[544] BigQuery

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Outline

Demos: Getting Started, Billing

Types: Simple and Arrays/Structs

Cross Joining

Unnesting, Correlated Cross Join

Demos: Working with Arrays

Geographic Data

Demos: Geographic Data

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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:

- 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

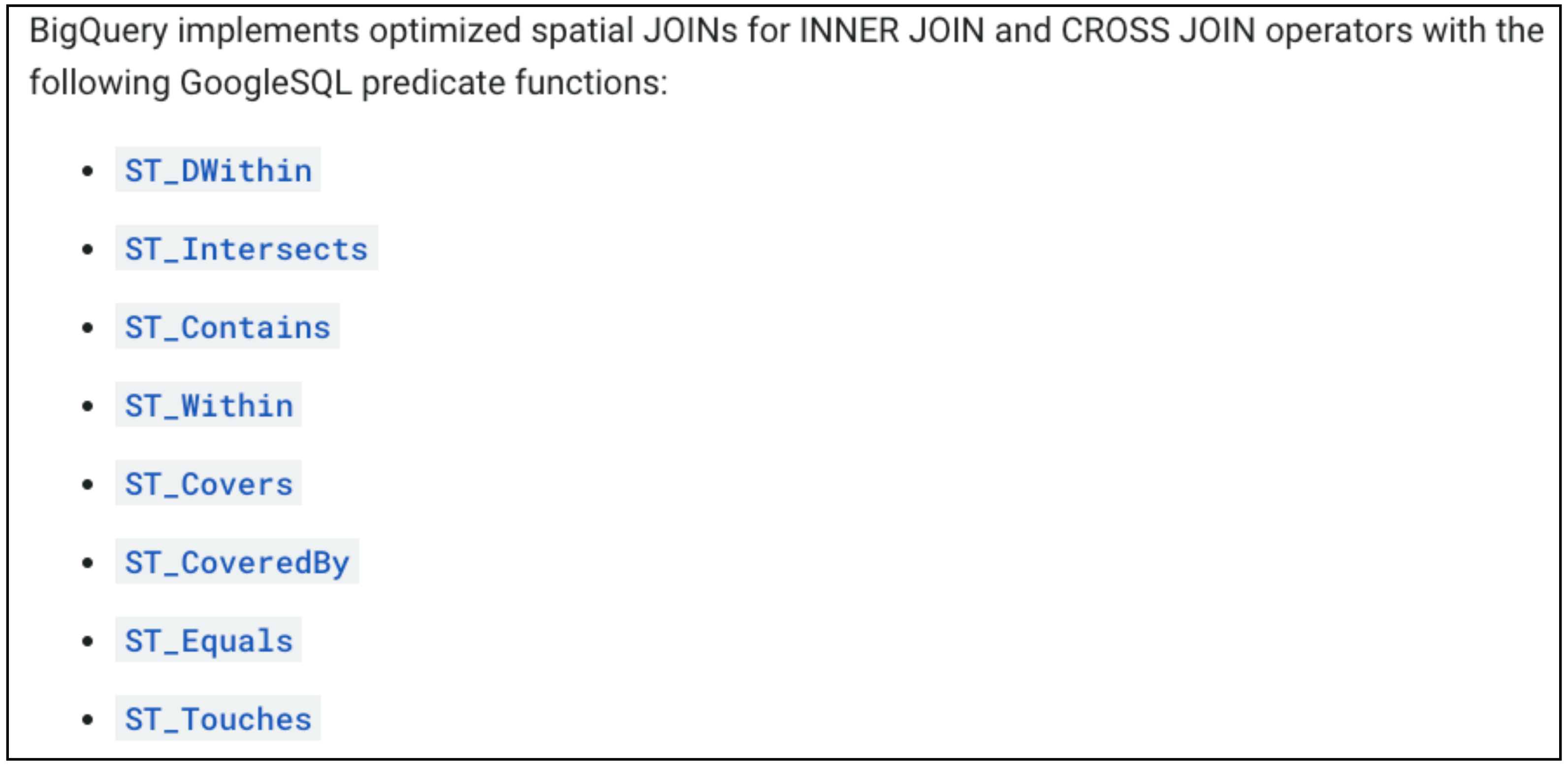
Cross Joins: Filtering

Predicates

- no "ON"
- sometimes 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}]

