

This is CS50

Favorites

* Required

language *

Which is your favorite language?

- Scratch
- C
- Python



100% | \$ % .0 .00 123 | Default... | - 10 + | B I A | [Grid Icons] | [More Options]

A1 | fx

	A	B	C	D	E	F	G	H	I	J	K
1	Type @ to insert										
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flat-file database

CSV

key

value

relational database

SQL

C
R
U
D

CREATE

READ

UPDATE

DELETE

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

...

WHERE

LIKE

ORDER BY

LIMIT

GROUP BY

...

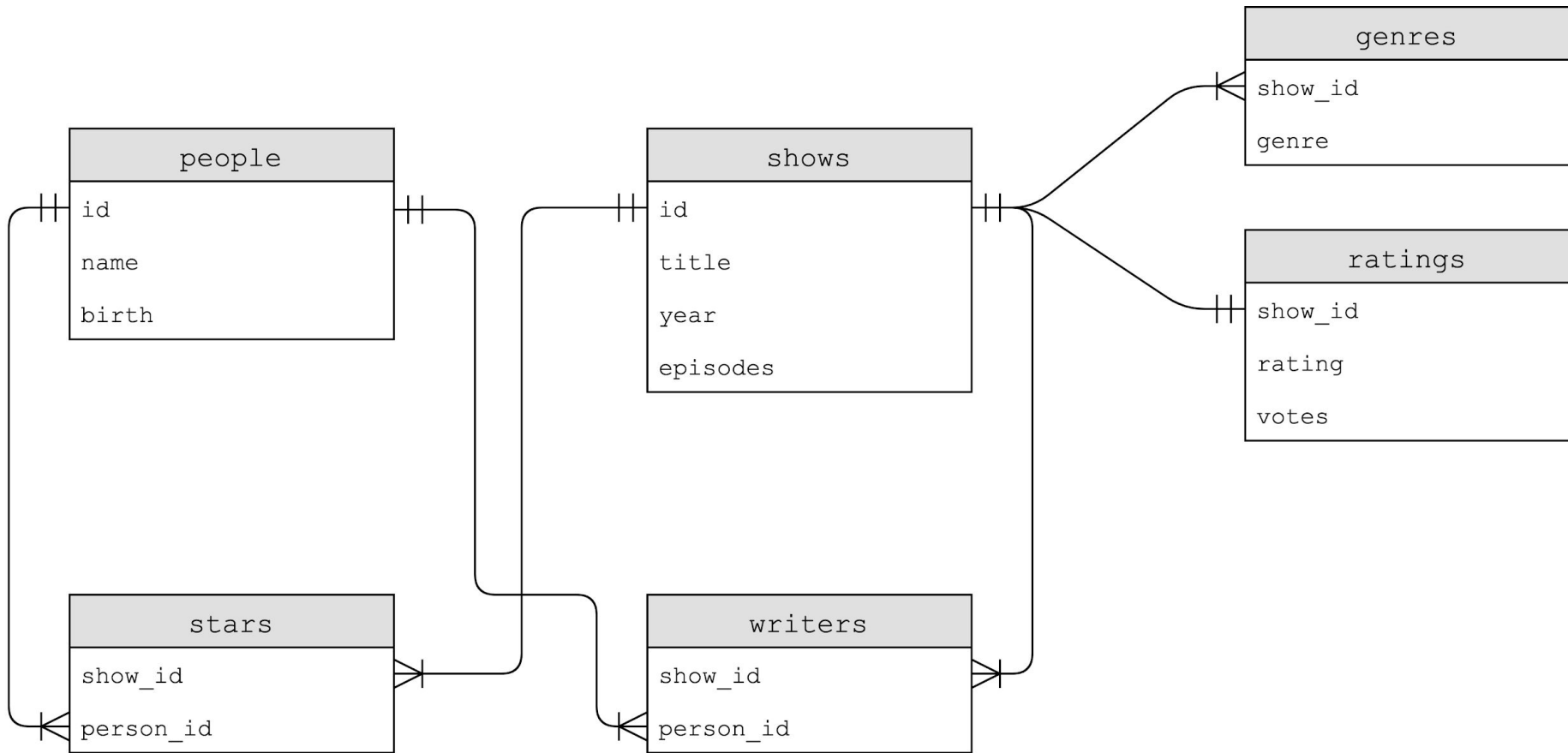
```
INSERT INTO table (column, ...) VALUES(value, ...);
```

