"The AI Said So?": How to Build Auditable AI Agents Using Context Graphs

Nyah Macklin
Sr. Developer Advocate, Artificial Intelligence

Nyah Macklin

Developer Relations @ Neo4j

- Bootcamp graduate - resilientcoders.org | 100devs
- Graph Theory, Graph Algorithms, & Context Engineering
- Ethics, Governance, Safety, Responsible A.I.
- Taught at universities,
  high schools, and nonprofits

Learn more with

neo4j | GraphAcademy

- **Completely Free**
- **Hands-on Courses** teaching Neo4j Fundamentals, Cypher, Drivers and Graph Data Science
- **Curated Learning Paths** catering for everyone from beginners to experts
- **Free Certifications**

graphacademy.neo4j.com

Introduction to Neo4j Graph Data Science

Gain a high-level technical understanding of the Neo4j Graph Data Science (GDS) library

30 minutes →

Neo4j Graph Data Science Fundamentals

Learn all you need to know about Graph Algorithms and Machine Learning Pipelines

1 hour →

Path Finding wi

Learn how to find th paths between pairs in the graph

1 hour

Building Neo4j Applications with .NET

Learn how to interact with Neo4j from .NET using the Neo4j .NET Driver

Building Neo4j Applications with Go

Learn how to interact with Neo4j from your Go application using the Neo4j Go Driver

Building Neo4j Applications wi TypeScript

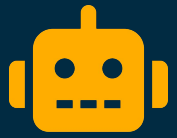
Learn how to interac Neo4j in your TypeS project using the Ne JavaScript Driver

What do I need?

Workshop materials:

- graphacademy.neo4j.com account
- graphacademy.neo4j.com/courses/genai-fundamentals

Question



What happens when *dozens* of AI Agents have to work together?


