This is CS50

favorites

* Indicates required question

language *

Which is your favorite language?

○ Scratch

○ C

○ Python

https://docs.google.com/spreadsheets/

Guest

View only

100%

A1 | Timestamp

	A	B	C	D	E
	Form_Responses1 ⌄				
1	Timestamp	language	problem		
2					
3					
4					
5					
6					
7					
8					
9					
10					

Form Responses 1 ⌄

flat-file database

CSV

key	value

relational database

SQL

C
R
U
D

CREATE

READ

UPDATE

DELETE

CREATE

SELECT

UPDATE

DELETE

```
CREATE, INSERT
SELECT
UPDATE
DELETE
```

```
CREATE, INSERT
SELECT
UPDATE
DELETE, DROP
```

```
CREATE, INSERT
SELECT
UPDATE
DELETE, DROP
...
```

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

sqlite3

```
sqlite3 FILE
```

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

`.schema`

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

AVG
COUNT
DISTINCT
LOWER
MAX
MIN
UPPER
...

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

language
C
Python
Python
SQL
Python
SQL

language
C
Python
Python
SQL
Python
SQL

language
C
Python
Python
SQL
Python
SQL

language
C
Python
Python
SQL
Python
SQL

language	COUNT(*)
C	1
Python	3
SQL	2

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

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

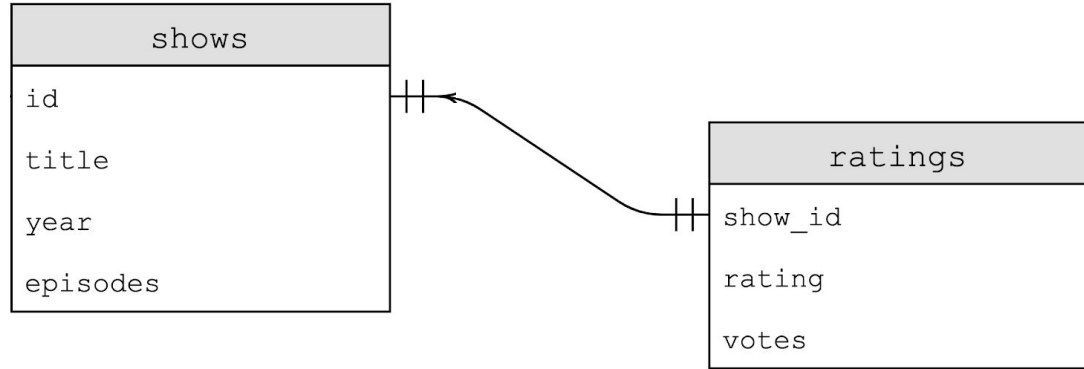NULL

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

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

IMDb

shows
id
title
year
episodes

ratings
show_id
rating
votes

one-to-one

shows

- id
- title
- year
- episodes
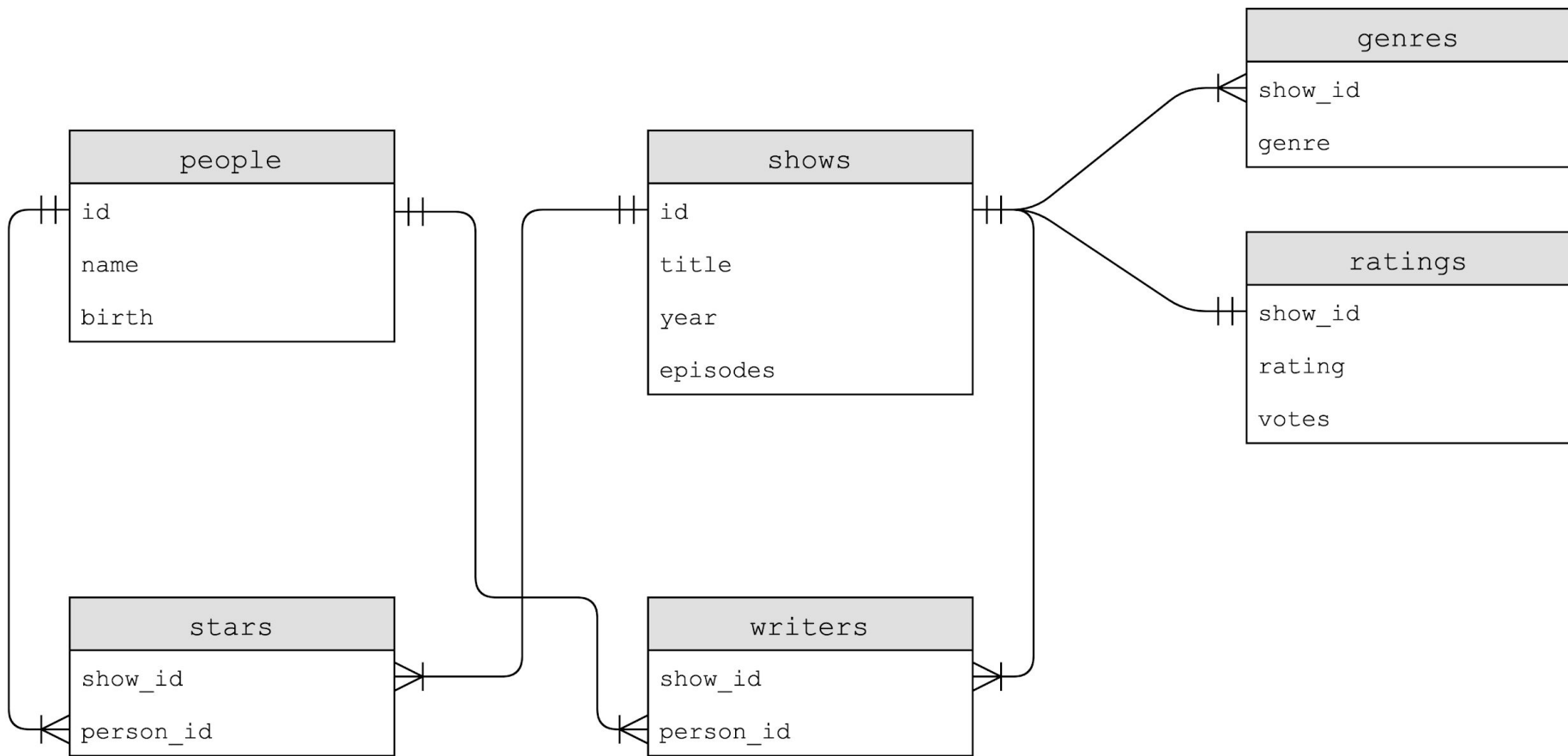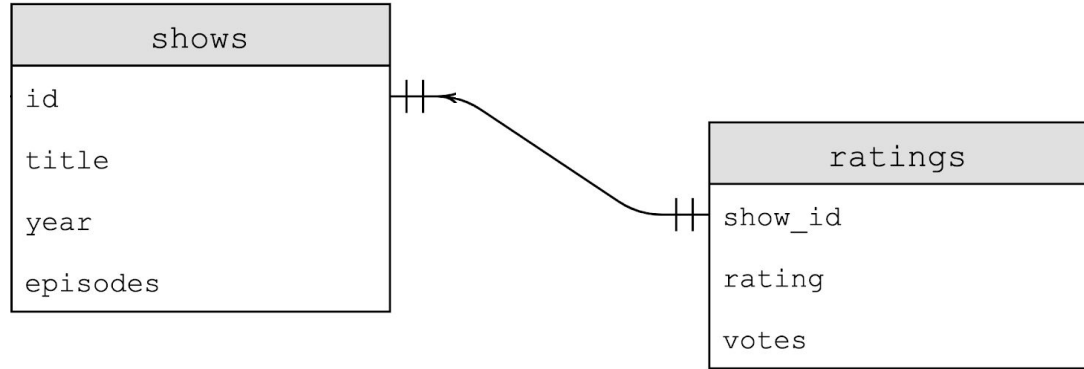
ratings