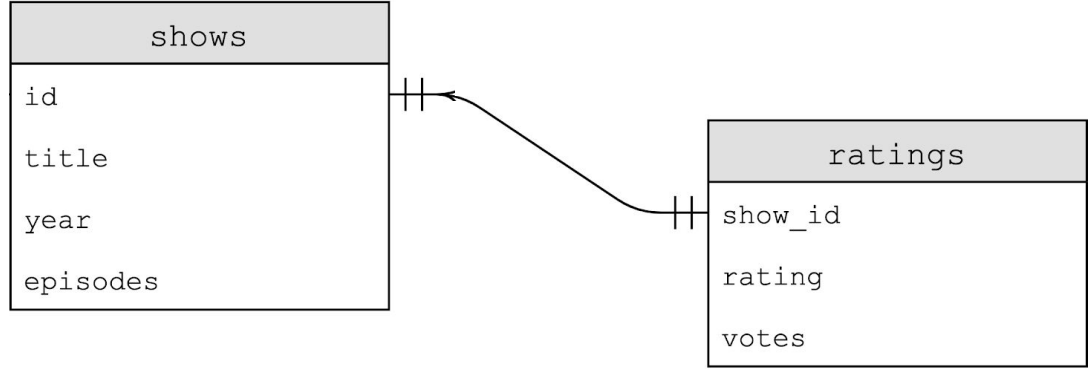
NULL

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

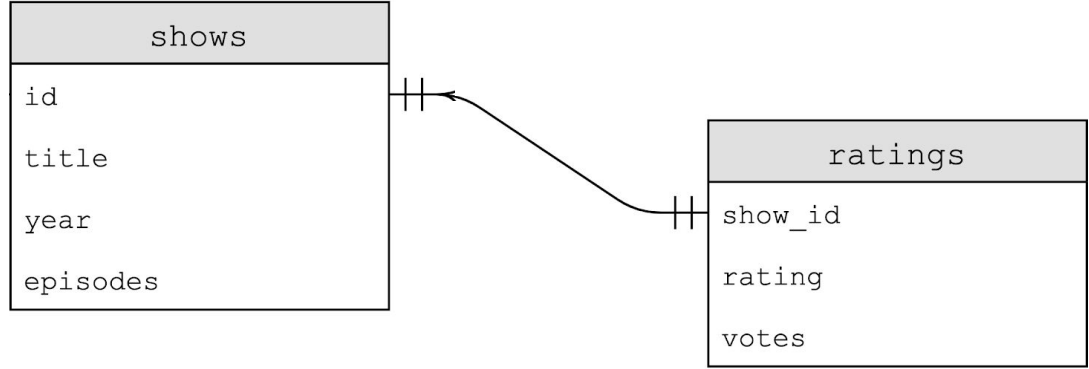
```
UPDATE table SET column = value WHERE condition;
```

IMDb





one-to-one



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	...

