

SQL Basics

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What's all this about?

We've got a database for storing data...

- ▶ It'd be nice to be able to actually use it and make queries!

For that we need SQL:

- ▶ Structured Query Language

Query language for asking questions about databases from 1974

- ▶ Standardized in 1986 in the US and 1987 everywhere else
- ▶ Still the dominant language for queries today

Not a general purpose programming language

- ▶ Not Turing complete
- ▶ Weird English-like syntax

Standardized?

You would be so lucky!

- ▶ *In theory*, yes
- ▶ *In practice*, absolutely not

Every database engine has *small* differences...

- ▶ Some have quite big ones too!

Lots have differences in performance

- ▶ SQLite is good with strings, most others prefer numbers

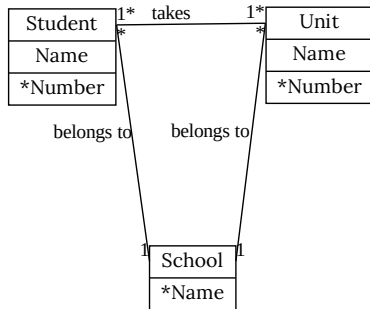
Managing these differences used to be an entire degree/job in its own right!

- ▶ Now we just manage databases badly!

I'll try and stick to SQLite's syntax...

CREATE TABLE

In the last lecture we had the following Entity relationship diagram:



```
CREATE TABLE IF NOT EXISTS student (  
  name TEXT NOT NULL,  
  number TEXT NOT NULL,  
  PRIMARY KEY (number));
```

```
CREATE TABLE IF NOT EXISTS unit (  
  name TEXT NOT NULL,  
  number TEXT NOT NULL,  
  PRIMARY KEY (number));
```

```
CREATE TABLE IF NOT EXISTS school (  
  name TEXT NOT NULL,  
  PRIMARY KEY (name));
```

```
CREATE TABLE IF NOT EXISTS class_register (  
  student TEXT NOT NULL,  
  unit TEXT NOT NULL,  
  FOREIGN KEY (student) REFERENCES student(number),  
  FOREIGN KEY (unit) REFERENCES unit(name),  
  PRIMARY KEY (student, unit));
```

Lets build it in SQL

DROP TABLE

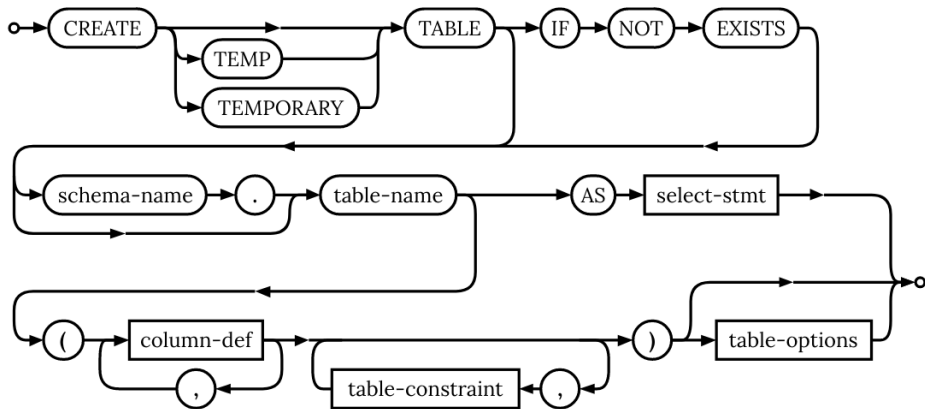
What about if we want to delete them?

```
DROP TABLE IF EXISTS class_register;  
DROP TABLE IF EXISTS student;  
DROP TABLE IF EXISTS unit;  
DROP TABLE IF EXISTS school;
```

Syntax, syntax, syntax

If you go on the SQLite documentation page...

- ▶ ...you can find syntax diagrams for all of SQL!
- ▶ https://www.sqlite.org/lang_createtable.html



Types

When creating the fields in our database we made them all of type **TEXT**...

- ▶ What other types exist?

INTEGER whole numbers

REAL lossy decimals

BLOB binary data
(images/audio/files...)

VARCHAR(10) a string of 10 characters

TEXT any old text

BOOLEAN True or false

DATE Today

DATETIME Today at 2pm

But really types

Databases sometimes *simplify* these types

- ▶ SQLite makes the following tweaks...

INTEGER whole numbers

REAL lossy decimals

BLOB binary data
(images/audio/files...)

VARCHAR(10) *actually TEXT*

TEXT any old text

BOOLEAN *actually INTEGER*

DATE *actually TEXT*

DATETIME *actually TEXT*

(others may exist... *read the manual!*)

Table constraints

In the earlier examples we marked some columns as NOT NULL

- ▶ Others as PRIMARY KEY and others as FOREIGN KEY...

- ▶ ...what other constraints have we got

...but SQLite won't actually enforce any of these types or constraints unless you ask it to :-)

- ▶ Check out the STRICT keyword when creating the table.

