SQL

Cheatsheet

Contents

Spreadsheets	Databases
Great for one-time analysis	Handle mass amounts of data
Quick with reasonable data size	Can automate for reuse
Small learning curve	Great for data integrity

Basic operators

- $<$: less than
- $>$: greater than
- $<=$: less than or equal to
- $>=$: greater than or equal to
- $=$: equal to
- $<>$ or $!=$: not equal to
- Random note – use '_' for any string/text or date value only.
- Use '*/ [...] /*' to comment large paragraphs inside the sql code.

1 SQL Fundamentals

- **SELECT**: most common, used to retrieve information/columns
  - Syntax
    - `SELECT column_name FROM table_name`
- **SELECT DISTINCT**: variation of SELECT, returns unique values in a column
  - Syntax
    - `SELECT DISTINCT column FROM table`
- **FROM**: used to choose the table from which to retrieve information
  - Syntax
    - `SELECT column FROM table`
- **WHERE**: specifies conditions for rows, acts like a filter
  - Syntax
    - `SELECT column FROM table WHERE condition for rows`
- **ORDER BY**: sorts output by the chosen column in ascending (ASC) or descending (DESC) order.
  - Including ASC or DESC is optional. If not included function defaults to ASC.
  - Syntax

    * `SELECT column_1, column_2, column_3 FROM table ORDER BY column_1, column_3 ASC`

- **ORDER BY**: sorts output by the chosen column in ascending (ASC) or descending (DESC) order.
  - Including ASC or DESC is optional. If not included function defaults to ASC.
  - Syntax
    * `SELECT column_1, column_2, column_3 FROM table ORDER BY column_1, column_3 ASC`

- **LIMIT**: allows to limit number of rows returned.
  - Always the last command in a query.
  - Syntax
    * `SELECT column FROM table WHERE condition ORDER BY column LIMIT #`

1.1 Keywords calls used with other functions

- **BETWEEN**: used to match a value against a range of values.
  - Similar to using `>=` for the low end of a range and `<=` for the high end of a range.
  - Commonly used with dates in the format of 'YYYY-MM-DD'.
  - Syntax
    * `WHERE value BETWEEN 1 AND 5`
    * `WHERE date_column BETWEEN '2020-02-20' AND '2022-02-22'`

- **AND/OR**: used to add more criteria to a function.
  - Is also used with keywords like BETWEEN.
  - Syntax
    * `WHERE value is > 1 AND value is < 5`
    * `WHERE value is > 1 OR value is < 5`
    * `WHERE column = 'Color' AND value = 'Blue'`
    * `WHERE color_column = 'Red' OR color_column = 'Blue'`

- **IN**: creates a condition to check to see if a value is included in a list.
  - Can be used instead of multiple AND keywords with a WHERE function.
  - Syntax (using last example from above)
    * `WHERE color_column IN ('red', 'blue')`

- **NOT**: used to negate a condition or keyword.
  - Syntax
    * `WHERE color_column NOT IN ('red', 'blue')`
    * `WHERE value NOT BETWEEN 1 AND 5`

- **LIKE**: allows us to perform pattern matching.
  - This keyword is case sensitive.
  - Wildcard characters to be used with this keyword – '%' and '_'.
    - '%' matches any sequence of characters.
    - '_' matches any single character.
  - Syntax – all names that begin with 'A':
    - `WHERE name LIKE 'A%'`
  - Syntax – get all Mission Impossible movies:
    - `WHERE movie LIKE 'Mission Impossible _'`

- **ILIKE**: allows to perform a matching pattern, just like LIKE, but it is not case sensitive.
  - Syntax – all names that begin with 'A':
    - `WHERE name ILIKE 'a%'`
    - This returns all names that start with the letter 'a', regardless of the names' capitalization.
  - Syntax – get all Mission Impossible movies:
    - `WHERE movie ILIKE 'mission impossible _'`
    - This returns all the Mission Impossible movies, regardless of the movies' capitalization in their title. This would not work for LIKE.

1.2 GROUP BY statements

1.2.1 Aggregate Functions

: commonly used to take multiple inputs and return them in a single output.

The following are the most used. These functions do not work without ( ) around the chosen data. When using aggregate functions, you cannot pull multiple columns + aggregate functions without using `GROUP BY`, as the results of the none-aggregated columns will have more rows than the aggregated ones and therefore produce an `ERROR MESSAGE` regarding syntax.

