

Advanced SQL Techniques: Manipulation, Integration, and Optimization

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

Expanding your Database:

INSERT, UPDATE, DELETE

Importing and Exporting Data

CROSS & Self Joins

Views

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* `r structure("\U1F631", class = "emoji")`
 - 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)

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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

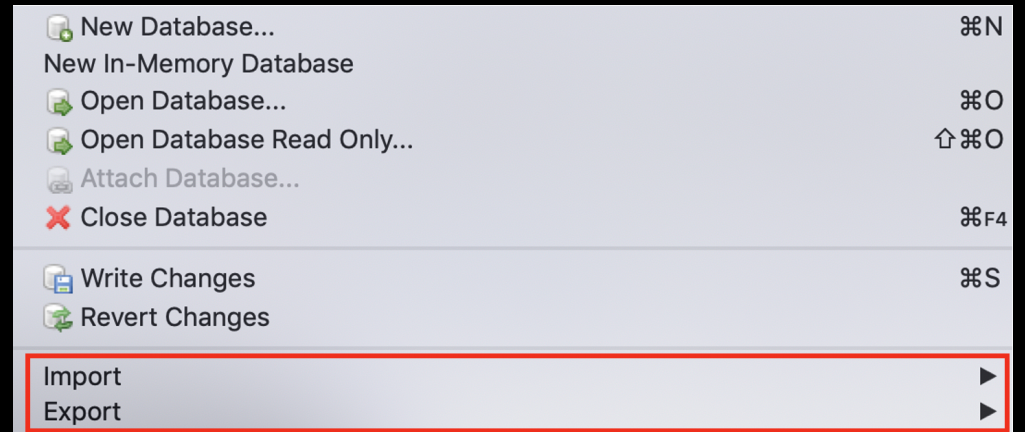
CSV

- 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"
- 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
```

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/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
 - e.g. `{"first_name":"Thomas", "last_name":"Rosenthal"}`
 - or for tables:

```
[ {"first_name":"A", "last_name":"Mahfouz"}  
  {"first_name":"Thomas", "last_name":"Rosenthal"} ]
```

- 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`
 - 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
```

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"}]')
```

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

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

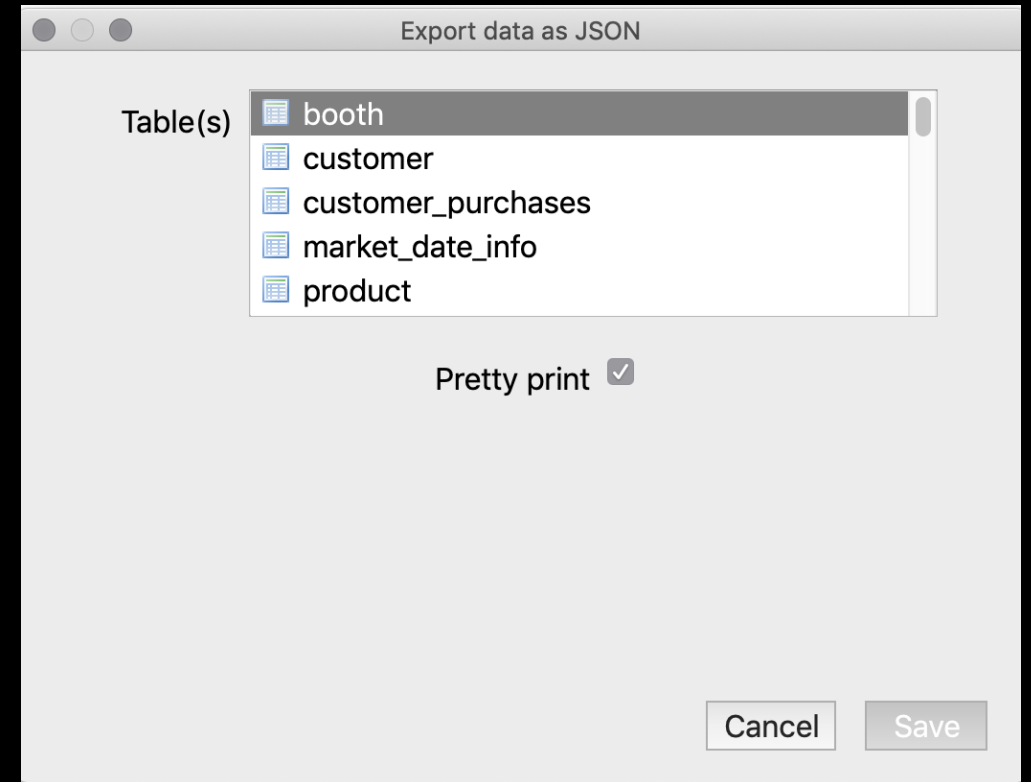
- Third, use this previous query as a subquery and combine with `JSON_EXTRACT` , using the value column `JSON_EACH` generated

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

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

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)

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Views

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
- 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)

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
- 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
```


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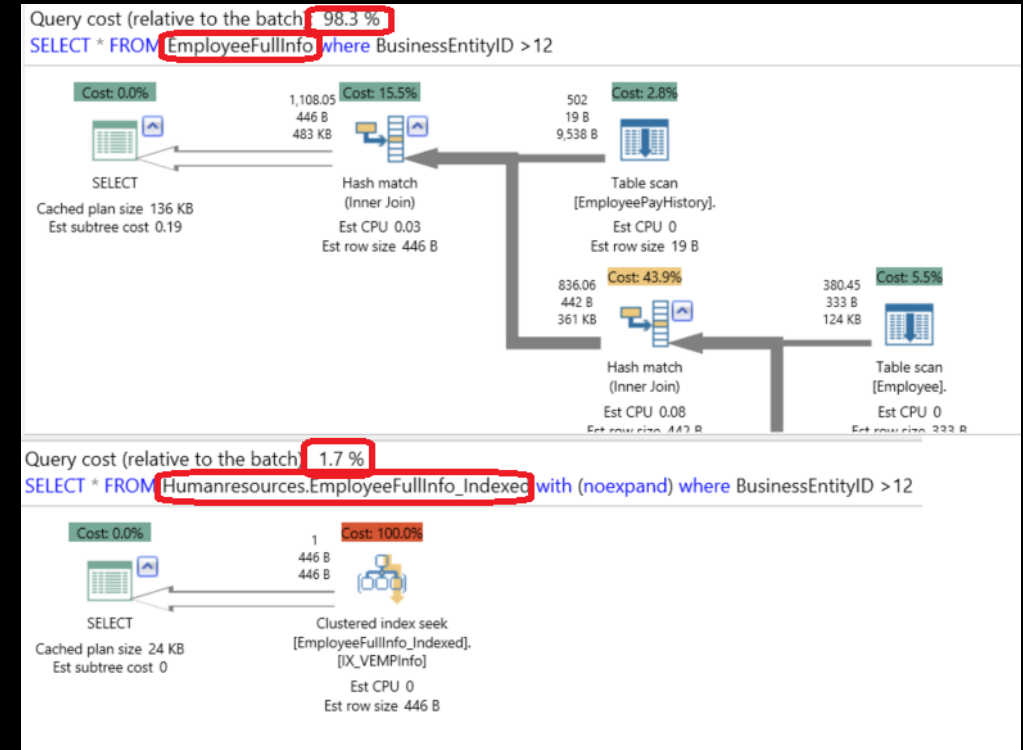
Views

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



Views

(Views live coding)