- show_id
- rating
- votes

```
BLOB
INTEGER
NUMERIC
REAL
TEXT
```

NOT NULL
UNIQUE

PRIMARY KEY
FOREIGN KEY

JOIN

id	title
386676	The Office

show_id	rating
386676	…

title	id
The Office	386676

show_id	rating
386676	…

title	id
The Office	386676

show_id	rating
386676	…

title	id	show_id	rating
The Office	386676	386676	…

title	id	rating
The Office	386676	…

title	rating
The Office	…

shows
id
title
year
episodes

genres
show_id
genre
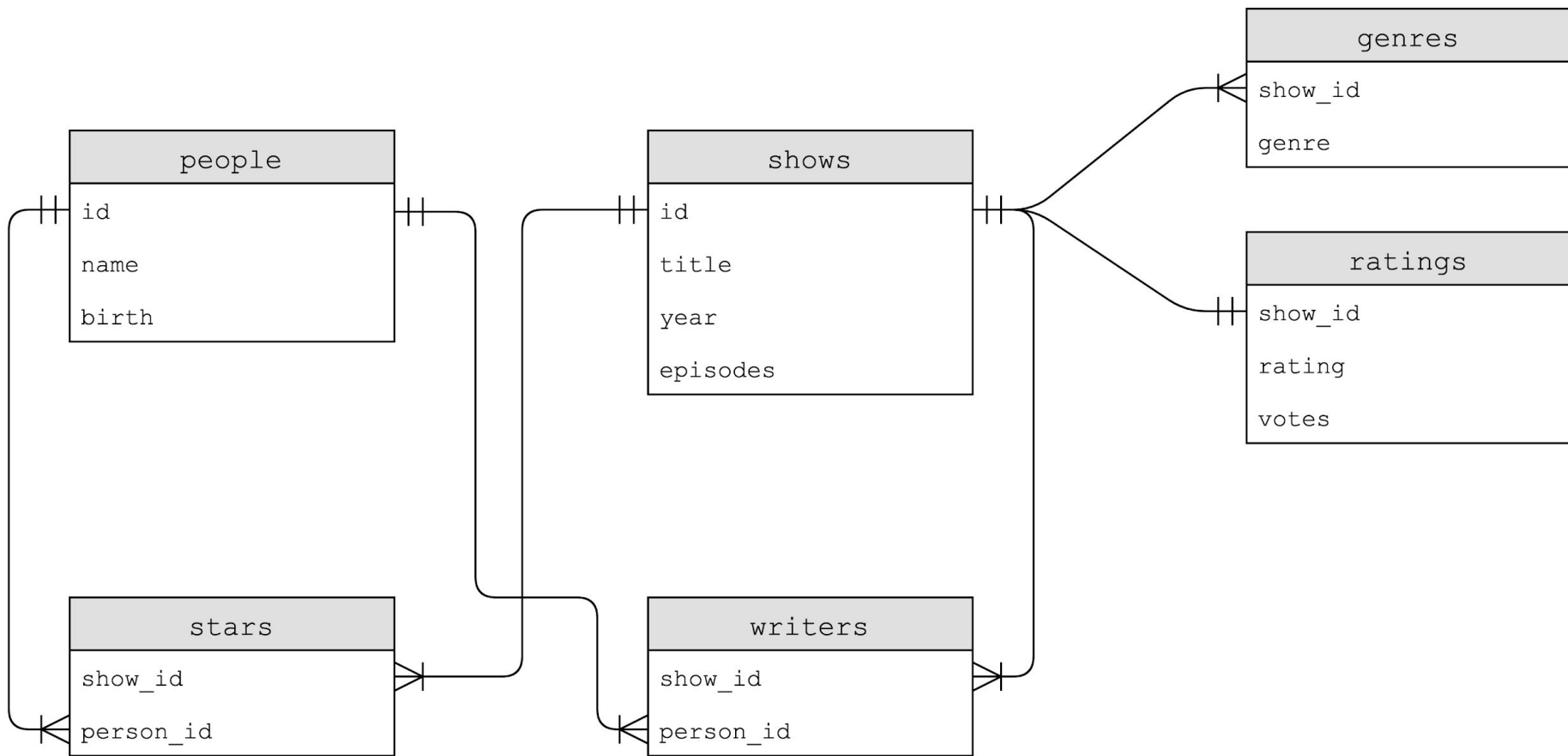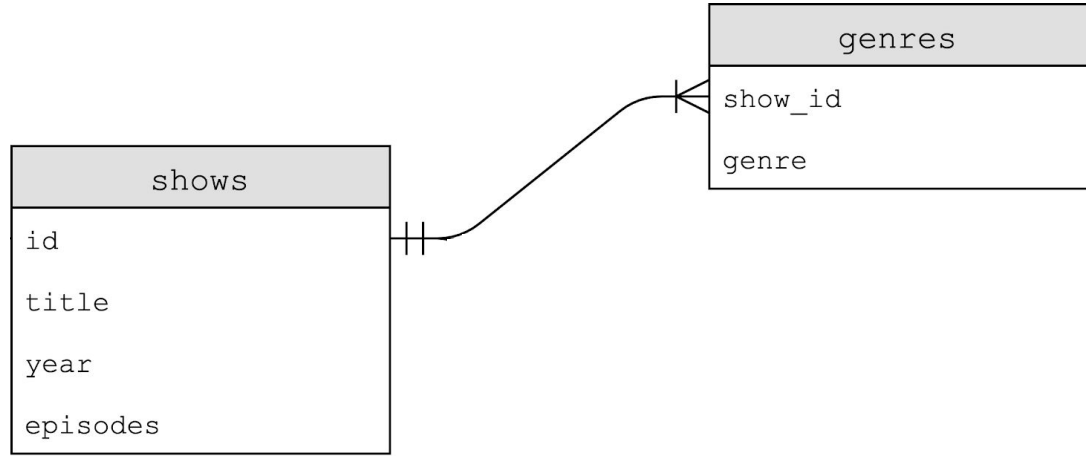
one-to-many

