[544] BigQuery: Complex Types

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Learning Objectives

- authenticate on a GCP VM to gain access to BiqQuery datasets
- execute BiqQuery queries in a variety of settings (console, Jupyter with extension, Python call)
- query complex data types (arrays and structs) using correlated cross joins

Demos...

Outline

Types: Simple and Arrays/Structs

Cross Joining

Unnesting, Correlated Cross Join

Geographic Data

Types

Basics

- BOOL, INT64, FLOAT64
- STRING, BYTES
- DATE, DATETIME
- etc.

Nesting

- **ARRAY** (repeated): `myarray[OFFSET(5)]`
- **STRUCT** (record) `mystruct.some_attribute`

example from https://cloud.google.com/bigquery/docs/nested-repeated

```
+-------------------+---------------------------------+-----------+
| title             | authors                         | num_pages |
+-------------------+---------------------------------+-----------+
| Example Book One  | [{123, Alex, 01-01-1960},       | 487       |
|                   |  {789, Kim, 01-01-1980}]        |           |
| Example Book Two  | [{456, Rosario, 01-01-1970}]    | 89        |
+-------------------+---------------------------------+-----------+
```

array of structs

struct

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Cross Joins

Previously covered JOIN types (they each specify "ON" to filter row pairings):

- INNER, LEFT, RIGHT

CROSS JOIN: every row in table 1 with every row in table 2

format 1

```
SELECT *
FROM tbl1
CROSS JOIN tbl2
```

format 2

```
SELECT *
FROM tbl1, tbl2
```

same meaning as format 1
(comma means "cross join")

tbl1

A	B
1	2
3	4

tbl2

C
X
Y

A	B	C
1	2	X
1	2	Y
3	4	X
3	4	Y

Cross Joins: Filtering

Predicates

- don't use "ON" as in other JOINs
- can optionally use "WHERE"

Naive version: get every combination of pairs, then filter down after.
Can we do better?

Sometimes query engines can optimize certain WHERE filters with CROSS JOIN.

BigQuery implements optimized spatial JOINs for INNER JOIN and CROSS JOIN operators with the following GoogleSQL predicate functions:

- `ST_DWithin`
- `ST_Intersects`
- `ST_Contains`
- `ST_Within`
- `ST_Covers`
- `ST_CoveredBy`
- `ST_Equals`
- `ST_Touches`

BigQuery Documentation

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Unnesting and Correlated Cross Join

```
SELECT x,y,z
FROM tbl
CROSS JOIN UNNEST(tbl.coord)
```

x	coord
1	[{2,3}, {4,5}]
6	[{7,8}, {9,10}]

unnest

y	z
2	3
4	5

y	z
7	8
9	10

different logical table for each row

Unnesting and Correlated Cross Join

SELECT x,y,z
FROM **tbl**
CROSS JOIN UNNEST(**tbl.coord)**

x	coord
1	[{2,3}, {4,5}]
6	[{7,8}, {9,10}]

unnest

y	z
2	3
4	5

y	z
7	8
9	10

x	y	z
1	2	3
1	4	5
6	7	8
6	9	10

"correlated" means we only cross against table unnested from row. No output row contains 5 and 6 for example.

TopHat

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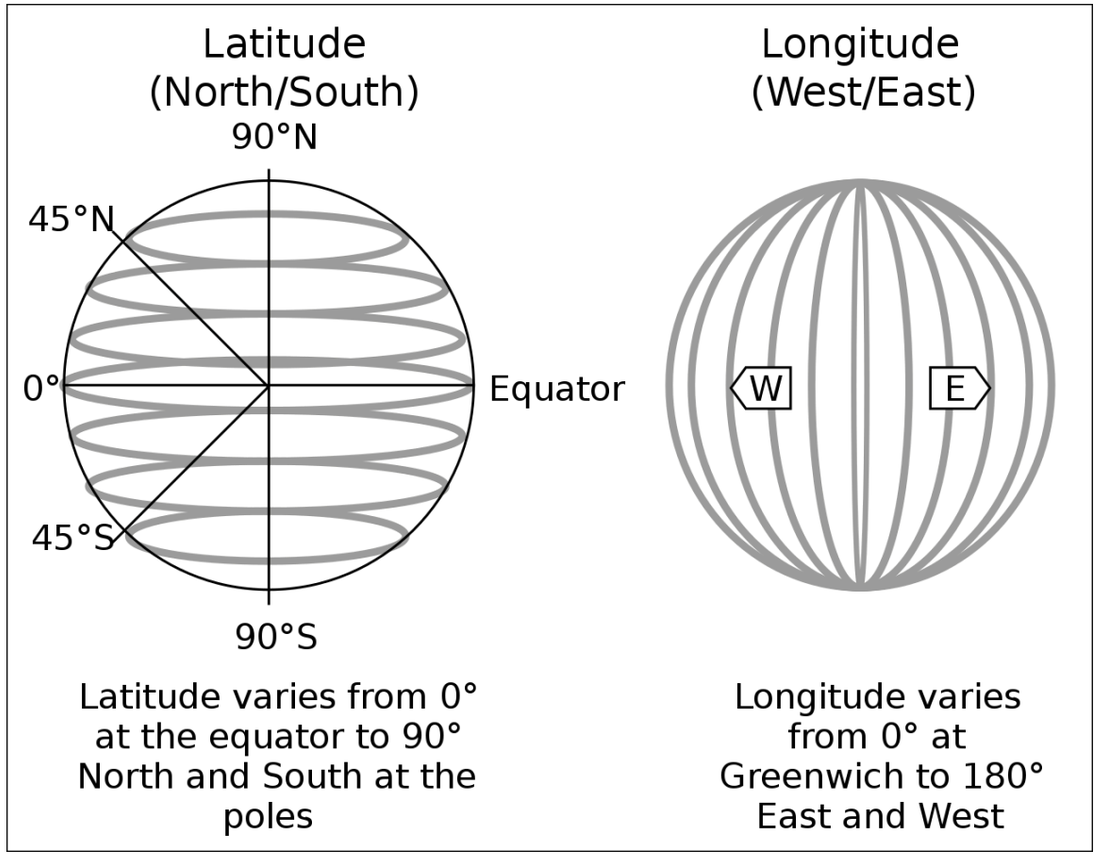
Geographic Data

Coordinate reference systems

- way to associate coordinates with a point on earth
- latitude/longitude (used by GPS) is most famous
- some systems incorporate altitude too (3D coordinate system)



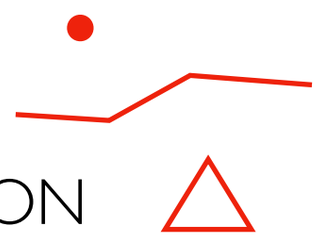
https://en.wikipedia.org/wiki/Geographic_coordinate_system#/media/File:FedStats_Lat_long.svg

BigQuery support

- common geo operations (e.g., geographic joins)
- uses lat/lon by default (no altitude)

Shape constructors

- ST_GEOGPOINT
- ST_MAKELINE
- ST_MAKEPOLYGON



other shape (e.g., multi-polygons) are possible with operations on these

Demos...