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Operational Property Graphs with SQL in Oracle Database 23ai

Your data is connected. Traversing connections in data usually requires recursive queries and multiple joins, which are harder to express using older SQL constructs. The new SQL:2023 GRAPH_TABLE function and MATCH clause syntax, implemented in Oracle Database 23ai, enable you to write simple SQL queries to follow connections in data. You can create a graph from data in relational tables and run graph queries to easily traverse connections in data. You can use graphs in transactional and analytical workloads, just like any other data in the database. Graphs have many applications—making product recommendations, detecting financial fraud, identifying dependencies in IT workflows, and more. Customers in financial services, manufacturing, retail, life sciences, healthcare, and the public sector rely on Oracle Graph technologies.

Native Representation of Graphs in Oracle Database

Oracle Database 23ai has native support for property graph data structures, enabling you to create and query graphs using SQL. You can build graph applications using existing SQL tools, languages, and development frameworks. You can use graphs in conjunction with transactional data, JSON, spatial data, and other data types. Data from online transaction processing (OLTP) applications with real-time updates can be modeled as a graph since SQL property graphs are like views on existing tabular or JSON data.

The property graph data model consists of vertices connected to other vertices by edges, each of which can have associated key-value pairs (properties). Typically, vertices represent entities in a data set (such as “customer” or “account”) and edges represent the relationships between them. Queries are based on specifying patterns that are matched against vertices and edges in a graph.

New SQL Standard for Property Graphs

SQL:2023 includes SQL syntax for property graphs (defined by the ISO standard ISO/IEC 9075-16). Oracle Database 23ai implements this new syntax so that graph operations can be executed using SQL. Before 23ai, graph operations were enabled by Property Graph Query Language (PGQL). Along with PGQL, Oracle Database 23ai supports the new SQL syntax for property graphs.

The `GRAPH_TABLE` operator and `MATCH` clause in SQL:2023

The `GRAPH_TABLE` operator is used to query a property graph for path patterns. A path pattern is a shape you search for in the graph, for example, a triangle or a path with three hop connections. The `MATCH` clause of the operator is used to specify the pattern, and the `COLUMNS` clause is used to specify what is returned as the result.

Advanced Graph Data Management for the Enterprise

"Property Graph can help make seemingly complex questions—when approached relationally—become fairly straightforward. SQL Property Graph allows us to combine the two approaches."
Lucas Jellema
Chief Technology Officer and IT Architect, Conclusion | Oracle ACE Director

"Wow, that GRAPH_TABLE extension of SQL is amazing. With Oracle Database 23ai, I can now create property graphs directly in my database with simple DDL, and the new GRAPH_TABLE SQL query syntax makes short work of building complex queries against property graphs."
Jim Czuprynski
Chief Storyteller, Zero Defect Computing, Inc. | Oracle ACE Director

Key Benefits

- Oracle Database scalability, security, and manageability for enterprise graph applications
- Extreme performance for critical enterprise graph data sets
- Commercial-strength scalability and comprehensive support for property graph query and analytics

Related Products

- Oracle Cloud
- Oracle Autonomous Database
- Oracle Machine Learning
- Oracle Exadata

Key Property Graph Features

- Support of SQL syntax for property graphs
- Java and Python API to execute 60+ powerful graph analytics

Results are returned as a table that you can use in other SQL queries. Here is an example of searching for a path with three hops:

```
SELECT account_id1, account_id2
    FROM GRAPH_TABLE(BANK_GRAPH
        MATCH (v1)-[IS BANK_TRANSFERS]->{1,3}(v2)
        WHERE v1.id = 387
        COLUMNS (v1.id AS account_id1, v2.id AS account_id2));
```

Graph analytics

Graph analytics uses algorithms from graph theory to analyze data represented as graphs. For example, you can use the Pagerank algorithm to identify highly connected vertices, use clustering algorithms to find communities by identifying tightly connected subgraphs, and more. With SQL property graphs, you can continue to use the 60+ prebuilt graph analytics algorithms to get more insights into your data.

Graph Database for the Enterprise

As part of Oracle's converged database offering, Oracle Graph eliminates the need to set up a separate database and move data into a siloed system. The graph capabilities are integrated with the database. Analysts and developers can include graphs in any application and benefit from enterprise-grade security, high availability, manageability, concurrency, transactional consistency, ease of data ingestion, and other features of Oracle Database. Graph analytics can enhance machine learning/AI and other types of workloads supported in the converged Oracle Database. Innovative technologies such as Oracle Autonomous Database—the industry's only self-driving, self-securing, and self-repairing database—are available to graph applications.

Working with Oracle Graph Server and Client tools

All currently shipping graph analytics and visualization functionality is compatible with SQL property graphs in Oracle Database 23ai. Take advantage of tools shipped with Graph Server and Client for SQL property graph exploration.

algorithms in parallel in the in-memory Graph Server

- Ease of development with SQL tools and graph visualization
- Property graph analysis of RDF graphs

Resources

For more information, visit **oracle.com/database/graph**

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