SQL (Structured Query Language)

"An RDBMS (Relational Database Management System) is a database management system based on the relational model…, which in turn is based on two mathematical branches: set theory and predicate logic" - *T-SQL Fundamentals | Itzik Ben-Gan*

Overview

Entity-Relationship (ER) Diagram visualization tool

ER diagrams allows one to visualize how a concept might map into a RDBMS layout, or visualize an existing RDBMS layout.

SQL is case and whitespace insensitive

- DML = Data manipulation Language
  - Examples: `INSERT, UPDATE, DELETE` (sometimes SELECT)
- DDL = Data Definition Language
  - Examples: `CREATE, DROP, ALTER`
- When referencing an object in SQL, proper convention is to **explicitly** call the entire object (i.e. database_name.schema_name.table_name, etc)

Querying

Basic structure:

```
SELECT ...
FROM ...
JOIN ...
ON ...
WHERE ...
GROUP BY ...
HAVING ...
ORDER BY ...;
```

Logical processing order of a SQL query:

```
FROM ...
ON ...
WHERE ...
GROUP BY ...
HAVING ...
SELECT ...
DISTINCT ...
ORDER BY ...
TOP(LIMIT, OFFSET, FETCH, etc) ...
```

Strings

To return rows that match a certain string/character sequence:

```
WHERE <COLUMN> LIKE '%b'
# return all observations that end with a 'b' (can have any
# characters preceding the 'b')
```

```
WHERE <COLUMN> LIKE 'b%'
# return all oObservations that start with a 'b' (can have any
# characters following the 'b')
```

```
WHERE <COLUMN> LIKE '%b%'
# return all observations that contain a 'b' (can have any
# characters before or after the 'b')
```

JOINS

- **LEFT (OUTER) JOIN** - Return all observations in the left table, along with the rows from the right table **that have a match in the left table.**
- **RIGHT (OUTER) JOIN** - Return all observations in the right table, along with the rows from the left table **that have a match in the right table.** (More commonly one will see a LEFT JOIN with the tables switched as opposed to a RIGHT JOIN)
- **INNER JOIN** - Return observations where all information is present in both tables
- **FULL JOIN** - Return all observations from both tables, regardless of whether the information is present in the other table.
- **SELF JOIN** - When joining a table to itself, table aliases must be used along with the `JOIN` keyword.

  ```
  SELECT alias_1.employee_id, alias_2.manager_id
  FROM table_1 alias_1
  JOIN table_2 alias_2
      ON alias_1.id = alias_2.id;
  ```

  Joining a table with itself is traditionally used when one wants to compare the values in one column to a value to another column **within the same table.**

Database Management/Creation

Stored Procedures

At its most basic, stored procedures are chunks of code that are saved (hence "stored") as objects in a SQL database. They allow a user to execute that code without having to retype it every time they want to use it. (analogous to writing functions in Python vs writing a script that can't be generalized to other tasks).

Stored procedures can be used to `INSERT, UPDATE, DELETE, SELECT` and are called with the `EXEC` statement (short for execute):

```
EXEC <stored_procedure_name>
```

To create a stored procedure:

```
CREATE PROC <procedure_name>
AS
    <T-SQL code>
GO
```

To alter a stored procedure:

```
ALTER PROC <procedure_name>
AS
```

```
    <T-SQL code>
GO
```

SSMS (SQL Server Management Studio)

- Many table will start with 'dbo' - this is the default schema in SSMS
- Using a `TOP` clause (synonymous to `LIMIT` in PostgreSQL) allows you to not overload the system
- use `NOLOCK`
- Ensures your queries have as little impact on other processes as possible.
- The risk of running your query with `NOLOCK` is that you might get "dirty/phantom" reads (observations that are not yet *committed* to the database, but is in an indeterminate state of being inserted, updated or deleted)
- Should be used primarily for ad-hoc queries, but not in development (NEVER use when updating or deleting observations from a table).
- Check the estimated query plan before executing your query
- Knowing the indexes a table has can be helpful in determining what columns to efficiently filter and sort on
- `ORDER BY` clauses restrict the performance of queries

To connect to SSMS from the commmand line:

`` `Z: \> SQLCMD -S <server_instance>` ``

if you are connected the command prompt will change to:

`` `1>` ``

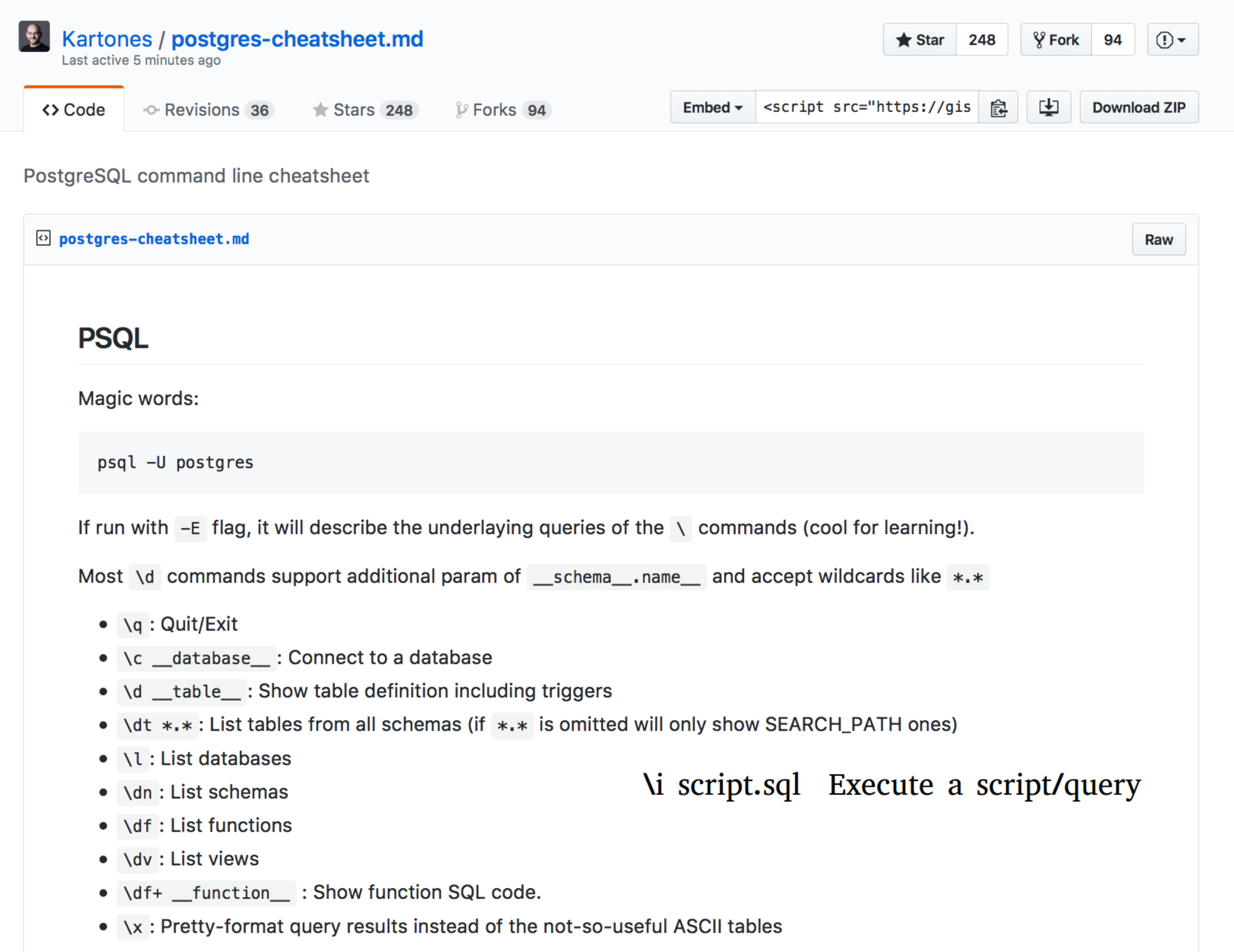
Execution Plans

Execution Plan: The result of the query optimizer's attempt to calculate the most efficient way to implement the request represented by the T-SQL query you submitted. Execution plans are the **primary** means of troubleshooting an inefficient query.

- The Query Optimizer parses your query and generates an execution plan (in binary) that is sent to the storage engine.
- Highlight a query and press CTRL + L (Windows) to view the execution plan
- The Query Optimizer determines the best exectution plan based on required CPU usage and I/)

Resources

PostgreSQL Practice



PostgreSQL command line cheatsheet

PSQL

Magic words:

```
psql -U postgres
```

If run with `-E` flag, it will describe the underlaying queries of the `\` commands (cool for learning!).

Most `\d` commands support additional param of `__schema__.name__` and accept wildcards like `*.*`

- `\q` : Quit/Exit
- `\c __database__` : Connect to a database
- `\d __table__` : Show table definition including triggers
- `\dt *.*` : List tables from all schemas (if `*.*` is omitted will only show SEARCH_PATH ones)
- `\l` : List databases
- `\dn` : List schemas
- `\df` : List functions
- `\dv` : List views
- `\df+ __function__` : Show function SQL code.
- `\x` : Pretty-format query results instead of the not-so-useful ASCII tables

\i script.sql Execute a script/query

Figure 1: PostgreSQL Commands