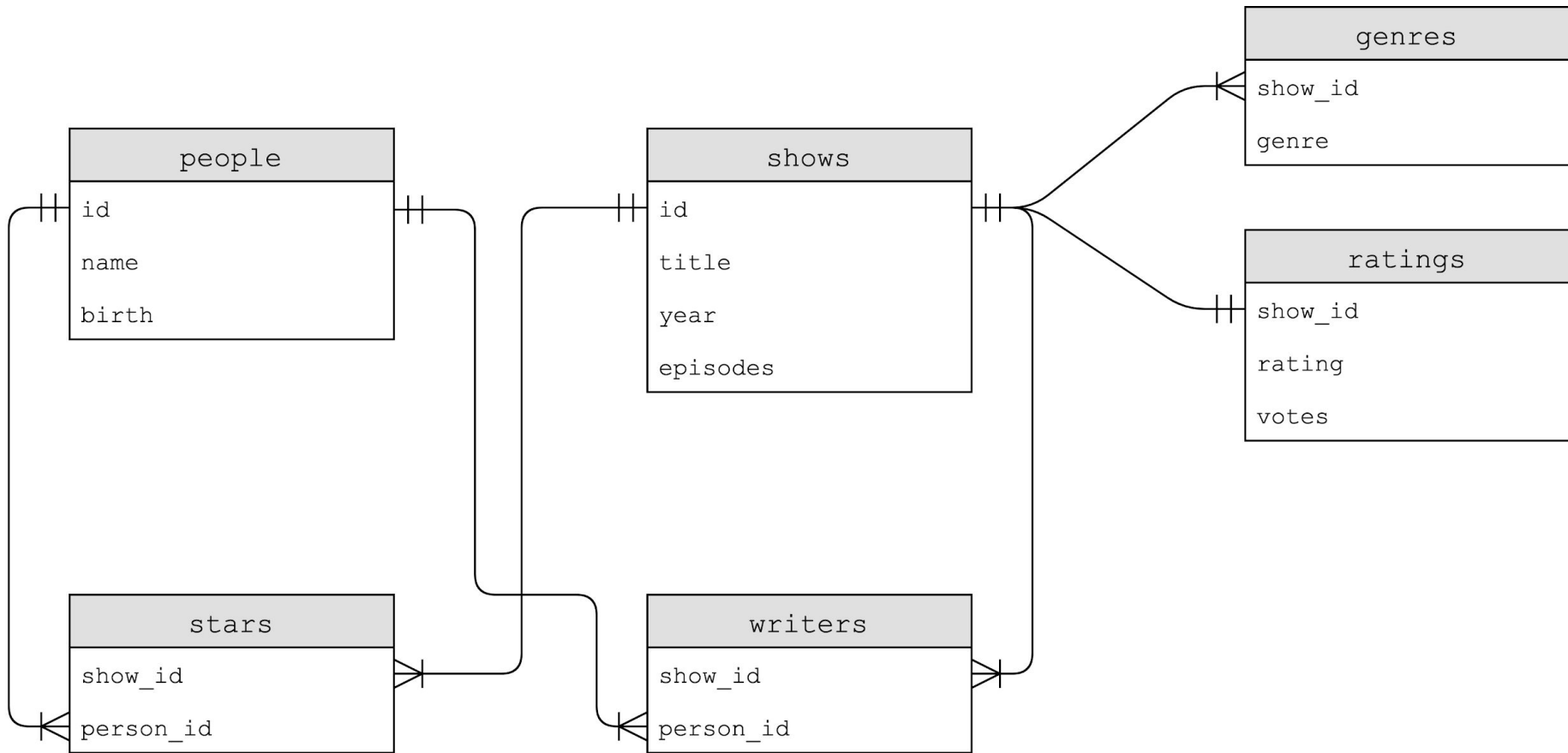
title	id
The Office	386676

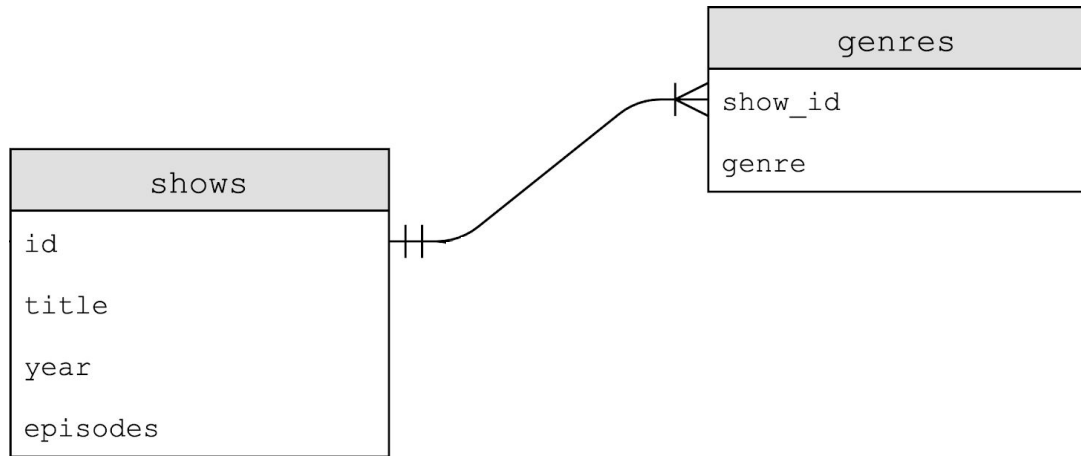
show_id	rating
386676	...

title	id	show_id	rating
The Office	386676	386676	...

title	id	rating
The Office	386676	...