- **AVG()**: returns the average value.
  - Returns output in a float data type; the numbers have multiple decimal places.
  - Use `ROUND()` to round-up to the desired amount of decimal places.
  - Syntax without `ROUND()` – i.e., output is 12.34567890123456:
    - `SELECT column1, AVG(column2) FROM table GROUP BY column1`
  - Syntax with `ROUND()` to get 2 decimal points in output – i.e., output is 12.35:
    - `SELECT column1, ROUND(AVG(column2), 2) FROM table GROUP BY column1`
  - The # after the comma in `ROUND()` represents the desired number of decimal places you wish to see.

- **COUNT()**: returns the number/count of values.
  - It can be used with `DISTINCT` to count unique values in a column.
  - Syntax:
    - `SELECT COUNT(column) FROM table`
    - `SELECT COUNT(DISTINCT(column)) FROM table`
  - Notice with `DISTINCT` you need to be careful with parentheses.

- **MAX()**: returns the maximum value.
  - Syntax:
    - `SELECT MAX(column) FROM table`

- **MIN()**: returns the minimum value.
  - Syntax:
    - `SELECT MIN(column) FROM table`

- **SUM()**: returns the sum of values.
  - Syntax:
    - `SELECT SUM(column) FROM table`

1.2.2 `GROUP BY` operators

- **GROUP BY**: aggregates columns per some category.
  - Must come after `FROM` or `WHERE`.
  - For timestamps, use `DATE()` function to convert into a categorical column, as it's too specific to be one as is.
  - `DATE` output will have the following format 'YYYY-MM-DD'.
    - Syntax – timestamp value format = 'YYYY-MM-DD HH:MM:SS.SSSSS'.
    - `SELECT DATE(timestamp_column)` → `converts to only date!` `FROM table`

- **HAVING**: filters after an aggregation has taken place.
  - Allows you to use aggregation result as a filter.
  - Syntax:
    - `SELECT company, SUM(sales) FROM table WHERE company != 'Google' GROUP BY company HAVING SUM(sales) > 100`

1.3 JOINS

JOIN Statement: allows us to combine information from different tables

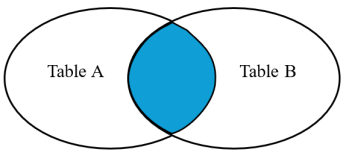
- **AS clause**: creates an alias for columns, tables, or results.
  - Syntax:
    - SELECT SUM(column) AS new_name FROM table
    - SELECT abc.column FROM table AS abc
  - AS must always go directly after the name you want to change.

- **ON clause**: helps join tables with a column from each.
  - Syntax:
    - SELECT * FROM tableA JOIN tableB ON tableA.column1 = tableB.column1

- **USING clause**: functions just as the ON clause, but works with columns from different tables that have the same name to shorten the process.
  - Syntax:
    - SELECT * FROM tableA JOIN tableB USING (column1)

1.3.1 INNER JOIN

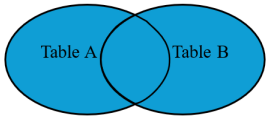
- **INNER JOIN**: will output matching set of records from both tables.
  - If only JOIN is written in PostgreSQL, it defaults to INNER JOIN.
  - Syntax:
    - SELECT * FROM tableA INNER JOIN tableB ON tableA.col_match = tableB.col_match



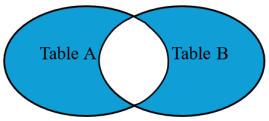
OUTER JOINs Different types of OUTER JOINs allow us to specify how to deal with values that are only present in one the tables. The different types include FULL OUTER, LEFT OUTER, & RIGHT OUTER JOIN.

- **FULL OUTER JOIN**: grabs everything from both tables.
  - If only OUTER JOIN is typed in, it defaults to a FULL OUTER JOIN.
  - When output is produced, anytime there are values missing from a column because the data doesn't match on both sides, the value will be 'null'.
  - Syntax:

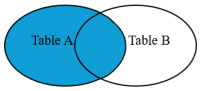
    * `SELECT * FROM tableA FULL OUTER JOIN tableB ON tableA.column = tableB.column`



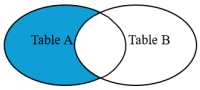
- **Syntax with WHERE**: creates the exact opposite result of an INNER JOIN.
  - Syntax:
    * `SELECT * FROM tableA OUTER JOIN tableB USING (column) WHERE tableA.id IS NULL OR tableB.id IS NULL`



