

# Graph Analytics for SQL Developers – The New MATCH Clause in SQL:2023

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Product Management – Oracle Spatial and Graph

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# Why would you use Graph Databases?

Graphs are useful when discovering and understanding relationships is important

## Customers

cst_id	name
c1	Alice
c2	Bob
c3	Charlie
c4	Dave
...	
...	

## Accounts

acc_id	cst_id
a1	c2
a2	c1
a3	c4
a4	c3
a5	c1
...	
...	

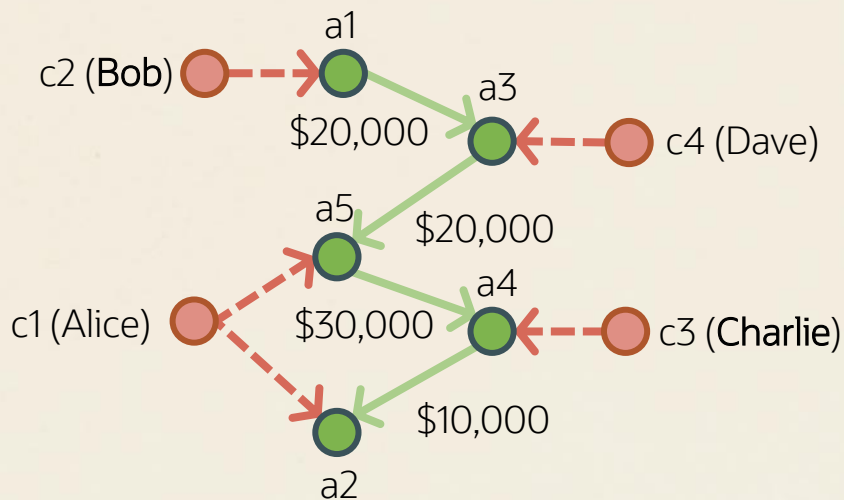
## Transactions

src_acc	dst_acc	amount	date
a1	a3	\$20,000	2023-10-01
a5	a4	\$30,000	2023-10-02
a4	a2	\$10,000	2023-10-03
a3	a5	\$20,000	2023-10-04
...			
...			



# Why would you use Graph Databases?

Is there *any money flow* between Bob & Charlie?



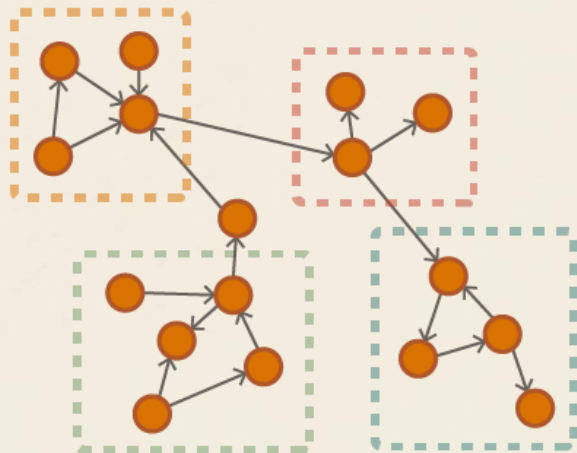
Graph-based queries:

- Fast traversals
- Path finding
- Identify patterns
- Extract subgraphs



# Why would you use Graph Databases?

*How to identify the clusters of transactions?*



Graph algorithms:

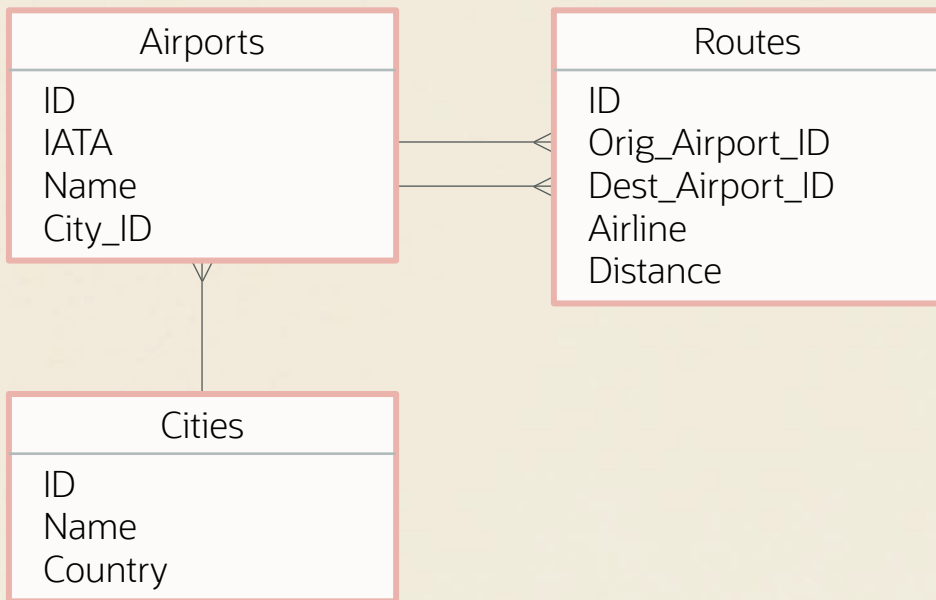
- Community Detection
- Ranking and Centrality
- Paths and Connectivity
- Link Prediction, Similarity

