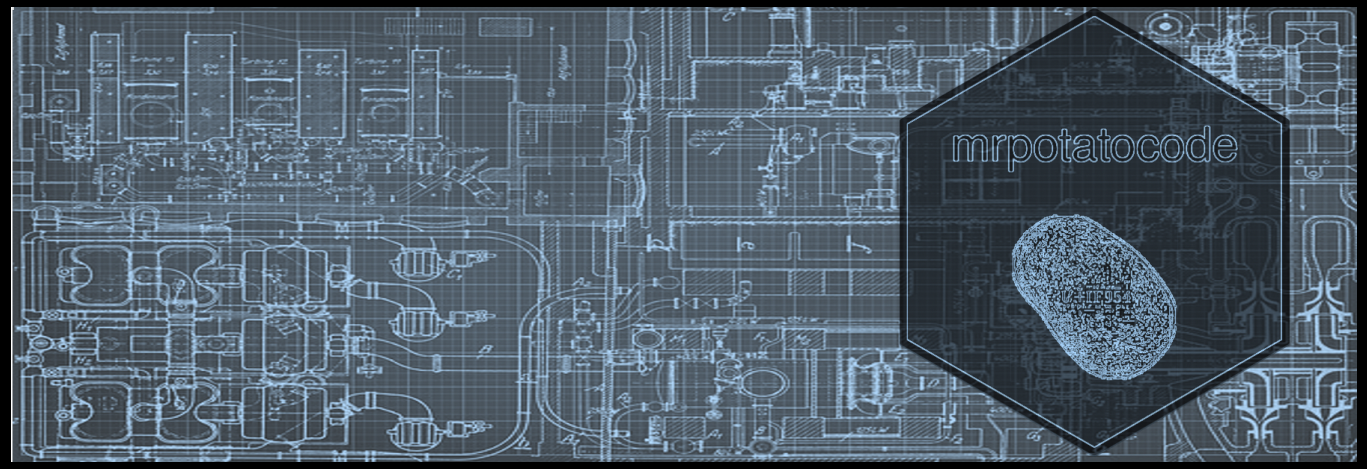

Introduction to Data Access and Storage

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Module 04

Advanced Techniques:

String Manipulation

CROSS JOIN

Self Joins

UNION & UNION ALL

INTERSECT & EXCEPT

Advanced Techniques:

String Manipulation

CROSS JOIN

Self Joins

UNION & UNION ALL

INTERSECT & EXCEPT

String Manipulation

LTRIM & RTRIM

REPLACE

UPPER & LOWER

Concatenation

(...)

String Manipulation (continued)

SUBSTR

LENGTH

CHAR & UNICODE

REGEXP

String Manipulation

LTRIM & RTRIM

REPLACE

UPPER & LOWER

Concatenation

(...)

LTRIM & RTRIM

- `LTRIM` and `RTRIM` serve two purposes in SQLite:
  - Their main function is to remove leading or trailing white spaces from strings
    - This is surprisingly common — many SQL databases are populated by human input, and this is a frequently overlooked input error
    - e.g. ' Thomas Rosenthal '
  - Alternatively, they act similarly to `REPLACE` (coming up next), but within their specific context:
    - `LTRIM` removes any specified set of characters from the *left*
    - `RTRIM` removes any specified set of characters from the *right*
      - The usefulness of this is going to be very case specific:
        - e.g. wanting to remove a prefix/suffix of an ID:
          - `LTRIM("A189A", 'A')` would result in '189A'
          - `RTRIM("A189A", 'A')` would result in 'A189'
          - `REPLACE` would remove both A's: '189'

LTRIM & RTRIM

(`LTRIM` & `RTRIM` live coding)

String Manipulation

LTRIM & RTRIM

REPLACE

UPPER & LOWER

Concatenation

(...)

REPLACE

- `REPLACE` is likely going to be one of your most commonly used string manipulations
- It substitutes a character or set of characters with another
  - We specify which string (or set of strings within a column), what we want to replace, and the replacement value
    - e.g. `REPLACE('A is an excellent instructor','instructor','TA')` results in 'A is an excellent TA'
  - You can also replace a character with nothing, using an empty string: `''`
    - e.g. `REPLACE('colour','u','')` results in 'color'

- `REPLACE` statements can be strung together — the innermost function will be executed first
  - e.g. `REPLACE(REPLACE(REPLACE(REPLACE('A?lot-of,punctuation.','.',' '),',',' '),'-',' '),'?',' ')` results in 'A lot of punctuation'

REPLACE

(REPLACE live coding)

String Manipulation

LTRIM & RTRIM

REPLACE

UPPER & LOWER

Concatenation

(...)