YOU ARE CLEAR TO DO WHATEVER..
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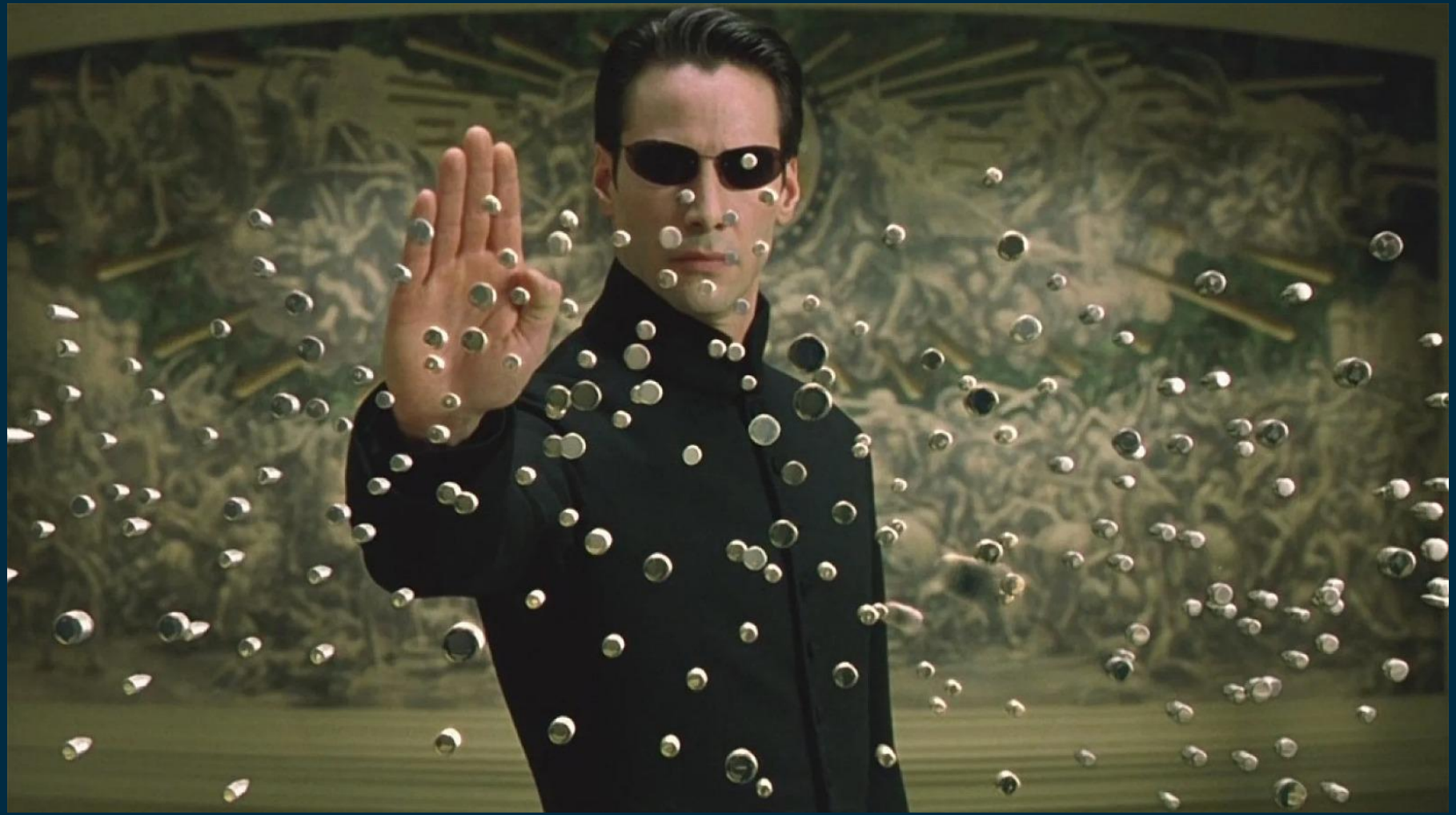
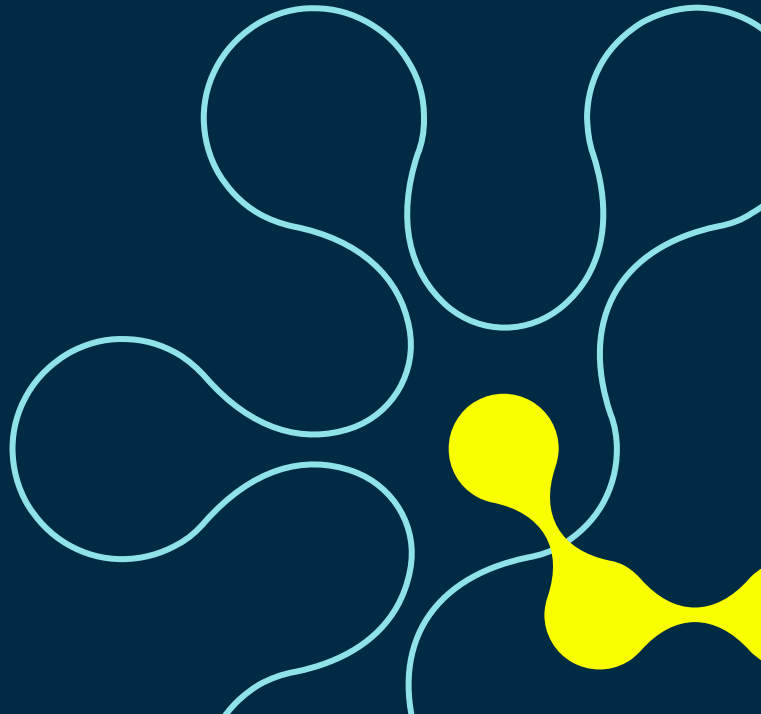
caglecartoons.com

