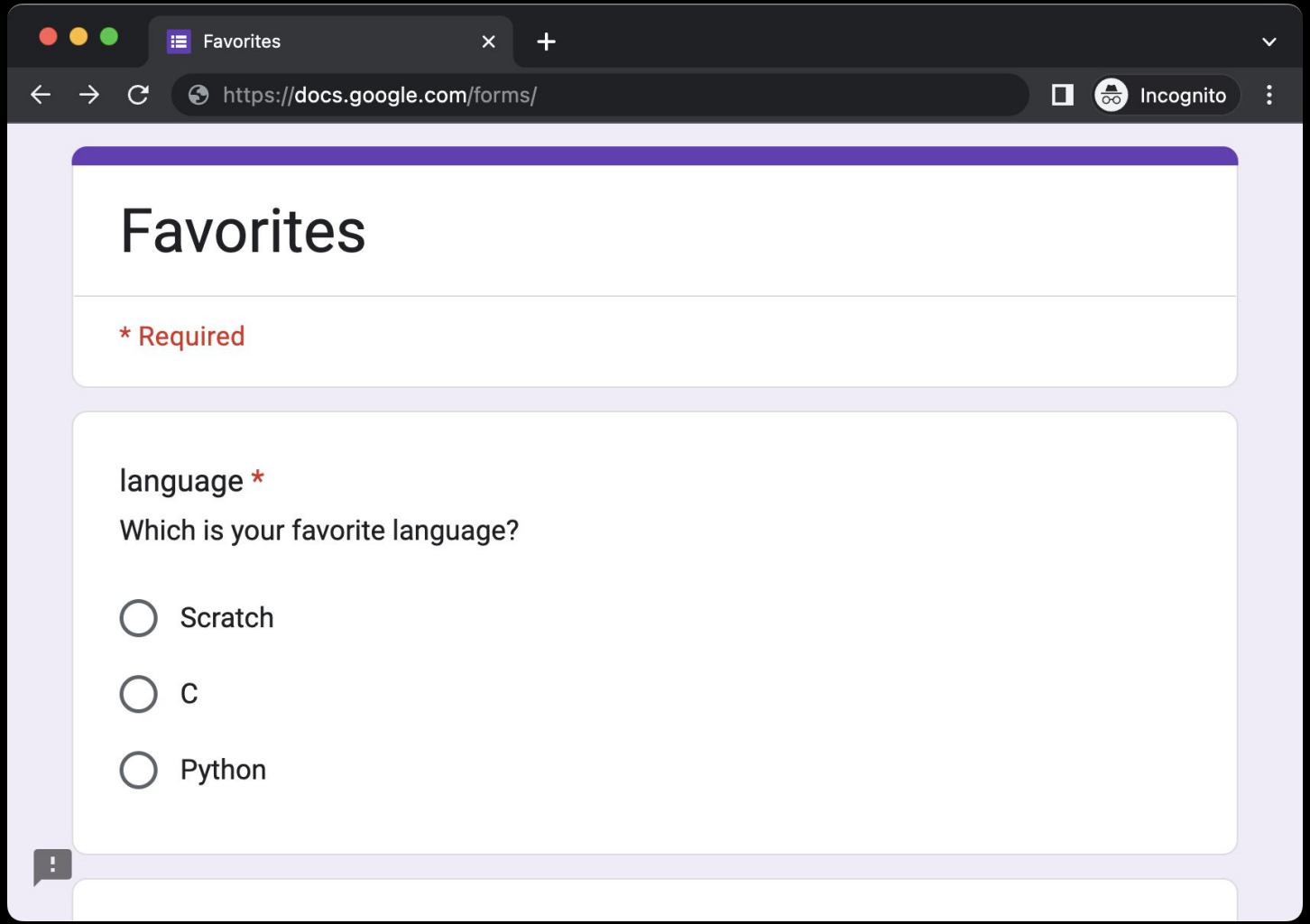
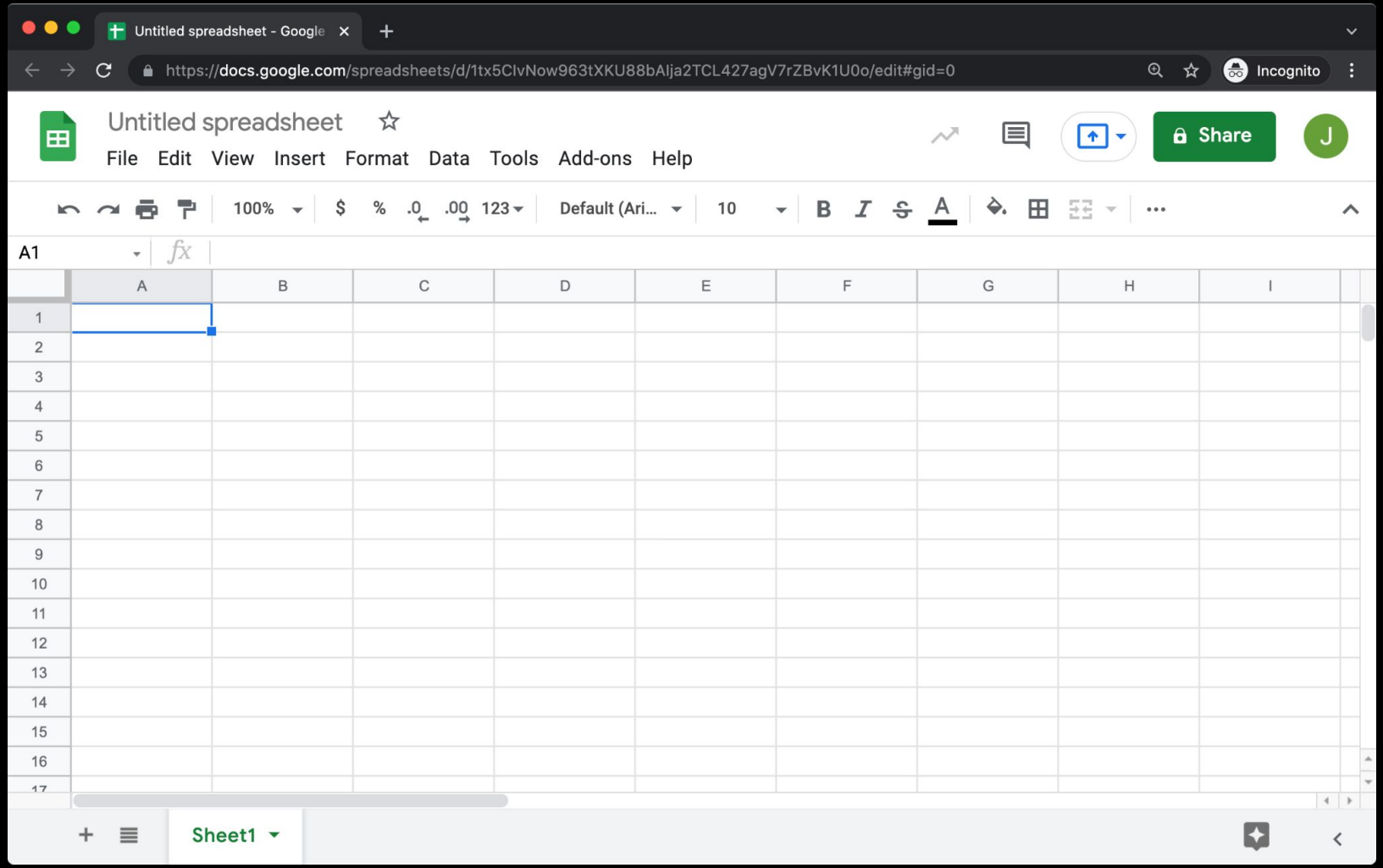
This is CS50