$\downarrow$ unnest

y	z
2	3
4	5

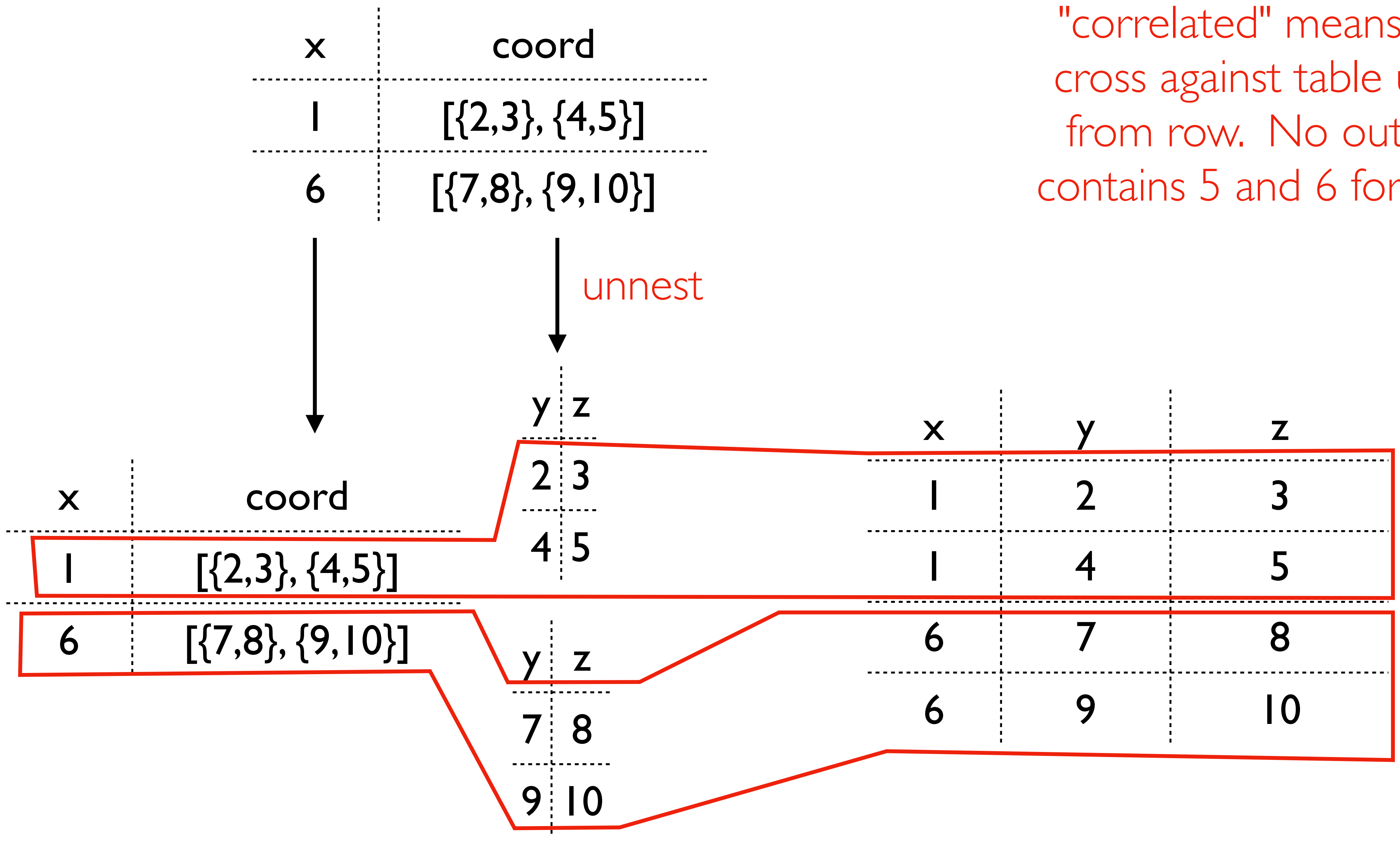
different logical table for each row

y	z
7	8
9	10

Unnesting and Correlated Cross Join

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

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



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

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

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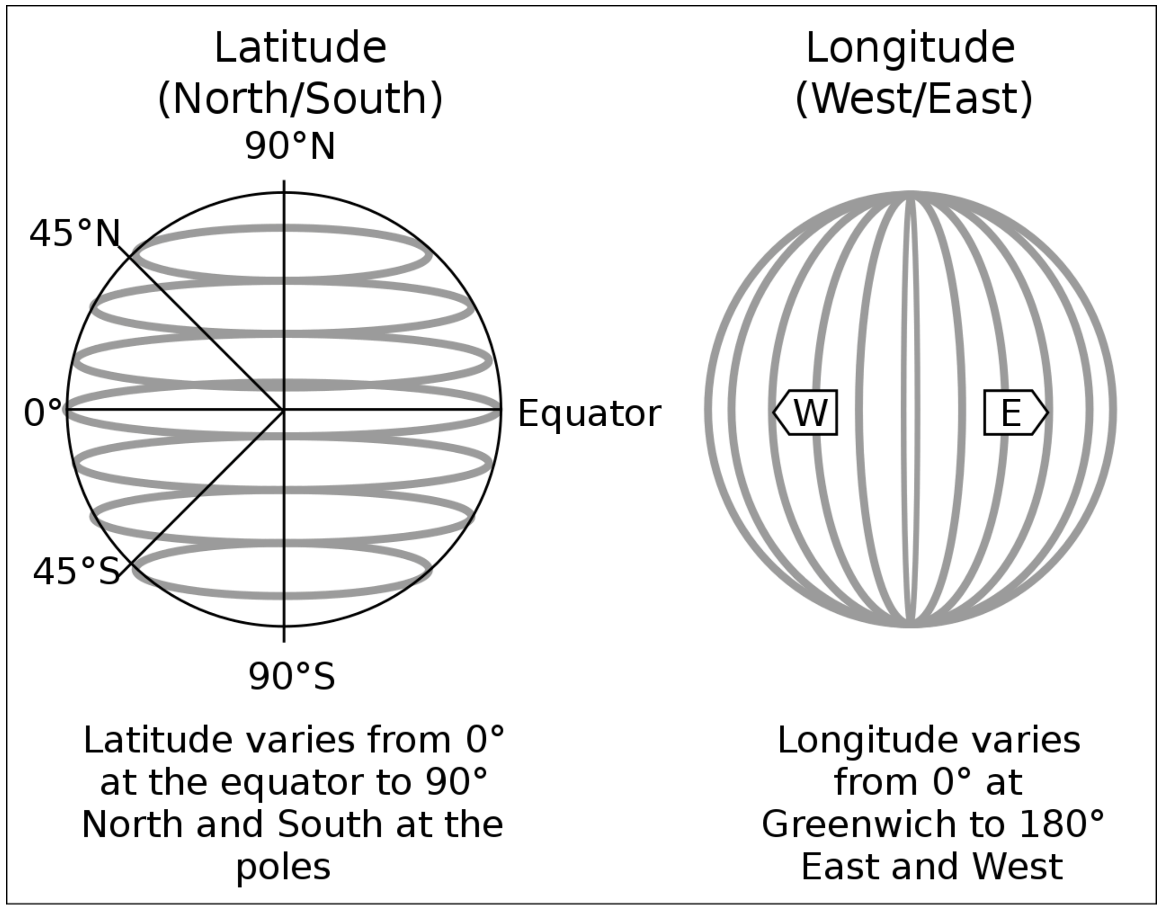
Geographic Data

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)


Latitude (North/South)
90°N
45°N
0°
Equator
45°S
90°S
Latitude varies from 0° at the equator to 90° North and South at the poles
Longitude (West/East)
W
E
Longitude varies from 0° at Greenwich to 180° East and West

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

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