id	title
63881	Catweazle

show_id	genre
63881	Adventure
63881	Comedy
63881	Family

title	id
Catweazle	63881

show_id	genre
63881	Adventure
63881	Comedy
63881	Family

title	id
Catweazle	63881

show_id	genre
63881	Adventure
63881	Comedy
63881	Family

title	id	show_id	genre
Catweazle	63881	63881	Adventure
		63881	Comedy
		63881	Family

title	id	show_id	genre
Catweazle	63881	63881	Adventure
Catweazle	63881	63881	Comedy
Catweazle	63881	63881	Family

title	id	genre
Catweazle	63881	Adventure
Catweazle	63881	Comedy
Catweazle	63881	Family

title	genre
Catweazle	Adventure
Catweazle	Comedy
Catweazle	Family

genre
Adventure
Comedy
Family

people	
id	
name	
birth	

shows	
id	
title	
year	
episodes	

stars	
show_id	
person_id	
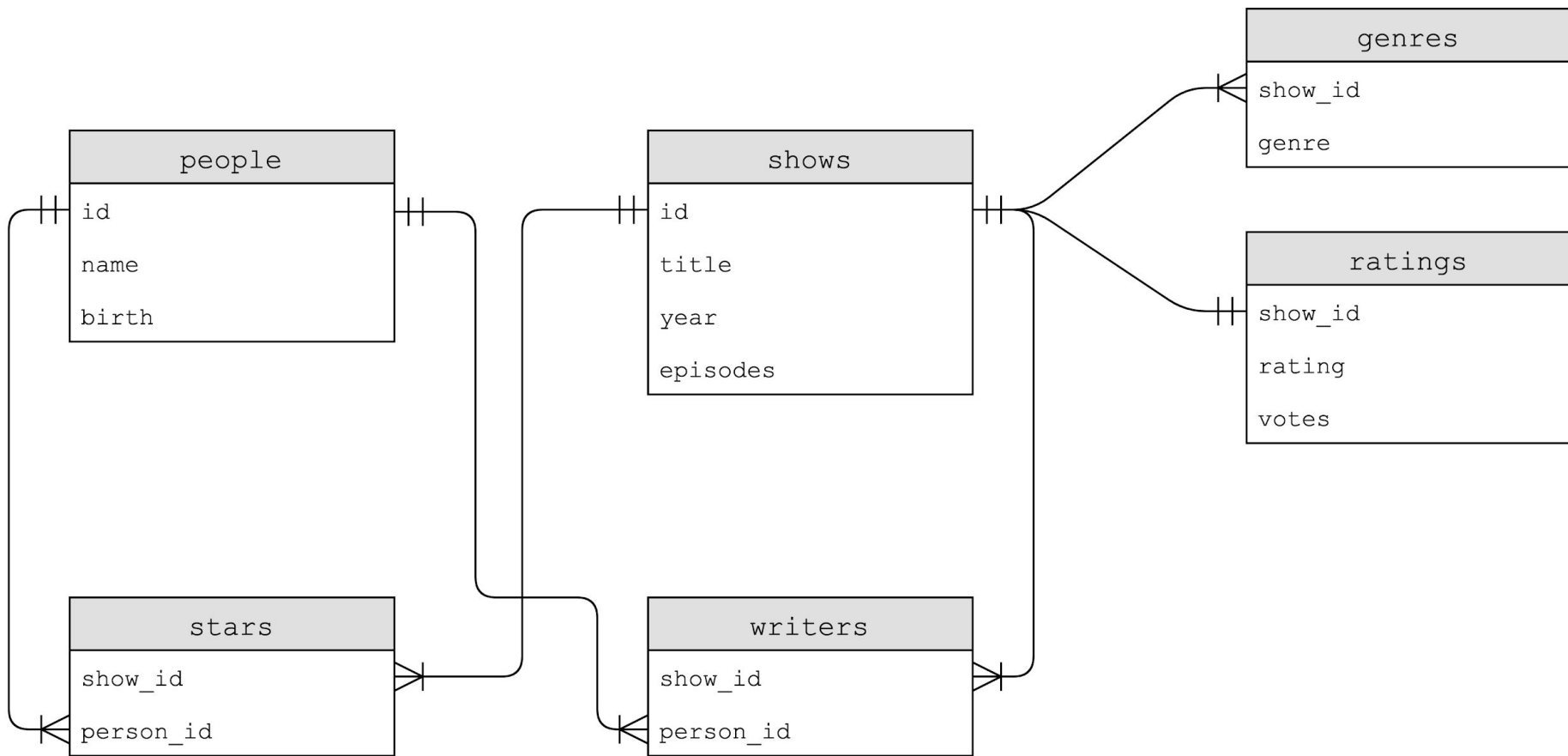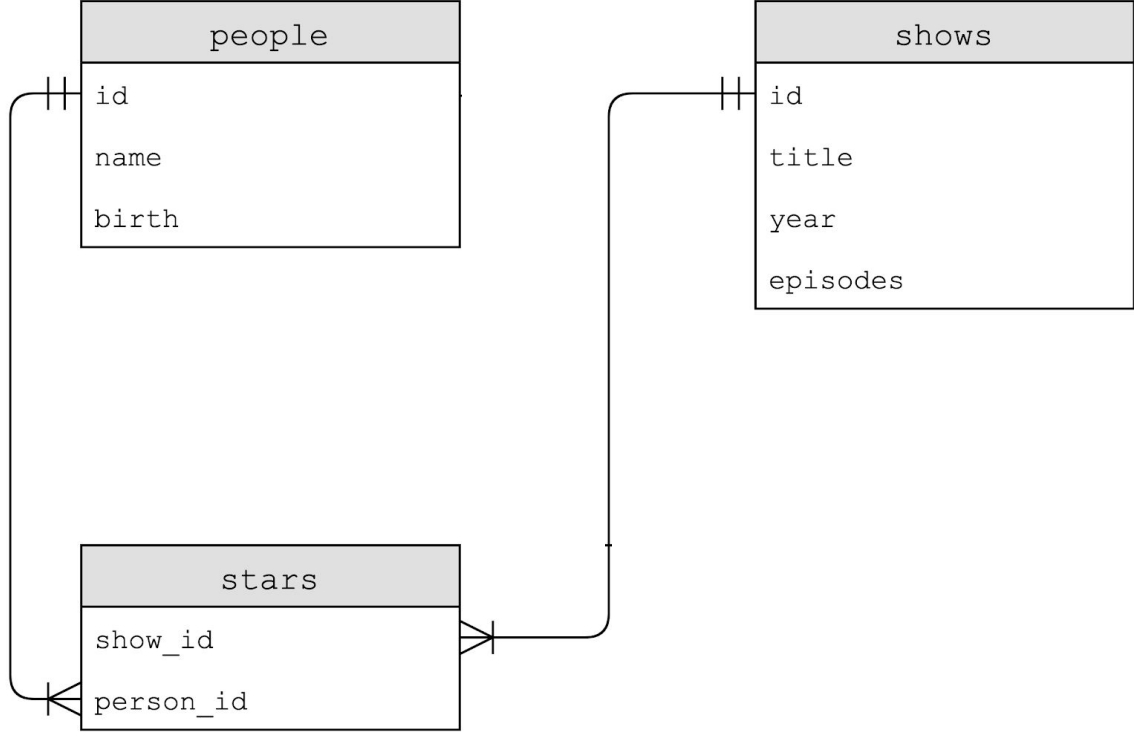
many-to-many
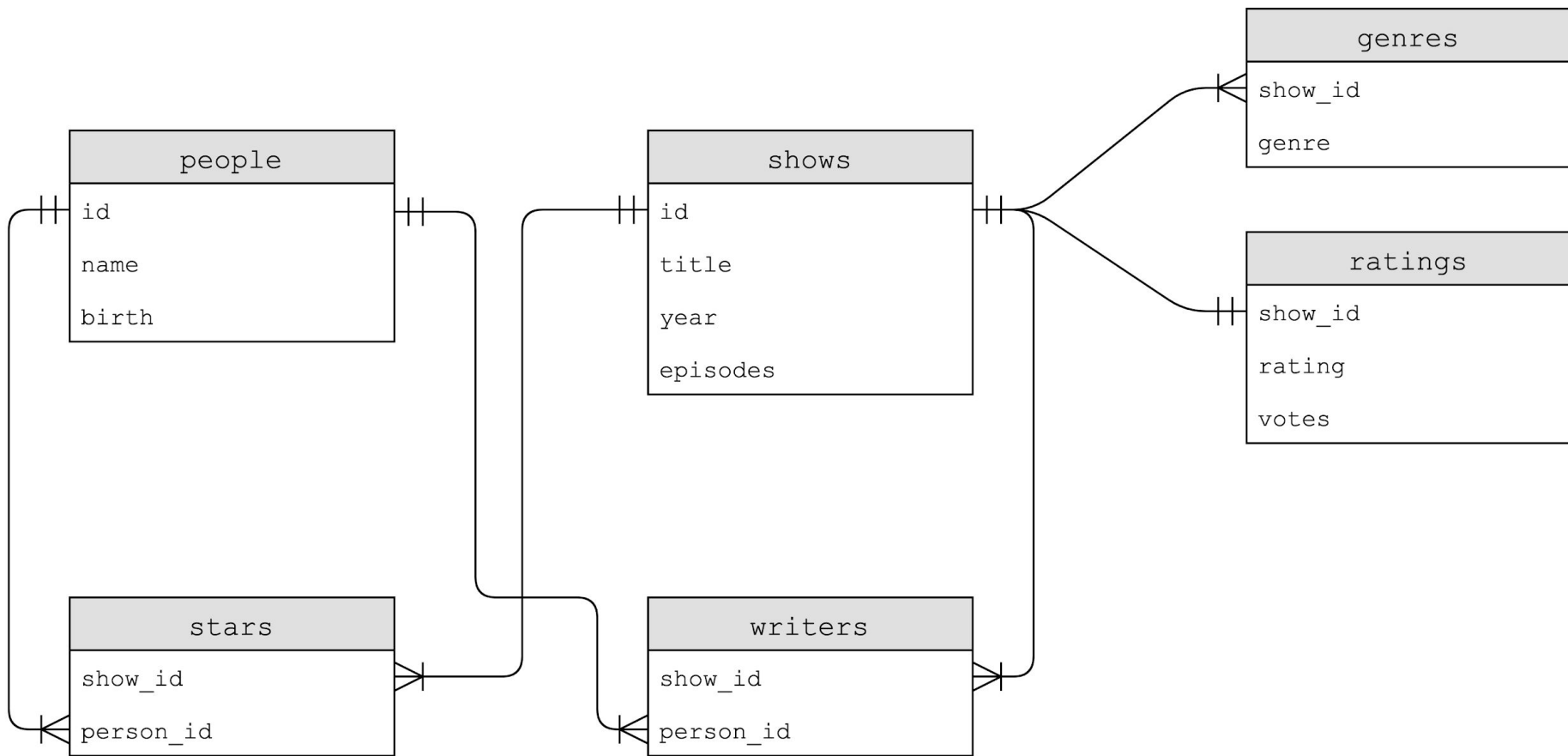
indexes

