Oracle Spatial and Graph

Oracle provides the industry's leading spatial and graph database management platform. Oracle Spatial and Graph includes advanced features for management and analysis of spatial data, property graphs, and RDF linked data applications.

Oracle includes in its graph data management a scalable property graph database, including over forty built-in, parallel, in-memory analytic functions for applications such as social network analysis (SNA), Internet of Things, entity analytics, and recommendation systems.

The geospatial data features support complex Geographic Information Systems applications, enterprise applications, and location-based services applications. The RDF Semantic Graph model provides standards based storage, query, and inference of data represented as triples for linked data applications.

Spatial and Graph Analysis

Spatial and graph analysis is about understanding relationships. As applications and infrastructure evolve, as new technologies and platforms emerge, we find new ways to incorporate and exploit social and location information into business and analytic workflows. The emergence of Internet of Things, Cloud services, mobile tracking, social media, and real time systems create new challenges to manage the volume of data, but more importantly, to discover patterns, connections, and relationships.

To address these opportunities, Oracle Database 18c includes a wide range of spatial analysis functions and services to evaluate data based on how near or far something is to one another, whether something falls within a boundary or region, or to visualize geospatial patterns on maps and imagery. Oracle Database 18c also includes a powerful property graph analysis feature. The feature combines graph data management and open APIs with built-in social network analysis analytics to address graph use cases.

Advanced Features for Spatial and Graph Analysis

Property Graph Features

General-purpose property graphs are included in Oracle Spatial and Graph. Much of the Big Data generated these days contains inherent relationships between the

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ADVANCED SPATIAL AND GRAPH DATA MANAGEMENT FOR THE ENTERPRISE

- Oracle Spatial and Graph is part of Oracle Database. For more information on licensing and availability by edition, please refer to official Oracle Database licensing documentation.

KEY BENEFITS

- Oracle Database scalability, security and manageability for enterprise spatial and graph applications
- Extreme performance for critical enterprise spatial and graph datasets with Oracle Engineered Systems
- Commercial strength and support for scalable property graphs and 40 built-in social network analytics
- Easily location-enable enterprise applications, processes, and workflows
- Store, manage, and analyze all major geospatial data types and models natively in Oracle Database

- Supported by all leading geospatial vendors
- W3C RDF semantic graphs with advanced support for Linked Data applications

NEW 18c PROPERTY GRAPH FEATURES

- Execute PGQL queries in the database
- Find subgraphs using PGQL
- Collaborative filtering with SQL-based property graph analytics
- More built-in algorithms
- Node.js support
- Apache Zeppelin Integration
- Execution and scheduler management for in-memory analytics
- Support for undirected graphs

KEY PROPERTY GRAPH FEATURES

- Optimized schema for storage of vertices, edges and k/v properties
- Ease of development with Java and Tinkerpop APIs, Groovy and Python scripting, SQL queries on graph data
- 40 powerful parallel, in-memory analytics for social network analysis
- Analytics execute in Java application or in multi-user, multi-graph in-memory analyst server running on WebLogic, Tomcat or Jetty
- Analysis results can flow into a bipartite, filtered, undirected, sorted or simplified edge output graph
- Fast retrieval of vertices and edges using text indexing of properties with Oracle Text, Apache Lucene, or optionally SolrCloud
- Spatial filtering, indexing and analytic functions on spatial data in properties
- Property graph analysis of RDF graphs using property graph views
- Parallel bulk load with optimized Oracle flat file format, rich data types and from relational and CSV data
- Open source formats GraphSON, GraphML and GML supported
- Groovy management console
- Security for graphs and graph elements

collected data entities. These relationships can be easily structured as a property graph – a set of connected entities. The property graph vertices denote entities, the edges denote relationships, and the associated properties or attributes are stored as key-value pairs for both. The major capabilities are the in-memory analyst and data access.

Graph querying can be performed in one of three ways: using the built-in declarative graph query language (PGQL), programming with Java APIs that implement the Apache Tinkerpop Gremlin interfaces or using SQL. PGQL is a SQL-like graph pattern-matching query language that finds the subgraph instances of a graph matching a specified query pattern and returns requested entities.

