

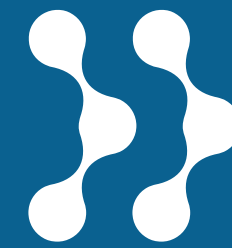


Agentic GraphRAG

AI's Logical Edge

Stephen Chin, VP of Developer Relations @ Neo4j
@steveonjava (linkedin, bsky, x, etc.)

GenAI Data Project Failures



Gartner Predicts **30% of
Generative AI Projects** Will
Be Abandoned After Proof
of Concept By End of 2025

Gartner®



Word Problem

“School Electives”

A school has an elective course choice of computer science, sports, or home economics. The computer science class has 36 students seated in a grid of desks. All the desks are occupied and none of the girls is sitting next to another girl. Also, none of the girls is sitting diagonally from another girl, but there is the maximum number of girls in the class this layout allows.

The teacher is a harsh grader and 75% of the students fail out of class. How many new students join the home economics course?

Word Problem: Part 1

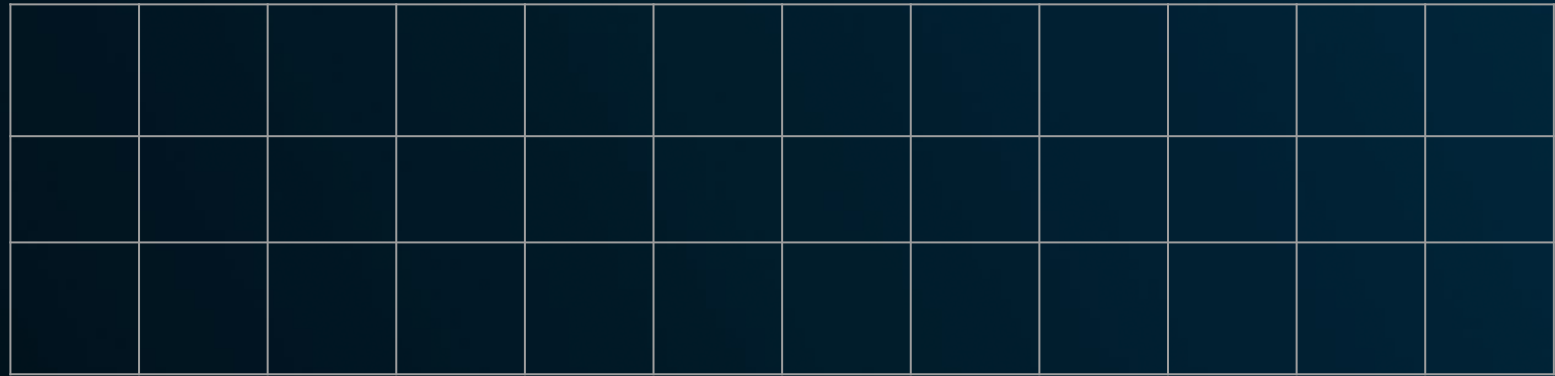
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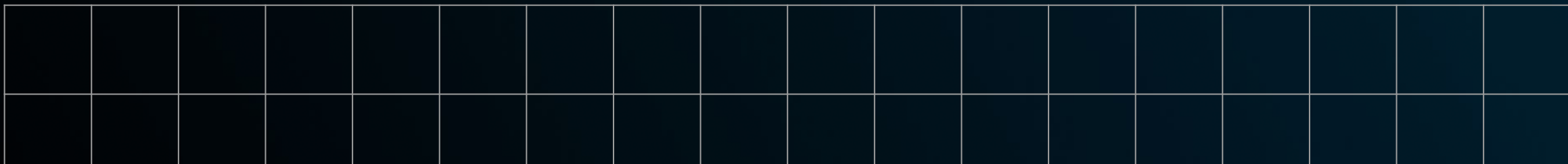
6x6



3x12



4x9



2x18

G		G		G	
G		G		G	
G		G		G	

6x6
G=9

G		G		G		G		G		G	
G		G		G		G		G		G	

3x12
G=12

G		G		G		G		G
G		G		G		G		G

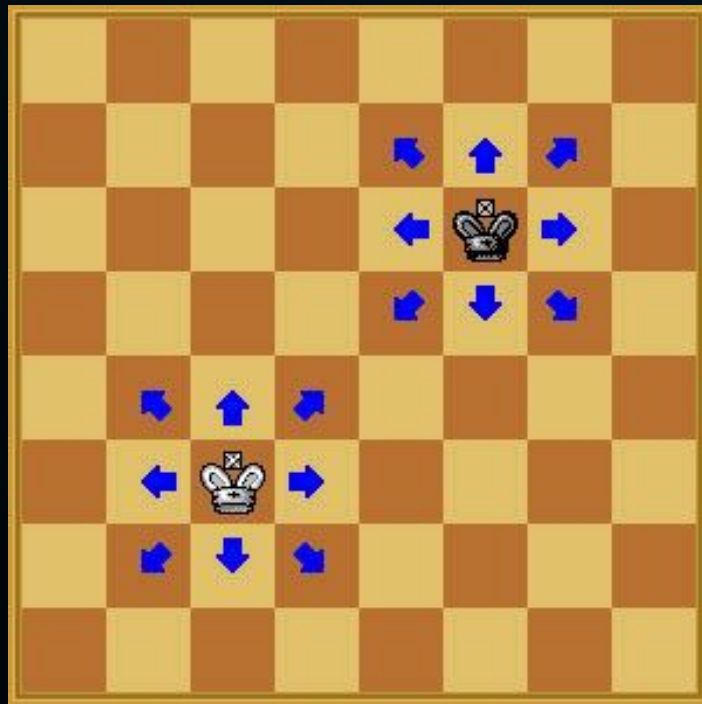
4x9
G=10

G		G		G		G		G		G		G		G		G	

2x18
G=9

OpenAI o3 Reasoning Response

(40 seconds):



***non-attacking
kings problem***

1. Determining the Maximum Number of Girls

The 36 students are arranged in a grid of desks (a 6×6 grid is most natural). The seating rule is that no two girls sit next to each other — not horizontally, vertically, or diagonally. This is equivalent to the “non-attacking kings” problem on a chessboard. In a 6×6 grid the maximum number of kings (or girls, here) you can place without any two “attacking” each other is given by placing them on every other row and every other column. For a 6×6 grid, one common optimal pattern is to place a girl at every position with both coordinates odd:

- Positions: (1,1), (1,3), (1,5); (3,1), (3,3), (3,5); (5,1), (5,3), (5,5).

This gives a total of 9 girls.

(The remaining $36 - 9 = 27$ students are boys.)



***Gives a total of
9 girls***

Word Problem: Part 2

“School Electives”

A school has an elective course choice of computer science, sports, or home economics. The computer science class has 36 students seated in a grid of desks. All the desks are occupied and none of the girls is sitting next to another girl. Also, none of the girls is sitting diagonally from another girl, but there is the maximum number of girls in the class this layout allows.

The teacher is a harsh grader and 75% of the students fail out of class. How many new students join the home economics course?

OpenAI o3 Reasoning Response (40 seconds):

2. Applying the Failure Rate

The teacher fails 75% of the students.
Out of 36 students:

$36 \times 0.75 = 27$ students fail

If we assume the failure rate applies uniformly (or proportionally) to both girls and boys, then the number of failing girls is:

$9 \times 0.75 = 6.75$

Since we can't have a fraction of a student, we interpret this as 7 girls failing (and 2 girls passing) so that the total failures come out right when paired with the boys. (Indeed, $27 \text{ boys} \times 0.75 = 20.25$, which we can assume rounds to 20, giving $7 + 20 = 27$ failures.)

3. Elective Options and Assignments

The school's elective choices are:

- Computer Science (the original course),
- Sports, and
- Home Economics.

