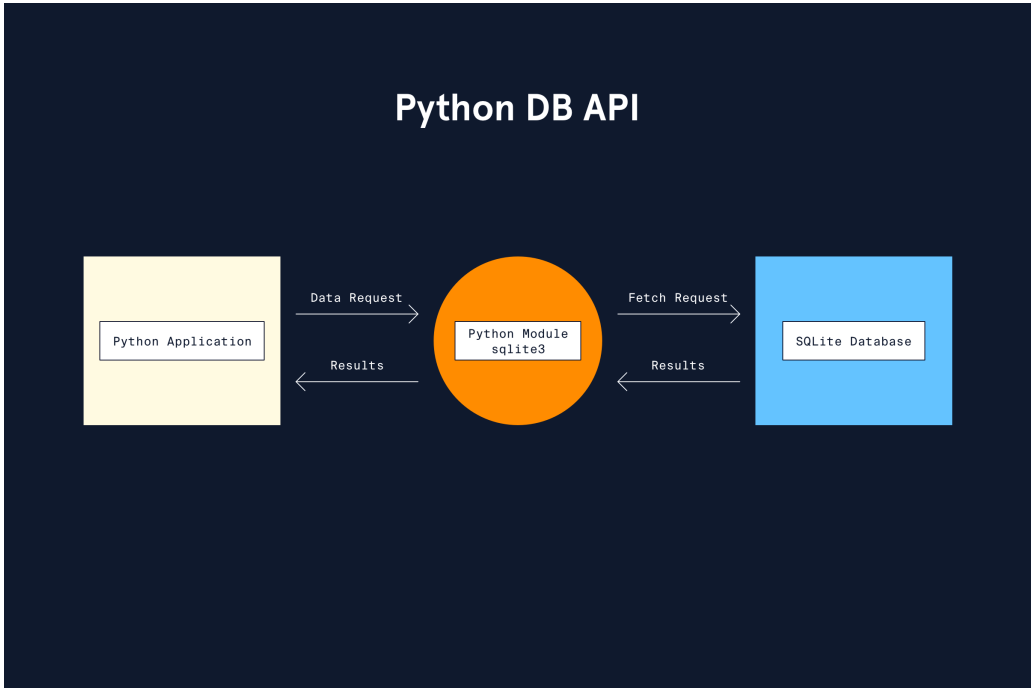
## SQL and Relational Databases

*Relational databases* are the primary means of storage for structured data. They organize data into tables that each contain data related to one another.
We commonly use *SQL*, which stands for Structured Query Language, to query and play around with relational databases. This programming language is designed to manage data stored in relational databases.
We can visualize a relational database in the image of tables below.



## Python and SQLite Working Together

Thanks to Python's Database-API (DB-API 2.0), we can connect Python to RDBMS (Relational Database Management Systems) like SQLite. To access a SQLite database, we must import the `sqlite3` into the Python environment.
The following image demonstrates how Python and SQLite function together.

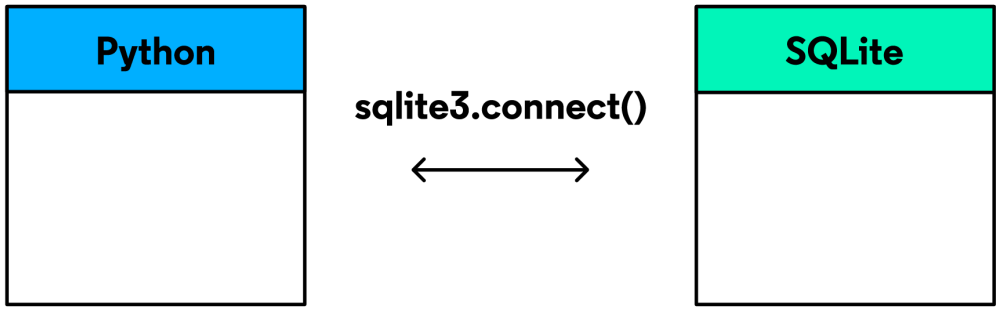


## Connecting to the SQLite Database

In order to edit a new or pre-existing SQLite database from a Python environment, one must connect with the database using `sqlite3.connect()` .

```
# Create connection to database
connection = sqlite3.connect("example.db")
```