Graph analytics are powered by the in-memory analyst (PGX) with over 40 built-in, powerful, parallel, in-memory analytics, including ranking, centrality, recommendation, community detection, and path finding routines. Several commonly used property graph analytics can also be executed in-database using SQL. The in-memory analyst performs a filter query on the database that reads a subgraph of interest into memory. The analytics can either be executed within a Java application or executed in the multi-user, multi-graph in-memory analyst server environment on Oracle WebLogic Server and Apache Tomcat. The output of graph analysis can be another graph, such as a bipartite, filtered, undirected, sorted or simplified edges graph.

Ease of development and management is provided through a Groovy-based console and a set of Java APIs to create and drop property graphs, add and remove vertices and edges, search for vertices and edges using key-value pairs, create text indexes, and perform other manipulations. The Java APIs include an implementation of the Apache TinkerPop interfaces. Support for scripting languages, such as Groovy and Python is included. The graph can also be queried with SQL.

Fast search is enabled through Apache Lucene and optionally Apache SolrCloud. They provide text indexing on properties for fast retrieval of vertices and edges. Native Oracle Text indexing is supported; text queries are automatically translated into SQL SELECT statements with a "contains" clause.

Fast, parallel bulk loading of very large graphs is accomplished with an easy to use, data type-rich Oracle flat file format. A utility is provided to easily convert Oracle tables and comma separated values (CSV) files into flat file format. The open source graph file formats GraphSON, GraphML and GML are also supported.

Spatial filtering in graph queries can enhance graph analysis. A spatial geometry, such as coordinates for an address can be stored as a property and analyzed; for example, a "within distance" query can determine whether to consider the associated entity in further analysis. Support for point, line and polygon geometries and function-based spatial indexing, and access to spatial analytic functions make this a powerful feature.

Multi-level security supports graph level access control and optional use of the Oracle Label Security option for fine-grained access control to individual vertices and edges.

New 18c capabilities include PGQL queries on graph data stored in Oracle Database, SQL-based collaborative filtering to make recommendations, and more in-memory analytics: new variants of Pagerank, Personalized SALSA to make recommendations, K-Core for finding subgraphs by properties, Diameter, Radius, and Eccentricity and PRIM for finding the minimum spanning tree of edges connecting all vertices in an undirected graph.

Spatial Features

Oracle Spatial and Graph provides advanced spatial analysis and processing. It supports all major spatial data types and models, addressing business-critical requirements from many industries, including transportation, utilities, energy, public sector, defense and commercial location intelligence. Its features include the following.

Native support for GeoJSON. This has become the standard format for reading and publishing spatial data on the Web, in Big Data, and for the Internet of Things.

A map visualization component enables developers to incorporate highly interactive maps and spatial analysis into business applications. Application content can be combined with maps and data from a variety of web services and data formats such as GeoJSON. This HTML5 map visualization is deployed in a Java EE container or in Oracle Java Cloud Service.

Location data enrichment services tag large collections of documents with location references. The enrichment process associates authoritative location terms (place names, addresses, and latitude / longitude) to text found in database tables. Users can perform spatial and text analysis on these enriched text sources.

Geocoding is a fundamental process that helps organizations refine and enrich existing address and location information found in relational tables. It generates latitude/longitude from existing customer addresses (or site locations) and is usually the first step in location intelligence applications.

A Network Data Model and Java APIs model physical and logical networks, and real world features with a geographic component and analyze them for shortest path, nearest neighbors, within cost and reachability. Loading partitioned networks into memory on demand enables scalable in-memory analysis of very large networks. Directed and undirected graphs with or without costs can be modeled. It is used in transportation, utilities, energy and communications.

GeoRaster stores and processes geo-referenced raster data, such as satellite imagery and gridded data. It provides a powerful raster algebra library and supports the creation of virtual mosaics. GeoRaster is commonly used in energy, natural resource management, and national security applications examining landscape changes in urban or rural areas.

