# Querying Spatial Data

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# Outlook:
# Beyond Relational Data

- Graph data

- Data streams

- Spatial data

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- Graph data

- Data streams

- **Spatial data**

# Reading Material

- ISO 19125-2:2004
  *Geographic information - Simple feature access -
  Part 2: SQL Option*
  https://www.iso.org/standard/40115.html

# Building Geography Values

- **ST_GEOGPOINT(longitude, latitude)**
  Builds new point with given coordinates

- **ST_MAKELINE(Geo_1, Geo_2)**
  Connect two geography values by line

# Calculating Boundaries

- ST_BOUNDARY(geography expression)

  - Returns the **union of boundaries** of given objects

    - **Points** have no boundaries

    - The boundary of a **line** are the endpoints

    - **Polygons** are bounded by lines

# Calculating Centroids

- ST_CENTROID(geography expression)

- Returns the **weighted average** of component centroids

  - Centroid of **point** coordinates is arithmetic mean

  - Centroid of **line** segment is the middle point

  - Centroid of a **polygon** is its center of mass

# Access to Specific Properties

- **ST_X(geography expression)**
  Returns the longitude

- **ST_Y(geography expression)**
  Returns the latitude

- **ST_DIMENSION(geography expression)**
  Returns dimension (of highest-dimensional element)

# Predicates Expressions

- **ST_CONTAINS(geo_1, geo_2)**
  TRUE if geo_1 contains geo_2


- **ST_DWITHIN(geo_1, geo_2, distance)**
  TRUE if distance of at least one point from geo_1 and one point from geo_2 is below the distance (in meters)

# Calculating Measurements

- **ST_AREA(geography expression)**
  Calculates the covered area in square meters

- **ST_MAXDISTANCE(geo_1, geo_2)**
  Longest distance between any two points in meters

# (Demo)

# Spatial Data Summary

- Various applications require **spatial data**

- Standard **data structures** are a bad match

  - Saw specialized data structures like **R trees**

- SQL query languages requires **extensions**

  - Saw extensions supported by **BigQuery Geo Viz**