Advanced SQL Techniques: Manipulation, Integration, and Optimization

```
$ echo "Data Sciences Institute"
```

Expanding your Database:

→ INSERT, UPDATE, DELETE

Views

Importing and Exporting Data

CROSS & Self Joins

INSERT, UPDATE, DELETE

Prior to this, we've focused solely on retrieving values from tables:

- Tables can also be manipulated with `INSERT`, `UPDATE`, and/or `DELETE`
- *A word of warning...these commands are PERMANENT* 😱
    - Generally, follow a policy that avoids altering data
    - Make backups of tables before you run a query
    - Never hurts to test on a temporary table first!
- But they are useful, and sometimes the correct solution
- There is no `SELECT` statement for these types of queries

INSERT

- `INSERT` allows you to add a record
- Specify where you want to add:
  - `INSERT INTO [some_table_name]`
- ...and what you want to add:
  - `VALUES(column_one_value, column_two_value)`
- `VALUES` come in the order of the columns within the tables
- `VALUES` must respect table constraints
  - e.g. NULLs, UNIQUE, data types, etc
- `INSERT` can help create small helper tables
  - **Can we think of any scenarios?**

UPDATE

- `UPDATE` allows you to change a record
- Specify where you are making your change:
  - `UPDATE [some_table_name]`
- ...and what you want to change:
  - `SET column_one = value1, column_one = value2`
- *SPECIFY A* `WHERE` *CONDITION*
  - `WHERE condition`
- You can change a single column, a few columns, all the columns, etc
  - (Respecting table constraints)
- **What happens if you don't specify a WHERE condition?**

DELETE

- `DELETE` allows you to remove a record
- Specify where you want to delete:
  - `DELETE FROM [some_table_name]`
- *SPECIFY A* `WHERE` *CONDITION*
  - `WHERE condition`
- **What happens if you don't specify a WHERE condition?!?**
- `DELETE` doesn't *remove* a table from a database
  - Instead it removes the data from it, leaving the table structure and constraints in place
    - `DROP TABLE` instead if you want to remove it altogether

INSERT, UPDATE, DELETE

(`INSERT` , `UPDATE` , `DELETE` live coding with a TEMP TABLE)

What questions do you have about INSERT UPDATE DELETE?

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Views

- Views instantiate a query result permanently
- They are particularly useful in highly normalized databases, where reproducing a query is tiresome or prone to query errors
- In databases that have live data flowing in:
    - Tables that are created from queries need to be continuously updated whenever there is new data
        - This requires either downtime where the table is empty
        - Or the chance of a "dirty read" (where a table is read before the data is fully updated)
    - Views, on the other hand, will always show the most up-to-date values!

Views

- Views are created just like tables:

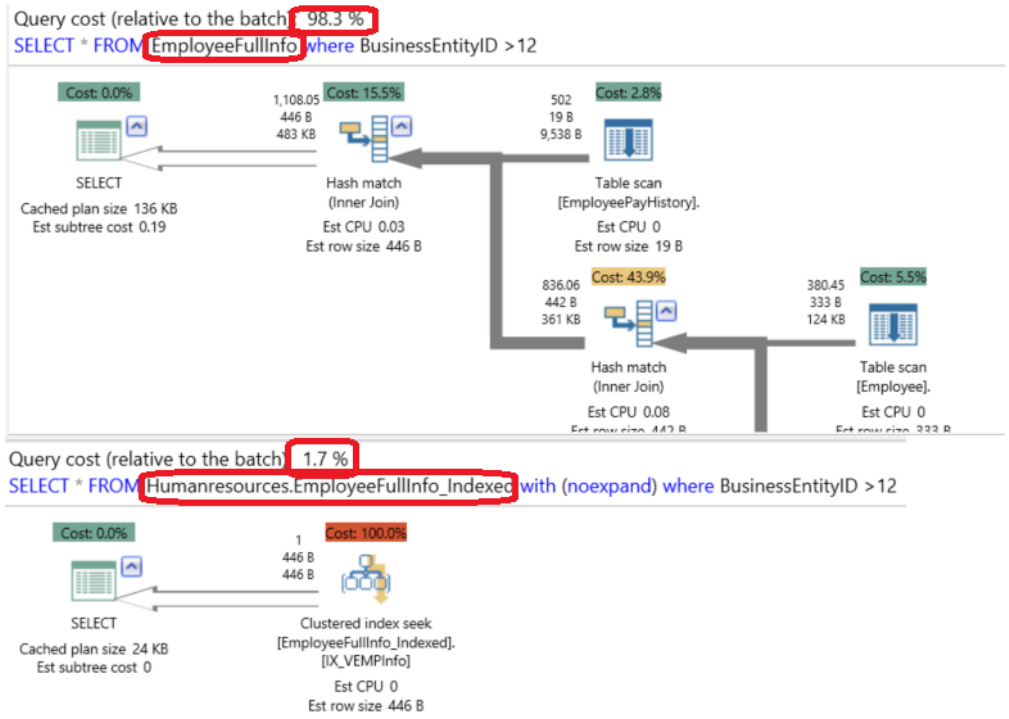
```
CREATE VIEW history AS
SELECT ...
```