UPPER & LOWER

- `UPPER` forces all string characters to be uppercase
- `LOWER` forces all string characters to be lowercase
- Both `UPPER` and `LOWER` are essential for filtering tables based on strings
  - It's always best to assume that there is some string variety
  - Sometimes a `LIKE` statement will not be an option

annoying_string_column
WORD
Word
word
wOrD
DifferentWord

- We can always use `UPPER` or `LOWER` in a `WHERE` clause, even without using the commands in the `SELECT` statement

```
SELECT annoying_string_column
FROM table
WHERE LOWER(annoying_string_column) = 'word'
```

- *(This is also true for all of these string manipulations!)*

UPPER & LOWER

(`UPPER` & `LOWER` live coding)

String Manipulation

LTRIM & RTRIM

REPLACE

UPPER & LOWER

Concatenation

(…)

Concatenation (sometimes CONCAT, flavour dependent)

- String concatenation combines two or more columns into a single column
- Concatenation can handle non-column values too
  - e.g. `first_name || ' ' || last_name as full_name`
  - or `last_name || ', ' || first_name AS full_name`
- In SQLite, `CONCAT` is replaced by two vertical bar characters: `||`
  - most other flavours use `CONCAT`
- By default, spaces are not included between columns
  - i.e. you need to add a blank space between quotes

Concatenation

(Concatenation live coding)

String Manipulation (continued)

SUBSTR

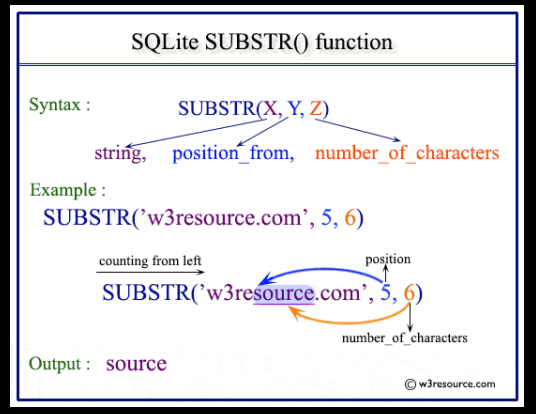
LENGTH

CHAR & UNICODE

REGEXP

SUBSTR ("substring")

- `SUBSTR` specifies any section of a string to return, based on:
  - which string (i.e. column)
  - where to begin the section (i.e. the string position to start, as an integer)
  - the (optional) number of characters to return (i.e. how far to go, as an integer)
- `SUBSTR` replaces flavour specific functions like `LEFT` or `RIGHT`
  - by default `SUBSTR` counts from the left
    - e.g. `substr('a long string', 3, 4)` will return "long"
  - to count from the right, specify a negative number to start
    - e.g. `substr('a long string', -6, 6)` will return "string"



SUBSTR

(SUBSTR live coding)

String Manipulation (continued)

SUBSTR

LENGTH

CHAR & UNICODE

REGEXP

LENGTH

- `LENGTH` returns the number of characters in a given string (or set of strings in a column)
  - `LENGTH` also works on integers
- `LENGTH` is perhaps less of a string manipulation in and of itself, but is useful in debugging
  - Combined with `MAX`, `LENGTH` can be useful, especially when adding string length constraints to a column
  - Combined with `SUBSTR`, `LENGTH` can cut strings within a column by a dynamic value
- What happens when we apply `SELECT SUBSTR(CanadianMusicians, 0, LENGTH(CanadianMusicians)-6)` to the table below?

CanadianMusicians
Neil Young
Leonard Cohen
Shania Twain
Michael Bublé

CanadianMusicians
Neil
Leonard
Shania
Michael

LENGTH

(`LENGTH` live coding)

String Manipulation (continued)

SUBSTR

LENGTH

CHAR & UNICODE

REGEXP

CHAR & UNICODE

CHAR

- When provided an ASCII value, `CHAR` will return the appropriate character from the ASCII table
  - e.g. `CHAR(98)` will result in 'b'
- Pronunciation is split on "char":
  - "char" as in "*char*-broiled"
  - "char" as in "*car*"
  - "char" as in "*char*acter"
  - "char" as in "*care*"

- `CHAR` is hugely useful with `REPLACE`
  - occasionally, line breaks affect SQL column validity, so `REPLACE(lf_column,CHAR(10),'')` and/or `REPLACE(cr_column,CHAR(13),'')` will be hugely useful
    - where `CHAR(10)` is a linefeed "lf" and `CHAR(13)` is a carriage return "cr"
- `CHAR` can help with structure and control of strings as they flow into columns

CHAR & UNICODE

UNICODE (ASCII in some flavours)

- `UNICODE` provides the ASCII value of any given character
  - i.e. the opposite of `CHAR`
- The usage? I'm a bit unsure! Maybe faster than looking it up online?
  - e.g. `UNICODE('b')` will result in '98'