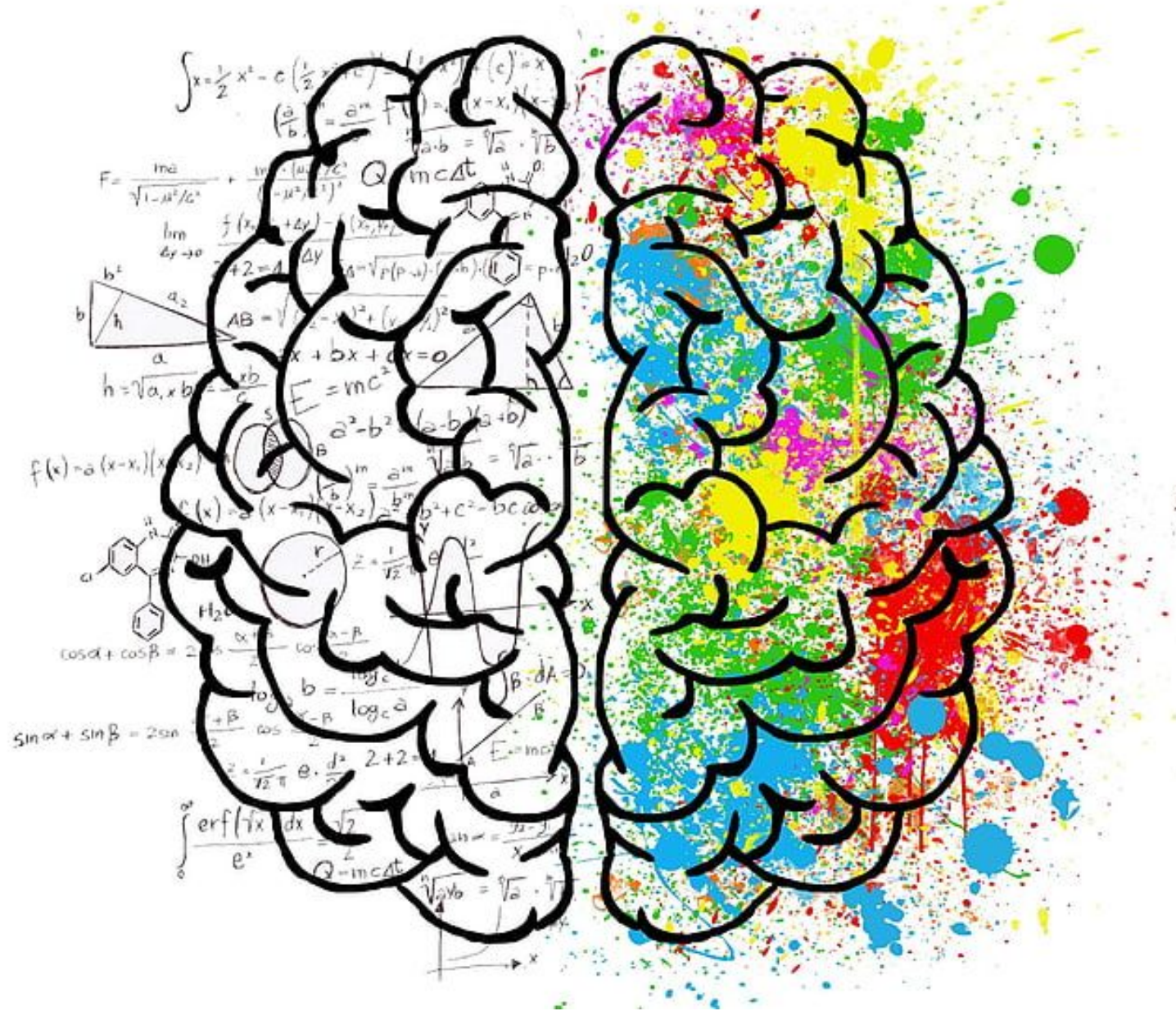
The problem context implies that when students fail the computer science class, they "move" to one of the other electives. Traditionally in these puzzles (and as in similar versions you may have seen) the idea is that girls are not inclined toward sports and so all failing girls go to home economics.

Thus, the failed girls (7 in number) join the home economics course.



LLMs Are Working with Only Half a Brain

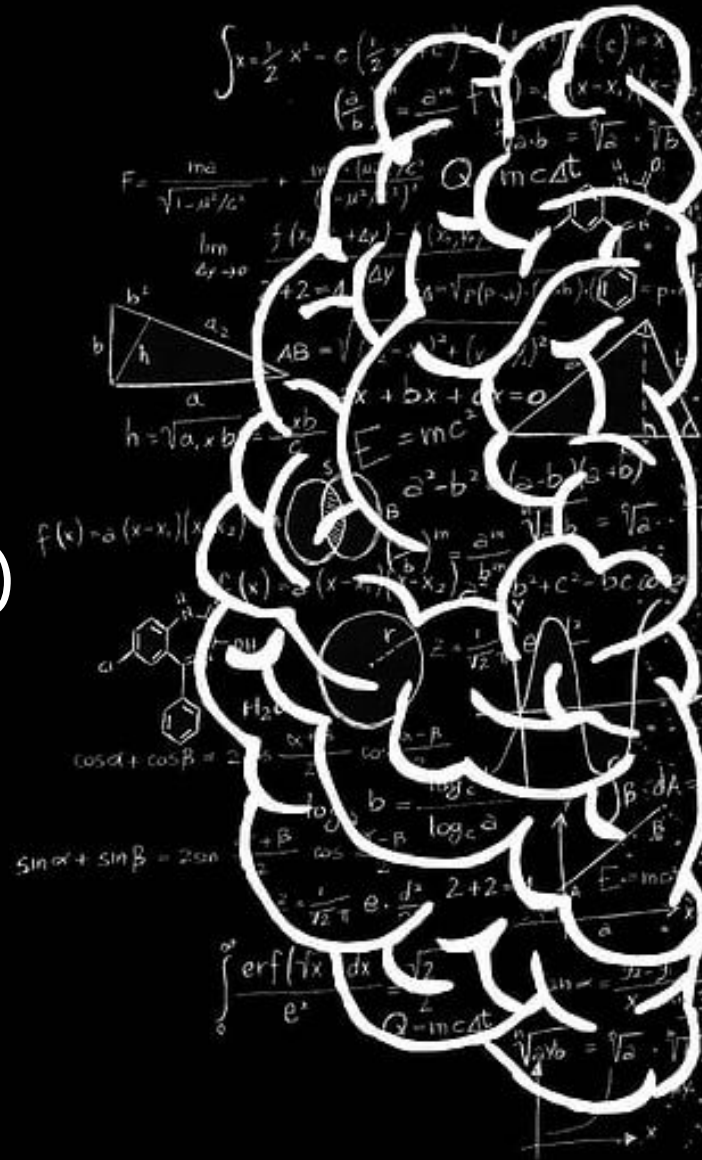
- logic
- sequencing
- linear thinking
- mathematics
- facts
- thinking in words



- imagination
- holistic thinking
- intuition
- arts
- rhythm
- nonverbal cues
- feelings visualization
- daydreaming