Views Performance

- Views can be very slow if poorly created
- Always use primary keys and indexing to make them more performative
- Select the most important columns
- Avoid stacking views (views within a view)

Views Performance

- In commercial RDBMs, use execution plans and/or performance dashboards to analyze the underlying engine mechanisms the view uses for instantiation
- Image: Yaseen, SQLShack



Views

(Views live coding)

What questions do you have about views?

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CROSS & Self Joins

Import & Export

- RDBMs allow data to flow into and out of them
  - Some processes are easy:
    - e.g. exporting a table as a CSV file
  - ...while others are complex
    - e.g. writing a CRM to a normalized data warehouse on a nightly basis
- In DB Browser for SQLite, we can make use of the following:
  - Import and export CSV files
  - Manipulate and export JSON files
- SQLite more broadly can:
  - Produce CSVs from queries (using the command line, which we won't do)
  - Connect to other programming languages

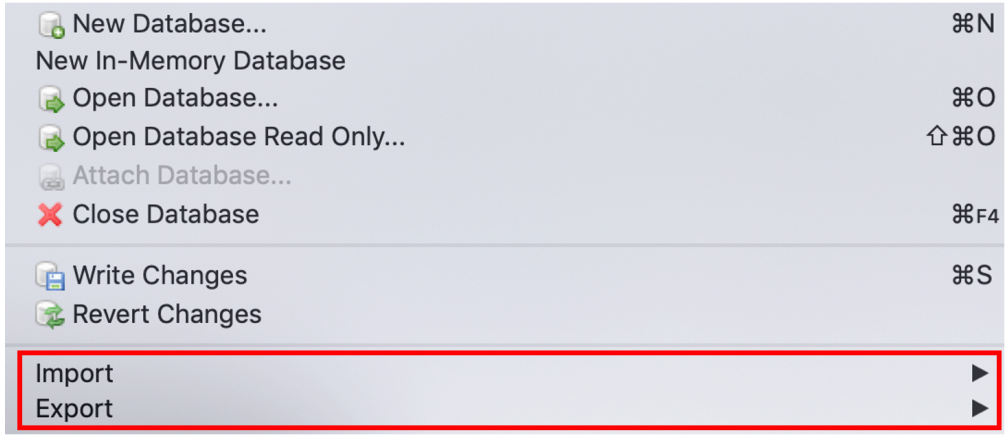
CSV

- CSV stands for "Comma Separated Values"
- CSVs are file formats well designed to store SQL tables
    - The values of each row are separated by commas
        - Sometimes it makes more sense to use a "|" (pipe), if there is complex text data stored, which might be more sensitive to the presence of commas and/or line breaks
- They are a common file format for transporting structured data
- CSVs can be opened by:
    - Excel
    - Simple text editors (e.g. notepad++, sublime)
    - Programming languages (e.g. python, R)

CSV

DB Browser for SQLite natively supports CSV importing and exporting for tables:

You can also export queries if they are stored in Temporary Tables



CSV

DB Browser for SQLite allows us to extract a query result in a somewhat roundabout method:

- First, write a query

```
SELECT * FROM product p
JOIN product_category pc ON p.product_category_id = pc.product_category_id
```

- Second, right click the results, and select "Copy as SQL"