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

B-trees
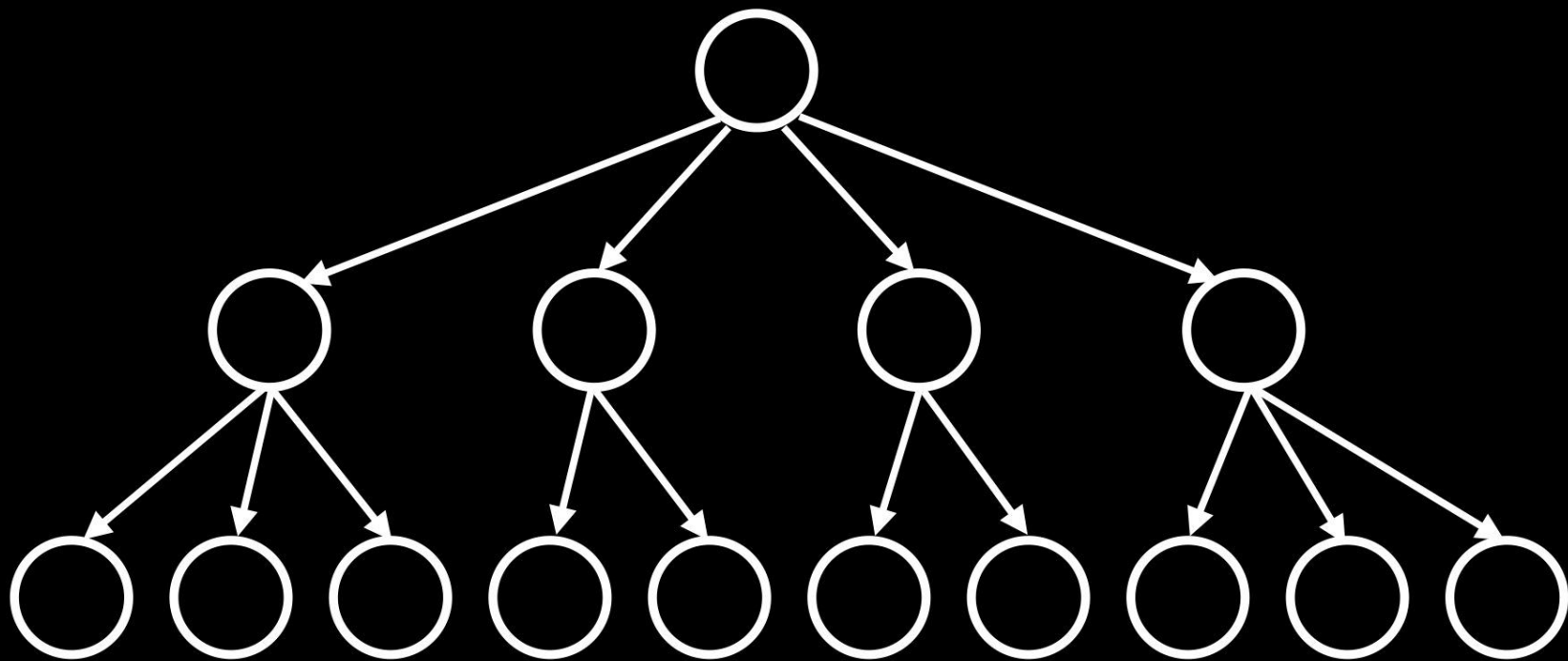
```
from cs50 import SQL
```

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

race conditions

```
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

Sign In

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

NetID

Password

Forgot My Password

SIGN IN

HARVARD**KEY**

Sign In

Email Address

Password 👁

SIGN IN

FORGOT YOUR PASSWORD?

HARVARD**KEY**

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:
    ...
```

```python
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(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:
    ...
```

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