

# Structured Query Language (SQL)

CS 272 Software Development

## Introduction

- Structured Query Language (SQL)
  - Often pronounced "sequel" or spelled out "S-Q-L"
  - Standard language for relational databases
- Relational Database Management System (RDBMS)
  - MySQL or MariaDB, PostgreSQL, SQL Server, Oracle, IBM DB2, SQLite, ...

## **SQL Statements**

## Keywords

- Traditionally UPPERCASE (optional)
- Includes operators (e.g. =, >, etc.)

### Identifiers

- Traditionally lowercase
- Literal values

https://dev.mysgl.com/doc/refman/8.0/en/language-structure.html

## **Example SQL Statement**

# **Example Keywords**

# **Example Identifiers**

# **Example Literal**

# **Example Clause**

SELECT name **FROM teams** WHERE id=9;

FROM Clause of a SELECT Statement

# Data Definition Language (DDL)

# Data Definition Language (DDL)

- Create and Manipulate Structure
  - e.g. tables, databases, schemas, etc.
- Example Statements
  - o **CREATE**: Add new database object
  - Manipulate existing database object ALTER:
  - O DROP: Remove database object

https://mariadb.com/kb/en/data-definition/

# Data Definition Language (DDL)

```
CREATE TABLE [tab_name] (
  [col name] [DATA_TYPE] [CONSTRAINTS], ...
CREATE TABLE students (
  id INTEGER NOT NULL PRIMARY KEY,
  name VARCHAR(50) NOT NULL,
  Program VARCHAR(50));
```

## **Column Data Types**

- Numeric Data Types
  - e.g. TINYINT, INTEGER, DECIMAL, FLOAT, etc.
- Character Data Types
  - e.g. CHAR, VARCHAR, BLOB, ENUM, etc.
- Temporal Data Types
  - o e.g. DATE, TIME, DATETIME, TIMESTAMP, etc.

https://mariadb.com/kb/en/data-types/

# **Numeric Data Types**

Туре	Bytes	Minimum	Maximum
TINYINT	1	–128 or 0	127 or 255
SMALLINT	2	-32,768	32,767
MEDIUMINT	3	-8,388,608	8,388,607
INTEGER	4	-2,147,483,648	2,147,483,647
BIGINT	8	-9,223,372,036,854,775,808	

https://mariadb.com/kb/en/numeric-data-type-overview/

## **Numeric Data Types**

- DECIMAL(precision[, scale]) for "exact" floating types
  - precision: total number of digits
  - scale: digits after decimal point
- FLOAT or DOUBLE for "approximate" floating types for really large or really small numbers

https://mariadb.com/kb/en/data-types-numeric-data-types/

## **Character Data Types**

- CHAR(width) for fixed width text
- VARCHAR(maxwidth) for variable width text
- BLOB (binary large object) for images, files, etc.
- TEXT for large variable-sized text (e.g. articles)
- ENUM for fixed text values (e.g. types of fruit)

https://mariadb.com/kb/en/string-data-types/

## Temporal Data Types

- DATE, TIME, DATETIME, TIMESTAMP, etc.
- Different input, storage, and display formats
- Input format depends on database system
  - e.g. usually YYYY-MM-DD date input format
- Display format controlled by query
  - o e.g. MM/DD/YYYY

https://mariadb.com/kb/en/date-and-time-data-types/

## **Column Constraints**

#### PRIMARY KEY

 Indicates column values can be used to uniquely identify each row

## AUTO\_INCREMENT

 Automatically increments value for each row (useful for primary keys)

https://mariadb.com/kb/en/create-table/#column-definitions

## **Column Constraints**

- UNIQUE
  - Indicates column values must be unique
- NULL or NOT NULL
  - Indicates column values may (or may not) be null
- DEFAULT
  - Uses a default value if no value provided

https://mariadb.com/kb/en/create-table/#column-definitions

# Data Manipulation Language (DML)

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- Create and Manipulate Data
  - e.g. create or modify row in table
- Example Statements
  - **INSERT**: Creates new row(s) in a table
  - **UPDATE**: Updates value(s) in a table
  - DELETE: Removes rows from a table

https://mariadb.com/kb/en/data-manipulation/

# Data Manipulation Language (DML)

```
INSERT INTO [tab name]
([column order])
VALUES ([column_values]);
INSERT INTO students
(name, degree)
VALUES ('Yasmin', 'CS');
```

https://mariadb.com/kb/en/insert/

## **SQL SELECT Statements**

- Retrieves information from database
- Common clauses
  - o FROM [tab name]
  - WHERE [condition], HAVING [condition]
  - GROUP BY [col name], ORDER BY [col name]

https://mariadb.com/kb/en/selecting-data/

## **SQL SELECT JOIN Clauses**

- Combines results together from multiple tables
- Multiple types of JOINs
  - e.g. INNER JOIN, LEFT OUTER JOIN, RIGHT OUTER JOIN, NATURAL JOIN, etc.
- Critical component of SELECT statements

https://mariadb.com/kb/en/joins/

## **INNER JOIN**

## **LEFT OUTER JOIN**

### upper

A
 B
 C

#### lower

b	2
С	3
d	4

### upper

1	Α
2	В
3	С

#### lower

b	2
С	3
d	4

## LEFT OUTER JOIN RIGHT OUTER JOIN

### upper

A
 B
 C

### lower

D 2C 3d 4

#### upper

1	Α
2	В
3	С

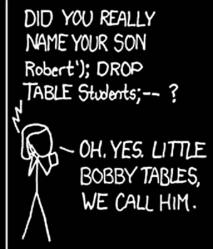
#### lower

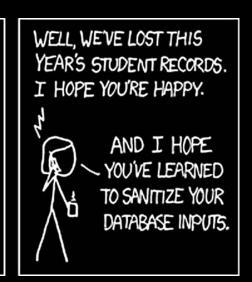
b	2
С	3
d	4

## **Bobby Tables**









https://xkcd.com/327/

# **Questions?**