title	rating
The Office	...





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

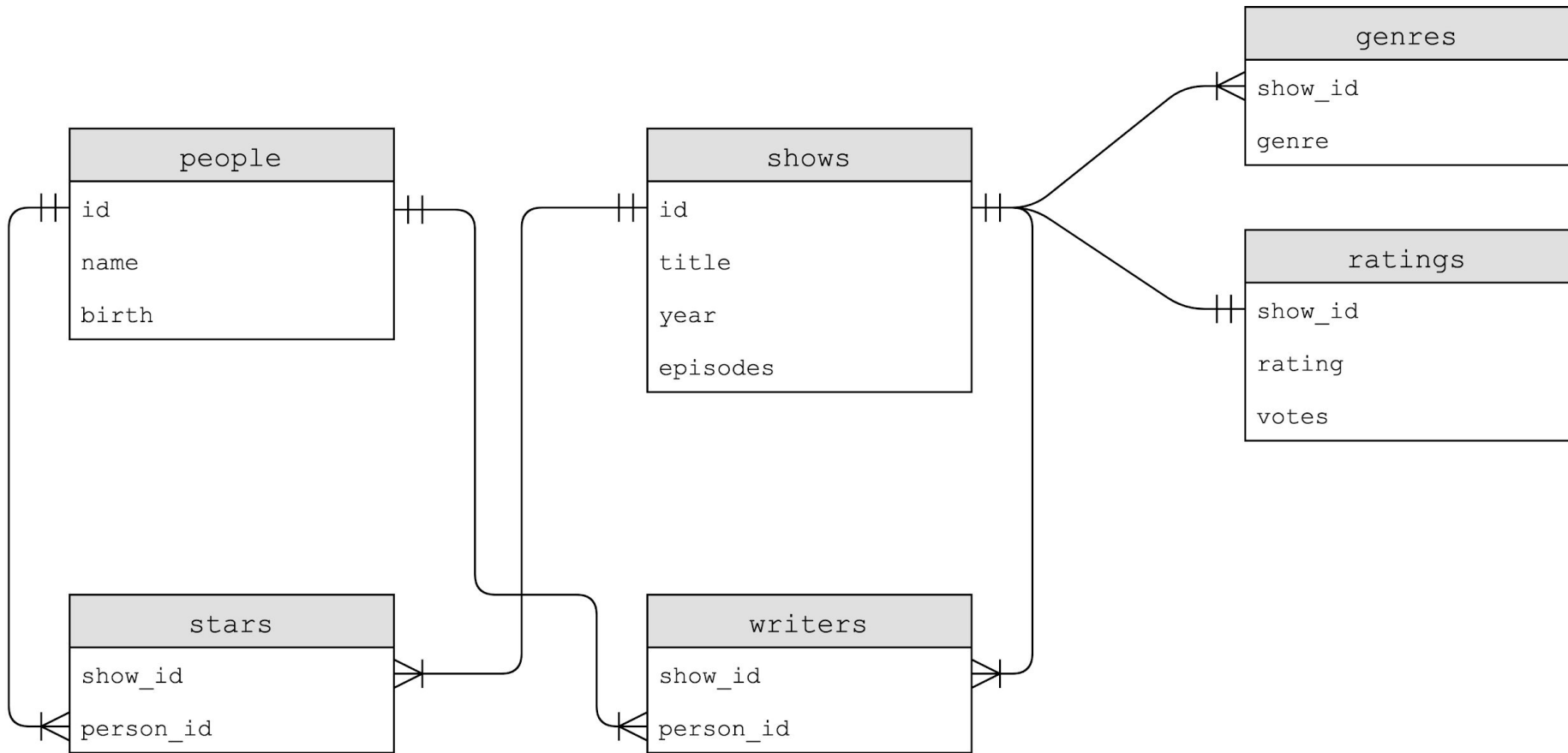
title	id	show_id	genre
Catweazle	63881	63881	Adventure
		63881	Comedy
		63881	Family

