

This is



Section.

Week 6: Python

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Attendance Form: cs50.ly/section_attendance

- In order to build increasingly complex websites, we depend on a **database** to store information long-term. The simplest form of a database with which we are all likely familiar is a basic spreadsheet, organized into rows and columns, tabs (tables), and individual files (databases).
- SQL is a programming language whose purpose is to *query* databases (perform operations on them).

siblings

id	first_name	last_name

siblings

id	first_name	last_name
1	gabe	leblanc
2	sophia	leblanc
3	ava	leblanc

```
CREATE TABLE siblings (  
    id INTEGER PRIMARY KEY AUTOINCREMENT,  
    first_name TEXT,  
    last_name TEXT,  
);
```

.schema

- After you create a database, you create one or more **tables**.
- For each table, you specify all of the **columns** in the table.
- When new information is added to the database, the new information (typically) goes into a new **row**.
- There are many data types that can be stored in a SQL database. This is just a small sample.

INT	SMALLINT	TINYINT	MEDIUMINT	BIGINT
DECIMAL	FLOAT	BIT	DATE	TIME
DATETIME	TIMESTAMP	CHAR	VARCHAR	BINARY
BLOB	TEXT	ENUM	GEOMETRY	LINestring

- After you create a database, you create one or more **tables**.
- For each table, you specify all of the **columns** in the table.
- When new information is added to the database, the new information (typically) goes into a new **row**.
- In SQLite, which we'll use in this course, we can consolidate these various datatypes into a few more general classes (though underlying types still exist)

NULL	INTEGER	REAL	TEXT	BLOB
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- Another consideration is choosing a column to be a **primary key**, guaranteed to be unique across rows. A good primary key makes subsequent table operations much easier.
- SQL is a programming language, but it has a limited vocabulary that we'll use.

- Another consideration is choosing a column to be a **primary key**, guaranteed to be unique across rows. A good primary key makes subsequent table operations much easier.
- SQL is a programming language, but it has a limited vocabulary that we'll use.

INSERT

SELECT

UPDATE

DELETE

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza

- An INSERT query adds information to a table.

```
INSERT INTO  
<table>  
(<columns>  
VALUES  
(<values>)
```

- An INSERT query adds information to a table.

```
INSERT INTO  
users  
(username, password, fullname)  
VALUES  
( 'newman', 'USMAIL', 'Newman' )
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza

- When defining the column that ultimately is your primary key, it's usually a good idea for that column to be an integer.
- Moreover, you can configure that column to **autoincrement**, so it will pre-populate that column for you automatically when rows are added, eliminating the risk that you'll accidentally try to insert something with a duplicate value.

- An INSERT query adds information to a table.

```
INSERT INTO
```

```
moms
```

```
(username, mother)
```

```
VALUES
```

```
('kramer', 'Babs Kramer')
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

- A SELECT query extracts information from a table.

```
SELECT  
<columns>  
FROM  
<table>  
WHERE  
<predicate>
```

- A SELECT query extracts information from a table.

```
SELECT  
idnum, fullname  
FROM  
users
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

- A SELECT query extracts information from a table.

```
SELECT  
password  
FROM  
users  
WHERE  
idnum < 12
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

- A SELECT query extracts information from a table.

```
SELECT
```

```
*
```

```
FROM
```

```
moms
```

```
WHERE
```

```
username = 'jerry'
```


users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
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kramer	Babs Kramer

SQL has a number of these commands:

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

SQL has a number of these commands:

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

qscore	course_name	school
5	cs50	Harvard College
4	cs50	Harvard College
5	cs224	Harvard GSAS
2	6.something	MIT

courses

SQL has a number of these commands:

WHERE

Ex: “SELECT AVG(qscore) FROM
courses

LIKE

ORDER BY

LIMIT

GROUP BY

qscore	course_name	school
5	cs50	Harvard College
4	cs50	Harvard College
5	cs224	Harvard GSAS
2	6.something	MIT

courses

SQL has a number of these commands:

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

Ex: “SELECT AVG(qscore) FROM
courses WHERE school LIKE
‘Harvard%’

qscore	course_name	school
5	cs50	Harvard College
4	cs50	Harvard College
5	cs224	Harvard GSAS
2	6.something	MIT

courses

SQL has a number of these commands:

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

Ex: “SELECT AVG(qscore) FROM
courses WHERE school LIKE
‘Harvard%’ GROUP BY course_name

qscore	course_name	school
5	cs50	Harvard College
4	cs50	Harvard College
5	cs224	Harvard GSAS
2	6.something	MIT

courses

SQL has a number of these commands:

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

Ex: “SELECT AVG(qscore) FROM
courses WHERE school LIKE
‘Harvard%’ GROUP BY course_name
ORDER BY AVG(qscore) LIMIT 1’

qscore	course_name	school
5	cs50	Harvard College
4	cs50	Harvard College
5	cs224	Harvard GSAS
2	6.something	MIT

courses

- Databases empower us to organize information into tables efficiently.
- We don't always need to store every possible relevant piece of information in the same table, but rather we can use relationships across tables to connect all the pieces of data we need.
- Let's imagine we're given the name of a mom and want to find all information about their child.

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

```
SELECT *  
FROM users  
WHERE username =  
(  
    SELECT username  
    FROM mothers  
    WHERE mother = "Helen Seinfeld"  
);
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

```
SELECT *  
FROM users  
WHERE username =  
(  
    SELECT username  
    FROM mothers  
    WHERE mother = "Helen Seinfeld"  
);
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
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kramer	Babs Kramer

users

idnum	username	password	fullname
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username	mother
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users

idnum	username	password	fullname
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moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

- A SELECT (JOIN) query extracts information from multiple tables.

```
SELECT  
<columns>  
FROM  
<table1>  
JOIN  
<table2>  
ON  
<predicate>
```

- A SELECT (JOIN) query extracts information from multiple tables.

```
SELECT
users.fullname, moms.mother
FROM
users
JOIN
moms
ON
users.username = moms.username
```

- A SELECT (JOIN) query extracts information from multiple tables.

```
SELECT
users.fullname, moms.mother
FROM
users
JOIN
moms
ON
users.username = moms.username
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
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moms

username	mother
jerry	Helen Seinfeld
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users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
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moms

username	mother
jerry	Helen Seinfeld
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users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
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moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

users & moms

users.idnum	users.username moms.username	users.password	users.fullname	moms.mother
10	jerry	fus!!!	Jerry Seinfeld	Helen Seinfeld
11	gcostanza	b0sc0	George Costanza	Estelle Costanza

users & moms

users.idnum	users.username moms.username	users.password	users.fullname	moms.mother
10	jerry	fus!!!	Jerry Seinfeld	Helen Seinfeld
11	gcostanza	b0sc0	George Costanza	Estelle Costanza

- An UPDATE query modifies information in a table.

UPDATE

<table>

SET

<column> = <value>

WHERE

<predicate>

- An UPDATE query modifies information in a table.

```
UPDATE
```

```
users
```

```
SET
```

```
password = 'yadayada'
```

```
WHERE
```

```
idnum = 10
```

users

idnum	username	password	fullname
10	jerry	yadayada	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
jerry	Helen Seinfeld
gcostanza	Estelle Costanza
kramer	Babs Kramer

- A DELETE query removes information from a table.

```
DELETE FROM  
<table>  
WHERE  
<predicate>
```

- A DELETE query removes information from a table.

```
DELETE FROM
```

```
users
```

```
WHERE
```

```
username = 'newman'
```

users

idnum	username	password	fullname
10	jerry	fus!!!	Jerry Seinfeld
11	gcostanza	b0sc0	George Costanza
12	newman	USMAIL	Newman

moms

username	mother
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songs