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Intelligente Suche mit Wissensgraphen und LLMs

Graph RAG: Bring the Power of Graphs to Generative AI

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Oracle Database Product Management
16.-17. Juni 2025 | Wien

Safe harbor statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, timing, and pricing of any features or functionality described for Oracle's products may change and remains at the sole discretion of Oracle Corporation.

As of tomorrow, scripts and data can be found here:
github.com/karinpatenge/events/tree/main/2025/06_AOUG

The next 40 mins at a glance

Graphs
A brief intro

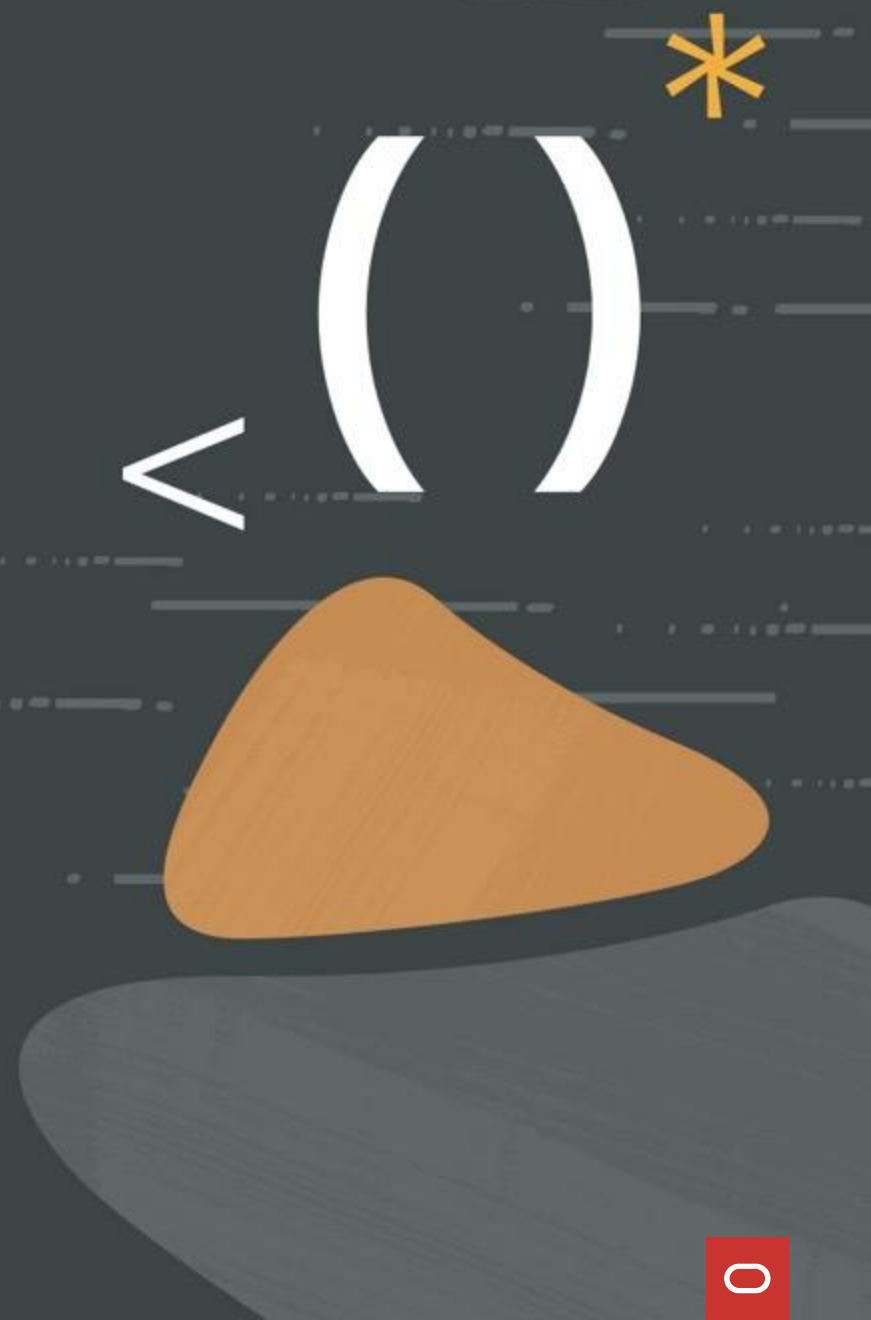
GenAI
Chatting with your DB

RAG
Briefly explained

Graph RAG
A brief intro

Graph RAG
Examples

A Brief Intro to Graphs

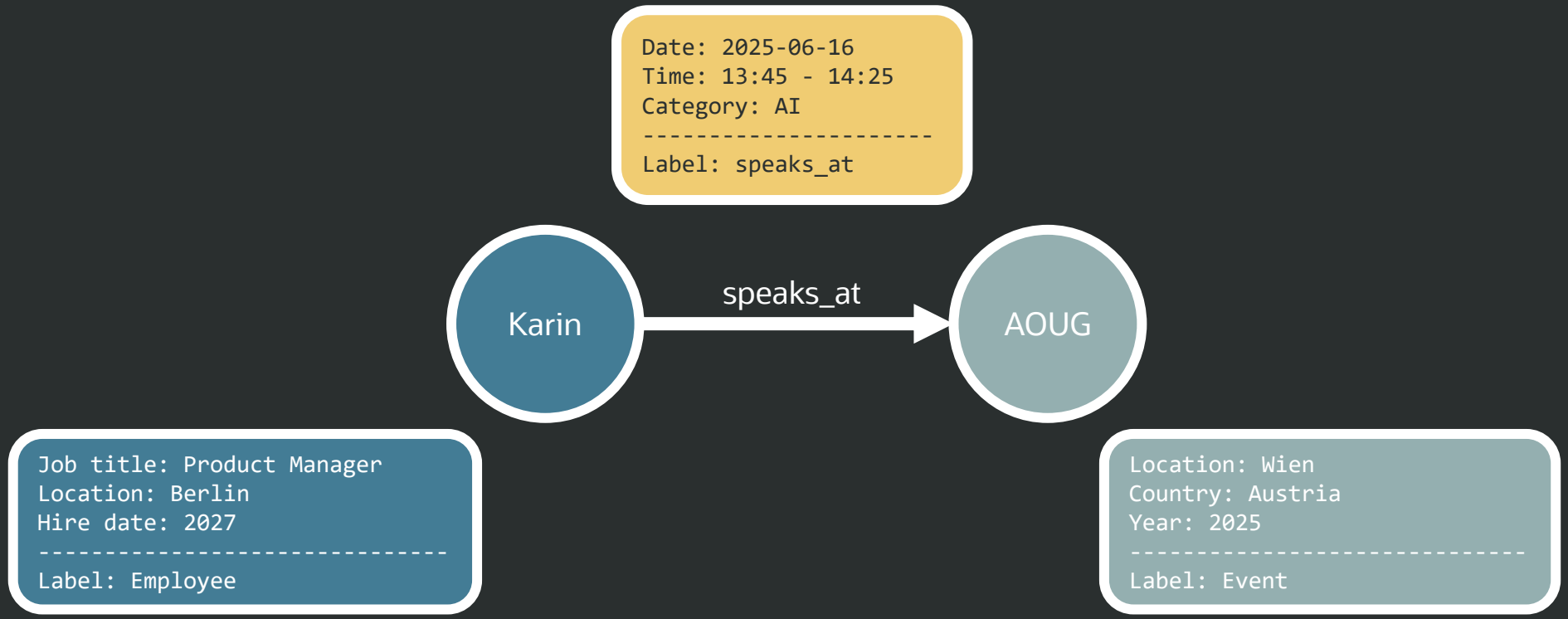


What is a graph?

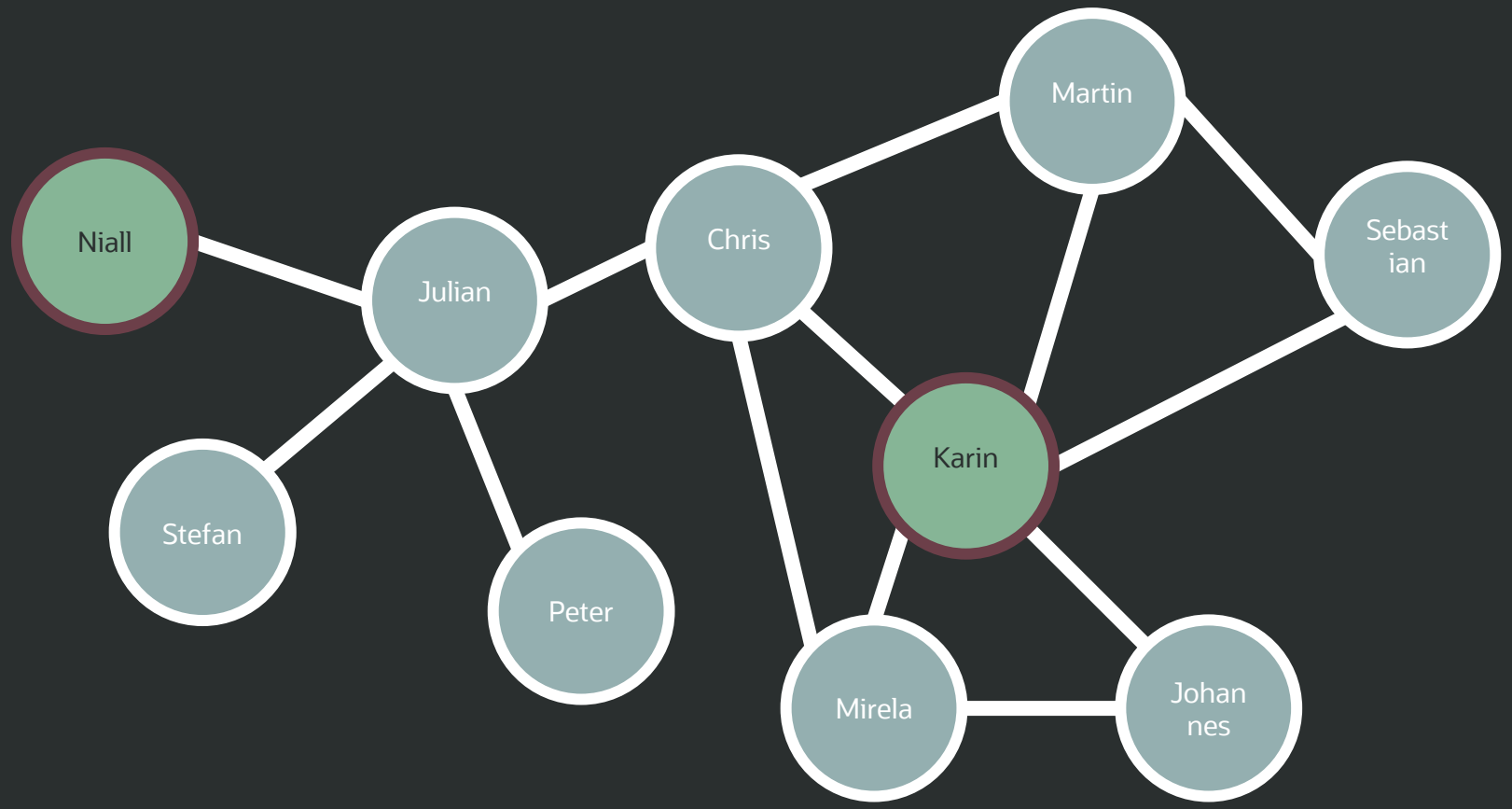
Nodes are also known as vertices.
Edges are also known as relationships or connections.