cs50.ly/favorites


Favorites
https://docs.google.com/forms/
Incognito
Favorites
* Required
language *
Which is your favorite language?
Scratch
C
Python


Untitled spreadsheet - Google
https://docs.google.com/spreadsheets/d/1tx5ClvNow963tXKU88bAlja2TCL427agV7rZBvK1U0o/edit#gid=0
Incognito
Untitled spreadsheet
File Edit View Insert Format Data Tools Add-ons Help
Share
J
100% $ % .0 .00 123 Default (Ari... 10
A1
A B C D E F G H I
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Sheet1

flat-file database

CSV

relational database

SQL

C
R
U
D

CREATE
READ
UPDATE
DELETE

CREATE, INSERT
SELECT
UPDATE
DELETE, DROP
...

```
CREATE TABLE table (column type, ...);
```

sqlite3

```
.mode csv
.import FILE TABLE
```

```
.schema
```

```
SELECT columns FROM table;
...
```

AVG
COUNT
DISTINCT
LOWER
MAX
MIN
UPPER
...

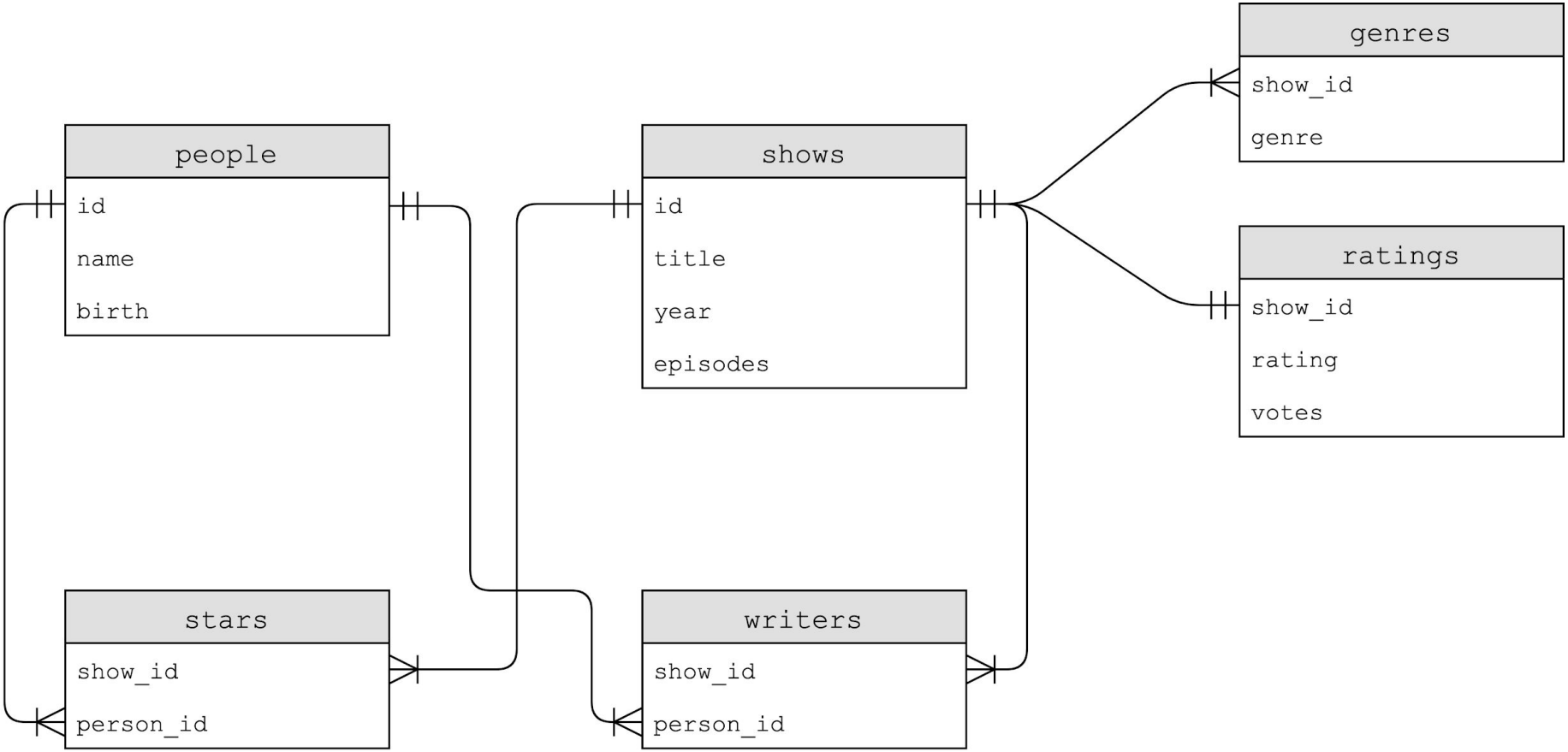
```
WHERE
LIKE
ORDER BY
LIMIT
GROUP BY
...
```

```
INSERT INTO table (column, ...) VALUES(value, ...);
```

```
UPDATE table SET column = value WHERE condition;
```

```
DELETE FROM table WHERE condition;
```

IMDb

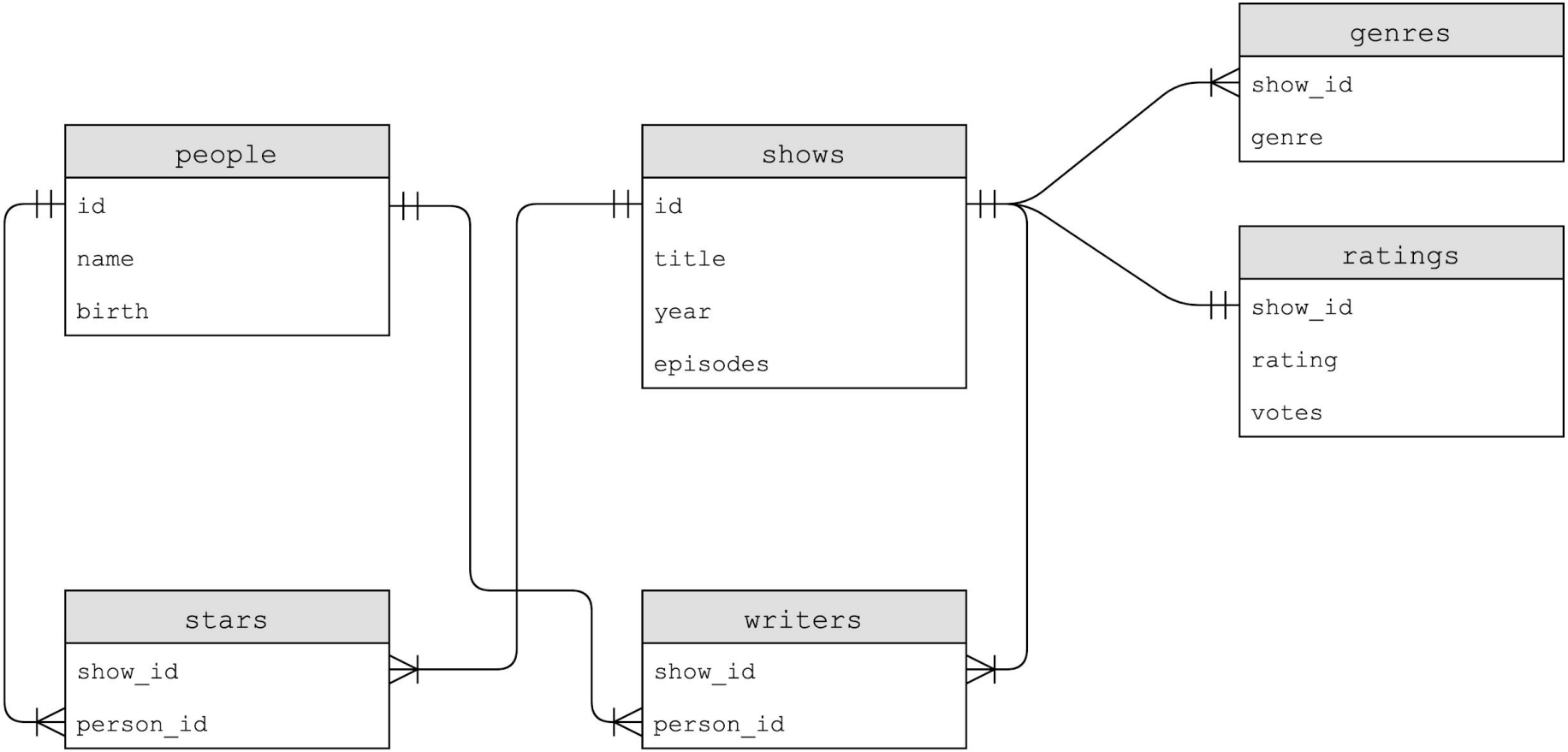

people
id
name
birth
shows
id
title
year
episodes
genres
show_id
genre
ratings
show_id
rating
votes
stars
show_id
person_id
writers
show_id
person_id