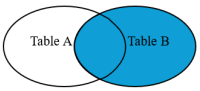
- **LEFT OUTER JOIN**: gives results present in the left table.
  - If there is not a match with values in the right table, the result will be NULL.
  - If you write `LEFT JOIN`, it will default to `LEFT OUTER JOIN`.
  - Syntax:
    * `SELECT * FROM tableA LEFT JOIN tableB USING (column)`



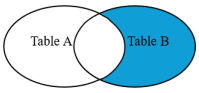
  - Syntax with `WHERE`: grabs rows unique to TableA.
    * `SELECT * FROM tableA LEFT JOIN tableB USING (column) WHERE tableB.id IS NULL`



- **RIGHT OUTER JOIN**: gives results present in the right table, same to LEFT JOIN but with the tables switched between the FROM and JOIN functions.
  - If there is not a match with values in the right table, the result will be NULL.
  - If you write `RIGHT JOIN`, it will default to `RIGHT OUTER JOIN`.
  - If tables are switched in order, it produces the same results as a LEFT JOIN.
  - Syntax:
    * `SELECT * FROM tableA RIGHT JOIN tableB USING (column)`



  - Syntax with `WHERE`: grabs rows unique to TableA.
    * `SELECT * FROM tableA RIGHT JOIN tableB USING (column) WHERE tableA.id IS NULL`



- **UNION**: used to combine outputs of two or more SELECT statements.
  - Basically, concatenates two or more results.
  - Syntax:
    * `SELECT * FROM table1 UNION SELECT * FROM table2`

2 Advanced SQL Commands

2.0.1 Timestamps `EXTRACT`

When choosing time data types for tables and databases, must be careful because not all data (like time zone) might be necessary. If too much is available, you can always remove some.

To pull time-type functions you must be aware of some different parameters. To learn about the different parameters, use `SHOW` to output the value of run-time parameters. Use `SHOW ALL` to see the current parameters your pc is working on. i.e., `SHOW TIMEZONE` outputs the pc's current time zone it is working on.

- **TIME**: contains only time.
- **DATE**: contains only date.
- **TIMESTAMP**: contains date & time.
- **TIMESTAMPTZ**: contains date, time, and time zone.
- **TIMEZONE**: gives time zone.
- **NOW()**: gives timestamp with time zone (GMT).
- **TIMEOFDAY**: gives timestamp with time zone as a string.
- **CURRENT_TIME**: gives current time with time zone.
- **CURRENT_DATE**: gives current date in international format.
- **EXTRACT()**: allows you to extract a sub-component of a date value.
  - Use with YEAR, MONTH, DAY, WEEK, QUARTER.
  - Syntax:
    * `EXTRACT(YEAR FROM date_col)`

- **AGE()**: calculates and returns the current age of a given timestamp.
  - Output will look like 13 years 1 month 5 days 01:23:45.678901234.
  - Syntax:
    - `AGE(date_col)` → takes current date & calculates how old timestamp is.

- **TO_CHAR()**: general job is to convert data types to text.
  - Particularly useful for timestamp formatting.
  - Syntax:
    - `TO_CHAR(date_col, 'mm-dd-yyyy')`

2.0.2 Mathematical Functions

Many math functions are available to use. To find them, go online as there are many resources detailing them all. The following are basic examples of some math functions:

- **Division:**
  - `SELECT value_col / value_col2 FROM table`
- **Rounded Division:**
  - `SELECT ROUND(value_col / value_col2, 2) FROM table`
- **Percentage:**
  - `SELECT ROUND(value_col / value_col2, 2) * 100 FROM table`
- **Multiplication:**
  - `SELECT value_col * 2 FROM table`

2.0.3 String Functions & Operations

The following are basic examples of functions and operators to manipulate string values.

- **LENGTH**: gives back the number of characters of a value.
  - `SELECT LENGTH(col) FROM table`
- **Concatenation using ——:**
  - `SELECT first_name || 'a' || last_name FROM table`
- **Combining concatenation with other functions to create new employee emails:**
  - `SELECT LOWER(LEFT(first_name, 1)) || LOWER(last_name) || '@gmail.com' FROM table`
    - `LOWER`: makes the output lowercase.
    - `LEFT(col_name, #)`: pulls the left-most characters of a string value. # refers to the number of characters to include, going from left to right.

2.0.4 Subquery

Allows you to create more complex queries by creating a query that's based on the results of another query.