NOT NULL can't be NULL

UNIQUE can't be the same as another row

CHECK arbitrary checking (including it conforms to a regular expression)

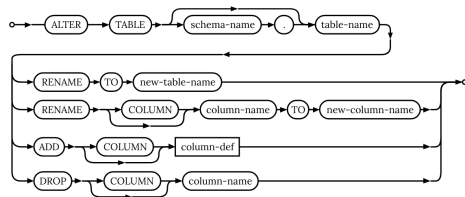
PRIMARY KEY unique, not NULL and (potentially) autogenerated

FOREIGN KEY **(IGNORED BY MARIADB)** other key must exist

Can I add constraints later?

Yes with the ALTER TABLE statement

- ▶ But often easiest just to save the table somewhere else
- ▶ Drop the table
- ▶ Reimport it



INSERT INTO

What about if we want to add data to a table?

```
INSERT INTO unit(name, number)
VALUES ("Software Tools", "COMS100012");
```

So far

We've introduced how to:

- ▶ CREATE TABLE
- ▶ DROP TABLE
- ▶ INSERT INTO

Next step: querying data!

I'm going to use a database from an old iTunes library for demo purposes

- ▶ Chinook database

SELECT

Basic command for selecting rows from a table
is SELECT

```
SELECT * FROM album  
LIMIT 5;
```

AlbumId	Title	ArtistId
1	For Those About To Rock We Salute You	1
2	Balls to the Wall	2
3	Restless and Wild	2
4	Let There Be Rock	1
5	Big Ones	3

```
SELECT * FROM artist  
LIMIT 5;
```

ArtistId	Name
1	AC/DC
2	Accept
3	Aerosmith
4	Alanis Morissette
5	Alice In Chains

JOIN

Ideally we'd like those two tables combined into one...

```
SELECT *  
FROM album  
JOIN artist  
ON album.artistid = artist.artistid  
LIMIT 5;
```

AlbumId	Title	ArtistId	ArtistId	Name
1	For Those About To Rock We Salute You	1	1	AC/DC
2	Balls to the Wall	2	2	Accept
3	Restless and Wild	2	2	Accept
4	Let There Be Rock	1	1	AC/DC
5	Big Ones	3	3	Aerosmith

Reducing the columns...

Clearly there are too many columns here... lets only select the ones we need

```
SELECT album.title, artist.name
FROM album
JOIN artist
ON album.artistid = artist.artistid
LIMIT 5;
```

Title	Name
For Those About To Rock We Salute You	AC/DC
Balls to the Wall	Accept
Restless and Wild	Accept
Let There Be Rock	AC/DC
Big Ones	Aerosmith

Renaming columns

Title and *Name* aren't particularly meaningful without context

- ▶ Lets name them something sensible

```
SELECT album.title AS album,  
       artist.name AS artist  
FROM album  
JOIN artist  
ON album.artistid = artist.artistid  
LIMIT 5;
```

album	artist
For Those About To Rock We Salute You	AC/DC
Balls to the Wall	Accept
Restless and Wild	Accept
Let There Be Rock	AC/DC
Big Ones	Aerosmith

I'm feeling rocky

I want to listen to something a bit rocky...

- ▶ Lets filter all the albums to the ones that have Rock in the title

```
SELECT album.title AS album,  
       artist.name AS artist  
FROM album  
JOIN artist  
ON album.artistid = artist.artistid  
WHERE album LIKE '%Rock%'  
LIMIT 5;
```

album	artist
For Those About To Rock We Salute You	AC/DC
Let There Be Rock	AC/DC
Deep Purple In Rock	Deep Purple
Rock In Rio [CD1]	Iron Maiden
Rock In Rio [CD2]	Iron Maiden

Who rocks?

So who has put out an album with Rock in it?

```
SELECT artist.name AS artist
FROM album
JOIN artist
ON album.artistid = artist.artistid
WHERE album.title LIKE '%Rock%'
LIMIT 5;
```

```
artist
AC/DC
AC/DC
Deep Purple
Iron Maiden
Iron Maiden
```

```
SELECT DISTINCT artist.name AS artist
FROM album
JOIN artist
ON album.artistid = artist.artistid
WHERE album.title LIKE '%Rock%'
LIMIT 5;
```

```
artist
AC/DC
Deep Purple
Iron Maiden
The Cult
The Rolling Stones
```

How many *rock* albums has each artist put out?

Lets group by artist and count the albums!

```
SELECT artist.name AS artist,  
       COUNT(album.title) as albums  
FROM album  
JOIN artist  
ON album.artistid = artist.artistid  
WHERE album.title LIKE '%Rock%'  
GROUP BY artist  
LIMIT 5;
```

artist	albums
AC/DC	2
Deep Purple	1
Iron Maiden	2
The Cult	1
The Rolling Stones	1

Really we want this list ordered...

Lets group by artist and count the albums...

- And order it by album count!

```
SELECT artist.name AS artist,  
       COUNT(album.title) as albums  
FROM album  
JOIN artist  
ON album.artistid = artist.artistid  
WHERE album.title LIKE '%Rock%'  
GROUP BY artist  
ORDER BY albums DESC  
LIMIT 5;
```

artist	albums
Iron Maiden	2
AC/DC	2
The Rolling Stones	1
The Cult	1
Deep Purple	1

Conclusions

So thats the basics of SQL!

- ▶ You can do a *bunch* more things with SQL SELECT statements...
- ▶ ...you can pick them up as you write queries.
- ▶ ...most SQL engines have a bunch more counting and query functions too

Go read the documentation!