95% AI pilots fail

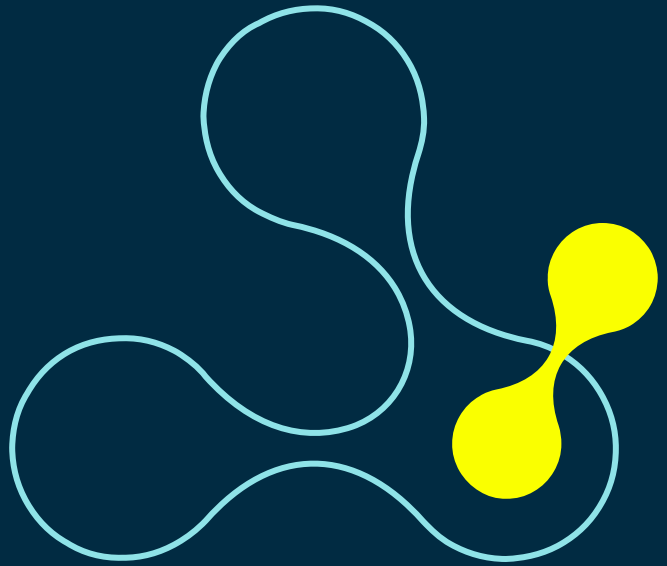
Massachusetts Institute of Technology



The past

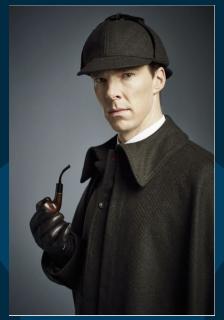


Context Engineering

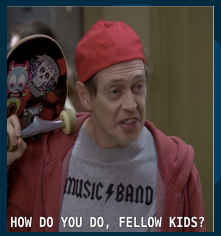


Context Engineering

Knowledge Graph-Augmented Context



RAG + Hybrid Search



Structure and Order of Context

Memory Management

Tools and Function Calling as Context

RAG + Hybrid Search

Memory Management

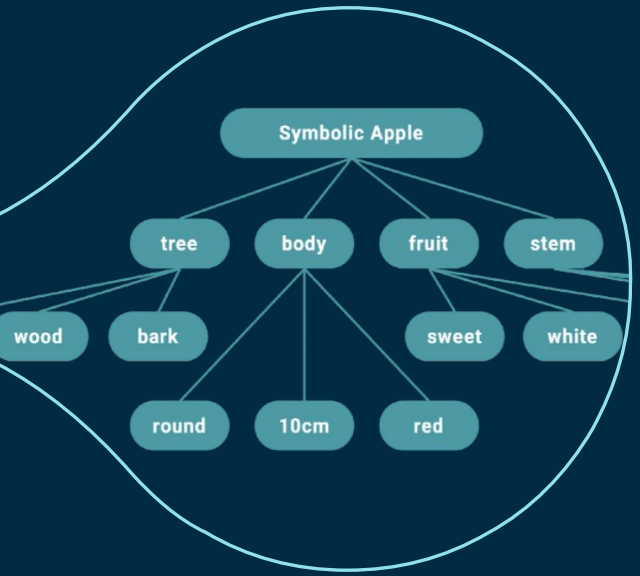
Structure and Order Context

Tools and Function Calling

Knowledge Graph Augmented Context

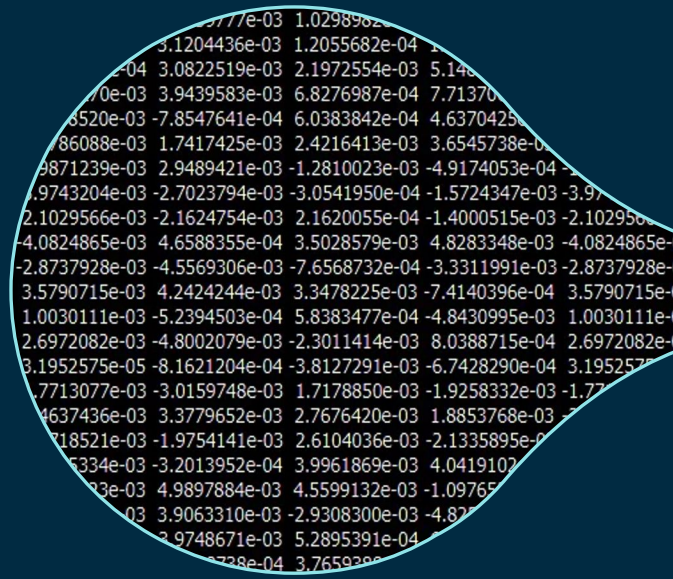
To Overcome AI's Black Box Problem
We Need Knowledge to be Transparent