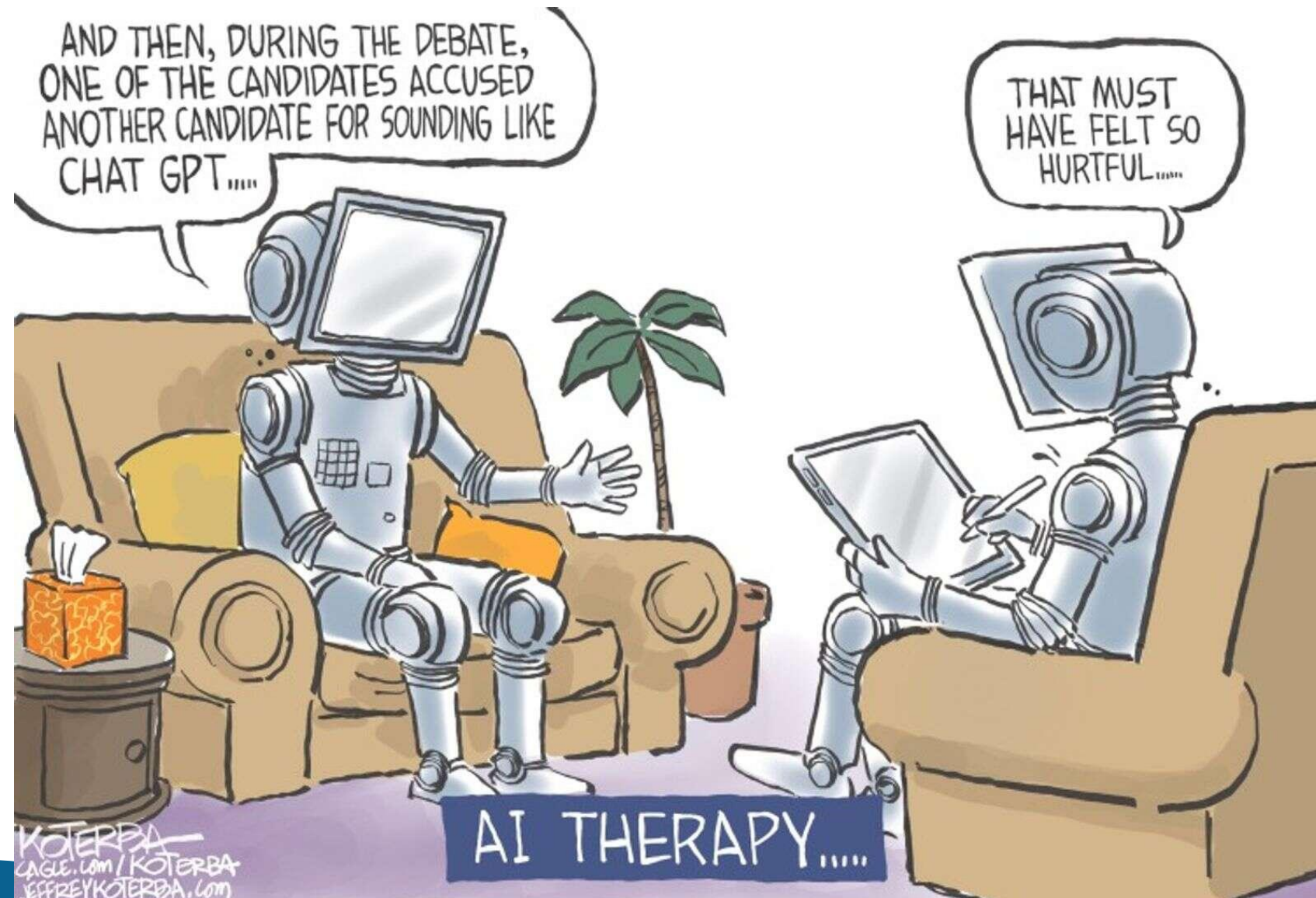
LLMs Are Working with Only Half a Brain

- ~~logic~~
- ~~sequencing~~
- ~~linear thinking~~
- ~~mathematics~~
- facts (trained only)
- ~~thinking in words~~



- imagination
- holistic thinking
- intuition
- arts
- rhythm
- nonverbal cues
- feelings visualization
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The Answer: AI Talking to AI



What is an Agent?



Agents are applications that use generative AI models to think and act towards goals

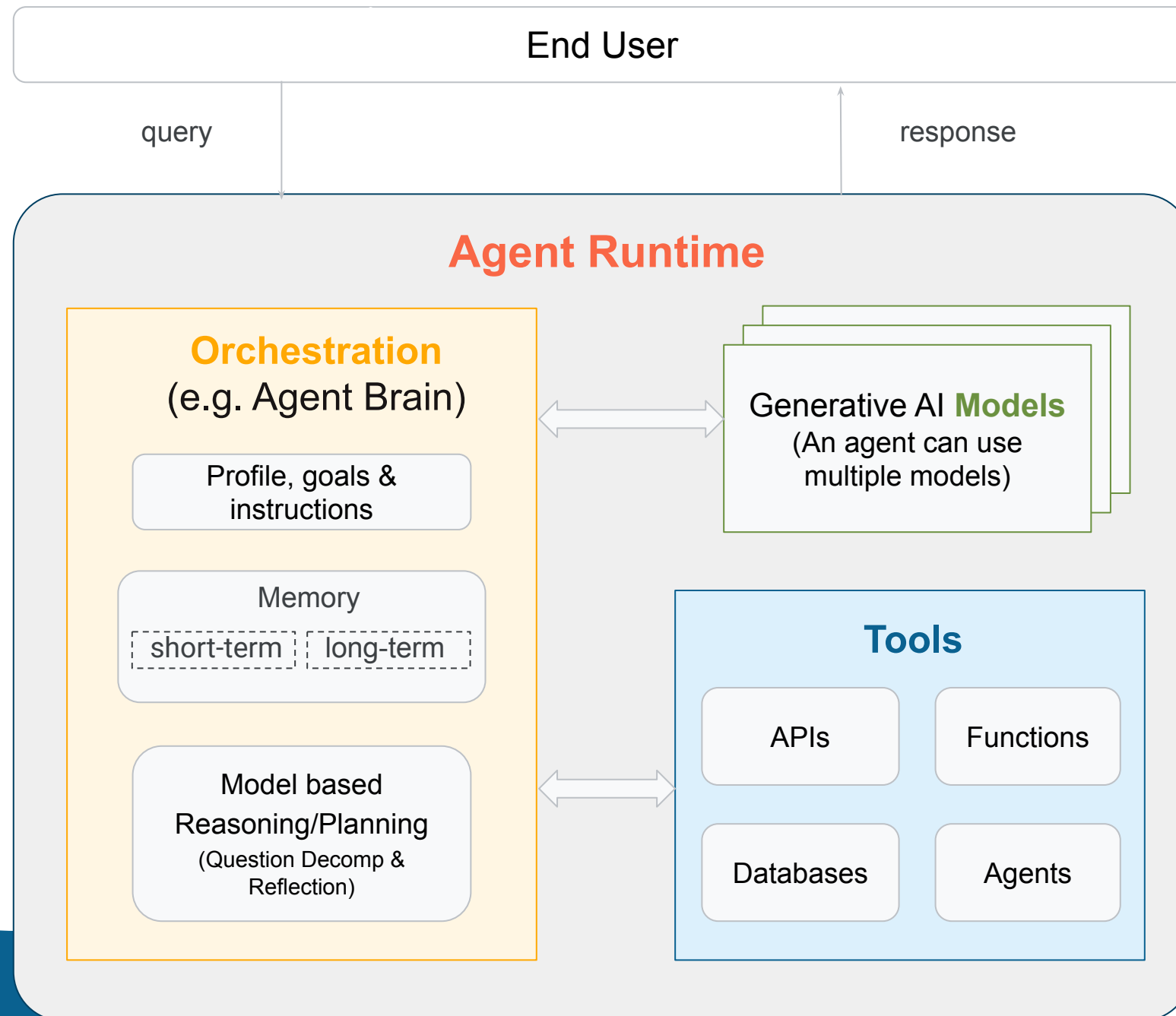
Automates **complex** enterprise workflows

Uses **reasoning** and planning to determine the steps

Utilizes **tools** to access data and take actions such as querying databases or calling APIs



