SQL Intro

Class outline:

- Databases
- SQL
- Querying tables

Databases

Database Management Systems

Database management systems (DBMS) are important, heavily used, and interesting!

Popular DBMSes: MySQL, Oracle, PostgreSQL, MS SQL Server, MongoDB, Redis

A DBMS allows for:

- Storing data in a structured way
- Updating that data
- Querying that data
- Optimizing all of those operations

Relational databases

A relational database consists of tables with data that is often related to each other.

For example, sections.cs61a.org uses MySQL DBMS and has these tables: `attendance`, `course_config`, `section`, `session`, `slot`, `survey`, `user`, `user_session_junction`.

section

id	capacity	staff_id	tag_string
145	35	142	Regular
146	36	188	Zoom
147	36	144	Scholars
148	45	145	Transfer
149	45	174	Regular

user

id	email	name	section_id
192	ana_kerluke@berkeley.edu	Ana Kerluke	149
255	paige_wintheiser@berkeley.edu	Paige Wintheiser	149
270	leanna.feest@berkeley.edu	Leanna Feest	149
387	marcelo35@berkeley.edu	Marcelo Gruno	149
401	baron95@berkeley.edu	Baron Weiss	149

Table terminology

A **table** is a collection of records, which are rows that have a value for each column.

A **row** has a value for each column.

A **column** has a name and a type.

section

id	**capacity**	**staff_id**	**tag_string**
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How many rows does that table have?
How many columns?

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How many rows does that table have? 5
How many columns?

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149	45	174	Regular

How many rows does that table have? 5
How many columns? 4

SQL

Structured Query Language

SQL is a declarative programming language for working with relational databases.

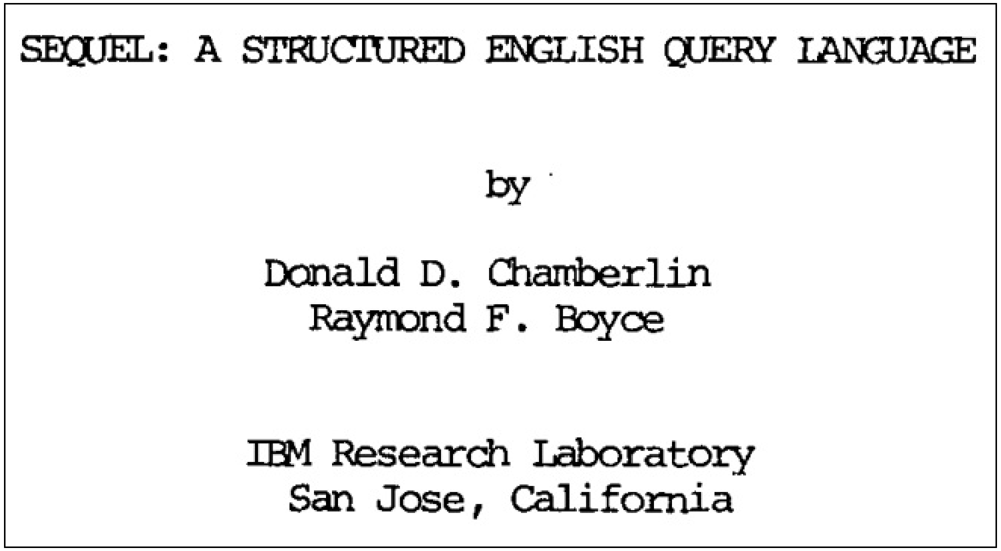
SQL is an ANSI and ISO standard, but DBMS's implement custom variants. We will use SQLite, a lightweight SQL implementation.

SQL variants generally include statements for:

- Querying a table for rows of data (`SELECT ...`)
- Creating new tables (`CREATE ...`)
- Inserting data into tables (`INSERT ...`)
- Updating existing rows in a table (`UPDATE ...`)
- Deleting data from a table (`DELETE ...`)

"S Q L" or "Sequel"?

From the original proposal for the language:



SEQUEL: A STRUCTURED ENGLISH QUERY LANGUAGE

by

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Raymond F. Boyce

IBM Research Laboratory
San Jose, California

One trademark dispute later, SEQUEL became SQL.

Pronounce it however you'd like. You do you. 😸

Using SQL

Install sqlite (version 3.8.3 or later):
http://sqlite.org/download.html

Or use SQLite online at code.cs61a.org.

Querying tables

Example table

songs

id	artist	title	release_year	views
1	Lil Nas X	Old Town Road	2018	851
2	Lil Nas X	Panini	2019	423
3	Lil Nas X	Montero (Call Me By Your Name)	2021	391
4	Lil Nas X	Sun Goes Down	2021	35
5	Lil Nas X	Industry Baby	2021	206
6	Lil Nas X	That's What I Want	2021	68
7	Janelle Monáe	Turntables	2021	2
8	Janelle Monáe	Make Me Feel	2018	31
9	Janelle Monáe	Tightrope	2010	28
10	Janelle Monáe	Dirty Computer	2018	3
11	Ben Platt	Grow as We Go	2019	23
12	Ben Platt	Rain	2019	4
13	Ben Platt	Older	2019	6
14	Ben Platt	Imagine	2021	2
15	Ben Platt	I Wanna Love You But I Don't	2021	1
16	Robyn	Dancing with Myself	2010	67
17	Robyn	Indestructible	2011	2
18	Robyn	Hang With Me	2010	7
19	Robyn	Call Your Girlfriend	2011	29
20	P!nk	Try	2012	487
21	P!nk	All I Know So Far	2021	18
22	P!nk	What About Us	2017	320
23	P!nk	Just Like A Pill	2009	137

SELECT statement

The `SELECT` statement queries a database and returns zero or more rows of data.

Return all the rows:

```
SELECT * FROM songs;
```

Return a subset of columns from all rows:

```
SELECT artist, title FROM songs;
```

Rename columns in the returned data:

```
SELECT artist AS singer, title AS song_title FROM songs;
```

Manipulate column values in the returned data:

```
SELECT title, views * 1000000 FROM songs;
```

Try these on code.cs61a.org - the songs table is built-in.

ORDER BY clause

The `SELECT` statement can have multiple optional clauses.

The `ORDER BY` clause specifies the order of rows returned:

Return the rows sorted by a column (highest to lowest):

```
SELECT title, views FROM songs ORDER BY views DESC;
```

Ditto, but ascending (lowest to highest):

```
SELECT title, views FROM songs ORDER BY views ASC;
```

Return the rows sorted by multiple columns:

```
SELECT title, release_year, views  FROM songs
    ORDER BY release_year DESC, views DESC;
```

WHERE clause

The `WHERE` clause can be used to filter rows, and must appear before the `ORDER BY` clause.

```
SELECT [columns] FROM [table] WHERE [condition] ORDER BY [order]
```

Returning rows that match a particular value:

```
SELECT title FROM songs WHERE artist = "Lil Nas X";
```

Using other comparison operators:

```
SELECT artist, title, release_year FROM songs
    WHERE release_year > 2020;
```

Using logical operators:

```
SELECT artist, title, release_year FROM songs
    WHERE release_year > 2020 AND views > 5;
```

Other clauses

The `SELECT` statement supports a wide array of optional clauses. See the full description in the SQLite SELECT documentation.

We will learn a few more clauses in the coming lectures, but not all of them!