Knowledge Graph View of an Apple



Human View of an Apple

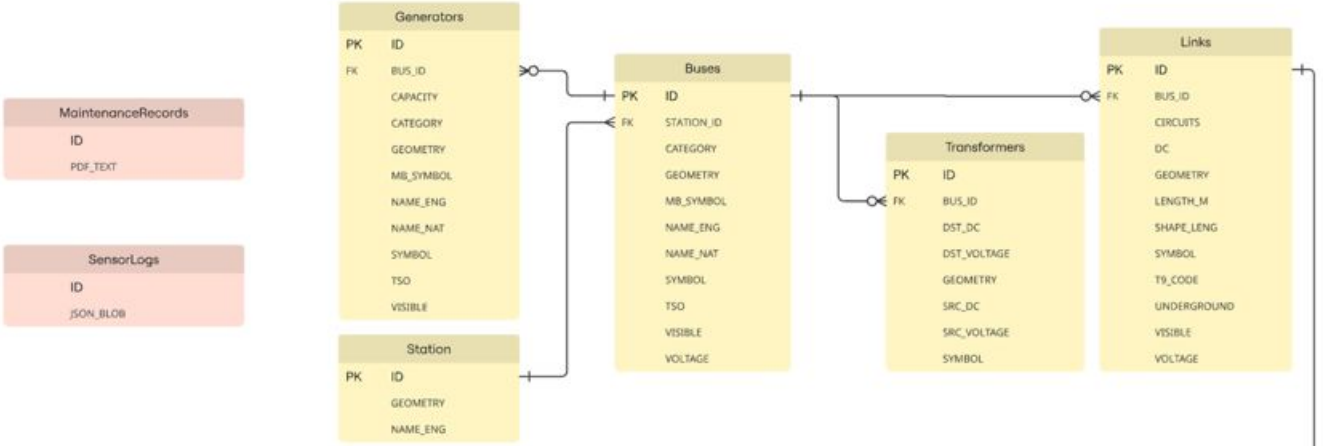
Vector View of an Apple



Network Data

Unstructured PDF & JSON

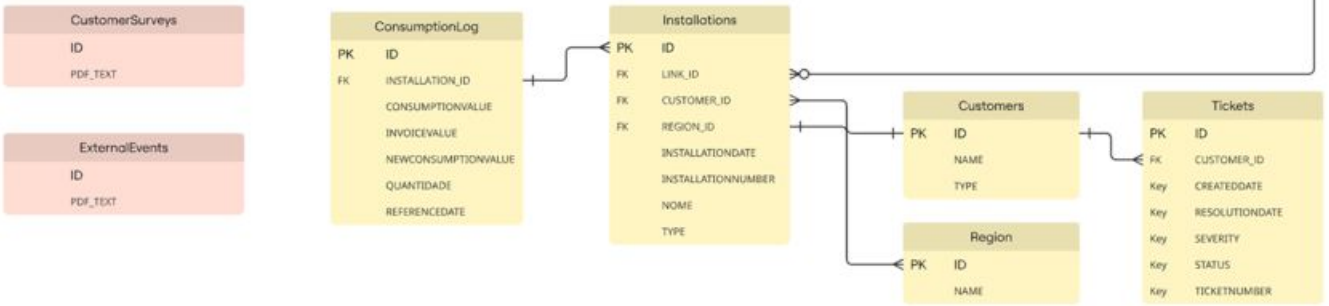
Structured (SQL)