A Representation of Connections between Entities

Attributed with Properties and Labels

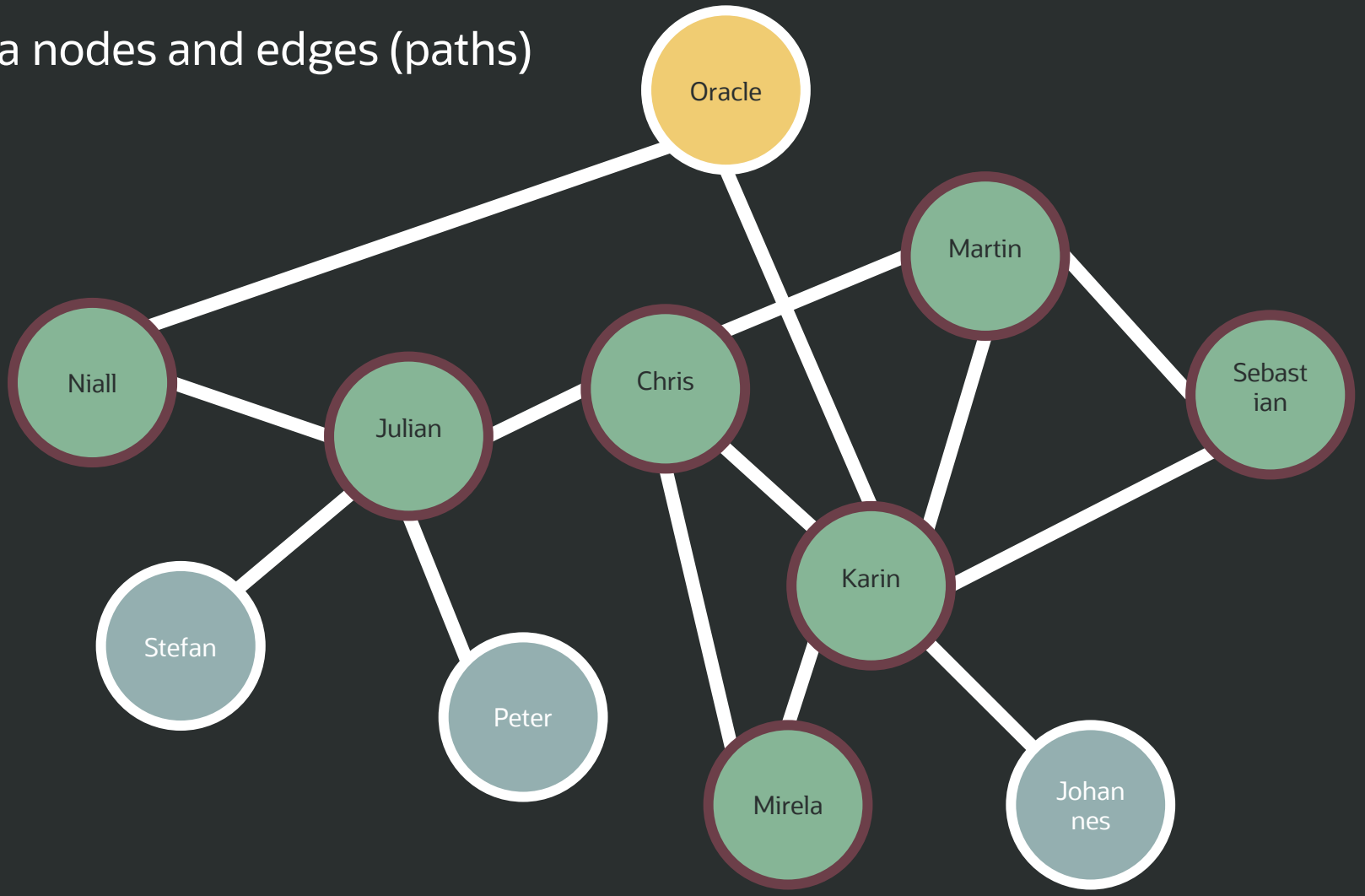


Am I connected to Niall?

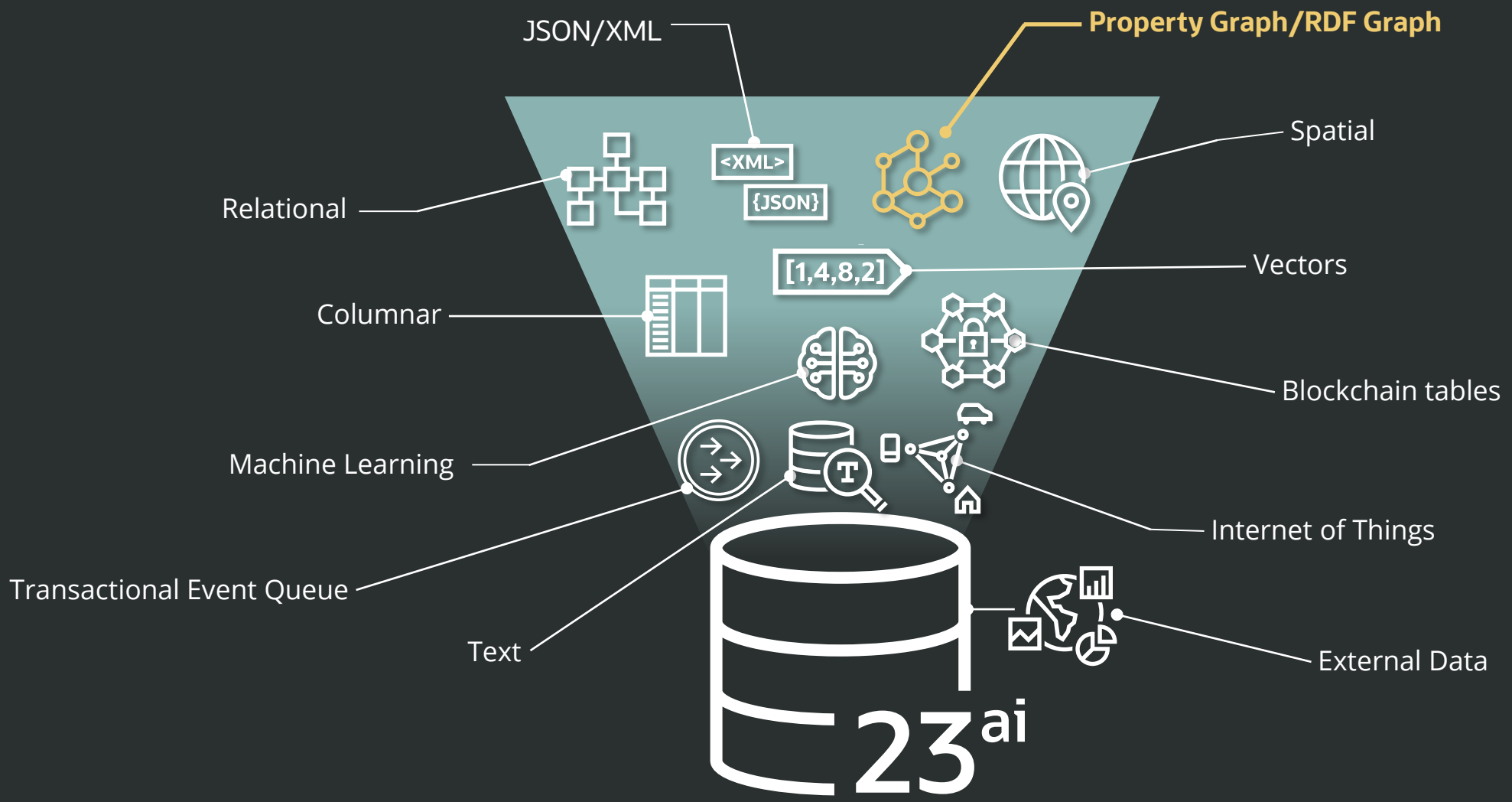


Yes, I am!

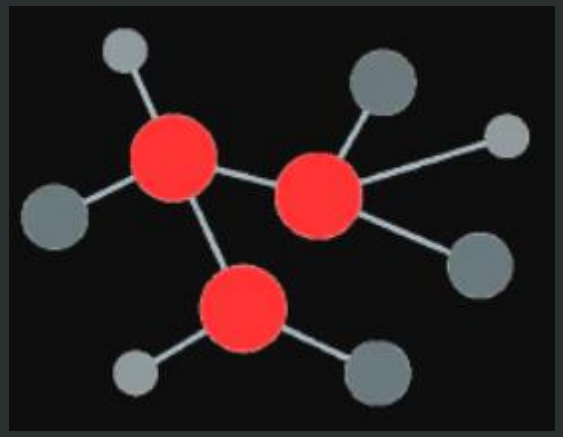
Connected via nodes and edges (paths)



How are Graphs connected to the Oracle Database?