BLOB
INTEGER
NUMERIC
REAL
TEXT

NOT NULL
UNIQUE

PRIMARY KEY

FOREIGN KEY


people
id
name
birth
shows
id
title
year
episodes
genres
show_id
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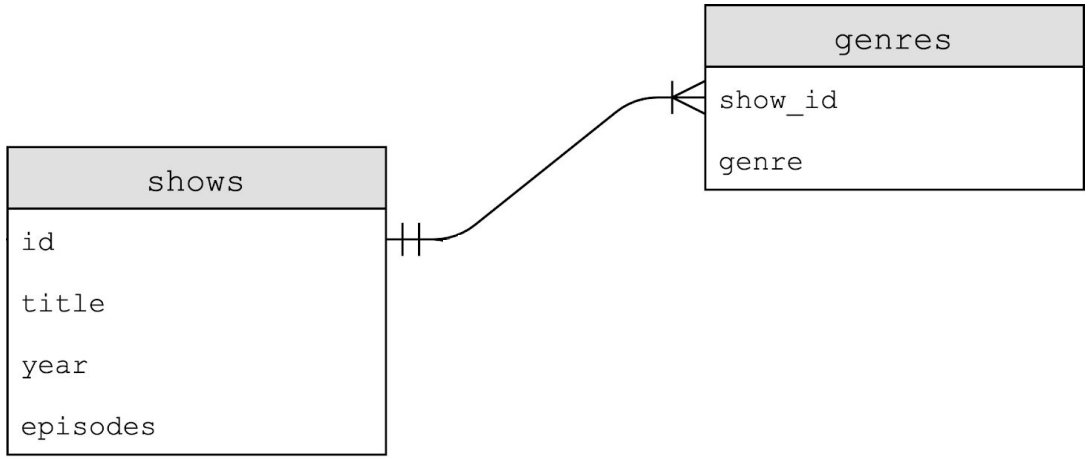
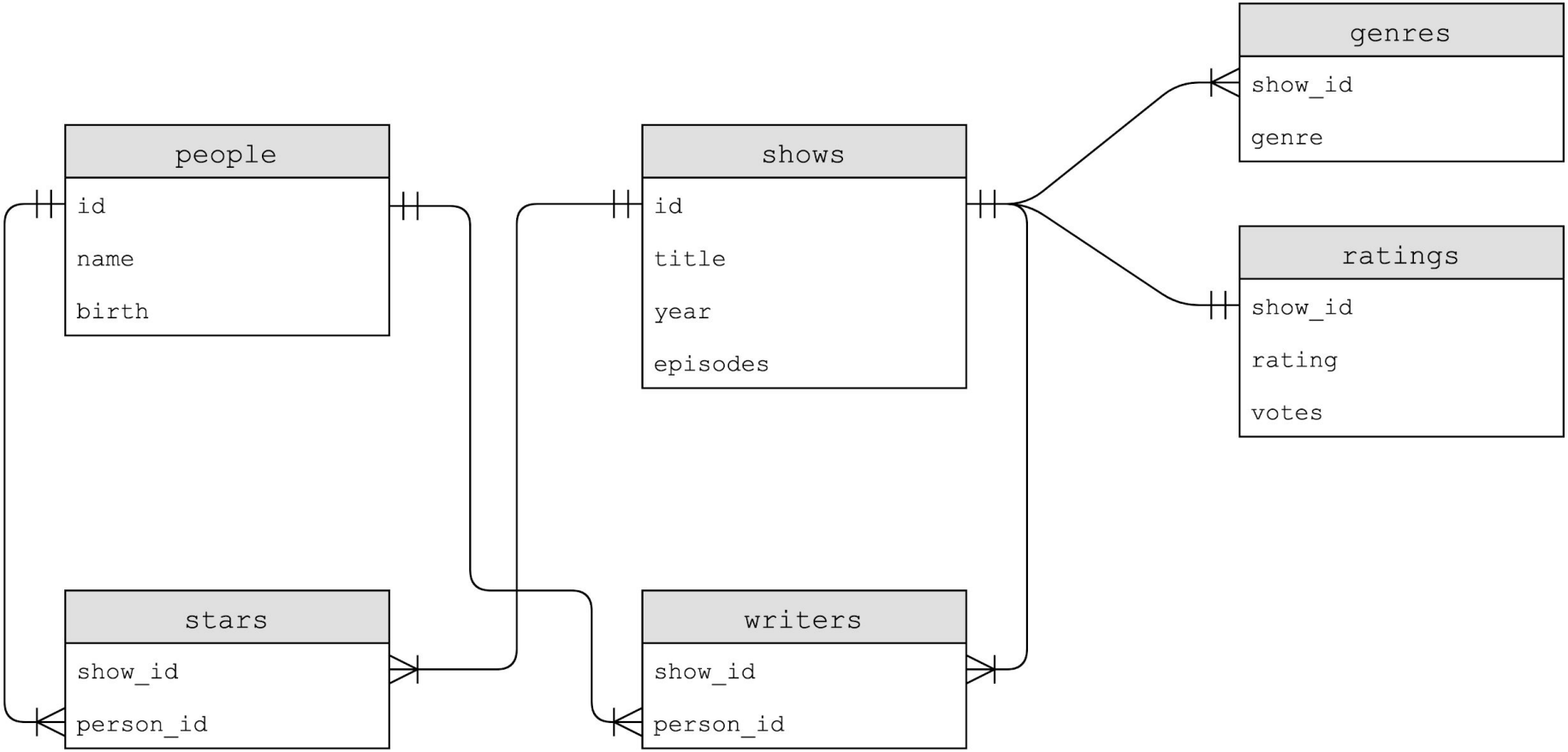
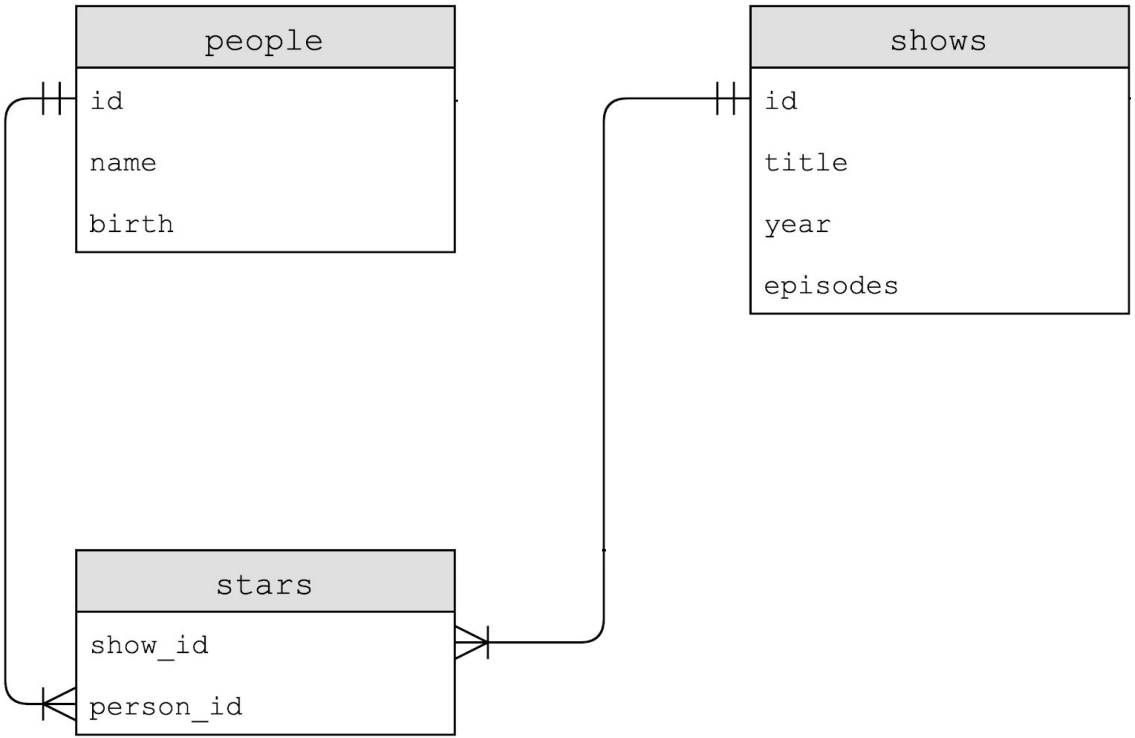
ratings
show_id
rating
votes
stars
show_id
person_id
writers
show_id
person_id