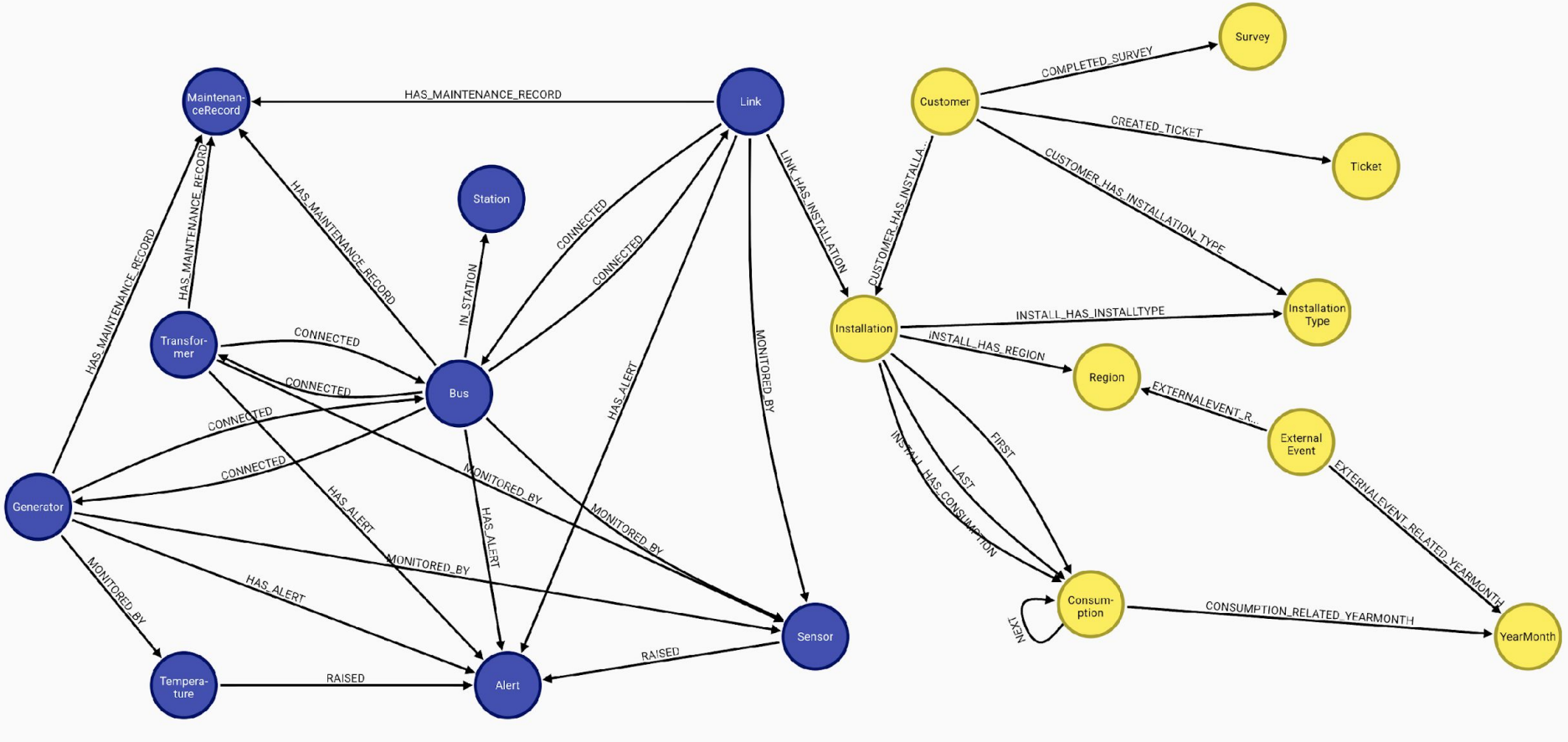


Customer Data

Unstructured PDF

Structured (SQL)

