Oracle Spatial and Graph in Oracle Database 19c
Multimodel Database

- Oracle Database supports multiple models
  - Relational, In-memory, Sharded
  - Document Store
    - JSON
    - XML
    - Text
    - OLAP
  - Spatial Database
  - Graph Database and Triple Store

- Oracle Database support multiple languages and access protocols
Spatial and Graph Analysis – It is about relationships

• Are things in the same location? Who is the nearest? What tax zone is this in? Where can deliver in 35 minutes? What is in my sales territory? Is this built in a flood zone?

• Which supplier am I most dependent upon? Who is the most influential customer? Do my products appeal to certain communities? What patterns are there in fraudulent behavior?
Oracle Spatial and Graph

Three major features

Spatial

Property Graph

RDF Graph
Oracle Spatial and Graph
On Premises, Cloud and in Autonomous Database
## Oracle Spatial and Graph

Location and graph analysis with secure storage for enterprise data

### Deployable Services

<table>
<thead>
<tr>
<th>Deployable Services</th>
<th>Mapping</th>
<th>Geocoding</th>
<th>Routing</th>
<th>Web Services (OGC)</th>
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</thead>
<tbody>
<tr>
<td>Points</td>
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<td>Lines</td>
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<td>Polygons</td>
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<td>Location Tracking (Geofencing)</td>
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<td>Networks</td>
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<td>RDF Graphs</td>
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<td>Property Graphs</td>
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<td>3D / LiDAR</td>
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Oracle Spatial and Graph 19c

Three major features

- Spatial
- Property Graph
- RDF Graph
Spatial Processing in Oracle Database

Native Geometry Data Types
Points, Lines, Polygons, etc.

Geometries in Oracle Tables

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<thead>
<tr>
<th>RNAME</th>
<th>ID</th>
<th>TYPE</th>
<th>LANES</th>
<th>GEOM1</th>
<th>GEOM2</th>
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<td>140</td>
<td>HWY</td>
<td>6</td>
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<td>M25</td>
<td>141</td>
<td>HWY</td>
<td>4</td>
<td></td>
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</tr>
</tbody>
</table>

Spatial Indexing

Operators and Functions
Select, within distance, nearest neighbor, intersection, union, centroid, ...

SQL Query and Analysis

SELECT a.owner_name, a.acquisition_status
FROM properties a, projects b
WHERE sdo_within_distance
(a.property_geom1, b.project_geom,
 'distance = .1 unit = mile') = 'TRUE' and
b.project_id=189498;
Spatial Analysis

- 100’s of SQL spatial analysis operators
  - Filter
  - Combine
  - Transform
  - Measure
Advanced Spatial Data Models

- Spatial networks for roads, transport, pipelines, telcos and other geographically connected analysis

- Topology for mapping, land management and cadastre applications
Raster, 3D, Point Clouds and LiDAR support

Raster

Point Clouds

Solids

Triangular Irregular

3D Coordinate Systems

Raster and 3D Queries

Raster Analysis and Operations

Volumetric Analysis

Visibility queries
Major New Spatial Features

Ease of Use
• JSON and Oracle REST Data Services improvements
• Improved web services user interface, CSW and WFS enhancements
• Self-service development tool

Performance
• Ability to use spatial operators without a spatial index
• Spatial index performance improvements
  – Enhancements to CBTree index to use the data layer directly for Spatial index access.
  – 3x faster query performance for large point data sets.

Improved Database Support
• Spatial support for distributed transactions
• Spatial support for database sharding
Spatial Visualization

Map authoring tool

Web-based admin

Self-service spatial analytics
Oracle Spatial and Graph 19c

Three major features

Spatial

Property Graph

RDF Graph
Property Graph Analysis for Business Insight

Identify Influencers

Discover Graph Patterns in Big Data

Generate Recommendations

We think you may like this.
Computational Property Graph Analytics: Built-in Package

Rich set of built-in parallel graph algorithms

- Detecting Components and Communities
  - Tarjan’s, Kosaraju’s, Weakly Connected Components, Label Propagation (w/ variants), Soman and Narang’s Specification

- Ranking and Walking
  - Pagerank, Personalized Pagerank, Betweenness Centrality (w/ variants), Closeness Centrality, Degree Centrality, Eigenvector Centrality, HITS, Random walking and sampling (w/ variants)

- Evaluating Community Structures
  - Conductance, Modularity, Clustering Coefficient (Triangle Counting), Adamic-Adar

- Path-Finding
  - Hop-Distance (BFS), Dijkstra’s, Bi-directional Dijkstra’s, Bellman-Ford’s

- Link Prediction
  - SALSA (Twitter’s Who-to-follow)

- Other Classics
  - Vertex Cover, Minimum Spanning-Tree (Prim’s)

... and parallel graph mutation operations

- The original graph
- Create Undirected Graph
- Create Bipartite Graph
- Sort-By-Degree (Renumbering)
- Filtered Subgraph
- Filter-Expression
- Left Set: “a,b,e”

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## RDF for Knowledge Graph, Linked-Data and Semantic Data Integration

### W3C Standards
- Native support for W3C standards for semantic data, ontologies and inferencing
- RDF and RDB2RDF
- Inferencing with RDFS, OWL, SKOS, and user-defined rules
- OGC GeoSPARQL support

### Languages, Tools, and APIs
- SQL query support
- SPARQL query language
- SPARQL/update, SPARQL endpoint
- Ontology-assisted query using SQL
- Java APIs via Jena, Joseki and Sesame
- Protégé ontology editing
- Cytoscape visualization plug-in

### Enterprise Database
- Scalable to over 54 billion triples, up to 8 PB
- Fine-grained Security
- RDF Views on relational tables and Property Graphs
- Supports Property Graph analysis on RDF data
- Compressed, partitioned storage
- Multitenant database support
Oracle’s Graph Advantages

Extreme Performance and Massively Scalable

Flexible Deployment

Ease of Development
Major New Graph Features

• SQL Developer for RDF
• Data Vault support and Schema-private networks in RDF
• Property Graph Query Language (PGQL) for in-memory and in-database Property Graphs
• New Property Graph in-memory analytics: Personalized SALSA, K-Core, Approximate and Weighted Pagerank
• Property Graph Views on RDF Graphs
• RDF Views on Property Graphs
Summary

By treating spatial and graph data the same as other business data, Oracle Spatial and Graph enables enterprises to realize these benefits:

• Integrate analysis in the IT infrastructure
• Reduce operational costs
• Minimize strategic risk
• Reduce development effort

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Resources
Oracle Spatial and Graph

Product homepage: oracle.com/database/technologies/spatialandgraph.html
Blog: blogs.oracle.com/oraclespatial
Forum: community.oracle.com/community/database/oracle-database-options/spatial
Oracle Spatial and Graph Group: linkedin.com/groups/1848520/
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