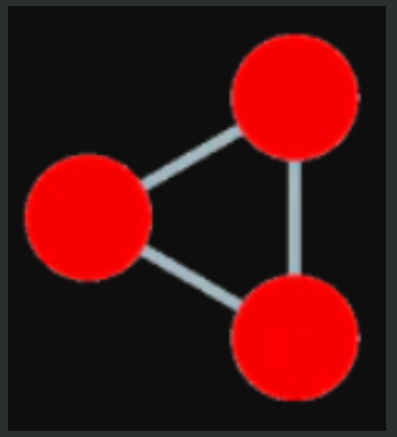


The Oracle Database as Graph Database



(Labeled) Property Graphs

- Generic graph model
- Since Oracle Database version 11.2
- Keywords: Graph Pattern-Matching, Graph Algorithms, Graph Machine Learning
- Query Languages:
  - Native: PGQL (pgql-lang.org)
  - ISO Standard: SQL/PGQ implemented in 23ai

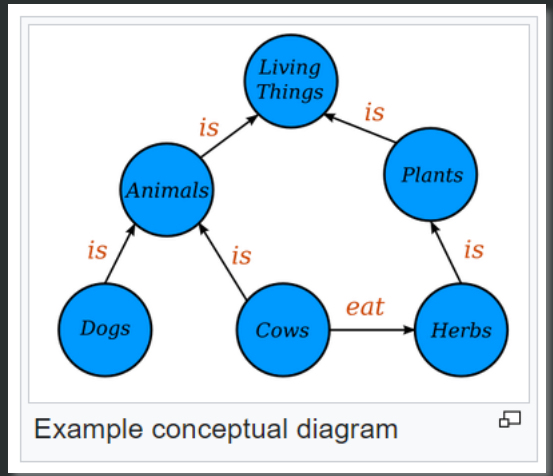


RDF Graphs

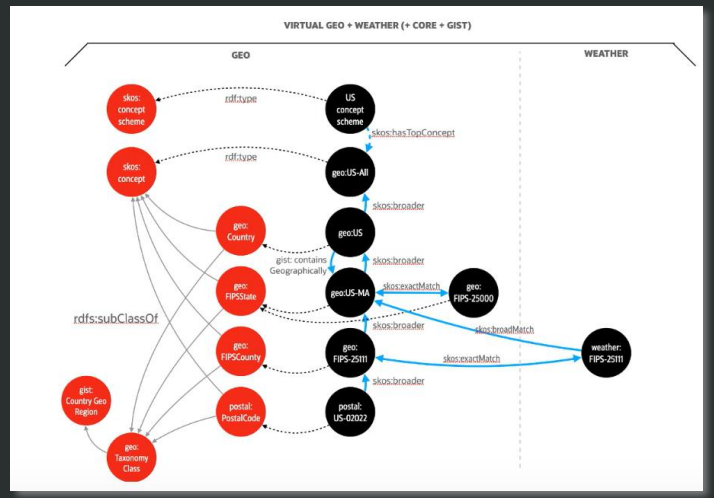
- Specialized, W3C Standards-based graph model
- Since Oracle Database version 10.2
- Keywords: Semantic Webs, Triples (Quads), Linked (Open) Data, RDF, RDFS, OWL, Ontologies, Vocabularies, Inferencing/Reasoning
- Query Language:
  - W3C Standard: SPARQL (www.w3.org/TR/sparql12-query/)
  - Native: SEM_MATCH embedding SPARQL

Knowledge Graphs

*"In knowledge representation and reasoning, a **knowledge graph** is a knowledge base that uses a graph-structured data model or topology to represent and operate on data. Knowledge graphs are often used to store interlinked descriptions of entities – objects, events, situations or abstract concepts – while also encoding the free-form semantics or relationships underlying these entities."*



Source (text and image on the right side):
en.wikipedia.org/wiki/Knowledge_graph



www.youtube.com/watch?v=RlyHAuvx93M

Both Graph Models are in use for Knowledge Graphs !

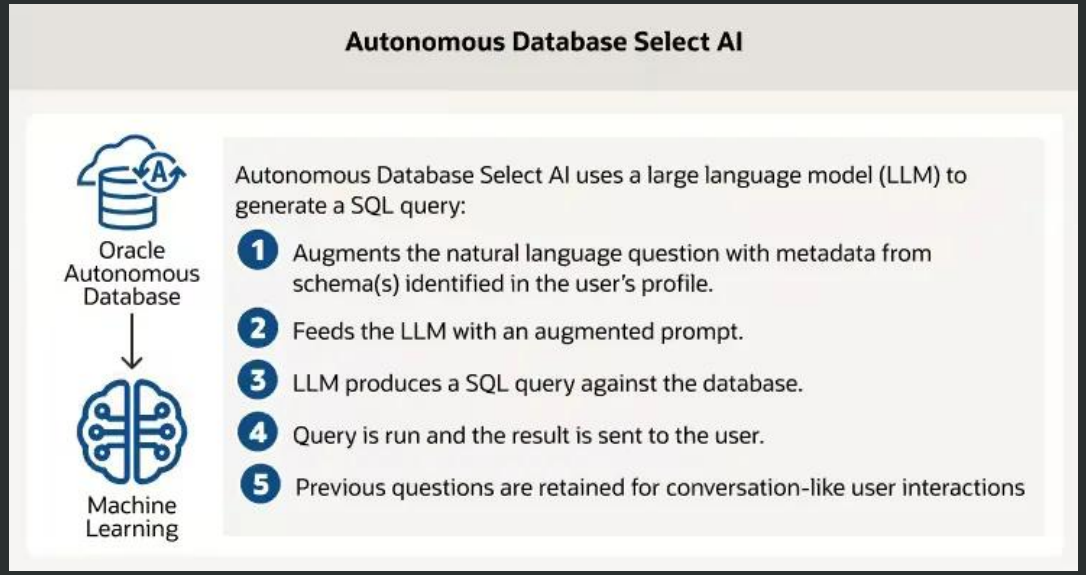
Generative AI

Chatting with your Oracle Database 23ai

Use Natural Language to Query Data (NL2SQL)

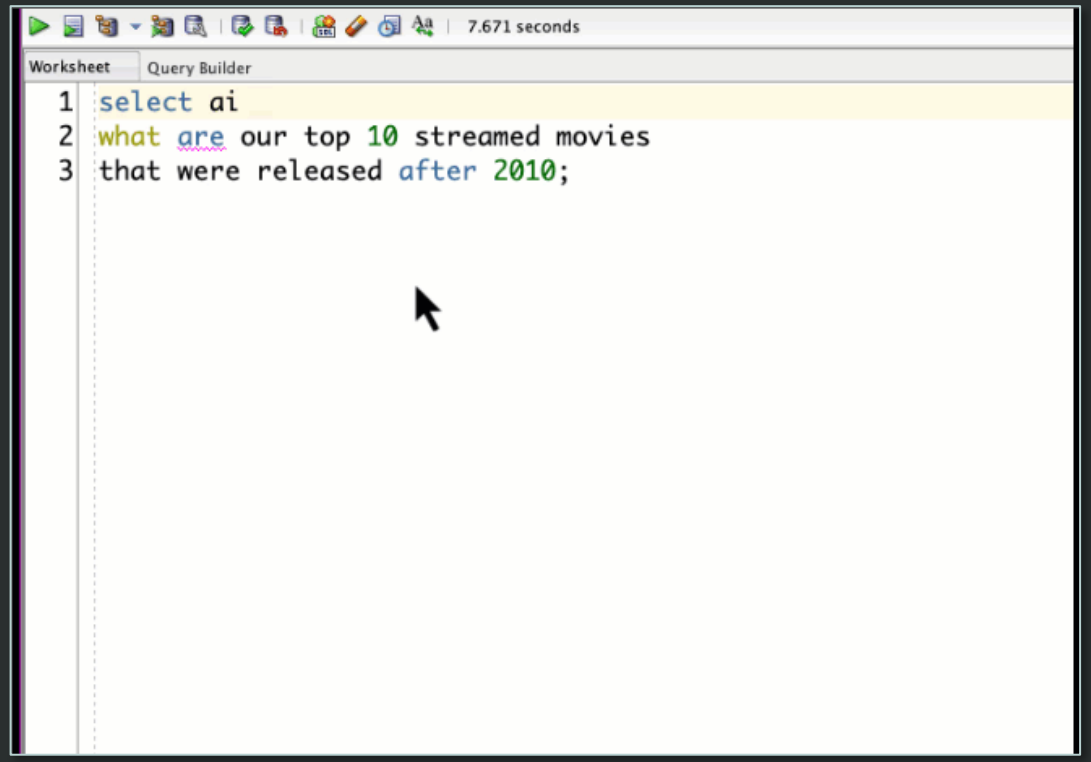
Get Responses using Generative AI

SELECT AI Actions	
runsql	Return the SQL result set
showsql	Return the generated SQL
explainsql	Explain the generated SQL
showprompt	Display the generated prompt
narrate	Return a conversational result
chat	General AI chat – passthrough to the LLM



SQL Generation with SELECT AI

- Use natural language to query data with the help of LLMs
- Increase application developer productivity
- Enable non-technical users to query information from their database
- Invoke from SQL command line and PL/SQL function
- Inherit security and authentication of the database