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HAS_ALERT
Sensor
Tempera-ture
RAISED
Alert
RAISED
Customer
COMPLETED_SURVEY
Survey
CREATED_TICKET
Ticket
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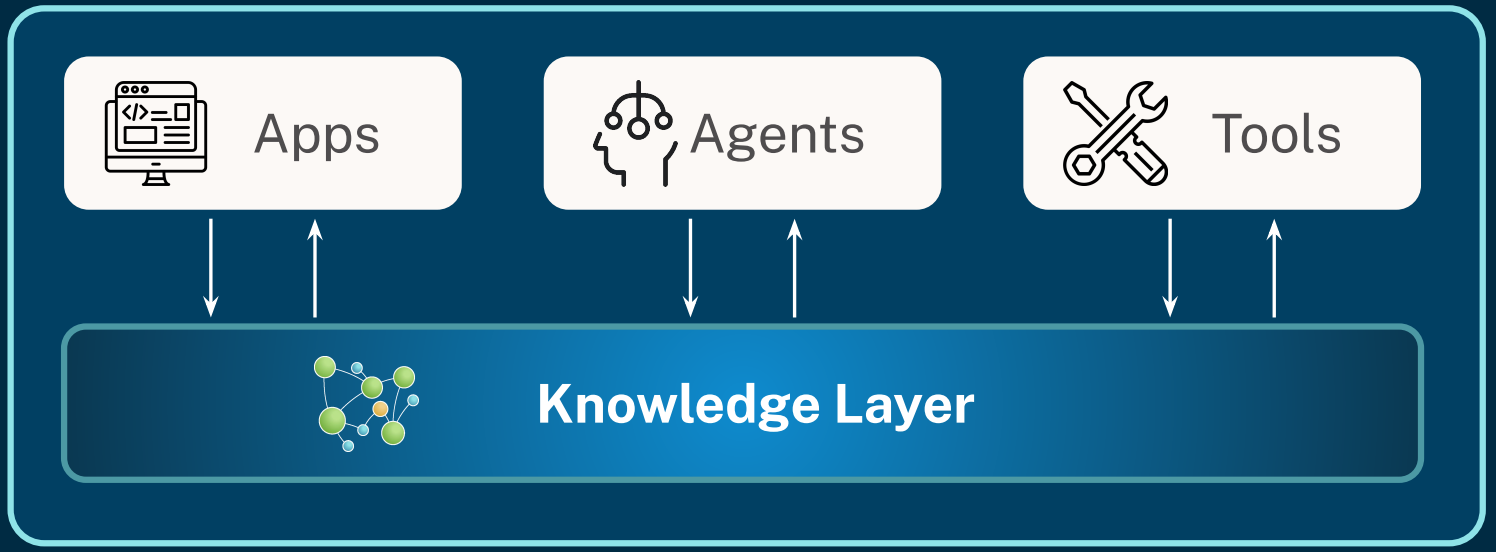
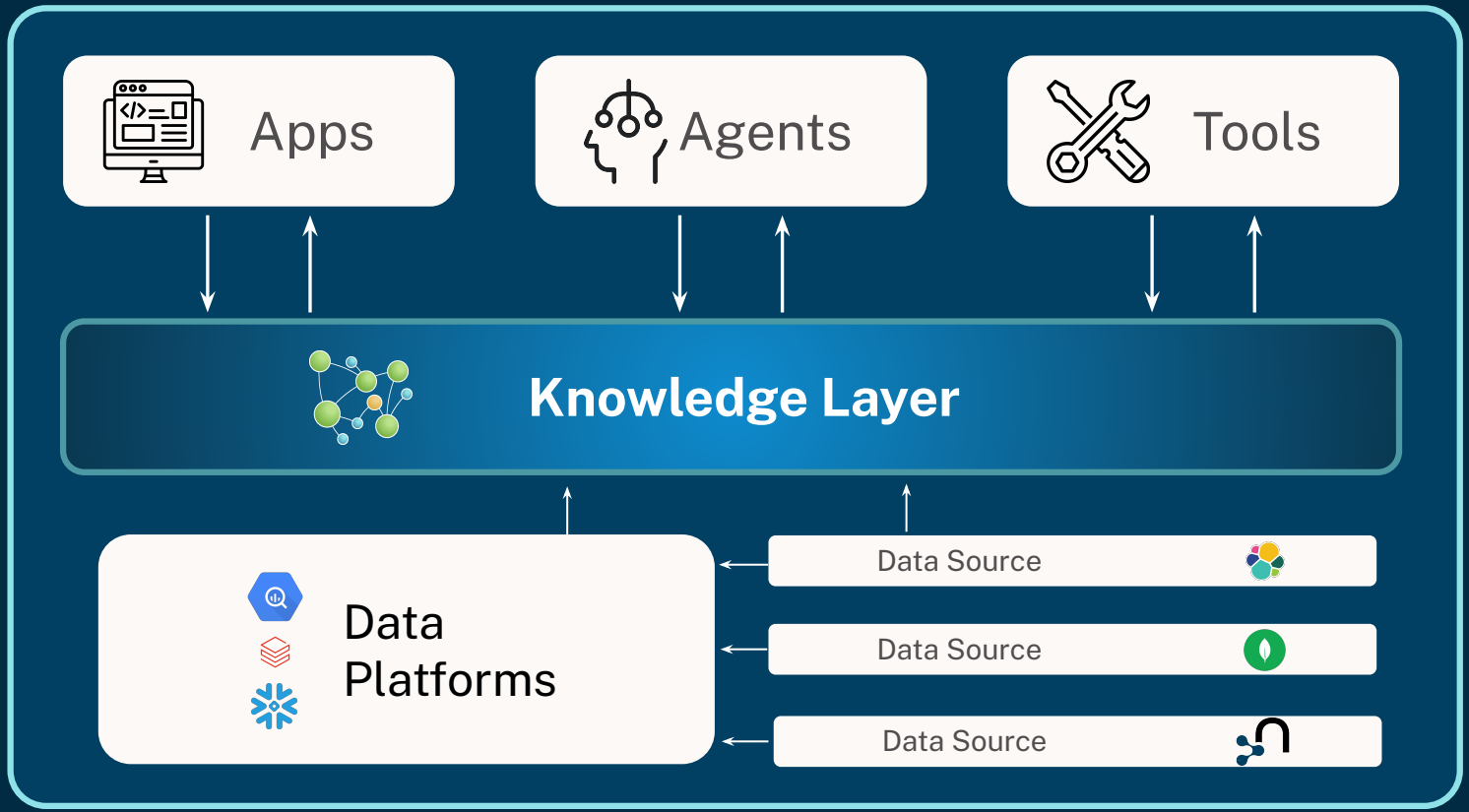
CUSTOMER_HAS_INSTALLATION_TYPE
Installation
INSTALL_HAS_INSTALLTYPE
Installation Type
INSTALL_HAS_REGION
Region
EXTERNALEVENT_R...
External Event
EXTERNALEVENT_RELATED_YEARMONTH
FIRST
LAST
INSTALL_HAS_CONSUMPTION
Consum-ption
NEXT
CONSUMPTION_RELATED_YEARMONTH
YearMonth