genres
show_id
genre
shows
id
title
year
episodes

JOIN

...


people
id
name
birth
shows
id
title
year
episodes
genres
show_id
genre
ratings
show_id
rating
votes
stars
show_id
person_id
writers
show_id
person_id


people
id
name
birth
shows
id
title
year
episodes
stars
show_id
person_id

JOIN

...

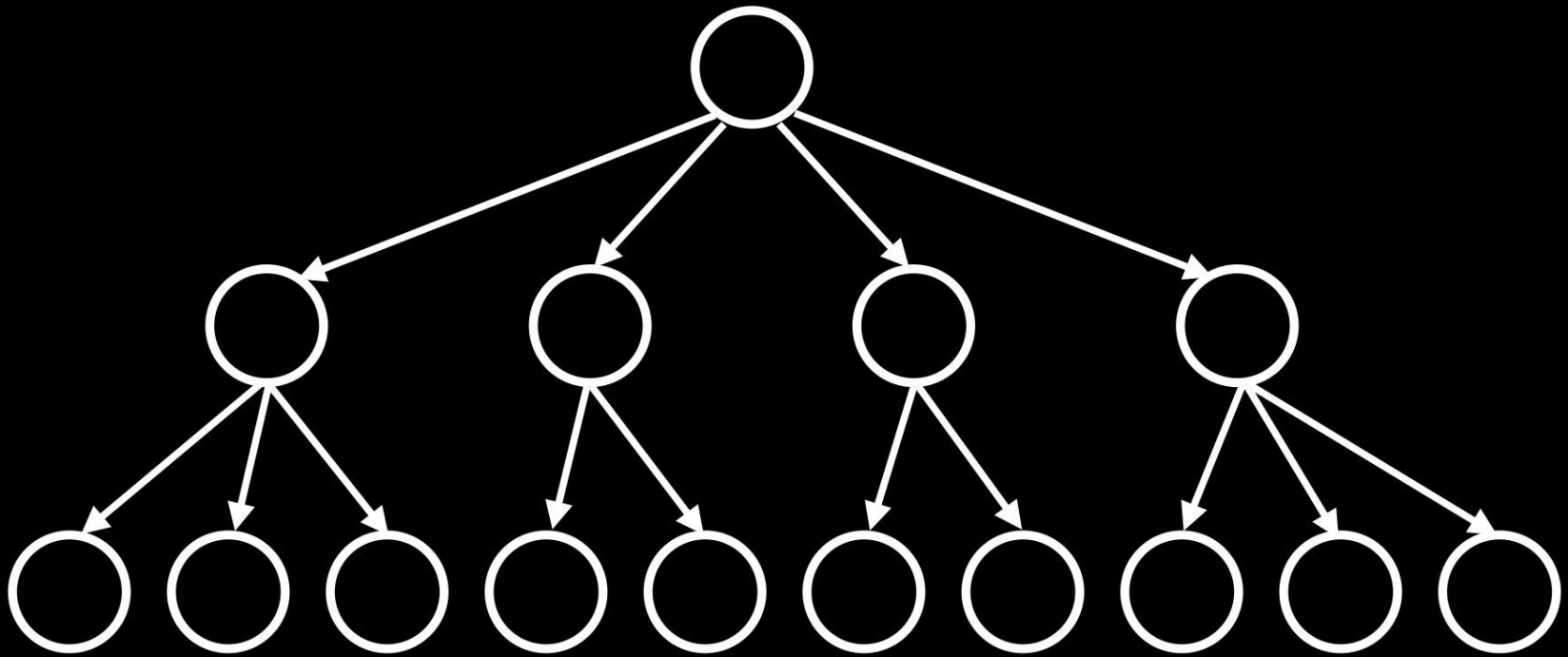
JOIN

...

indexes

```
CREATE INDEX name ON table (column, ...);
```

B-trees



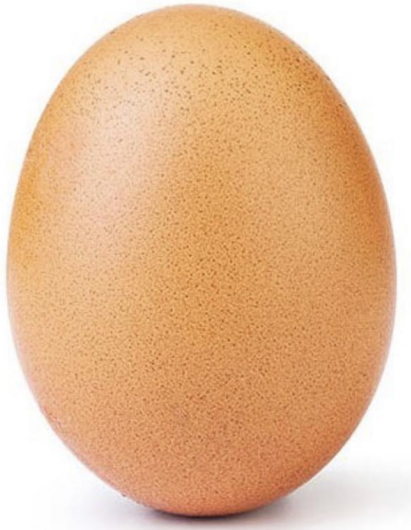
```
from cs50 import SQL
```

cs50.readthedocs.io/libraries/cs50/python/#cs50.SQL

race conditions

Photo

world_record_egg



```
rows = db.execute("SELECT likes FROM posts WHERE id = ?", id);
likes = rows[0]["likes"]
db.execute("UPDATE posts SET likes = ? WHERE id = ?", likes + 1, id);
```

```
BEGIN TRANSACTION
COMMIT
ROLLBACK
```

```
db.execute("BEGIN TRANSACTION")
rows = db.execute("SELECT likes FROM posts WHERE id = ?", id);
likes = rows[0]["likes"]
db.execute("UPDATE posts SET likes = ? WHERE id = ?", likes + 1, id);
db.execute("COMMIT")
```

SQL injection attacks

Central Authentication Service

Manage NetID Account | Help

Make sure your session is secure

Before entering your NetID and password, verify that the URL for this page begins with:

https://secure.its.yale.edu

To protect your privacy, quit your web browser when you are finished with your session