CSV

- Third, instantiate a table with `CREATE`

```
CREATE TABLE "example" ("product_id", "product_name", "product_size",
"product_category_id", "product_qty_type", "product_category_name") ;
```

- Fourth, paste the results from your clipboard

```
INSERT INTO "example" ("product_id", "product_name", "product_size",
"product_category_id", "product_qty_type", "product_category_name")
VALUES ('1', 'Habanero Peppers - Organic', 'medium', '1', 'lbs', 'Fresh Fruits & Vegetables');
...etc for each row
```

- Finally, export the table to CSV

CSV

We can also extract a query result to CSV with python:

```
import pandas as pd
import sqlite3

#set your location, slash direction will change for windows and mac
DB = '/Users/thomas/Documents/GitHub/DSI_SQL/SQL/FarmersMarket.db'

#establish your connection
conn = sqlite3.connect(DB, isolation_level=None,
                       detect_types=sqlite3.PARSE_COLNAMES)

#run your query, use "\" to allow line breaks
db_df = pd.read_sql_query("SELECT p.*,pc.product_category_name \
                           FROM product p \
                           JOIN product_category pc \
                              ON p.product_category_id = pc.product_category_id"
                           ,conn)

#save
db_df.to_CSV('database-py.CSV', index=False)
```

CSV

(CSV live importing to update our view, CSV live exporting)

JSON

- JSON stands for "JavaScript Object Notation"
- JSONs are file formats well designed to store tables, lists, arrays, and nested objects
    - Their syntax follows specific rules:
        - Data is in name/value pairs
        - Data is separated by columns
        - Curly brackets '{ }' hold objects
        - Square brackets '[ ]' hold arrays

JSON

- e.g. `{"first_name":"Ralph", "last_name":"Kimball"}`
- or for tables:

```
[ {"first_name":"Ralph", "last_name":"Kimball"},
    {"first_name":"Bill", "last_name":"Imnom"} ]
```

- JSON can be opened by:
  - Web browsers
  - Simple text editors (e.g. notepad++, sublime)
  - Programming languages (e.g. python, R)
- SQLite also provides support for JSON value query and manipulation

JSON

DB Browser for SQLite supports a lot of JSON functions:

- Some are helper functions:
  - `JSON` and `JSON_VALID`, which confirm whether or not a string is JSON and/or in a valid JSON format
  - `JSON_TYPE`
    - When using extracting, type will help to inform column types that SQL will assume, based on the JSON
- Other functions can be used for manipulation or extraction:
- `JSON_EXTRACT` will allow you to return the values of a well-formed JSON string into desired parts
  - Importing JSON into SQL will use either `JSON_EXTRACT` or `JSON_EACH`

JSON

- SQLite gives the following (fairly comprehensive) example set:

```
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$')` → '{"a":2,"c":[4,5,{"f":7}]}'
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$.c')` → '[4,5,{"f":7}]'
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$.c[2]')` → '{"f":7}'
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$.c[2].f')` → 7
    - `json_extract('{"a":2,"c":[4,5],"f":7}','$.c','$.a')` → '[[4,5],2]'
    - `json_extract('{"a":2,"c":[4,5],"f":7}','$.c[#-1]')` → 5
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$.x')` → NULL
    - `json_extract('{"a":2,"c":[4,5,{"f":7}]}', '$.x', '$.a')` → '[null,2]'
    - `json_extract('{"a":"xyz"}', '$.a')` → 'xyz'
    - `json_extract('{"a":null}', '$.a')` → NULL
```

JSON

Importing a JSON array (table) into SQL with DB Browser for SQLite requires a bit more of nuanced approach:

- First copy and paste your JSON table array into SQLite, and put it in a temp table:

```
CREATE TEMP TABLE IF NOT EXISTS temp.[new_json]
(col BLOB);

INSERT INTO temp.[new_json](col)
VALUES('[{"a": 7, "b": "string"}]')
```

JSON

- Second, use the `JSON_EACH` function as a table-valued function

```
SELECT key,value
FROM new_json,JSON_EACH(new_json.col, '$' )
```

- Third, use this previous query as a subquery and combine with `JSON_EXTRACT`, using the value column `JSON_EACH` generated