# Demo scenario

## Travel analysis



# Travel analysis



Finding and analyzing connections between cities

Property graph analysis

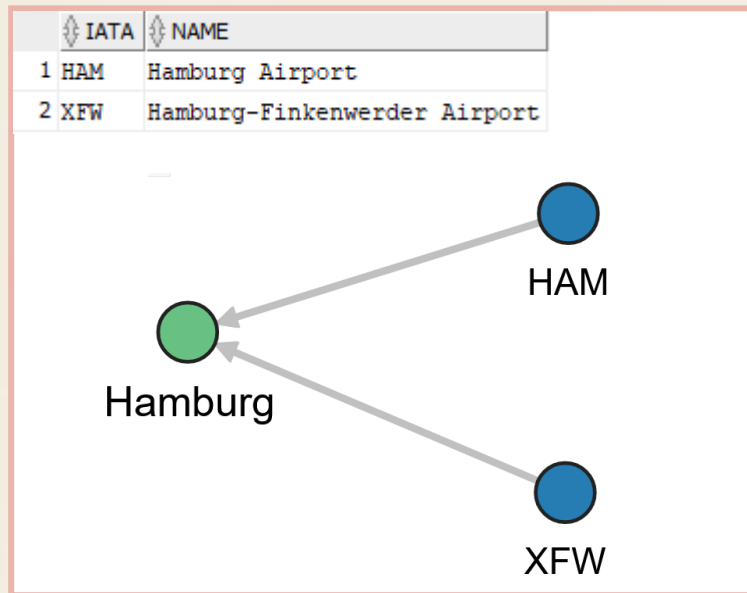
- Relational data model as a starting point
- 1:n and n:m relationships
- GRAPH\_TABLE/MATCH clause in Oracle 23c (ANSI SQL:2023)

# MATCH clause vs. regular join

Find all airports in Hamburg

```
SELECT a.iata, a.name
FROM airports a, cities c
WHERE c.city='Hamburg'
      AND a.city_id=c.id;
```

```
SELECT * FROM GRAPH_TABLE(flights_graph
MATCH (a IS airport)
->
(c IS city WHERE c.city='Hamburg'))
COLUMNS (a.iata, a.name) );
```

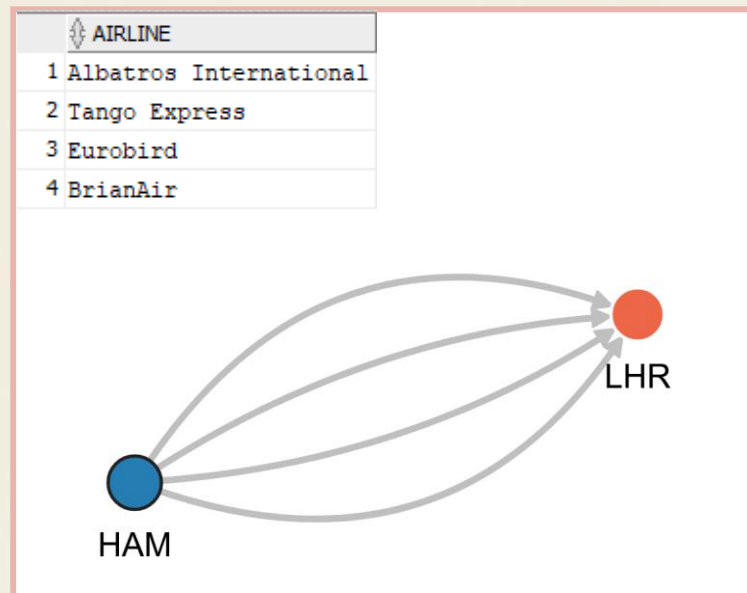


# MATCH clause vs. regular join

Find airlines connecting HAM and LHR

```
SELECT airline
FROM airports a, routes r, airports d
WHERE a.iata='HAM'
      and a.id=r.src_airport_id
      and d.id=r.dest_airport_id
      and d.iata='LHR';
```

```
SELECT * FROM GRAPH_TABLE(flights_graph
MATCH (a IS airport WHERE a.iata='HAM')
      -[r]->
      (d IS airport WHERE d.iata='LHR')
COLUMNS (r.airline) );
```