3D point clouds and LiDAR are used for enterprise 3D GIS and Smart City applications. The 3D support is optimized for point cloud and CityGML workflows. It enables the production and management of seamless 3D point cloud models ranging from small local areas, to large cities and countries.

A topology data model is used by mapping and land management organizations that require a high degree of feature editing and data integrity across their maps and map layers.

New 18c capabilities include spatial support for distributed transactions used in large scale web and cloud-based applications, spatial database sharding for massively scalable and reliable OLTP applications, and spatial index performance improvements.

RDF Semantic Graph Features

RDF Semantic Graph is a graph for linked data and semantic web applications

- Oracle Big Data SQL
- Oracle Exadata Database Machine

KEY RDF GRAPH FEATURES
- RDF Triple store in compressed, partitioned tables
- Support for W3C and OGC standards: RDF, SPARQL, R2RML, OWL, SKOS
- SPARQL 1.1: including Update and ORDER BY, and query functions
- Parallel load, query and inference
- RDF views on property graph data
- Property graph views on RDF data
- Oracle Flashback Query support
- Semantic indexing of text
- Ontology-assisted relational querying

NEW 18c RDF GRAPH FEATURES
- Oracle Database In-Memory support
- List-hash composite partitioning
- Faster loading of long literals
- Support Turtle and Trig RDF formats

RESOURCES
For more information, visit
Oracle Technology Network
Software downloads, documentation, tutorials, white papers, use case studies: www.oracle.com/technetwork/database/options/spatialandgraph

Oracle.com
Product overviews, videos, customer stories: www.oracle.com/goto/spatial
Communities
Forums, blogs, worldwide user groups, social networks: tinyurl.com/oraclespatialcommunity

conforming to World Wide Web Consortium standards. Parallel loading, querying and inferencing support a trillion triples. Pattern-matching queries can be executed with SPARQL 1.1 in SQL, with Apache Jena Java APIs, and with the Fuseki SPARQL end-point web services. Built-in reasoning uses forward-chaining rules and inference - OWL 2, SKOS, and user-defined. Open Geospatial Consortium standards-based GeoSPARQL evaluates spatial data in an RDF graph. RDF views defined on tables enable SPARQL queries on relational data. Property graph views enable SNA analytics. A framework for third party natural language processing enables semantic text indexing.

Enterprise applications benefit from RDF Semantic Graph's extensive integration with Oracle Database and Oracle tools. Oracle Database management utilities and tuning can be applied to RDF graphs, including Enterprise Manager, Oracle optimizer hints, SQL*Loader direct path load, Data Guard physical standby, Data Pump import/export, RMAN Recovery Manager and external tables. Access controls can be applied at the model level and optionally at the triple level using the Oracle Label Security option. RDF graphs can be analyzed using SPARQL 1.1 path expressions, Apache Jena compliant graph visualization tools, Oracle SQL Developer and Advanced Analytics data mining and R Enterprise. Results can be reported in Oracle Business Intelligence EE.

New 18c capabilities include faster operations with Oracle Database In-Memory, better SPARQL performance with list-hash composite partitioning, faster loading of RDF quads having literals greater than 4000 bytes, and native support for Turtle and Trig formats.

The World's Leading IT Platform for Spatial and Graph Data

Oracle Spatial and Graph is a native component of Oracle Database – and of the world's leading information technology platform for Oracle Cloud, on premises, and big data deployments. Applications developed with Oracle Spatial and Graph benefit from the leading performance, scalability and security capabilities of Oracle Database 18c. They can exploit the extreme processing power and bandwidth of Oracle Exadata Database Machine. Developers can easily incorporate these capabilities in their solutions using modern development frameworks. Oracle tools and enterprise applications, and leading vendors support Oracle Spatial and Graph. The largest enterprises worldwide – mapping agencies, transportation, utilities, telcos, insurance, energy, financial services and more – rely on Oracle Spatial and Graph.

CONTACT US
For more information about Oracle Spatial and Graph, visit oracle.com or call +1.800.ORACLE1 to speak to an Oracle representative.

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