Sign In

NetID

Password

Forgot My Password

SIGN IN

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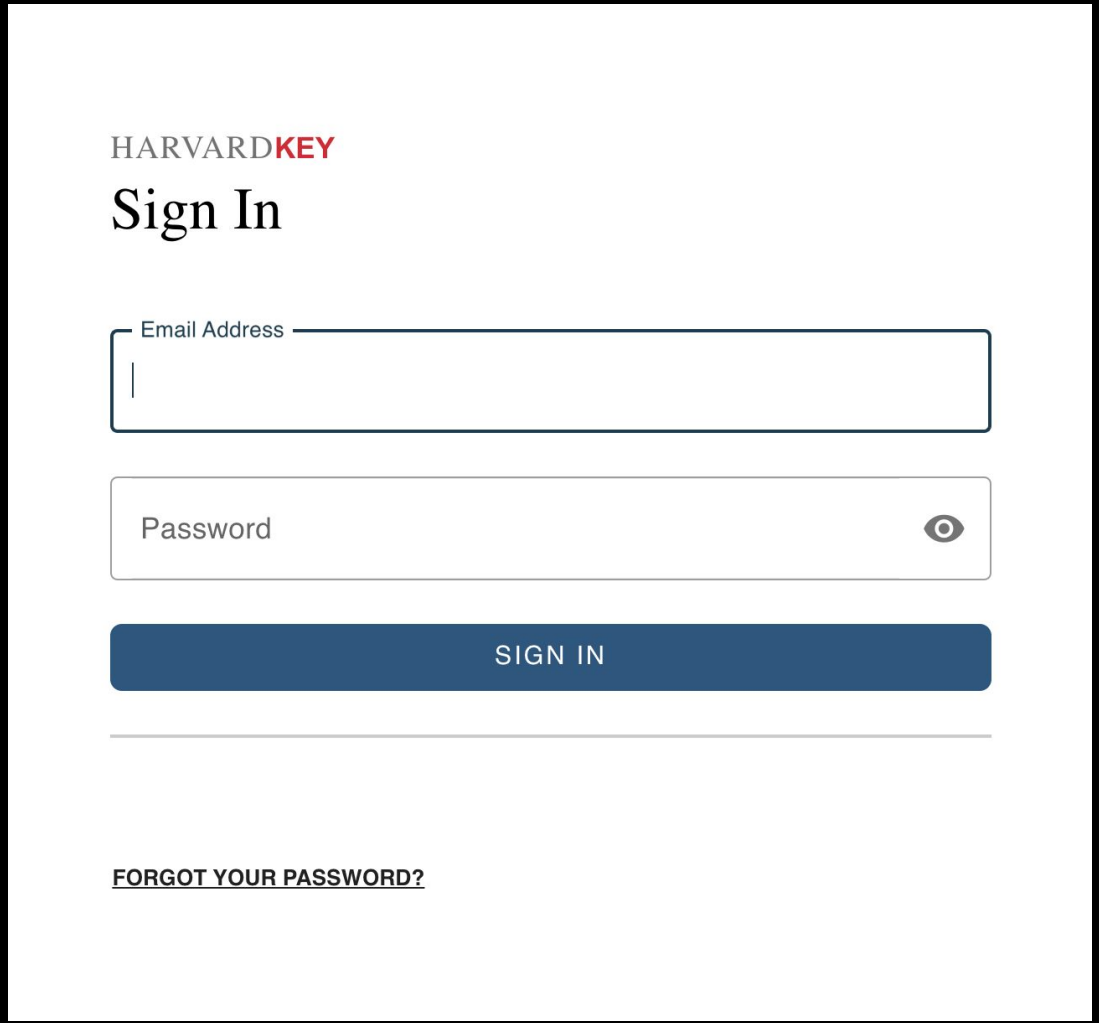
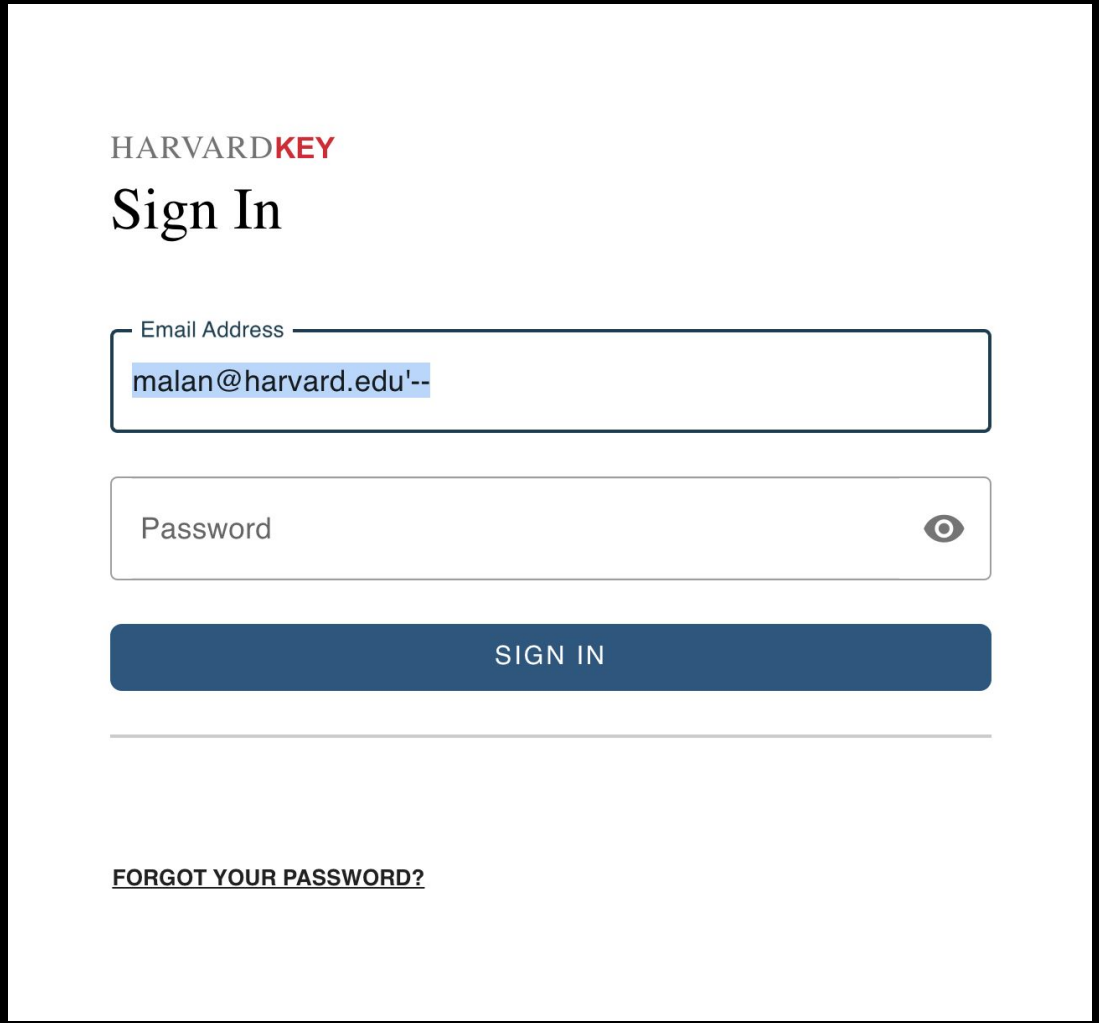