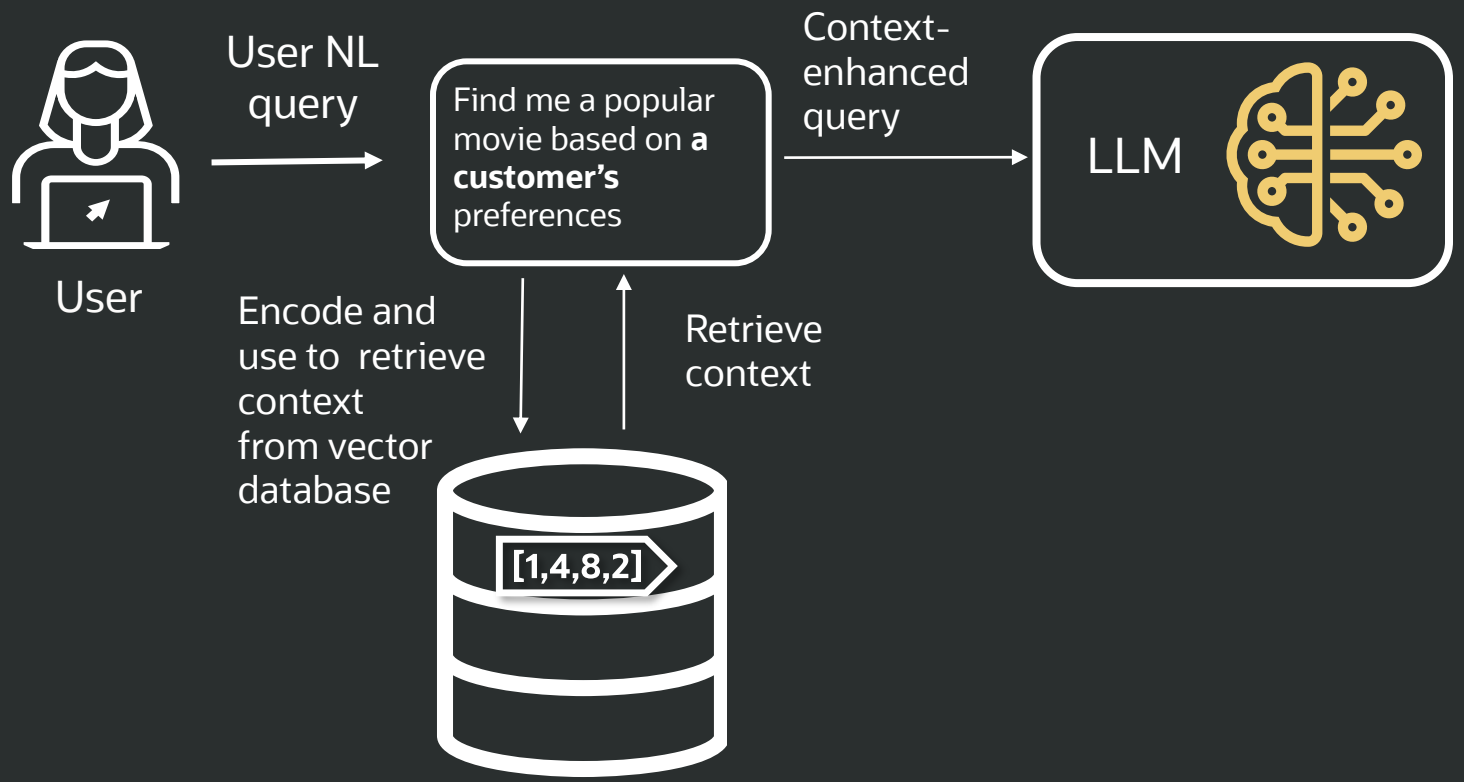
Try it out!

Oracle LiveLabs: Chat with Your Data in Autonomous Database Using Select AI

Retrieval Augmented Generation (aka RAG)

A brief overview

Enhance Queries with Data in the Database



- Use latest and private data from a database to provide context to LLM
- Typically use vector search to find matching data in a database to provide as context to an LLM
  - Create embeddings for data and store as vectors in a vector database
  - Vectorize user's natural language query and match with stored vectors
  - Augment user query with top matches from the database

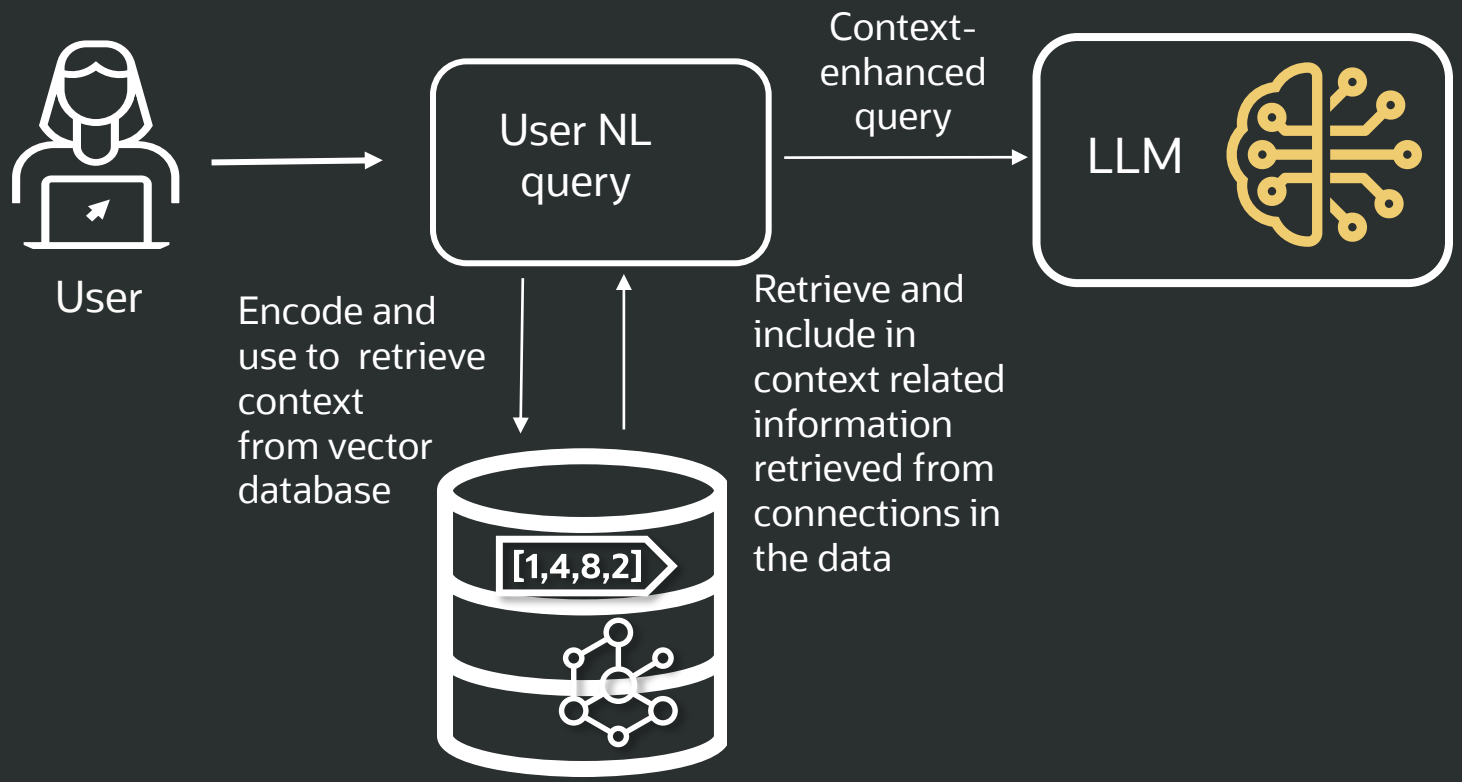
Try it out: livelabs.oracle.com/pls/apex/r/dbpm/livelabs/view-workshop?wid=4114

Graph RAG

Going a step further

Enhance Queries with Connections in Data

Vectors & Graphs are even better together



Graph RAG

Benefits of RAG

\+

Connections in Data

blogs.oracle.com/database/post/graph-rag-bring-the-power-of-graphs-to-generative-ai

References to Graph RAG and Knowledge Graphs

Neo4j
https://www.neo4j.com › genai

Ground Your LLM in Graph - RAG and Knowledge Graphs

Unify knowledge graphs, vector search, & LLMs for accurate, efficient chatbot interactions. Store structured and unstructured text from multiple sources within a single database.

graphrag.com
https://graphrag.com · Diese Seite übersetzen

GraphRAG with a Knowledge Graph | GraphRAG

What is a **Knowledge Graph**? Sections. Concepts Learn key GraphRAG concepts and how they fit together.

Intro to Knowledge Graphs | Intro to GraphRAG | Basic Retriever

Ontotext
https://www.ontotext.com › wha... · Diese Seite übersetzen

What is Graph RAG | Ontotext Fundamentals

We can summarize several varieties of **Graph RAG**, depending on the nature of the questions, the domain and information in the **knowledge graph** at hand: Graph ...

Medium · Steve Hedden
Ca. 1800 „Gefällt mir"-Angaben · vor 9 Monaten

How to Implement Graph RAG Using Knowledge ...

In this post, I will focus on one popular way KGs and LLMs are being used together: RAG using a **knowledge graph**, sometimes called **Graph RAG**, GraphRAG, GRAG, or ...

graphrag.com
https://graphrag.com › concepts · Diese Seite übersetzen

Intro to GraphRAG

06.05.2025 — GraphRAG is Retrieval Augmented Generation (RAG) using a **Knowledge Graph**. Have you ever stumbled upon the term GraphRAG while diving into ...

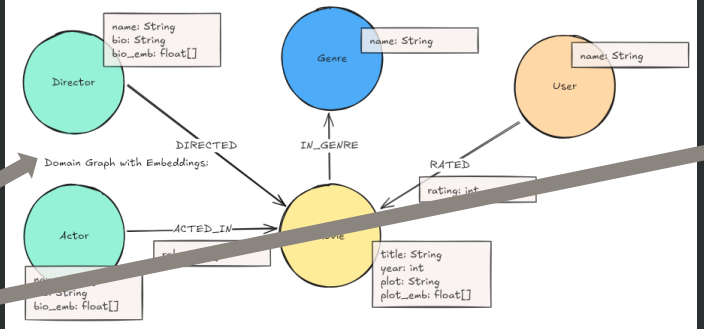
Source: google.com

Domain Graph

A Domain Graph contains Business Domain Knowledge. It contains real-world entities and the relationships between them. Frequently used example Domain Graphs are the Movie Graph or the Northwind Graph.