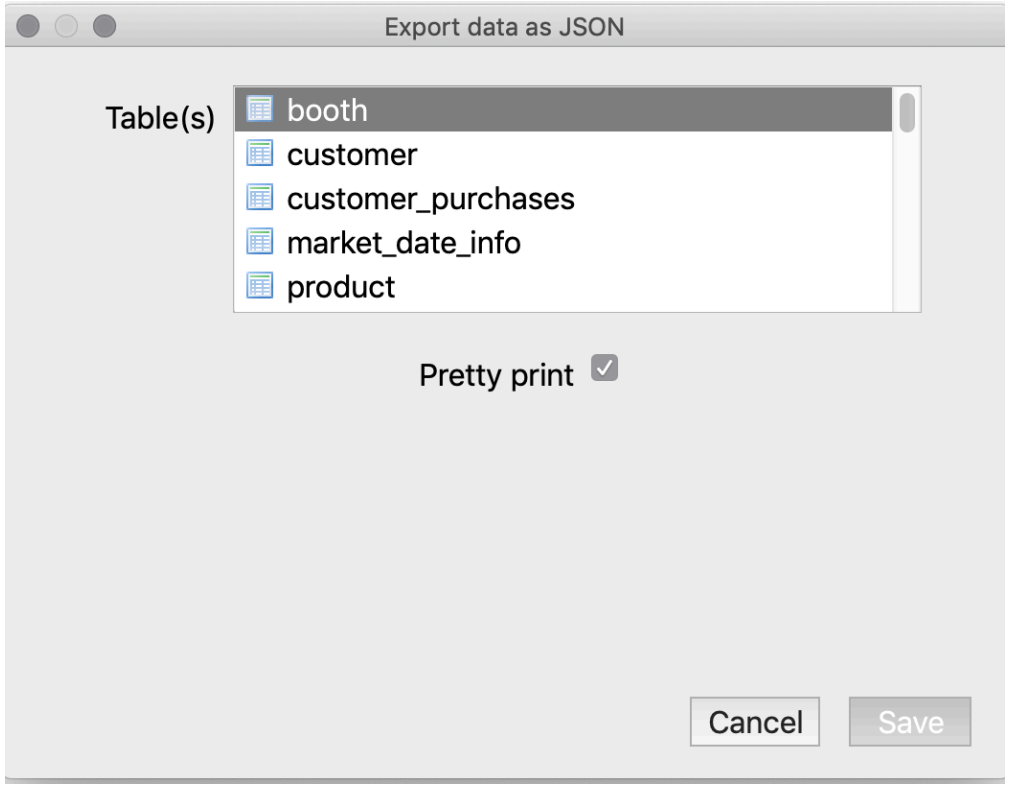
```
SELECT * ,
JSON_EXTRACT(value, '$.a') AS a,
JSON_EXTRACT(value, '$.b') AS b

FROM (...{subquery goes here}...)
```

- You now have a normal SQL table from a JSON array!

JSON

- DB Browser for SQLite natively supports JSON exporting for tables 👉
- This also works for Temporary Tables, so queries can be exported as well



JSON

(JSON live exporting)

What questions do you have about Importing and Exporting data into SQL?

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→ CROSS & Self Joins

CROSS JOIN

- `CROSS JOIN` creates an unfiltered Cartesian Product
- They are not joined on any columns
- Recall our deck of cards example in Module 2:

```
SELECT suit, rank
FROM suits
CROSS JOIN ranks
```

- Because tables 'suits' and 'ranks' contain no common columns, we would have no other means to join

CROSS JOIN

- I love to `CROSS JOIN`!
- They can be super useful when used correctly
    - **What are some good examples that could be useful? 💭 Think, Pair, Share**

CROSS JOIN

(`CROSS JOIN` live coding)

```
No complex query is complete without at least one `CROSS JOIN`

- (me, jokingly)
```

What questions do you have about CROSS JOIN?

Self Joins

- Self Joins are somewhat uncommon, but are the last type of possible join
- They are useful for comparison:
    - Determine maximum to-date
    - Generating pairings
- They can help with hierarchy
    - Child-to-Parent relationships

Self Joins

- The syntax is as we might expect:

```
SELECT
e.name as employee_name,
m.name as manager_name

FROM people e
LEFT JOIN people m ON e.manager_id = m.id
```

What questions do you have about anything from today?