- **Syntax – we want the values from the table that were above the average of that same table's values:**
  - `SELECT col_1, col_num FROM table WHERE col_num > (SELECT AVG(col_num) FROM table)`
- Subqueries are run first because they are inside parentheses, similar to PEMDAS.
- **IN can also be used with subqueries to create a "list":**
  - **Syntax – want to include values that are inside of another table:**
    - `SELECT col_1, col_2 FROM table1 WHERE col_1 IN (SELECT col_1 FROM table2)`
- **EXISTS: used to test for the existence of rows in subqueries:**
  - **Syntax:**
    - `SELECT col_name FROM table WHERE EXISTS (SELECT col_name FROM table WHERE condition)`

2.0.5 Self-Join: a query where the table is joined to itself

Useful for comparing values in a column within the same table. It basically joins 2 copies of the same table – an alias is necessary in order to maintain the data organized.

- **Syntax:**
  - `SELECT tableA.col, tableB.col FROM table AS tableA JOIN table AS tableB ON tableA.some_col = tableB.other_col`
- **Syntax Order:**
  - `SELECT column1, SUM(column2) FROM table1 JOIN table2 ON table1.column = table2.column WHERE column1 = 'Red' GROUP BY column1 HAVING SUM(column2) > 5 ORDER BY column1 DESC LIMIT 10`

3 Creating Databases & Tables

Data types:

- Boolean (TRUE or FALSE)
- Character (text)
- Numeric (integers, float,...)
- Temporal (date, time, interval,...)

- UUID
- Array
- JSON

3.0.1 Primary & Foreign Keys

Primary Key: column or group of columns to identify a row uniquely in a table (non-null), (ID = 1,2,3,4,...). [PK]

Foreign Key: Under the 'schemas' you can view the dependencies; the tables and and columns. Under schemas > tables > constraints you can view the primary (golden key icon) / foreign keys

3.0.2 Creating a table

- **CREATE TABLE**: creates a table.
  - **Syntax:**
    * `CREATE TABLE table_name (`
      `Column_name1 data_type(#characters allowed) Constraints,`
      `Column_name2`
      `)`
  - **Example:**
    * `CREATE TABLE account (`
      `user_id SERIAL PRIMARY KEY,`
      `username VARCHAR(50) UNIQUE NOT NULL,`
      `password VARCHAR(50) NOT NULL,`
      `email VARCHAR(250) UNIQUE NOT NULL,`
      `created_on TIMESTAMP NOT NULL,`
      `last_login TIMESTAMP`
      `)`

`SERIAL` = data type, creates unique number/identifier.

- **REFERENCES**: references values from different tables.
  - **Syntax:**
    * `CREATE TABLE table1 (`
      `Column_name1 INTEGER REFERENCES table2(column_from_table2),`
      `Column_name2 INTEGER REFERENCES table2(column_from_table2),`
      `Column_name3 TIMESTAMP`
      `)`

- **INSERT INTO**: allows you to add rows to a table.

  - **Syntax using SELECT:**
    * `INSERT INTO table(column1, column2, ...)`
      `SELECT column1, column2, ...`
      `FROM another_table`
      `WHERE condition;`
  - You can also insert values directly:
    * **Syntax using VALUES:**
      · `INSERT INTO table1(column1, column2, column3, column4)`
        `VALUES`
        `(value_for_column1, value_for_column2, value_for_column3, value_for_column4)`

- **UPDATE**: allows you to update values in a table.
  - **Syntax:**
    * `UPDATE table`
      `SET column1 = value1,`
      `column2 = value2, ...`
      `WHERE condition;`
  - **Example:**
    * `UPDATE account`
      `SET last_login = CURRENT_TIMESTAMP`
      `WHERE last_login IS NULL;`
    * `Or:`
    * `UPDATE account`
      `SET last_login = created_on;`
    * `Or:  using another table's values (UPDATE join)`
    * `UPDATE TableA`
      `SET original_col = TableB.new_col`
      `FROM TableB`
      `WHERE TableA.id = TableB.id;`
    * **Return affected rows:**
      · `UPDATE account`
        `SET last_login = created_on`
        `RETURNING account_id, last_login.`

- **DELETE**: allows you to delete columns in a table.
  - **Syntax:**
    * `DELETE FROM table`
      `WHERE condition;`
  - **Example:**
    * `DELETE FROM table`
      `WHERE row_id = 1;`