CHAR & UNICODE

(`CHAR` & `UNICODE` live coding)

String Manipulation (continued)

SUBSTR

LENGTH

CHAR & UNICODE

REGEXP

REGEXP (flavour dependent)

- `REGEXP` allows for string filtering based on regular expressions (regex)
- Situated within a `WHERE` clause, very similar to `LIKE`

- Can use either SQL's or regex's Boolean operators
  - e.g. `WHERE austen_books REGEXP '(sion|ice)$'`
  - or `WHERE austen_books REGEXP 'sion$' OR book_title REGEXP 'ice$'`

austen_books
Sense & Sensibility
Pride & Prejudice
Mansfield Park
Emma
Persuasion
Northanger Abbey

austen_books
Pride & Prejudice
Persuasion

REGEXP (flavour dependent)

(Quick `REGEXP` live coding)

> Some people, when confronted with a problem think: "I know, I'll use regular expressions." Now they have two problems.
>
> Jamie Zawinski (probably)

Advanced Techniques:

String Manipulation

CROSS JOIN

Self Joins

UNION & UNION ALL

INTERSECT & EXCEPT

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?

CROSS JOIN

(`CROSS JOIN` live coding)

> No complex query is complete without at least one `CROSS JOIN`
>
> (me, jokingly)

Advanced Techniques:

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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
```

Advanced Techniques:

String Manipulation

CROSS JOIN

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UNION & UNION ALL

INTERSECT & EXCEPT

UNION & UNION ALL

- `UNION` and `UNION ALL` combine the results of two or more queries vertically (i.e. row-wise)
- `UNION ALL` keeps duplicate values, whereas `UNION` removes them
    - the difference between the two is one of the most common interview questions!
- `UNION` and `UNION ALL` require both/all queries to have the same number of columns
    - You could `UNION` unrelated columns if you had a specific use-case for it
        - Column names will come from the first query
    - In situations where you don't have exactly the same columns, but still need to `UNION`, you can pass a `NULL` (or zero, or blank) column
        - Similarly, you can pass a string character to keep track of which data is associated to which query

```
SELECT number_of_chips, number_of_tacos, 0 AS number_of_burritos, 'lunch' AS meal
FROM lunch

UNION

SELECT NULL as number_of_chips, number_of_tacos, number_of_burritos, 'dinner' AS meal
FROM dinner
```

UNION & UNION ALL

- If we recall SQLite's lack of support for `FULL OUTER JOINS`, `UNION ALL` will allow us to emulate one:

```
SELECT s1.quantity, s1.costume, s2.quantity
FROM store1 s1
LEFT JOIN store2 s2 ON s1.costume = s2.costume

UNION ALL

SELECT s1.quantity, s2.costume, s2.quantity
FROM store2 s2
LEFT JOIN store1 s1 ON s2.costume = s1.costume

WHERE s1.quantity IS NULL
```

UNION & UNION ALL

(`UNION` & `UNION ALL` live coding)

Advanced Techniques:

String Manipulation

CROSS JOIN

Self Joins

UNION & UNION ALL

INTERSECT & EXCEPT

INTERSECT & EXCEPT

- Both `INTERSECT` and `EXCEPT` require both/all queries to have the same number of columns

INTERSECT

- `INTERSECT` returns data in common with both/all `SELECT` statements
- Values returned will be distinct
- What's the difference between `INTERSECT` and `INNER JOIN`?

EXCEPT

- `EXCEPT` returns the opposite of an `INTERSECT`
  - for whatever rows are returned by the first `SELECT` statement, `EXCEPT` will return rows that were *not* returned by the second `SELECT` statement
- The "direction" of `EXCEPT` matters a lot
  - `EXCEPT` is relative the the first `SELECT` statement, so changing which comes first will always change the results of the query

INTERSECT & EXCEPT

Let's consider an example:

For the following `product` table,

product	product_id
blue bike	1
tiger onesie	2
house plant	3
headphones	4

and `order` table,

order_id	product_id
1	1
2	1
3	1
4	4

`INTERSECT` will find all products with work orders

```
SELECT product_id FROM product
INTERSECT
SELECT product_id FROM orders
```

Resulting in product_id's 1 & 4

`EXCEPT` will find all products *without* work orders

```
SELECT product_id FROM product
EXCEPT
SELECT product_id FROM orders
```

Resulting in product_id's 2 & 3

OR all work orders *without* products

```
SELECT product_id FROM orders
EXCEPT
SELECT product_id FROM product
```

Resulting in nothing (because no orders have a product_id that is not found in the product table)

INTERSECT & EXCEPT

(`INTERSECT` & `EXCEPT` live coding)

Lingering Questions?