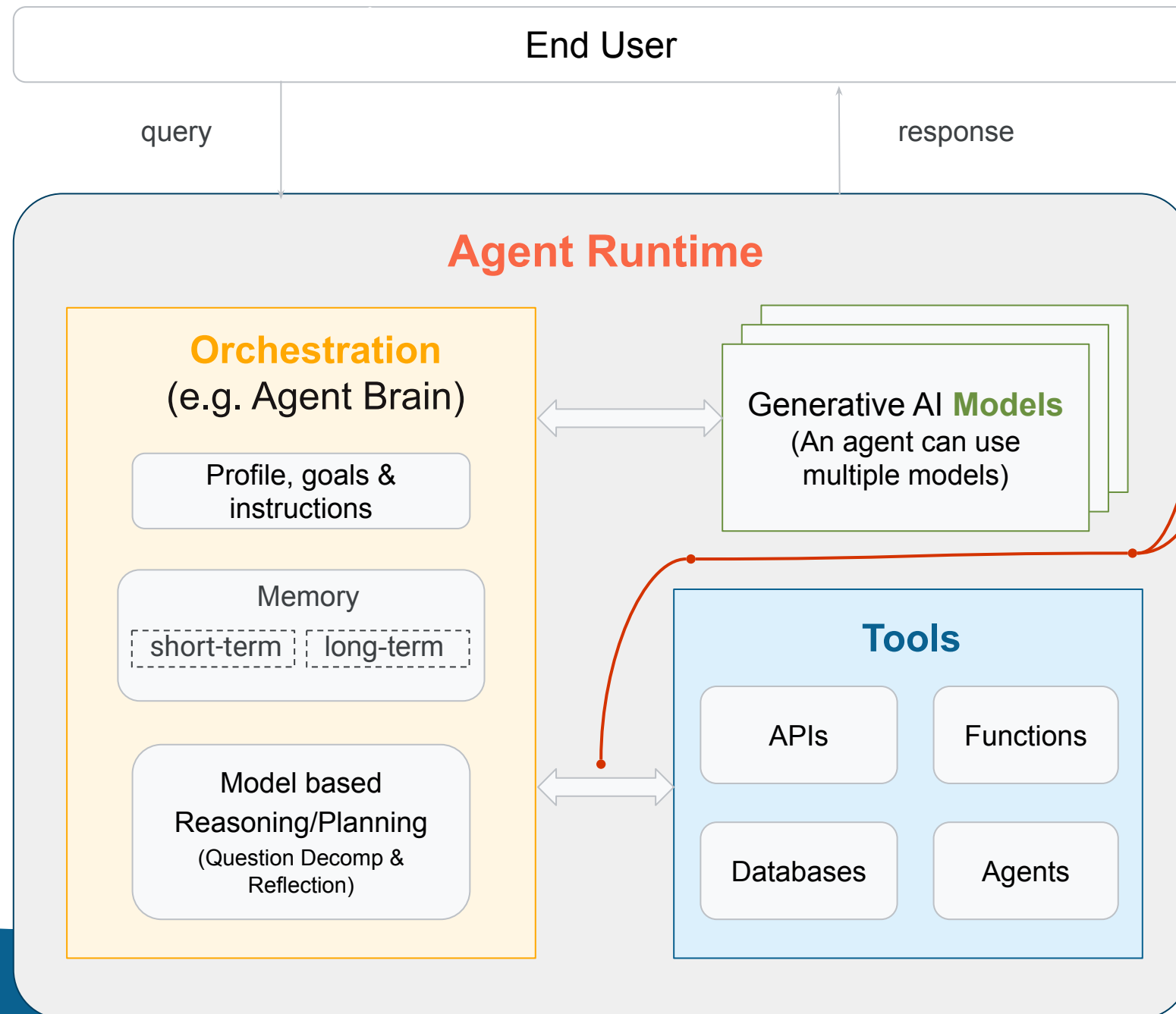
AI Agents plan, reason, and execute tasks for users



Four Key Components

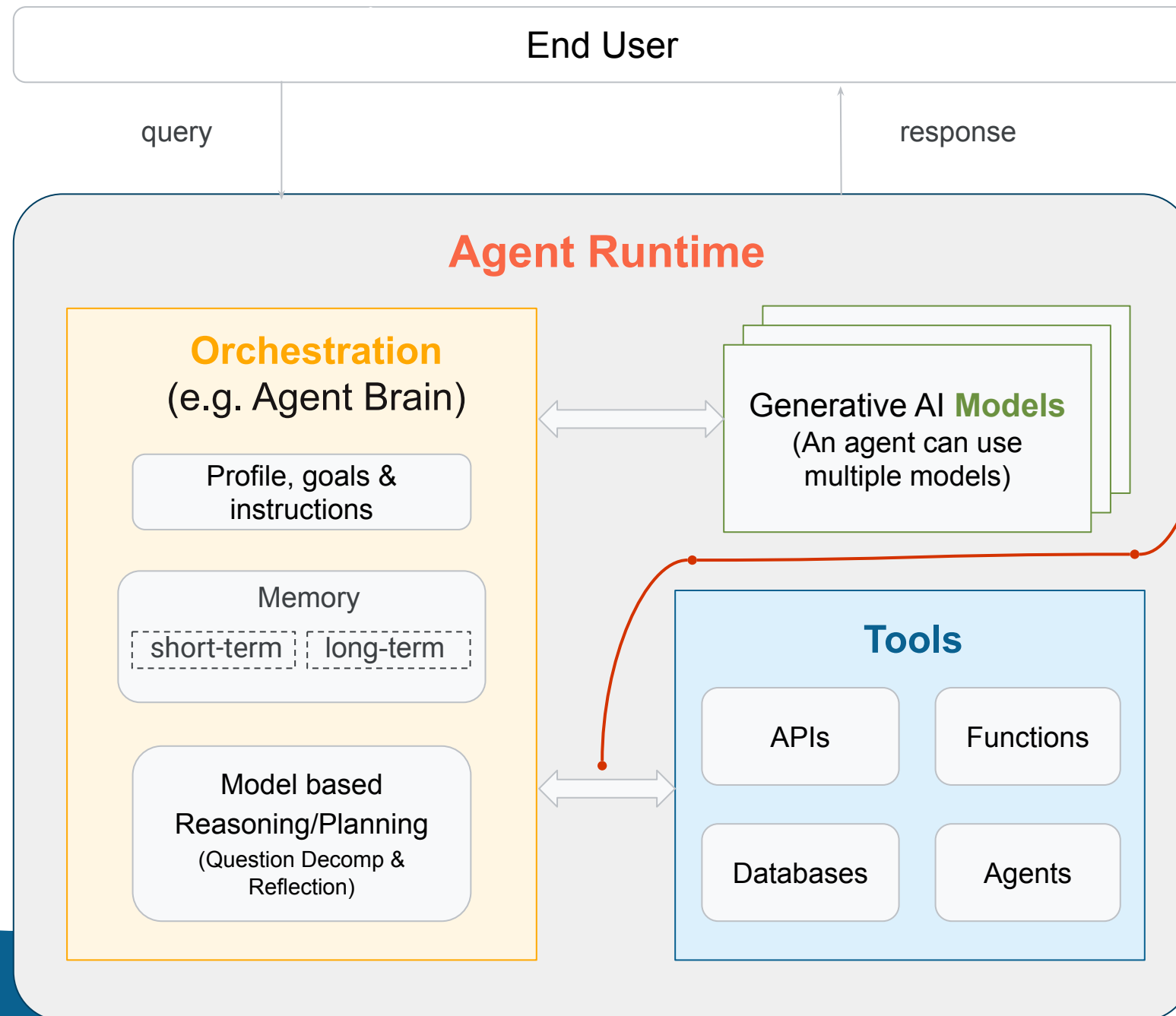
- **Model**: Used to reason over goals, determine the plan and generate a response
- **Tools**: Fetch data, perform actions or transactions by calling other APIs or services
- **Orchestration**: Maintain memory and state (including the approach used to plan), tools, data provided/fetched, etc
- **Runtime**: Execute the system when invoked

Challenges with Agents



- 1 Lack of implementation standards** for agent-tool communications
- 2 Monolithic architecture** - Agents and tool/context tightly coupled in the same application

Challenges with Agents



Lack of standards and monolithic applications imply:

1. **Complex many-to-many vendor integrations** for APIs, servers, and client tools
2. **Poor tool re-usability & inability to scale tool offerings**
3. **Lower quality agents** as it is difficult to connect agents to the right tools quickly.



The Solution....



Model Context Protocol

An open protocol that standardizes how applications provide context to LLMs.