HARVARDKEY
Sign In
Email Address
Password
SIGN IN
FORGOT YOUR PASSWORD?


HARVARDKEY
Sign In
Email Address
malan@harvard.edu'--
Password
SIGN IN
FORGOT YOUR PASSWORD?

```
rows = db.execute("SELECT * FROM users WHERE username = ? AND password = ?", username, password)

if rows:
    ...
```

```
rows = db.execute("SELECT * FROM users WHERE username = ? AND password = ?", username, password)

if rows:
    ...
```

```
rows = db.execute("SELECT * FROM users WHERE username = ? AND password = ?", username, password)

if rows:
    ...
```

```
rows = db.execute(f"SELECT * FROM users WHERE username = '{username}' AND password = '{password}'")

if rows:
    ...
```

```
rows = db.execute(f"SELECT * FROM users WHERE username = '{username}' AND password = '{password}'")

if rows:
    ...
```

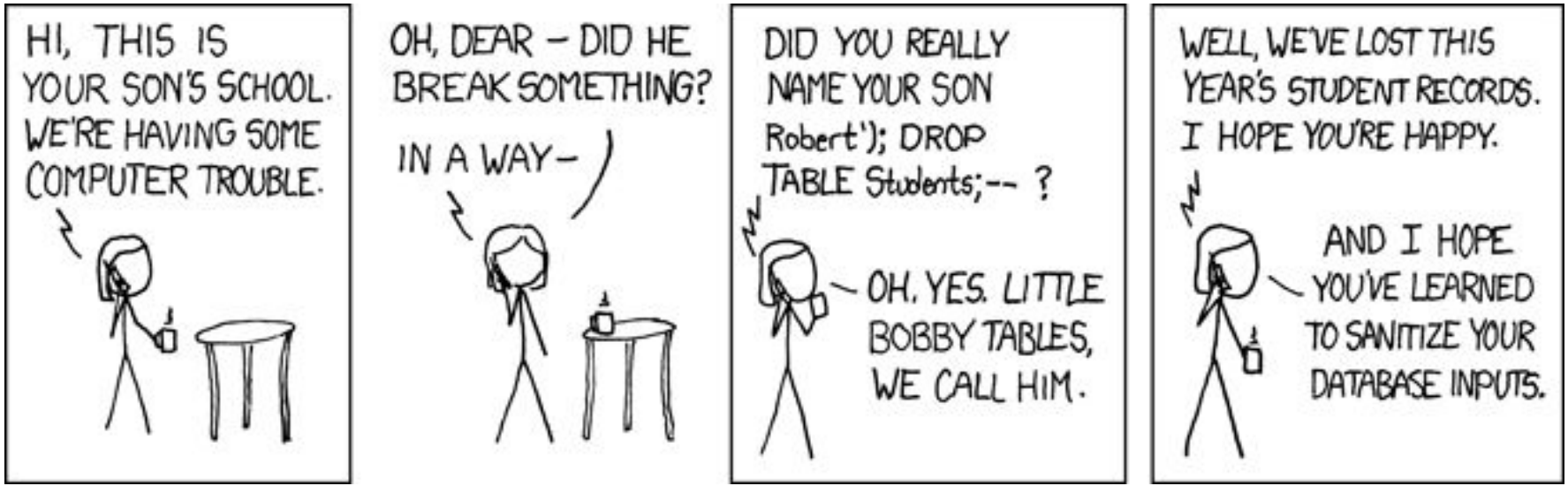
```
rows = db.execute(f"SELECT * FROM users WHERE username = 'malan@harvard.edu'--' AND password = '{password}'")

if rows:
    ...
```

```
rows = db.execute(f"SELECT * FROM users WHERE username = 'malan@harvard.edu'--' AND password = '{password}'")

if rows:
    ...
```

```
rows = db.execute("SELECT * FROM users WHERE username = ? AND password = ?", username, password)

if rows:
    ...
```

ZU 0666', 0, 0); DROP DATABASE TABLICE;

ZU 0666',0,0); DROP DATABASE TABLICE;


HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
IN A WAY–
DID YOU REALLY NAME YOUR SON Robert'); DROP TABLE Students;-- ?
OH. YES. LITTLE BOBBY TABLES, WE CALL HIM.
WELL, WE'VE LOST THIS YEAR'S STUDENT RECORDS. I HOPE YOU'RE HAPPY.
AND I HOPE YOU'VE LEARNED TO SANITIZE YOUR DATABASE INPUTS.

This is CS50