Intro to SQL

Databases

Databases

Data can be stored in a database, a program that knows how to store, modify, and retrieve data.

A **relational** database stores each kind of data in a table. Each table has columns and rows.

Column 1	**Column 2**	**Column 3**
Row 1	...	...
Row 2	...	...
Row 3	...	...

Example tables

users:

id	nickname	location
1	Sal	California
2	John	New York
3	MayLi	Washington

badges:

id	name	points
1	Guru	1000
2	Oracle	2000
3	Wizard	500

Relating Tables

users:

id	nickname	location
1	Sal	California
2	John	New York
3	MayLi	Washington

user_badges:

user_id	badge_id
1	1
1	2
2	3
3	3

badges:

id	name	points
1	Guru	1000
2	Oracle	2000
3	Wizard	500

SQL

Structured Query Language

Originally called SEQUEL!
(Structured English QUEry Language)

The most popular language for interacting with relational databases. Commands like...

- `CREATE TABLE ...`
- `INSERT INTO ...`
- `UPDATE ...`
- `SELECT * FROM ...`

CREATE & INSERT

```
CREATE TABLE users (id INTEGER PRIMARY KEY,
    nickname TEXT, location TEXT);

INSERT INTO users VALUES (1, "Sal", "California");
INSERT INTO users VALUES (2, "John", "New York");
INSERT INTO users VALUES (3, "MayLi", "Indonesia");

SELECT * FROM users;
```

Try it on code.cs61a.org or khanacademy.org

Documentation: SQLite.org: CREATE TABLE, SQLite.org: INSERT, KA: CREATE TABLE, KA: INSERT

UPDATE

Update column values of existing rows

```
CREATE TABLE users (id INTEGER PRIMARY KEY,
    nickname TEXT, location TEXT);

INSERT INTO users VALUES (1, "Sal", "California");
INSERT INTO users VALUES (2, "John", "New York");
INSERT INTO users VALUES (3, "MayLi", "Indonesia");

UPDATE users SET nickname = "Joan" WHERE id = 2;
```

Documentation: KA: UPDATE

DELETE

Delete entire rows that match criteria

```
CREATE TABLE users (id INTEGER PRIMARY KEY,
    nickname TEXT, location TEXT);

INSERT INTO users VALUES (1, "Sal", "California");
INSERT INTO users VALUES (2, "John", "New York");
INSERT INTO users VALUES (3, "MayLi", "Indonesia");

DELETE FROM users WHERE id = 3;
```

Documentation: KA: DELETE

SELECT

Most of the complexity and power of SQL is in the `SELECT` statement.

```
SELECT nickname FROM users;

SELECT nickname, location FROM users;

SELECT nickname, location FROM users ORDER BY nickname;

SELECT nickname FROM users WHERE location = "California";
```

Documentation: SQLite.org: SELECT,
KA: SELECT, KA: SELECT WHERE, KA: ORDER BY,

Aggregate functions

Aggregates column values in some way:

`MAX`/`MIN`, `SUM`, `AVG`, `COUNT`

```
CREATE TABLE groceries (id INTEGER PRIMARY KEY,
    name TEXT, quantity INTEGER, aisle INTEGER);
INSERT INTO groceries VALUES (1, "Bananas", 56, 7);
INSERT INTO groceries VALUES(2, "Peanut Butter", 1, 2);
INSERT INTO groceries VALUES(3, "Dark Chocolate Bars", 2, 2);
INSERT INTO groceries VALUES(4, "Ice cream", 1, 12);
INSERT INTO groceries VALUES(5, "Cherries", 6, 2);
INSERT INTO groceries VALUES(6, "Chocolate syrup", 1, 4);

SELECT MAX(quantity) FROM groceries;
```

Documentation: SQLite.org: Aggregate functions,
KA: SELECT with aggregate

GROUP BY

Groups rows that share the same column value

```
CREATE TABLE groceries (id INTEGER PRIMARY KEY,
    name TEXT, quantity INTEGER, aisle INTEGER);
INSERT INTO groceries VALUES (1, "Bananas", 56, 7);
INSERT INTO groceries VALUES(2, "Peanut Butter", 1, 2);
INSERT INTO groceries VALUES(3, "Dark Chocolate Bars", 2, 2);
INSERT INTO groceries VALUES(4, "Ice cream", 1, 12);
INSERT INTO groceries VALUES(5, "Cherries", 6, 2);
INSERT INTO groceries VALUES(6, "Chocolate syrup", 1, 4);

SELECT aisle, SUM(quantity) FROM groceries GROUP BY aisle;
```