Since Domain Graphs will look different based on the underlying domain, it isn't possible to provide a blueprint of how one would look. Just keep in mind that they contain structured data adhering to a schema.

Providing the information contained in a Domain Graph within a question-answer application where natural language queries lead to (deterministic) structured retrieval of data can be executed in several ways.



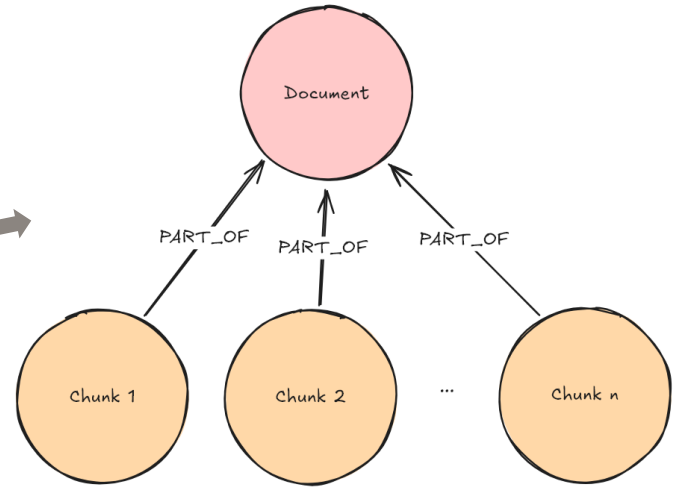
Source: graphrag.com/reference/knowledge-graph/domain-graph/

Lexical Graph

Context

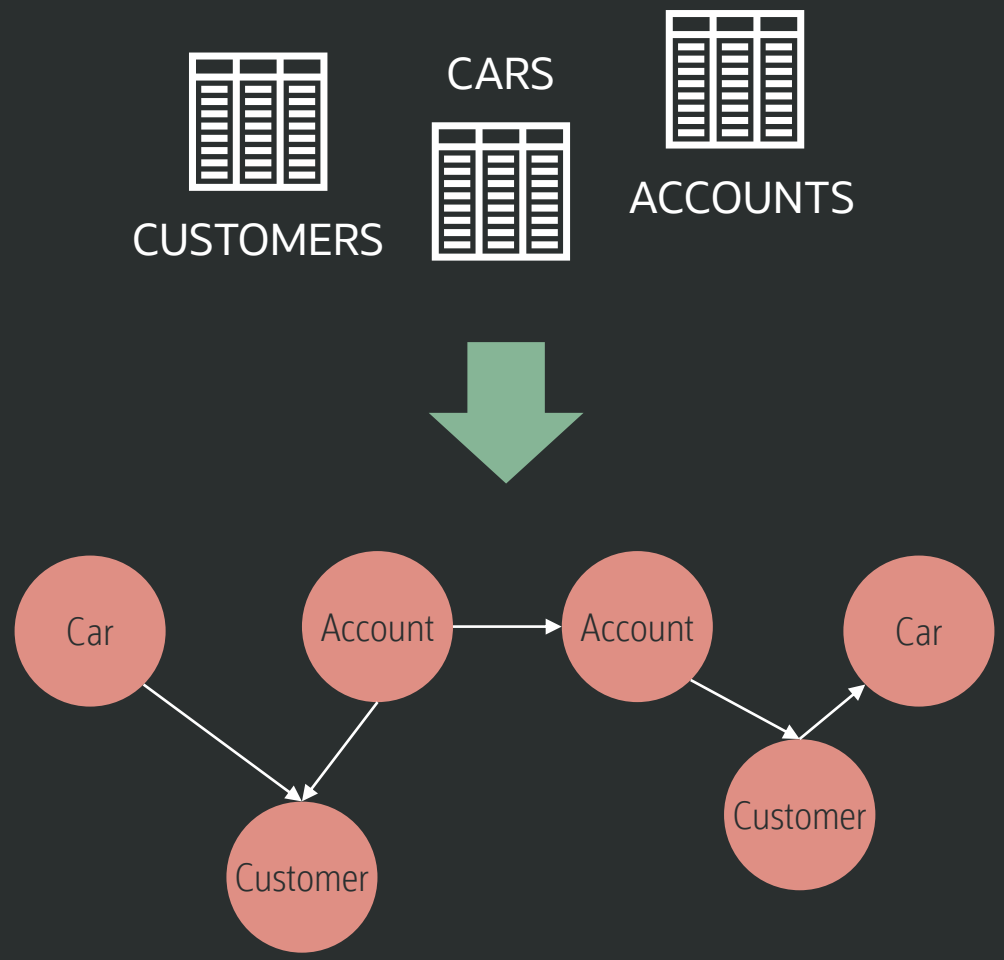
It is useful to chunk large documents into smaller pieces for creating embeddings. An embedding is a text's semantic representation capturing the meaning of what the text is about. If the given text is long and contains too many diverse subjects, the informative value of its embedding deteriorates.