The Next Layer in the AI Stack: Knowledge



- Holds structure, context, and meaning
- Uniform memory & retrieval layer for agents
- Bridges human and machine understanding
- Links and unifies data sources and objects

The Next Layer in the AI Stack: Knowledge



Hands on Demo

What do I need?

Link!

- **https://dev.neo4j.com/workshop-genai-fundamentals-notes**

Workshop materials:

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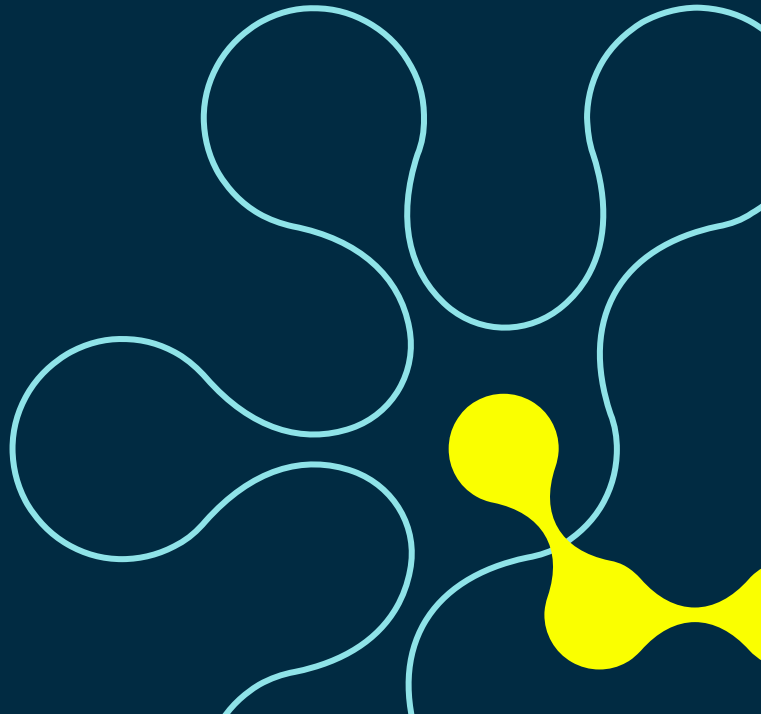
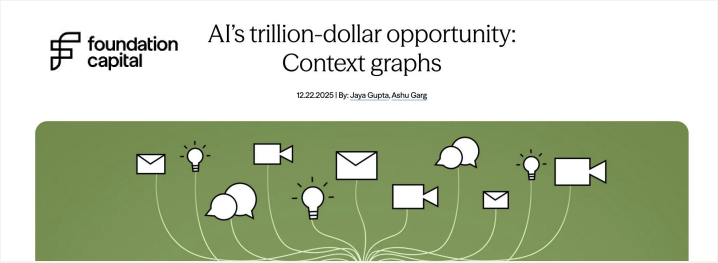
- graphacademy.neo4j.com/courses/genai-fundamentals

