Operational Property Graphs with SQL in Oracle Database 23c

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 23c, 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 public sector rely on Oracle Graph technologies.

Native Representation of Graphs in Oracle Database

Oracle Database 23c 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, and other data types. Data in 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 dataset (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 23c implements this new syntax so that graph operations can be executed using SQL. Before 23c, graph operations were enabled by the Property Graph Query Language (PGQL). Along with PGQL, Oracle Database 23c 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. 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:

```sql
SELECT account_id1, account_id2
FROM GRAPH_TABLE (BANK_GRAPH)
MATCH (v1)-[IS BANK_TRANSFERS]->(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 find important vertices using the PageRank algorithm to identify highly connected vertices, find communities by identifying tightly connected subgraphs using clustering algorithms, and more. With SQL Property Graphs you can continue to use the 60+ pre-built 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 23c. Take advantage of tools shipped with Graph Server and Client for SQL Property Graph exploration.

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**Resources**

For more information, visit [oracle.com/database/graph](https://oracle.com/database/graph).

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