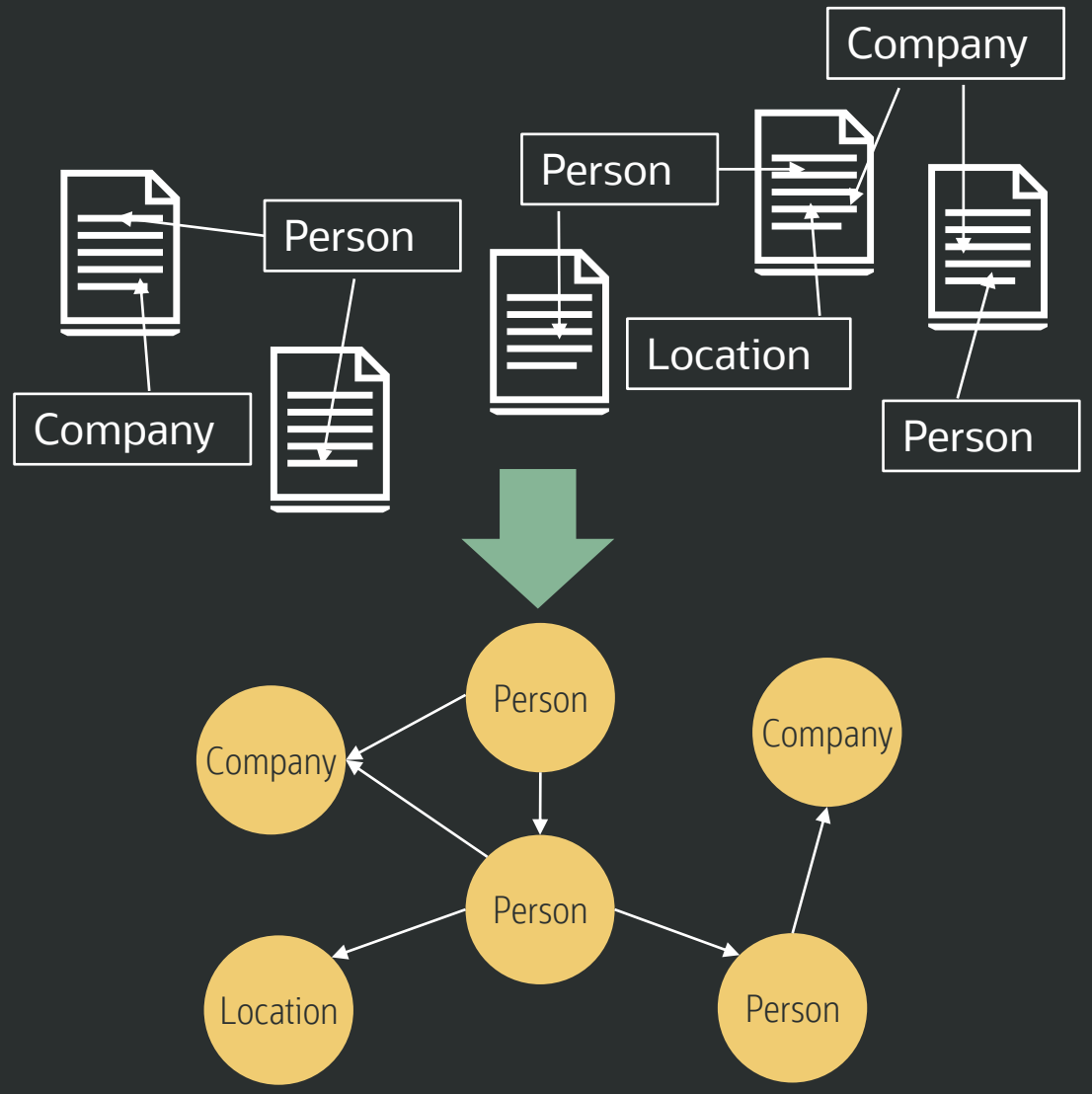
Graph Pattern



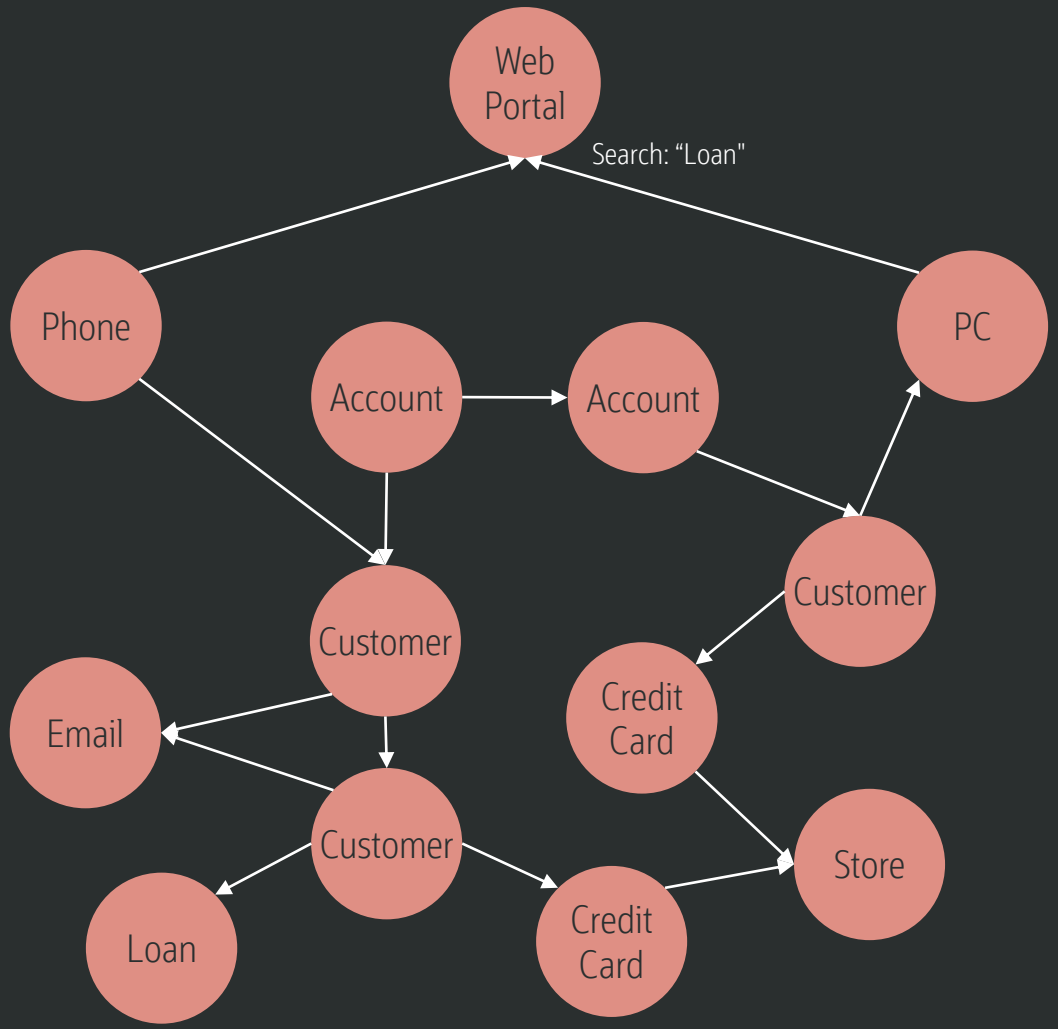
Source: graphrag.com/reference/knowledge-graph/lexical-graph/

Where do Graphs come from?

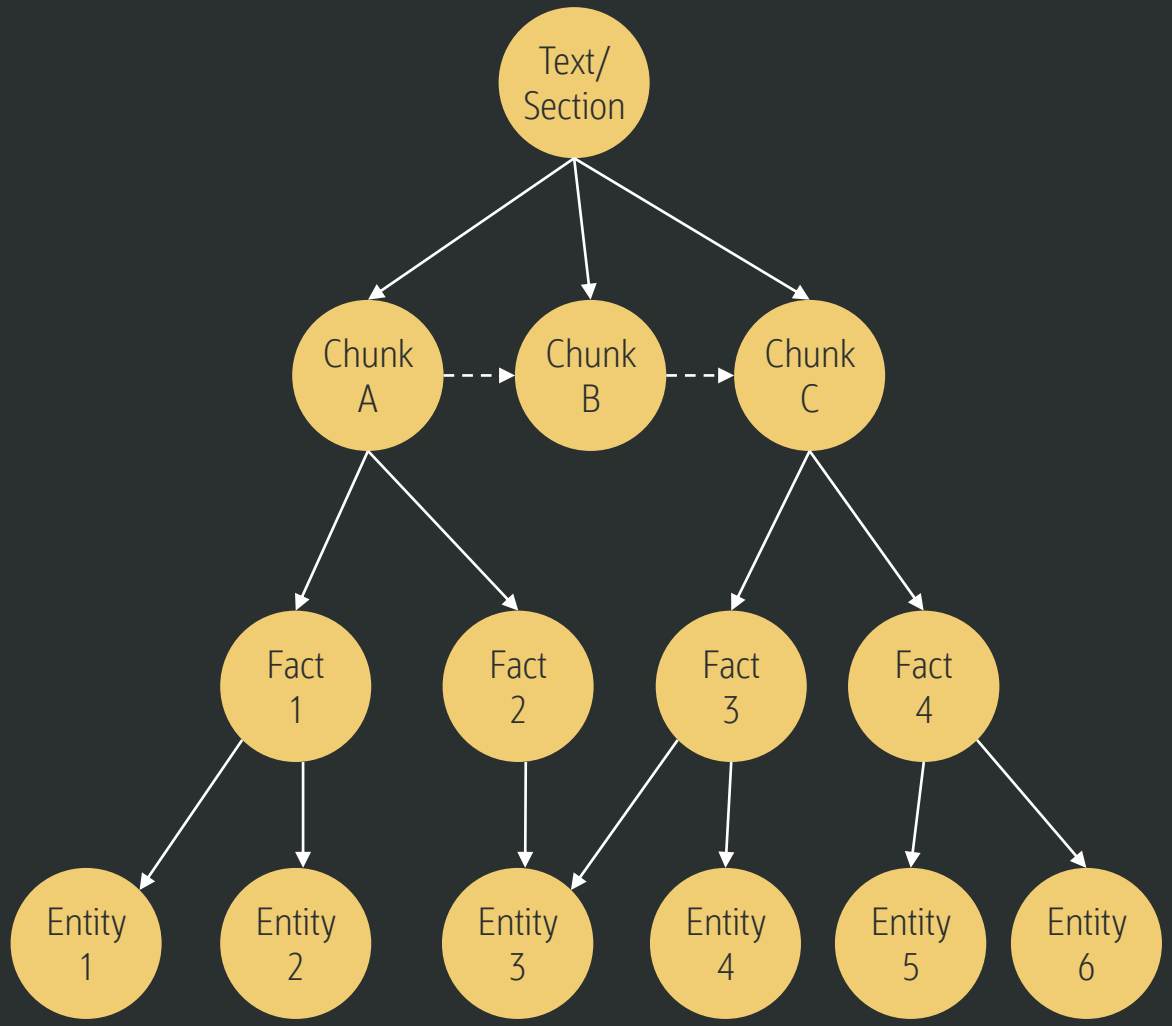




Graphs extracted from tables or documents



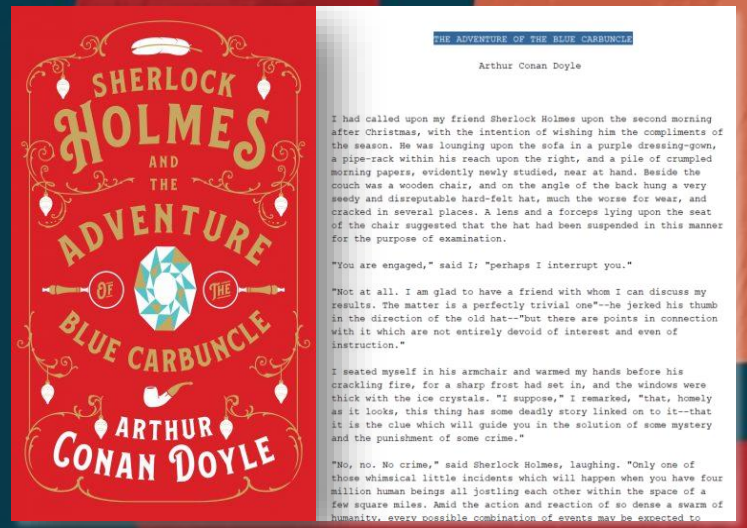
Domain graph



Lexical graph

Demo 1

Build a **Lexical Graph** from text and use it to enrich the context used by the LLM for even better responses



Model used: Tiny BERT (Bidirectional Encoder Representations from Transformers)

Source:
apexapps.oracle.com/pls/apex/r/dbpm/livelabs/view-workshop?wid=4174

Kudos to Eduard Cuba

The Adventure of the Blue Carbuncle

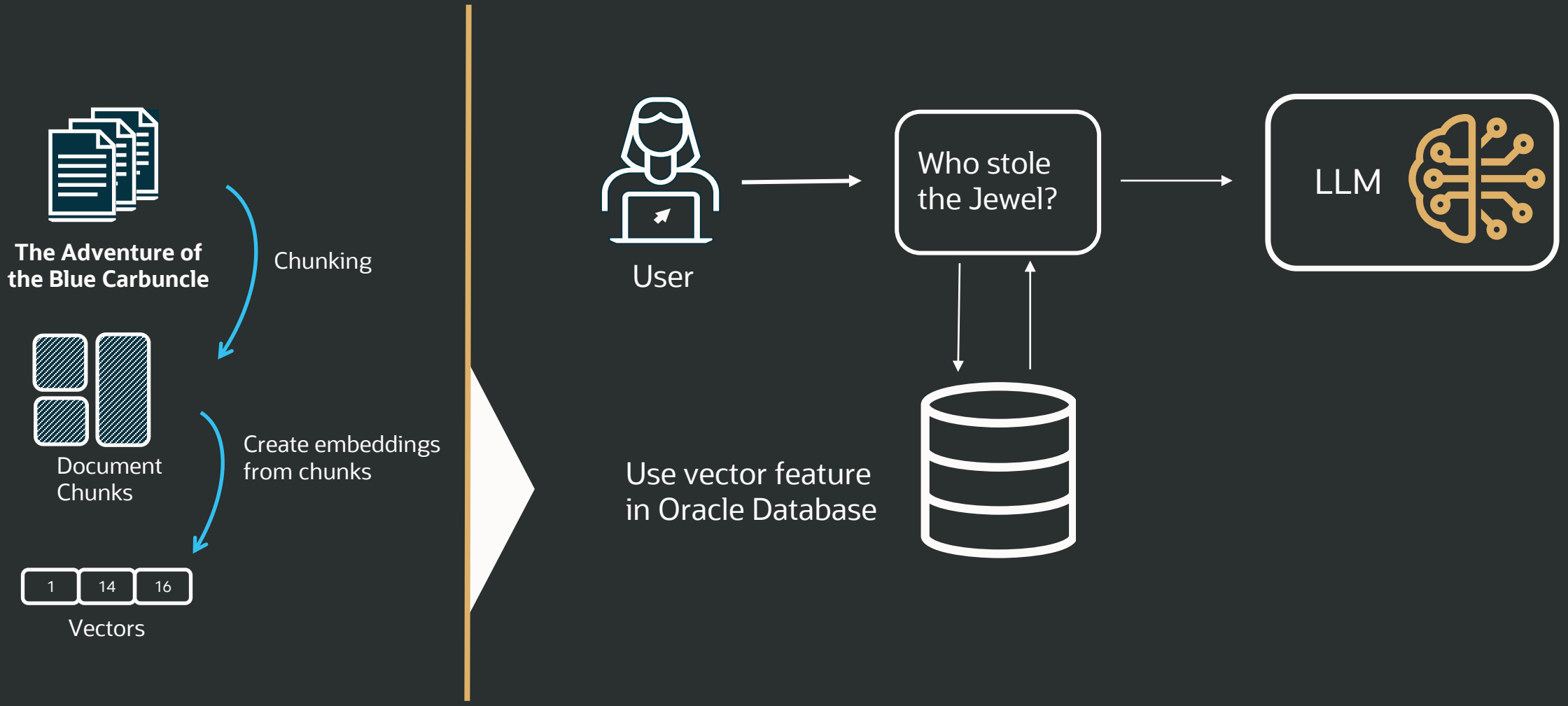
I had called upon my friend Sherlock Holmes upon the second morning after Christmas, with the intention of wishing him the compliments of the season. He was lounging upon the sofa in a purple dressing-gown, a pipe-rack within his reach upon the right, and a pile of crumpled morning papers, evidently newly studied, near at hand. Beside the couch was a wooden chair, and on the angle of the back hung a very seedy and disreputable hard-felt hat, much the worse for wear, and cracked in several places. A lens and a forceps lying upon the seat of the chair suggested that the hat had been suspended in this manner for the purpose of examination.