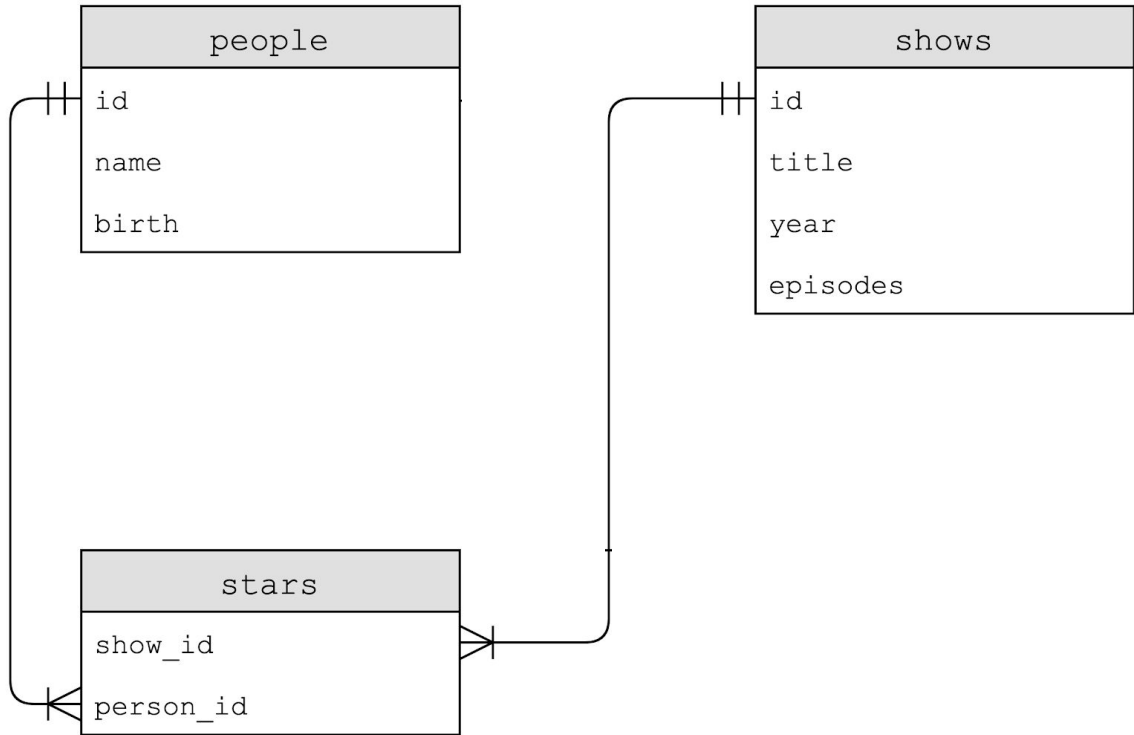
title	id	show_id	genre
Catweazle	63881	63881	Adventure
Catweazle	63881	63881	Comedy
Catweazle	63881	63881	Family