Like a USB-C port for
AI applications



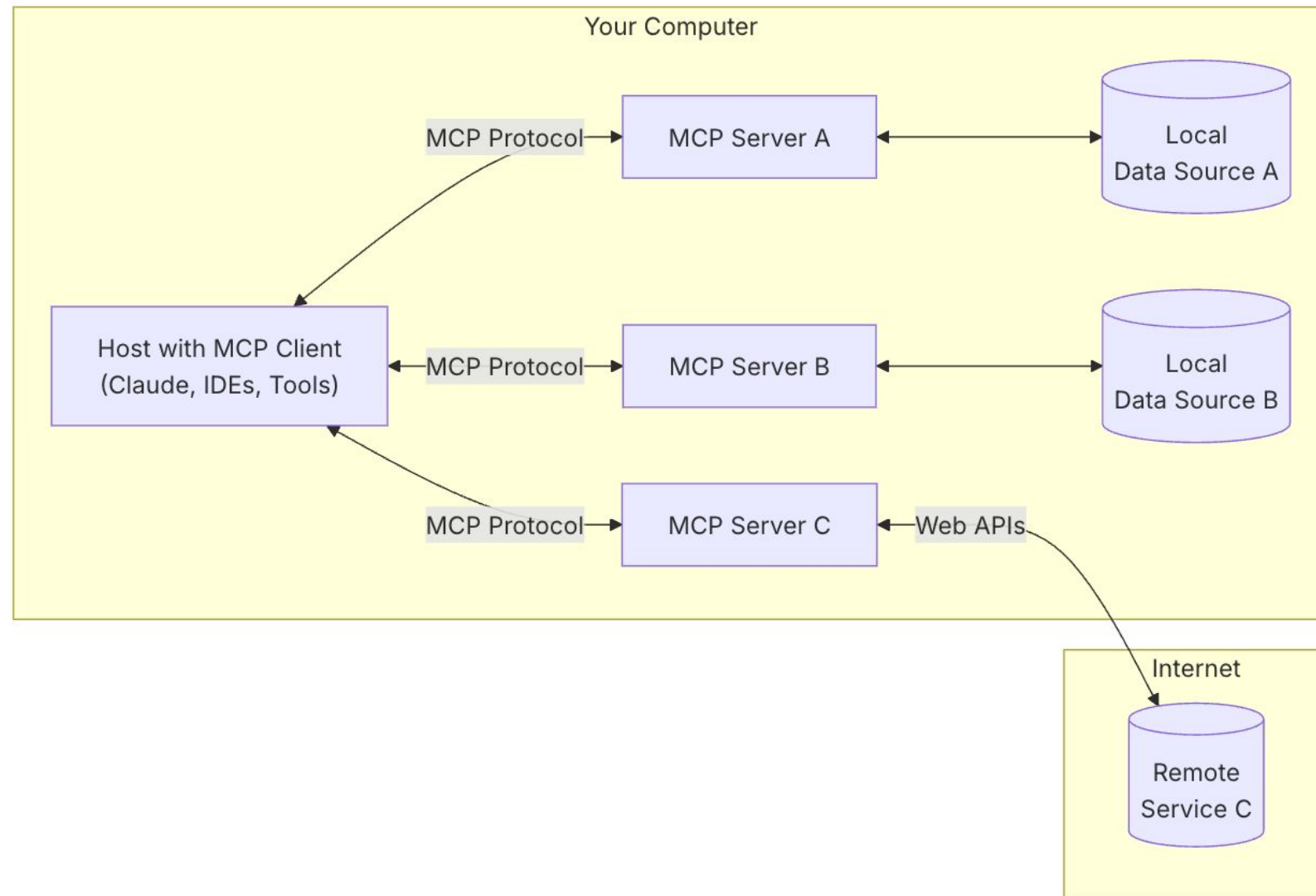
Standardized how to
connect AI to data
sources and tools



MCP Solves Agent Challenges



MCP follows a client-server architecture where a host application can connect to multiple servers



1. **Composable & Modular:** Combine reusable, independent components
2. **Shareable & Reusable:** Discover, share, and reuse components via registries and marketplaces
3. **Secure & Isolated:** Each component accesses only necessary context, ensuring privacy and safety
4. **Rapid Innovation & Dev Uptake:** Low barrier to entry. Easily swap or add modules to prototype and scale faster. Fuels ecosystem growth and collaboration