"You are engaged," said I; "perhaps I interrupt you."

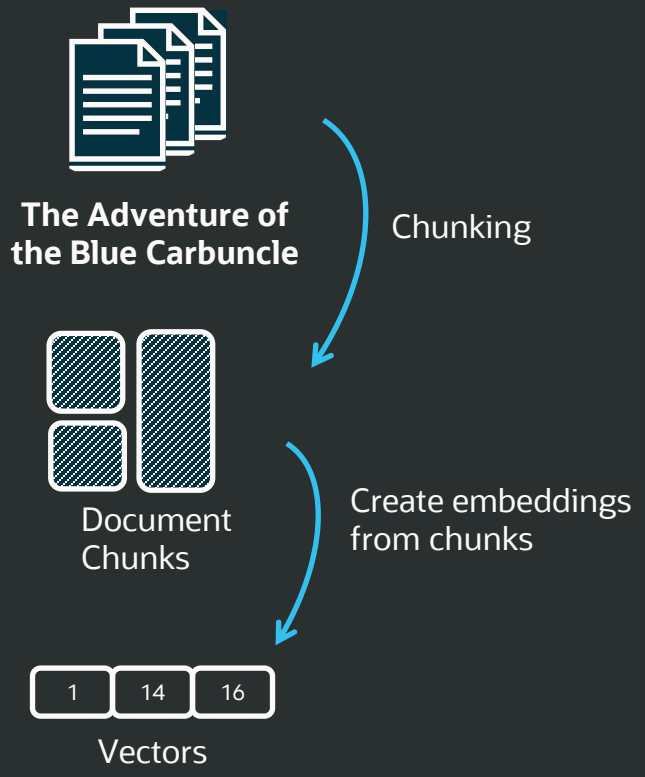
"Not at all. I am glad to have a friend with whom I can discuss my results. The matter is a perfectly trivial one" -- he jerked his thumb in the direction of the old hat --"but there are points in connection with it which are not entirely devoid of interest and even of instruction."

I seated myself in his armchair and warmed my hands before his crackling fire, for a sharp frost had set in, and the windows were thick with the ice crystals. "I suppose," I remarked, "that, homely as it looks, this thing has some deadly story linked on to it -- that it is the clew which will guide you in the solution of some mystery and the punishment of some crime."

Create Text Chunks and Vector Embeddings for RAG



Query Text Chunks using Vector Search



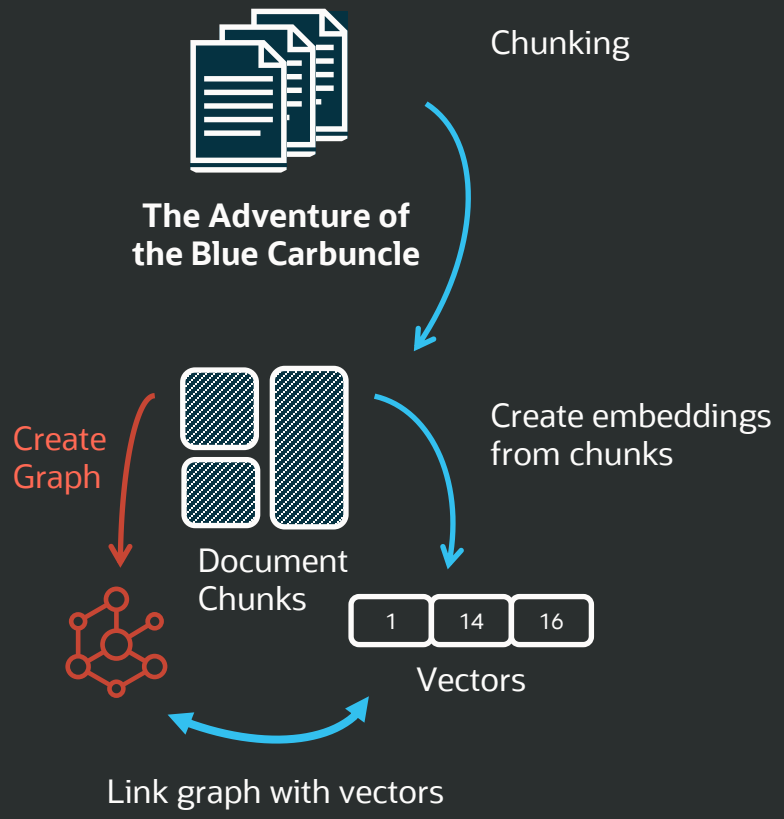
lady's jewel-case. The evidence against him was so strong that the case has been referred to the Assizes.

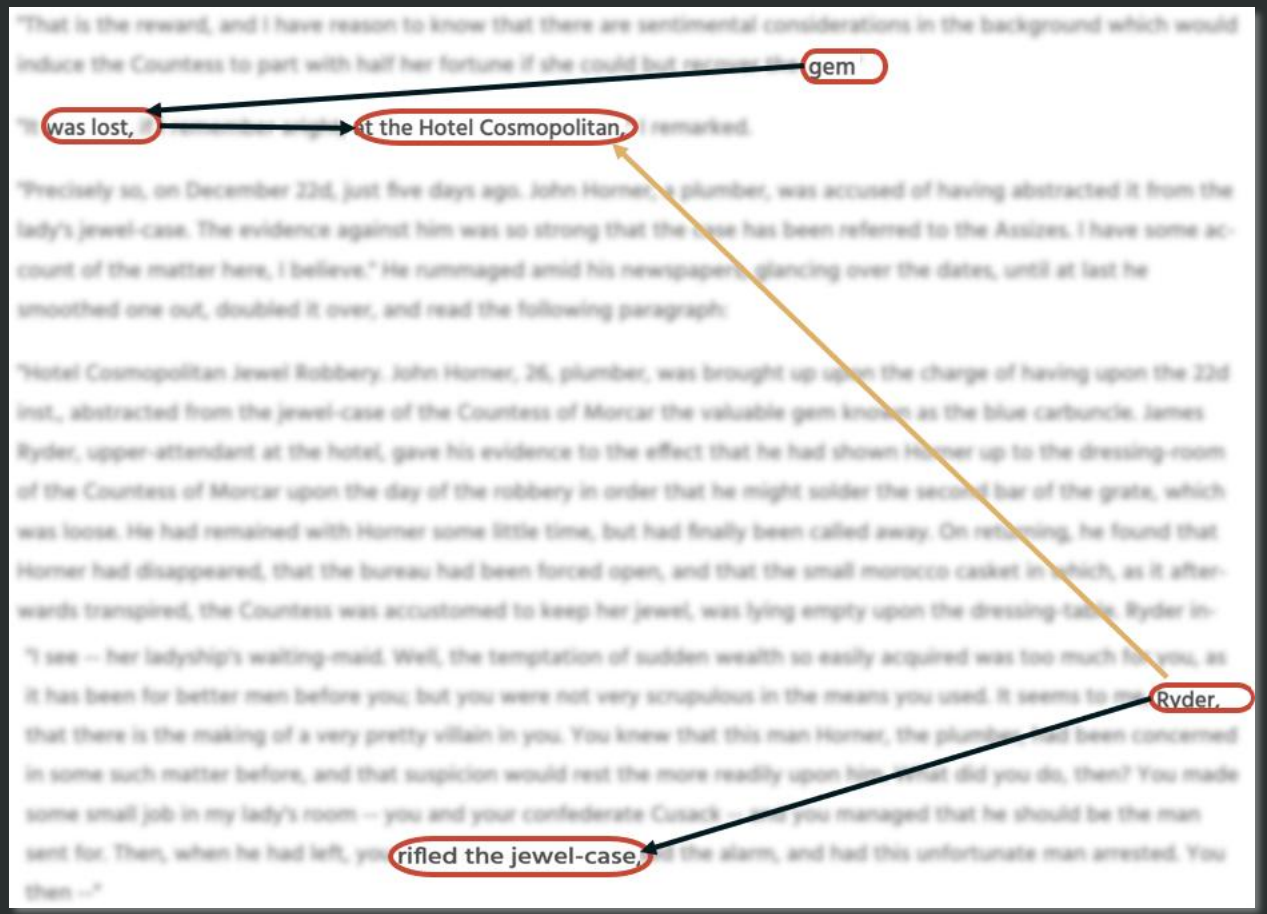
John Horner, 26, plumber, was brought up upon the charge of having upon the 22d inst., abstracted from the jewel-case of the Countess of Morcar the valuable gem known as the blue carbuncle.