    - **Example using another table (DELETE join):**
        - `DELETE FROM TableA`
          `USING TableB`
          `WHERE TableA.id = TableB.id;`
  - **Deleting all rows:**
    - `DELETE FROM table;`
  - **Can also return the columns that were deleted:**
    - `RETURNING account_id, last_login.`

- **ALTER**: allows you to make changes to an existing table structure:
  - Adding, dropping, or renaming columns.
  - Changing a column's data type.
  - Setting DEFAULT values for a column.
  - Adding CHECK constraints.
  - Renaming a table.
  - **Syntax:**
    - `ALTER TABLE table_name action`
  - **Examples:**
    - `ALTER TABLE table RENAME C`
    - `ALTER TABLE table_name ALTER COLUMN col_name ADD CONSTRAINT constraint_name`

- **DROP**: allows you to remove columns from a table (indexes and constraints included).
  - **Syntax:**
    - `ALTER TABLE table_name DROP COLUMN col_name`
  - **Example:**
    - `ALTER TABLE table_name DROP COLUMN IF EXISTS col_name CASCADE;`
      - To remove all dependencies.
    - `ALTER TABLE table_name DROP COLUMN col_name1 DROP COLUMN col_name2;`

- **CHECK**: The CHECK constraint allows us to create more customized constraints that adhere to a certain condition, such as ensuring all inserted integer values fall below a certain threshold.
  - **Syntax:**
    - ```
      CREATE TABLE example (
      ex_id SERIAL PRIMARY KEY,
      age SMALLINT CHECK (age > 21),
      parent_age SMALLINT CHECK (parent_age > age)
      );
      ```
      ```

4 CASE

- **CASE**: To only execute SQL code to only execute SQL code when certain conditions are met. (similar to IF/ELSE statements in Python).

  There are two ways:

  1. **General Case**
     - **Syntax:**
       * `CASE`
       * `WHEN` condition1 `THEN` result1
       * `WHEN` condition2 `THEN` result2
       * `ELSE` some_other_result
       * `END;`
     - **Example:**
       * `SELECT column,`
       * `CASE WHEN (customer_id <= 100) THEN 'Premium'`
       * `WHEN (customer_id BETWEEN 100 AND 200) THEN 'Plus'`
       * `ELSE 'other'`
       * `END AS label`
       * `FROM customer;`
  2. **Expression syntax:** The `CASE` expression syntax first evaluates an expression and
     - **Syntax:**
       * `CASE expression`
       * `WHEN` value1 `THEN` result1
       * `WHEN` value2 `THEN` result2
       * `ELSE` some_other_result
       * `END;`
     - **Example:**
       * `SELECT a,`
       * `CASE a WHEN 1 THEN 'one'`
       * `WHEN 2 THEN 'two'`
       * `ELSE 'other'`
       * `END AS label`
       * `FROM test;`
     - **Example:**
       * `SELECT customer_id,`
       * `CASE customer_id`
       * `WHEN 2 THEN 'Winner'`
       * `WHEN 5 THEN 'Second Place'`
       * `ELSE 'Normal'`
       * `END AS raffle_results`

```
        * FROM customer;
```

- **Another example:**

```
- SELECT
- SUM (CASE rental_rate
- WHEN 0.99 THEN 1
- ELSE 0
- END) AS bargains,
- SUM (CASE rental_rate
- WHEN 2.99 THEN 1
- ELSE 0
- END) AS regular;
```

Example:

- **Example 1:**

```
- SELECT
    * SUM(CASE
        · WHEN rating = 'PG-13' THEN 1
        · ELSE 0
    * END) AS pg13,
    * SUM(CASE
        · WHEN rating = 'R' THEN 1
        · ELSE 0
    * END) AS r,
    * SUM(CASE
        · WHEN rating = 'PG' THEN 1
        · ELSE 0
    * END) AS pg
- FROM film;
```

Or, when include the 'rating' column, you are using an aggregate function, thus you need to group to results: otherwise there is a missmatch of amount of values.

- **Example 2:**

```
- SELECT film,
    * SUM(CASE
        · WHEN rating = 'PG-13' THEN 1
        · ELSE 0
```

```
    * END) AS pg13,
    * SUM(CASE
        · WHEN rating = 'R' THEN 1
        · ELSE 0
    * END) AS r,
    * SUM(CASE
        · WHEN rating = 'PG' THEN 1
        · ELSE 0
    * END) AS pg
- FROM film
- GROUP BY film;
```

Carpe diem

$$\lim_{T \to \infty} \beta^T \lambda^*_{T+1} s^*_{T+1} = 0$$