Documentation: SQLite.org: Generating results,
KA: SELECT with GROUP BY

JOIN

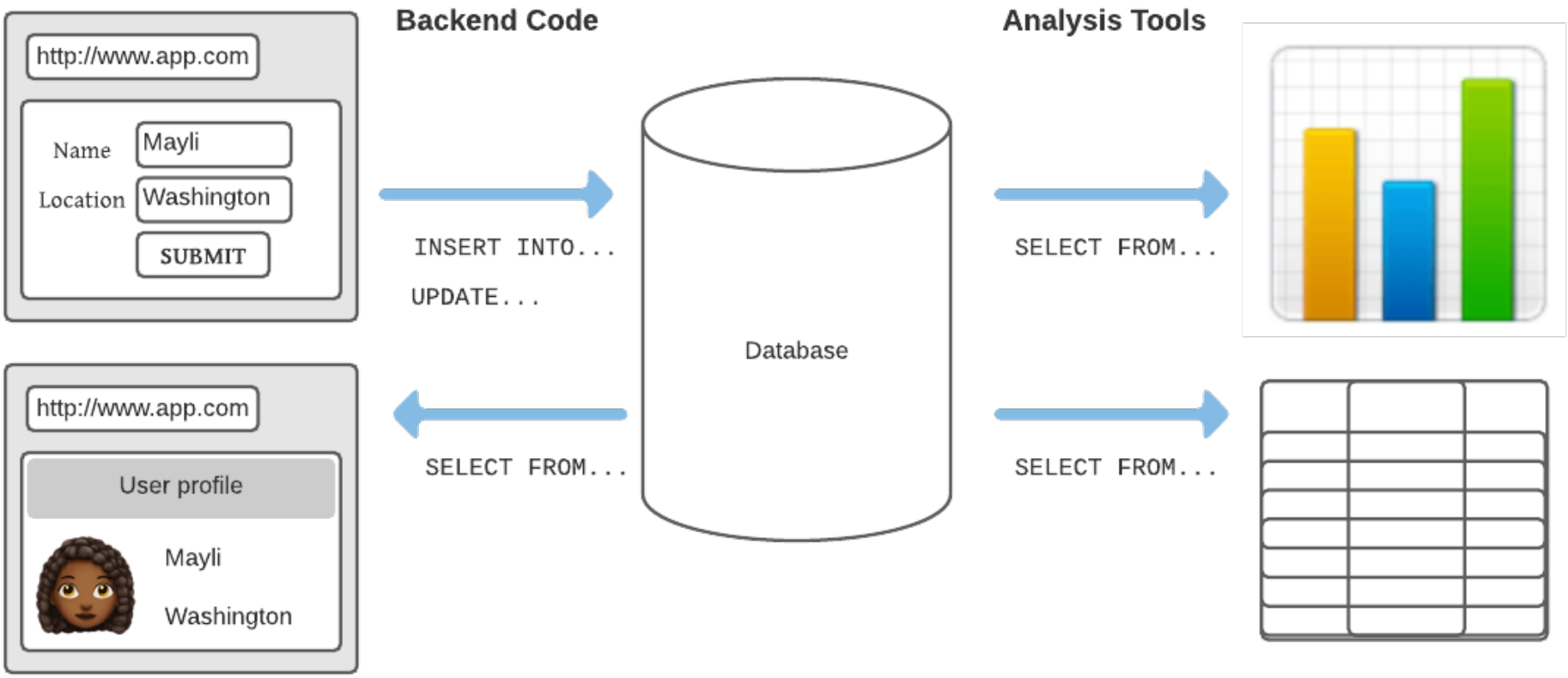
Generates results from two related tables that share a column.

```
CREATE TABLE students (id INTEGER PRIMARY KEY, first_name TEXT,
    last_name TEXT, email TEXT, phone TEXT, birthdate TEXT);

INSERT INTO students (first_name, last_name, email, phone, birthdate)
    VALUES ("Peter", "Rabbit", "peter@rabbit.com", "555-6666", "2002-06-24");
INSERT INTO students (first_name, last_name, email, phone, birthdate)
    VALUES ("Alice", "Wonderland", "alice@wonderland.com", "555-4444", "2002-07-04");

CREATE TABLE student_projects (id INTEGER PRIMARY KEY,
    student_id INTEGER, title TEXT);

INSERT INTO student_projects (student_id, title) VALUES (1, "Carrotapault");

SELECT students.first_name, students.last_name, student_projects.title
    FROM students
    JOIN student_projects
    ON students.id = student_projects.student_id;
```

Documentation: KA: JOIN

Where is SQL used?

1) Application data storage and 2) data analysis



Demo App: Native or Not?

flask-db-example.pamelafox2.repl.co

Demo App: 61A Merch

flask-db-example-1.pamelafox2.repl.co/

Includes a transaction:

```
BEGIN;

UPDATE products SET quantity = quantity - 1
    WHERE id = 1;

INSERT INTO orders (customer, product_id)
    VALUES ("Animesh", 1);

COMMIT;
```

Further learning

There's lots we didn't cover today! `IN`, `HAVING`, `CASE`, `ALTER TABLE`, more `JOIN`s, transactions, security, etc.

Online learning:

- Khan Academy SQL course
- Kaggle: Intro to SQL
- Stanford's Database courses
- Coursera: Exploring data with BigQuery

Berkeley classes:

- CS 186: Intro to Database Systems
- Data 100: Principles and Techniques of Data Science
- CS194/INFO290: Data Engineering