Question: **Who stole the Jewel?**

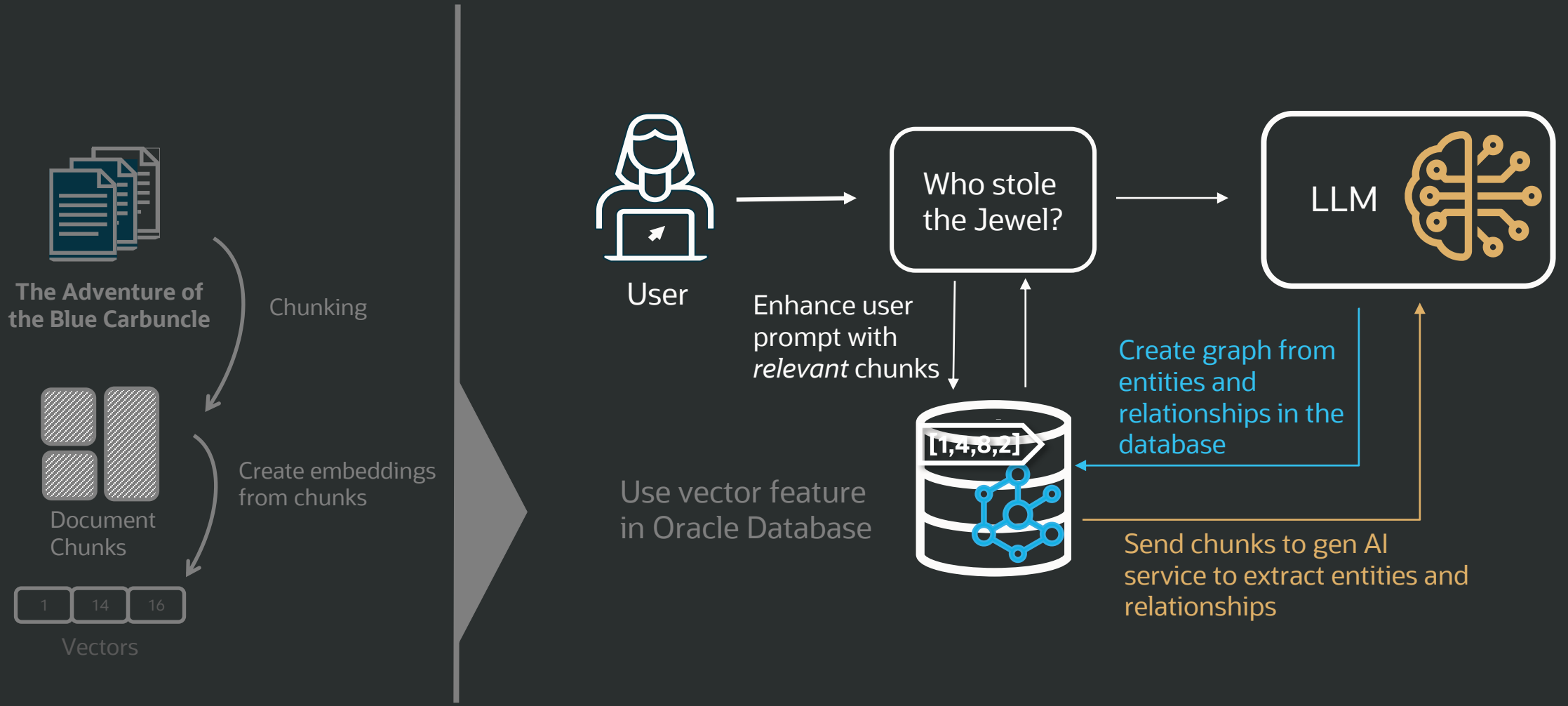
Answer: **The jewel was stolen by** John Horner, a **plumber, who was accused of ...**

Extract a Graph and Link with Text Chunks





Extract Entities and Relationships for each Text Chunk



Graphs Connect Entities Across Text Chunks

Graph RAG

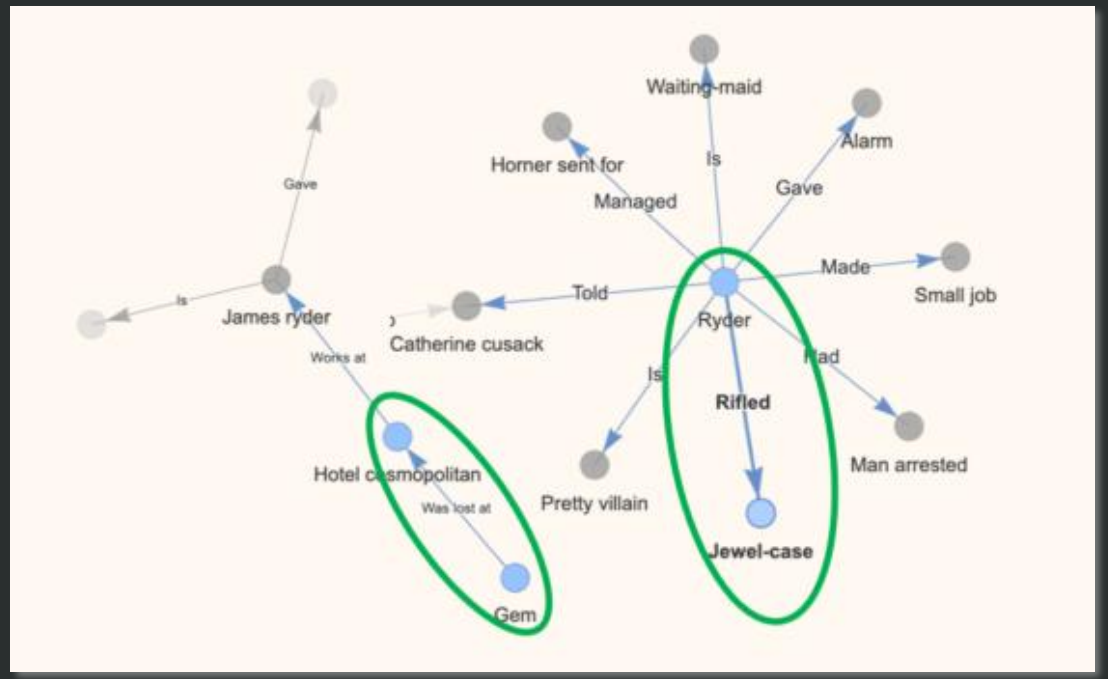
1. Find entities related to “Who Stole the Jewel”?
2. Retrieve text chunks associated with those entities

   The jewel robbery -> LOCATION_OF -> Hotel Cosmopolitan

   Ryder -> EMPLOYED_BY -> Hotel Cosmopolitan

   Ryder -> RIFLED -> The jewel case

Answer: James Ryder, the hotel attendant, is implicated in the theft of the jewel.



Demo 2

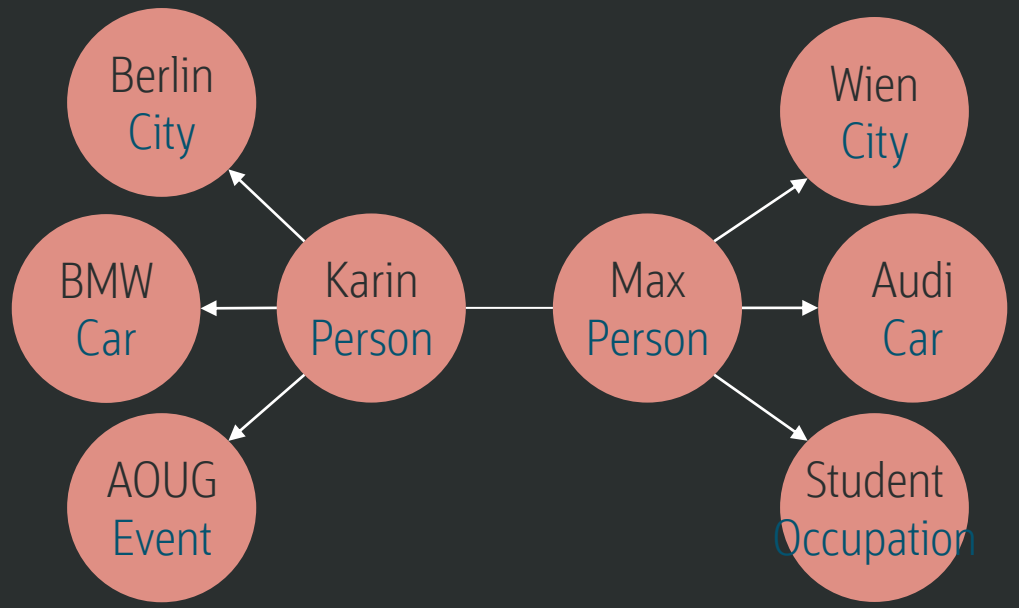
GraphRAG using Langchain and Oracle Graph on Oracle Database 23ai

Source:
medium.com/oracledevs/graphrag-using-langchain-and-oracle-graph-on-oracle-database-23ai-part-1-dc76b48a4ca1

Kudos to Rahul Tasker

Benefits of Graph RAG

- Graphs contain explicit representations of connections in data
- They take the semantics into account
- Searching data is based on graph traversal



Compared to vectors:

- Opaque data structure
- Different distance metrics
- Search based on proximity

Karin: `[0.273, 0.165, 0.268, 0.183,…]`

Max: `[0.734, 0.707, 0.413, 0.229,…]`

Summary

GraphRAG produces more accurate, explainable results than baseline RAG

Using Oracle 23ai and Oracle Graph simplifies development of GraphRAG workflows

GraphRAG as a technique offers huge potential and is evolving rapidly

Vielen Dank !

Karin Patenge

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