MCP Architecture

MCP Client

Interacts with the user, agents or other systems

Invokes **Tools**

Queries for **Resources**

Interpolates **Prompts**

*Stateful, persistent,
bi-directional connection*

MCP Server

Offers capabilities

Exposes **Tools**

Exposes **Resources**

Exposes **Prompts**

Tools

Model-controlled

Functions Invoked by the
model

Retrieve / search

Send a message

Update DB records

Resources

Application-controlled

Data exposed
to the application

Files

Database Records

API Responses

Prompts

User-controlled

Pre-defined templates for AI
interactions

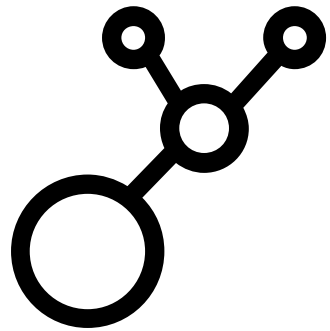
Document Q&A

Transcript Summary

Output as JSON



Graph Database MCP Tools



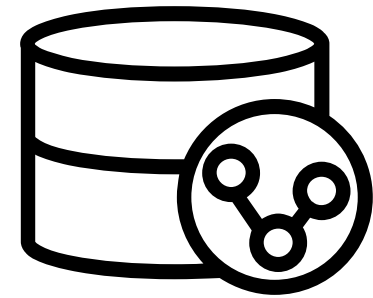
mcp-neo4j-cypher

natural language to
Cypher queries



mcp-neo4j-memory

knowledge graph
memory stored in
Neo4j



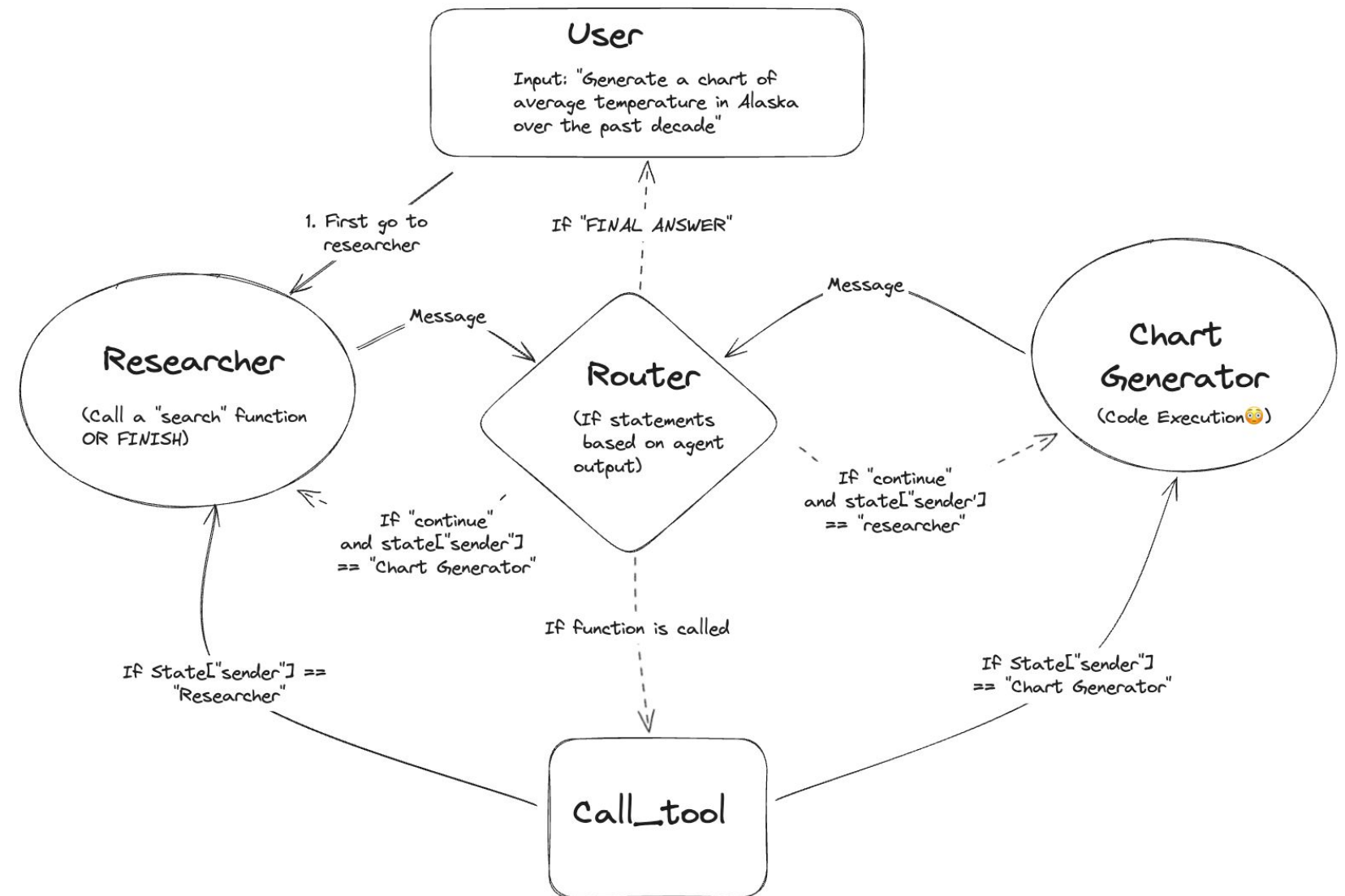
mcp-neo4j-cloud-aura-api

Neo4j Aura cloud service
management API

Agent Modeling is Graphs



LangGraph



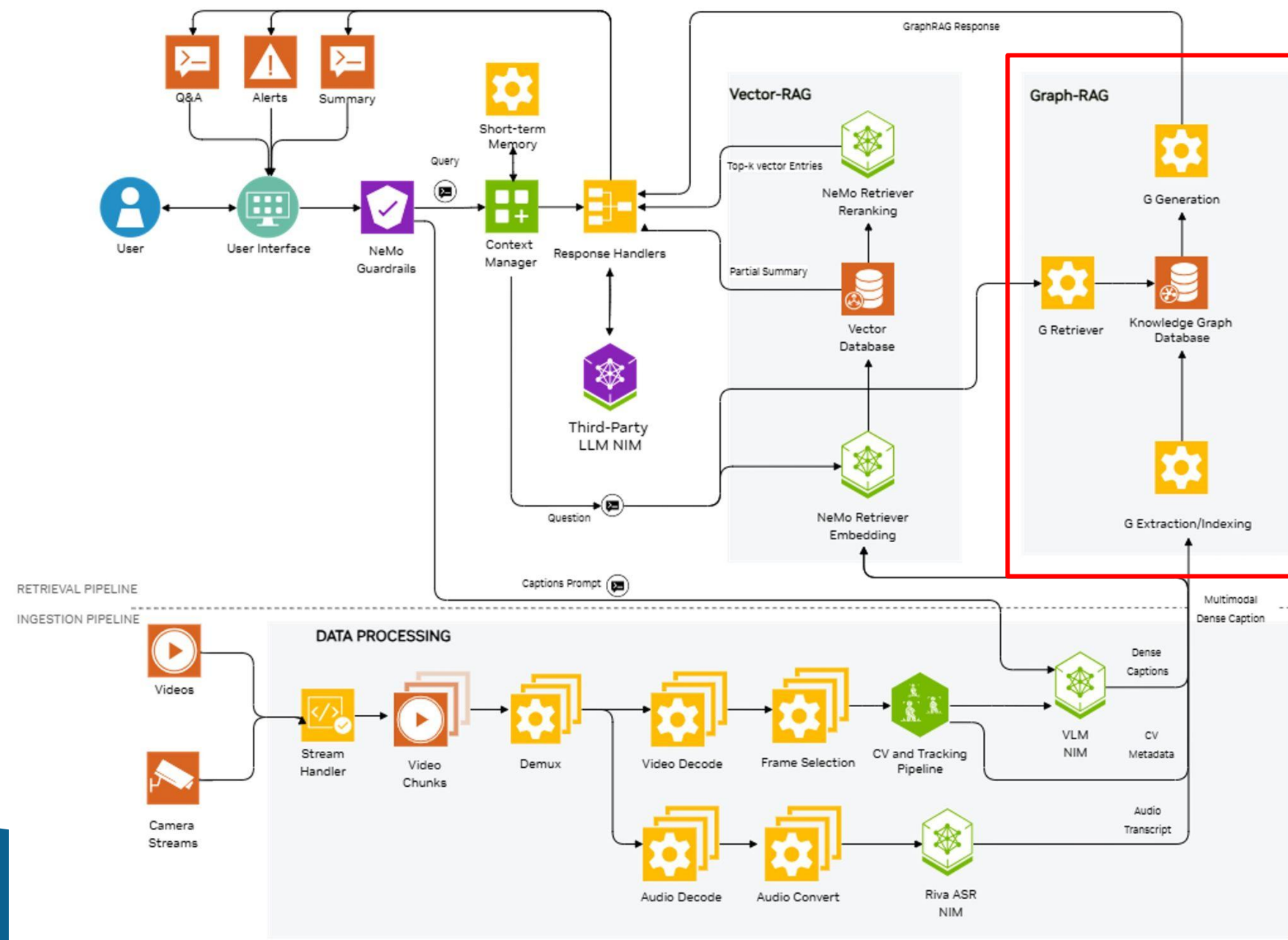
Agent Memory is Graphs



cognee

Agent Retrieval is Graphs

NVIDIA Video Search and Summarization Agent



Hallucinations



Enhance Relevance with Domain Context

What was in the Care Plans associated with Andrea Jenkins's emphysema?

Baseline RAG

LlamaIndex-RAG backed by GPT 4.0
and Chroma vector database

The Care Plan associated with Andrea Jenkins' emphysema included activities **respiratory therapy, specifically deep breathing and coughing exercises.**

LLM Direct

OpenAI over Neo4j
function call

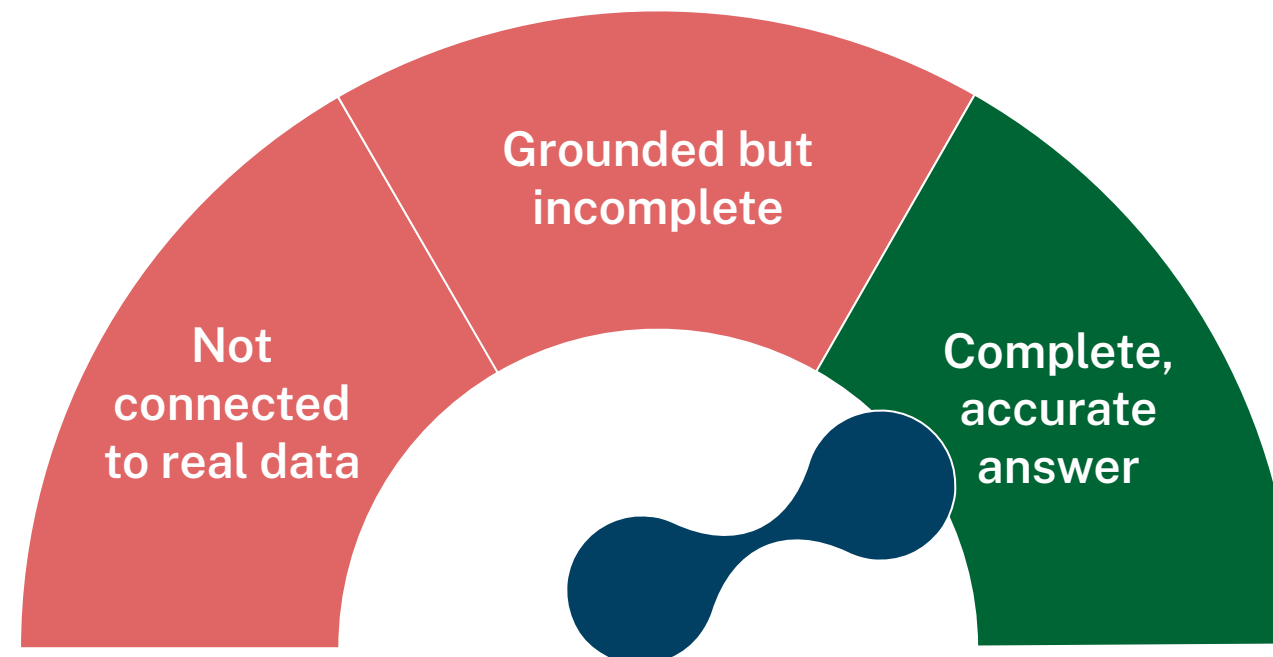
The care plan associated with Andrea7 Jenkins714 emphysema **likely** included the following components:

1. Preventing further damage to the lungs: This may involve advising the patient to.....

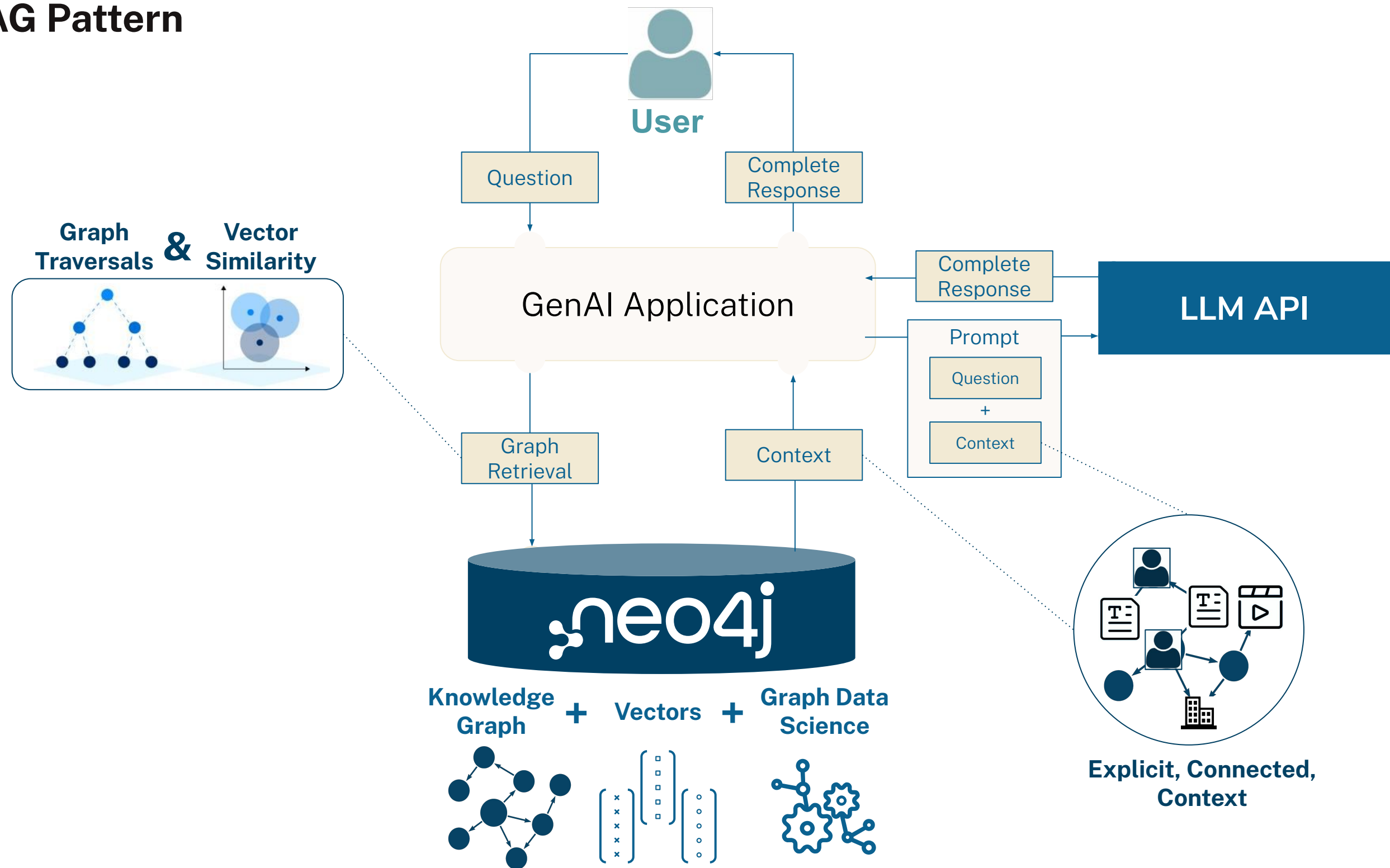
GraphRAG

Neo4j, LangChain,
and OpenAI

The Care Plan for Andrea7 Jenkins714's emphysema included **medication management, smoking cessation counseling, and pulmonary rehabilitation exercises.**



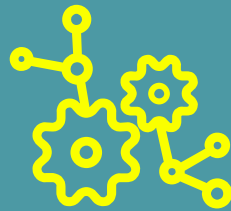
GraphRAG Pattern



GraphRAG Patterns

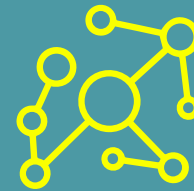
Text2Cypher

Convert natural language prompts to explicit Cypher queries for retrieval



Graph Vectors

Use graph embeddings for retrieval - incorporating both structured and unstructured data in vector similarity search



Vector Search with Graph Context

Use graph patterns to retrieve items related to vector search results



Graph Filtering

Use graph patterns and properties to pre/post filter vector search results. Also includes hybrid search



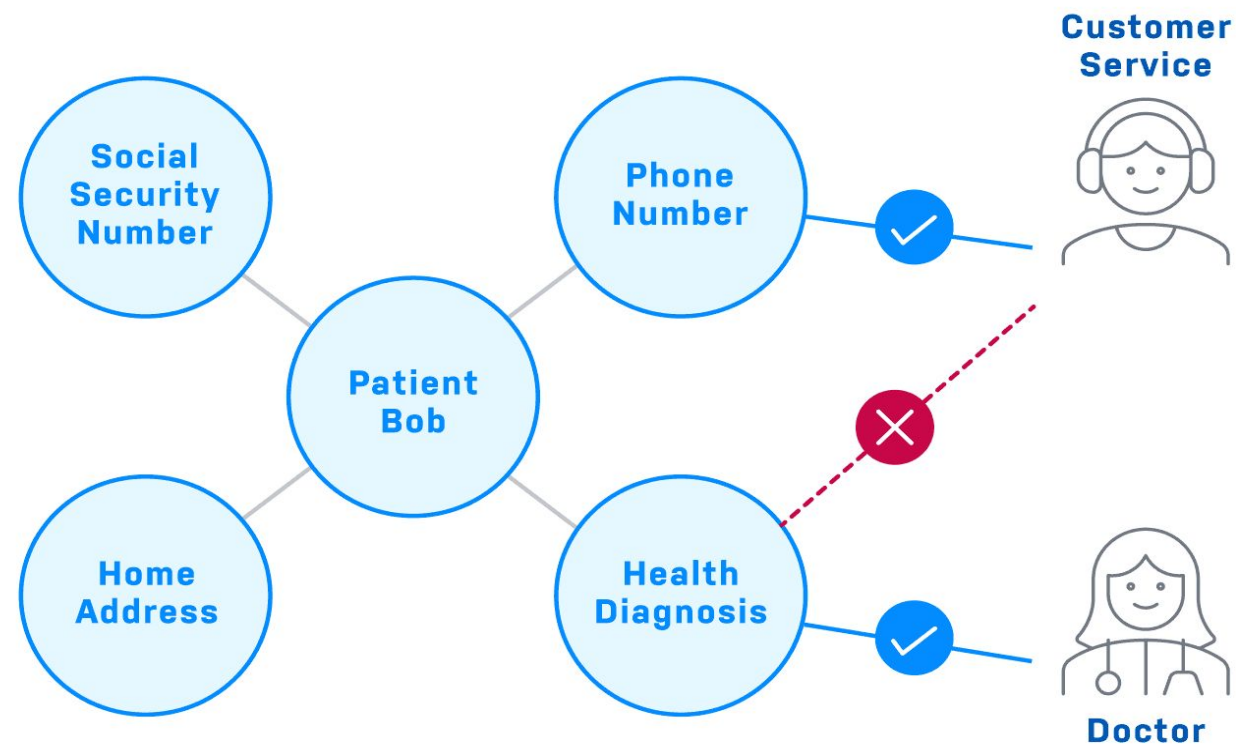
Agents and Multi-Step

Combine multiple tools and GraphRAG patterns together for intelligent GenAI applications. Leverage corrective GraphRAG , semantic layers, and more



Knowledge Graphs Enable GenAI Governance

LLM retrieves and returns information **governed by your enterprise security and access control policies** - down to the node level for security & privacy