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

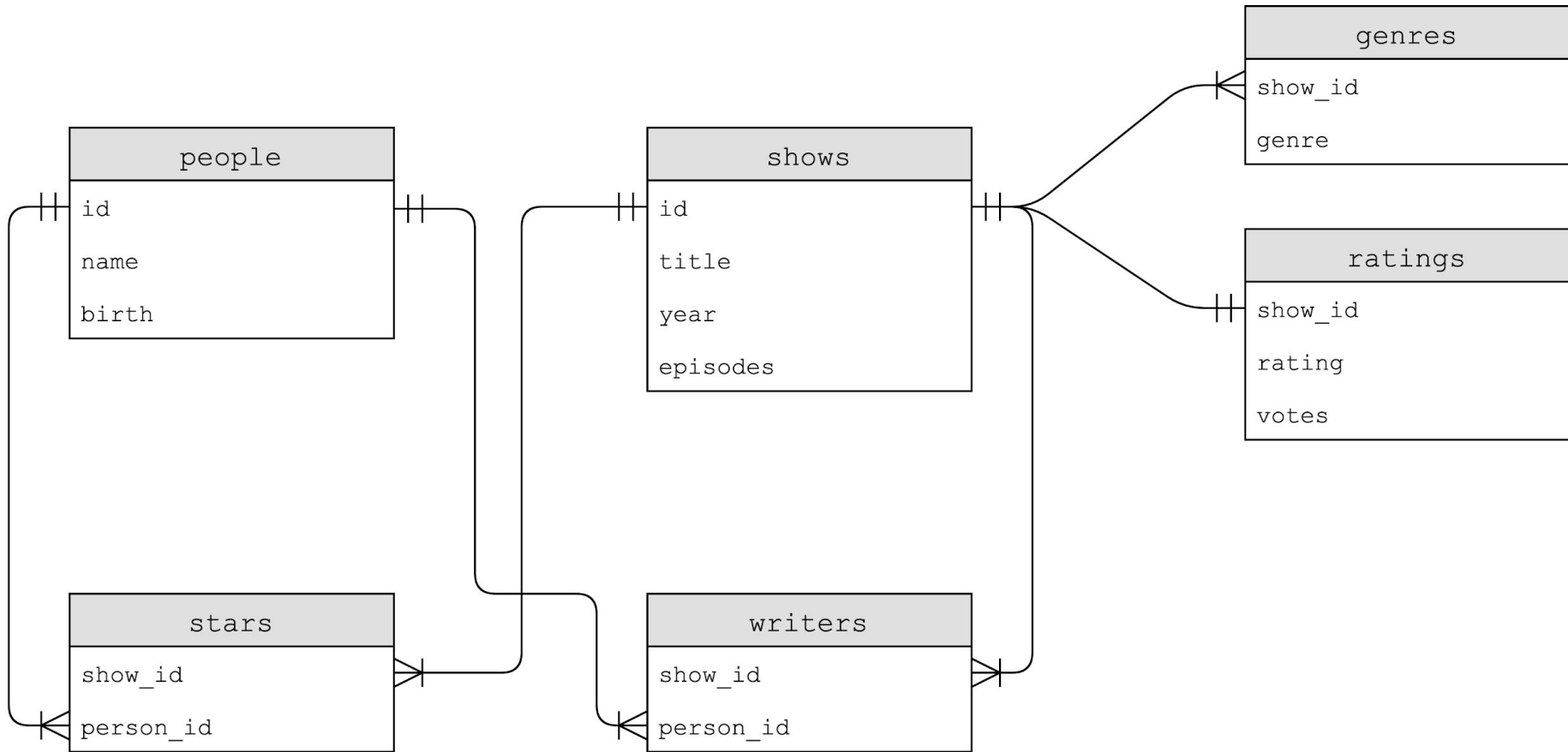
title	genre
Catweazle	Adventure
Catweazle	Comedy
Catweazle	Family