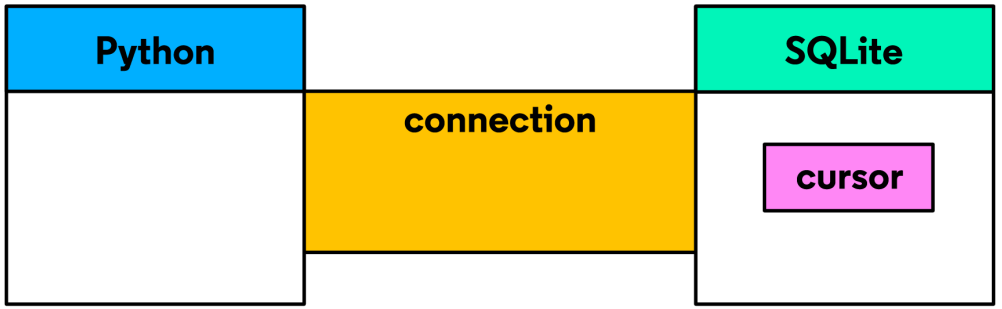
The connection object is like a cable that connects our python environment to our SQLite database.




## Creating a Cursor Object

In a database, a cursor allows us to call statements and return data.
To create a cursor object from a Python environment, one must attach the connection object (in this case `connection` ) to the `.cursor()` method.

```
# Create cursor object
cursor = connection.cursor()
```



## Executing SQL Statements in Python

Once we have connected to the SQLite database, we can use our cursor object and the `.execute()` method to execute a SQL statement.
Using the `.execute()` method with the `CREATE` clause will create a table within our SQLite database.

```
# Create cursor object
curs = connection.cursor()
# Create table named members
curs.execute('''CREATE TABLE members (
                    id INTEGER,
                    name TEXT)''')
```

We can also use the INSERT clause to insert data into a pre-existing table.

```
# Insert a row of data in the members table
curs.execute('''INSERT INTO members VALUES (2244560,
```

## Fetching SQLite Data in Python

We can pull data from a SQLite data table into our Python environment by using the fetch methods: .fetchone() , .fetchmany() , and .fetchall() .

.fetchone() example:

```
# Return first row in students
cursor.execute("SELECT * FROM students").fetchone()
# Output
(101, 'Alex', 32, '2022-05-16', 'Pass')
```

.fetchmany() example:

```
# Return first three rows in students
cursor.execute("SELECT * FROM students").fetchmany(3)
# Output
[(101, 'Alex', 32, '2022-05-16', 'Pass'),
(102, 'Joe', 32, '2022-05-16', 'Pass'),
(103, 'Stacy', 10, '2022-05-16', 'Pass')]
```

.fetchall() example:

```
# Return all rows in students
cursor.execute("SELECT * FROM students").fetchall()
```

## For Loop with SQLite Statement

We can use a for loop and a SQL statement to retrieve SQLite data.
The following code will iterate through each row in the `students` table and print each row where the `Grade` field is `'Pass'`.

```
for row in cursor.execute(```SELECT * FROM students W
    print(row)
```

You can also use a for loop to iterate through a table field and calculate a measurement.

```
# save all rows from a field, then use a for loop to
major_codes = cursor.execute("SELECT major_code FROM


# Find the average of the tuple list using a for loop
sum = 0
for num in major_codes:
    for i in num:
        sum = sum + i
average = sum / len(major_codes)

# Show average
print(average)
```

## Committing and Closing SQLite

After making changes to the SQLite database, we must commit the changes using the `.commit()` method. Committing the changes ensures that others can view these changes in the database.

```
# commit changes to database
connection.commit()
```

When we've finished editing the SQLite database and have committed the changes, we may use the `.close()` method to close the database connection.

```
# close connection
connection.close()
```

## Inserting many rows with SQLite

To insert multiple rows/records of data into a SQLite database via Python, use the `.executemany()` method.
In the example below, the object `new_students` containing a list of rows is inserted into the already existing `students` data table. Remember, these rows follow the same table schema as the `students` table.

```
# Insert multiple values into table at once
new_students = [(102, 'Joe', 32, '2022-05-16', 'Pass'
           (103, 'Stacy', 10, '2022-05-16', 'Pass'),
           (104, 'Angela', 21, '2022-12-20', 'Pass'),
           (105, 'Mark', 21, '2022-12-20', 'Fail'),
           (106, 'Nathan', 21, '2022-12-20', 'Pass')
           ]
# Insert values into the students table
cursor.executemany('''INSERT INTO students VALUES (?,
```

In the last line of code, there is a list of question marks that act as field placeholders. The five question marks represent each of the five fields in the database we are inserting values into.