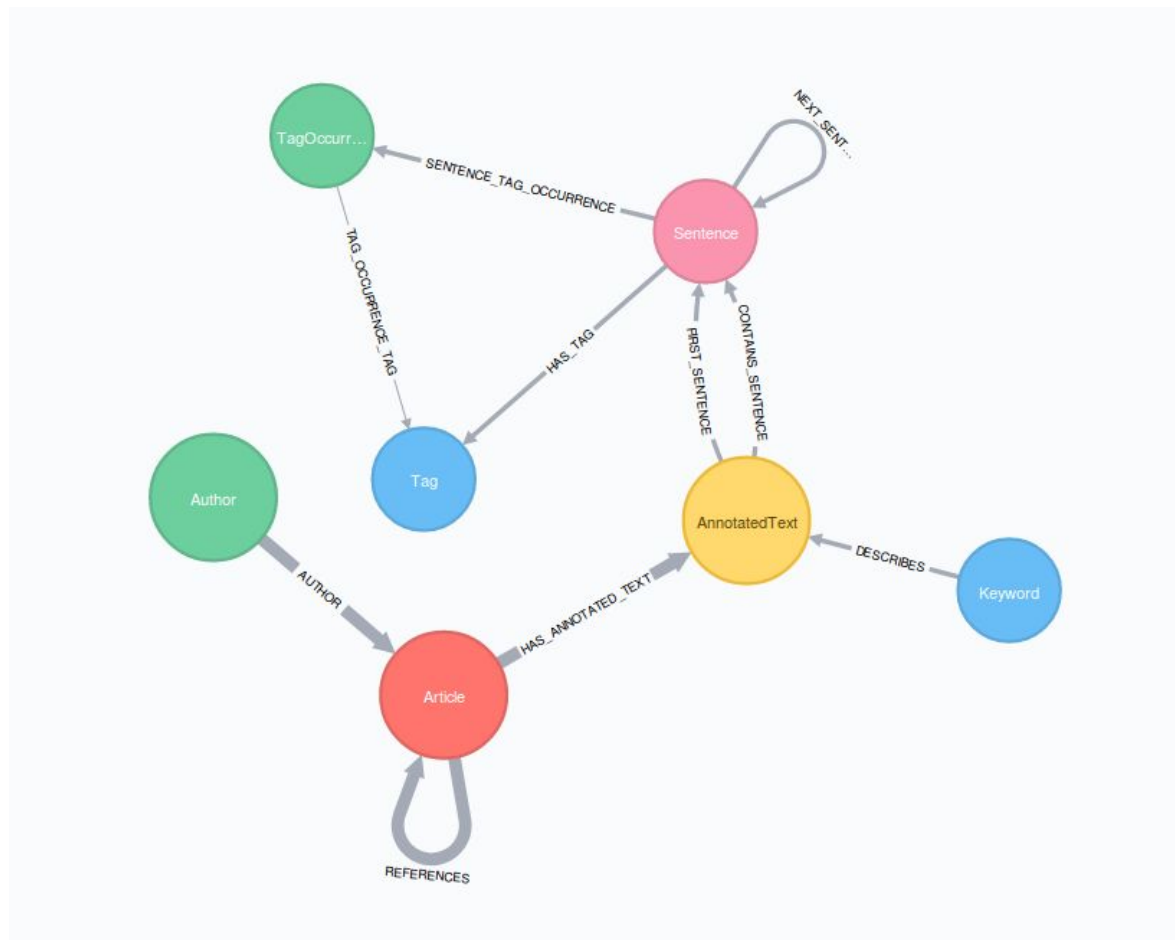
Integrates with identity and access management provider with SSO

Define policies by **role or identity**

Build constraints on nodes, labels, relationships, properties, specific parts of the graph, and even traversal depth

Knowledge Graphs Enable GenAI Explainability

Verify the enriched responses from your LLM because each piece of information is linked to its sources and origins.



Represent **data sources** as nodes

Map **relationships** between search results and data source nodes

Add **metadata or annotations**

The Klarna logo is displayed in a pink rounded rectangle. It consists of the word "Klarna." in a bold, black, sans-serif font.The TechCrunch logo is displayed in a light gray rounded rectangle. It features a green "TC" monogram followed by the word "TechCrunch" in a bold, black, sans-serif font.

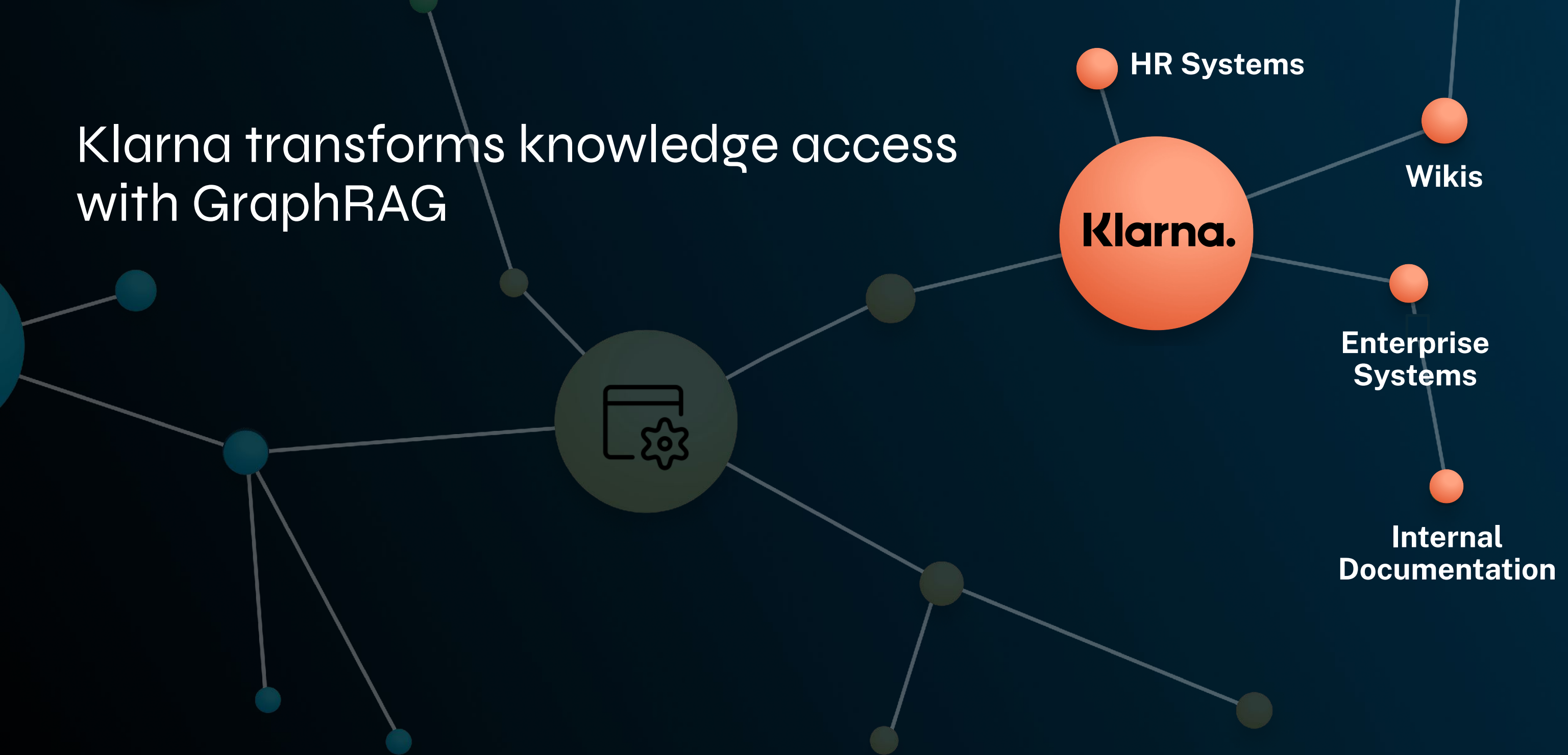
“So no, we did not replace SaaS with an LLM, and storing CRM data in an LLM would have its limitations. But we developed an internal tech stack, using Neo4j and other things, to start bringing data=knowledge together”



Sebastian
Siemiatkowski
Co-Founder and CEO



Klarna transforms knowledge access
with GraphRAG



FROM SEARCHING TO KNOWING

Klarna transforms knowledge access
with GraphRAG



HR Systems

Wikis

Enterprise
Systems

Internal
Documentation

250K Employee questions
answered in first year

2,000 Daily queries processed

85% Employee adoption

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THEMES

Applications

Libraries, Frameworks, and Platforms

AI Engineering

GenAI, Knowledge Graphs, and RAG

Data Intelligence

ML, Graph Data Science, and Models

Graphs

Visualization, Data Integrations, and Tips & Tricks

Architecture

Frameworks, Data Platforms, Clouds and Beyond



neo4j.com/nodes-2025

Thanks for Coming!

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@steveonjava (linkedin, bsky, x, etc.)