genre
Adventure
Comedy
Family





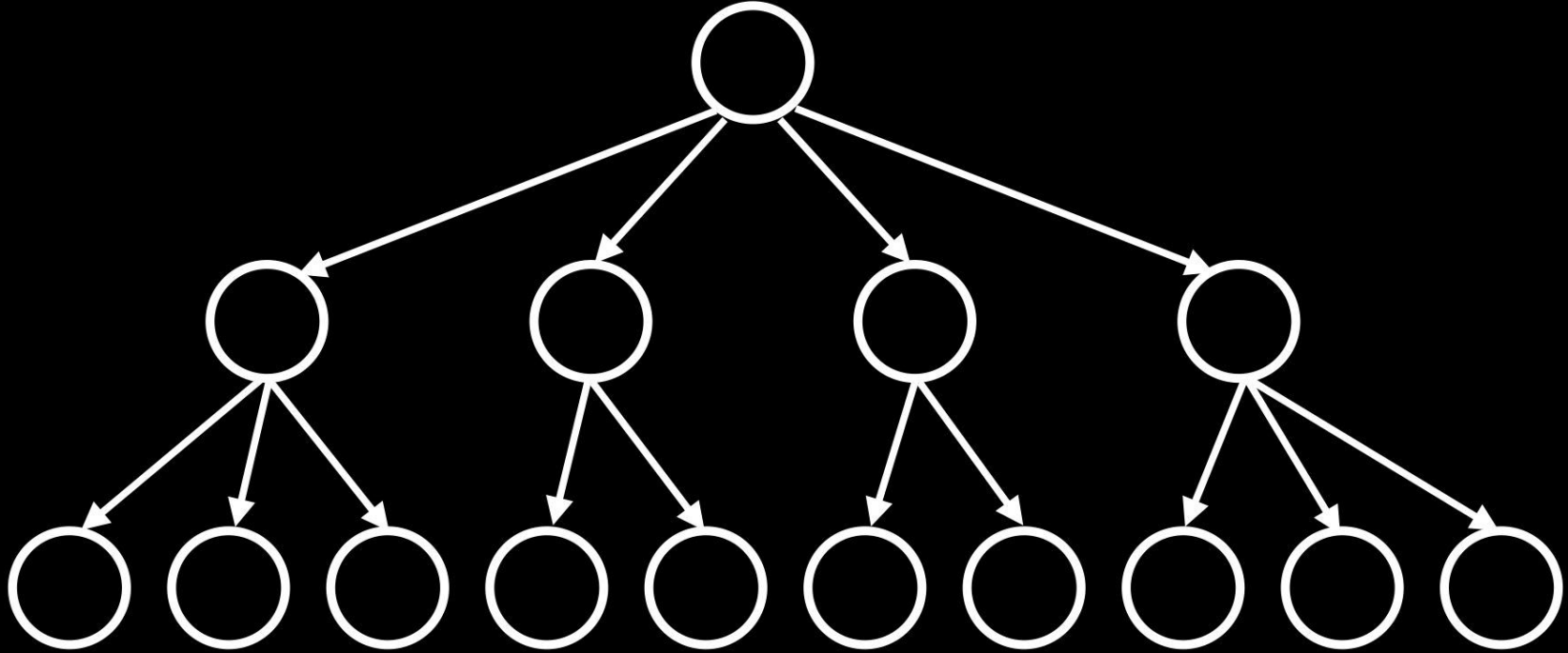
many-to-many



indexes

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

B-trees



```
from cs50 import SQL
```

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

race conditions



Post



leomessi 
Lusail Stadium



```
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);
```

```
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

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<https://secure.its.yale.edu>

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

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NetID

Password

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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(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;

CLASZCIEP PASIENKOWSKI Sp. z o.o. ul. B. Dąbrowskiego 11, 14-100 Białystok, tel. 85 422 10 10

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

PL PASIŃKOWSKI D. 114 M. Białe Błonie 4 251 07 948

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