# Demo

MATCH clause in SQL/PGQ

# Mapping relational tables to a graph

Definition of vertices and edges  
with single DDL statement

More than one mapping possible

- Model depends on planned queries and analyses

Creating metadata, not copying data

- Transactional consistency
- Regular objects in data dictionary

```
CREATE PROPERTY GRAPH flights_graph
  VERTEX TABLES (
    airports
      LABEL airport
      PROPERTIES (name,iata),
    cities
      LABEL city
      PROPERTIES (city,country) )
  EDGE TABLES (
    routes
      SOURCE KEY (orig_airport_id) REFERENCES airports
      DESTINATION KEY (dest_airport_id) REFERENCES airports
      LABEL route
      PROPERTIES (airline,distance),
    airports AS airports2
      SOURCE KEY (city_id) REFERENCES cities
      DESTINATION KEY (id) REFERENCES airports
      LABEL located_in
      NO PROPERTIES )
```

# Mapping relational tables to a graph

Data structure similar to view

Schema-flexibility

Support for JSON

- JSON document as property
- Element of JSON document as property

Enterprise-level security

- Redaction, VPD, ...

```
CREATE PROPERTY GRAPH flights_plus
  VERTEX TABLES (
    airports
    <...> ,
    cities
    <...> )
  EDGE TABLES (
    routes
    <...> ,
    airports AS airports2
    <...> ,
    train_connections AS tc
    SOURCE KEY (orig_airport_id) REFERENCES airports
    DESTINATION KEY (dest_airport_id) REFERENCES airports
    LABEL train_connection
    PROPERTIES (tc.details.Operator.string() as operator,
                distance) )
```

# Demo

Create and query property graph metadata



# Tooling

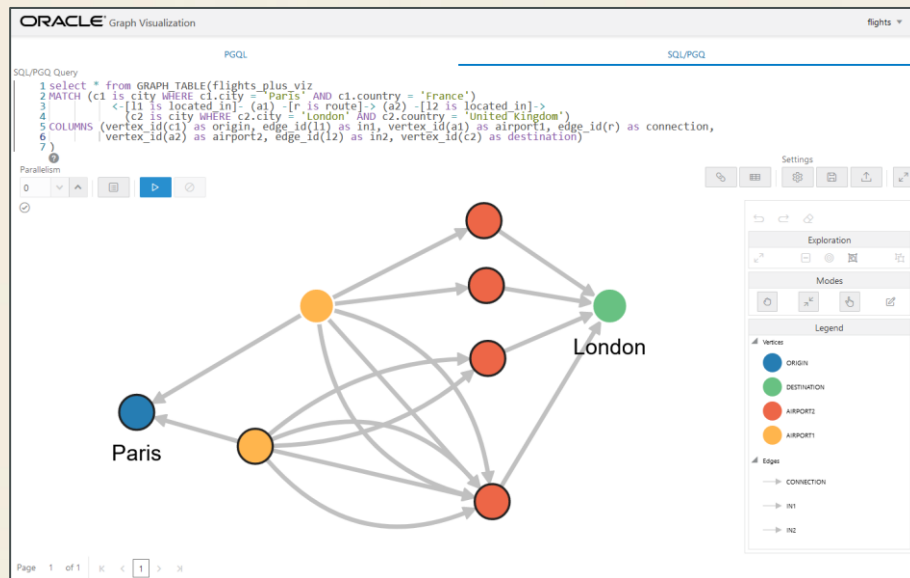
All your existing tools work with graphs

Specific support in

- SQL Developer
- SQLcl
- Graph Visualization Tool
- Apex (Plug-in)

SQL-based graphs can be consumed by Graph Server

- Advanced queries, graph algorithms



# Demo

## Property graphs in Apex



Graphs offer a different view on your data

With Oracle 23c you can use your existing tools to work with graphs

Oracle Graph is the graph database for the enterprise





ORACLE  
CloudWorld

Thank you

For more information on Oracle Graph  
go to [oracle.com/goto/graph](https://oracle.com/goto/graph)

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