The present + future



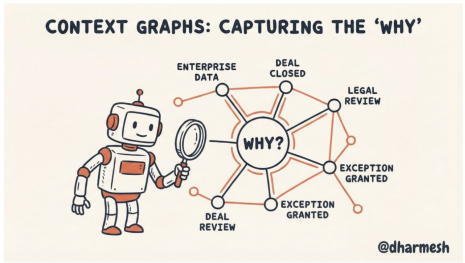


https://foundationcapital.com/context-graphs-ais-trillion-dollar-opportunity/

https://arxiv.org/abs/2406.11160

Graphs, Graphs Everywhere—with Sudhir Hasbe (Ep 43)

https://www.youtube.com/watch?v=iO4rWgj1Grs



Context Graphs: Capturing The "Why" In The Age of AI

Dharmesh Shah
Founder and CTO at HubSpot. Helping millions grow better.

https://www.linkedin.com/pulse/context-graphs-capturing-why-age-ai-dharmesh-shah-oyvze/

Hands On With Context Graphs And Neo4j

Building AI systems that don't just make decisions, but remember and use the "why".

William Lyon 9 min read · Jan 14, 2026

https://neo4j.com/blog/agentic-ai/hands-on-with-context-graphs-and-neo4j/

The Missing "Why"

When an AI agent recommends approving a $100K credit line increase, the question isn't just "is this the right answer?"

No Memory

Ask an agent about last week's conversation — blank stare

No Audit Trail

When something goes wrong, no one knows why the agent decided that

No Shared Learning

Deploy multiple agents and they can't share what they've learned

95% of AI pilots fail to deliver returns — MIT

What is a Context Graph?

A knowledge graph specifically designed to capture decision traces — the full context, reasoning, and causal relationships behind every significant decision.

Traditional Audit Log	Context Graph
Records actions only	Captures the full "why"
"Transaction rejected at 14:32"	Decision traces & causal chains
No relationships between events	Entities, relationships, events
No causal chain or reasoning	Tribal knowledge made queryable
Flat, disconnected records	Connected, traversable structure

Jaya Gupta & Ashu Garg, *"AI's Trillion-Dollar Opportunity: Context Graphs"* — Foundation Capital, Dec 2025

Context Graph: Financial Services Data Model

ENTITIES (What exists)

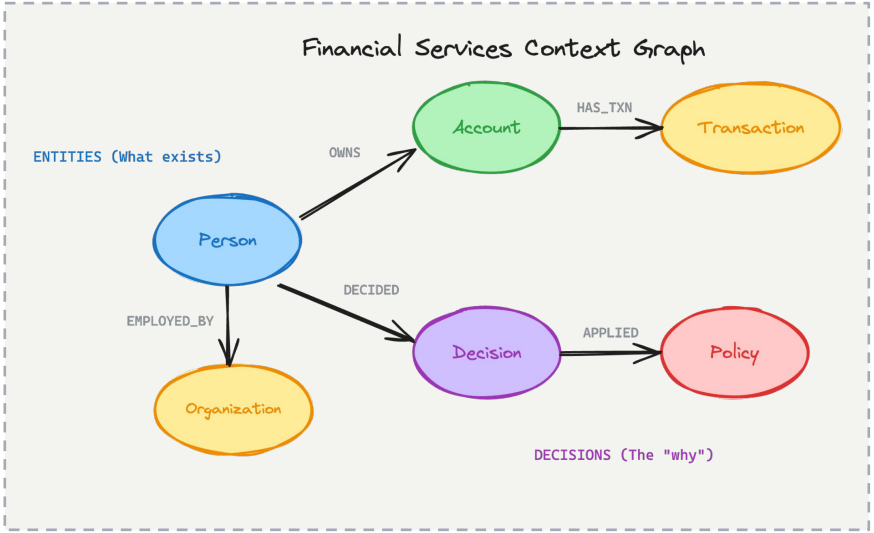
Person, Account, Transaction, Organization

EVENTS (What happened)

Decisions, Transactions, Approvals, Rejections

CONTEXT (The why)

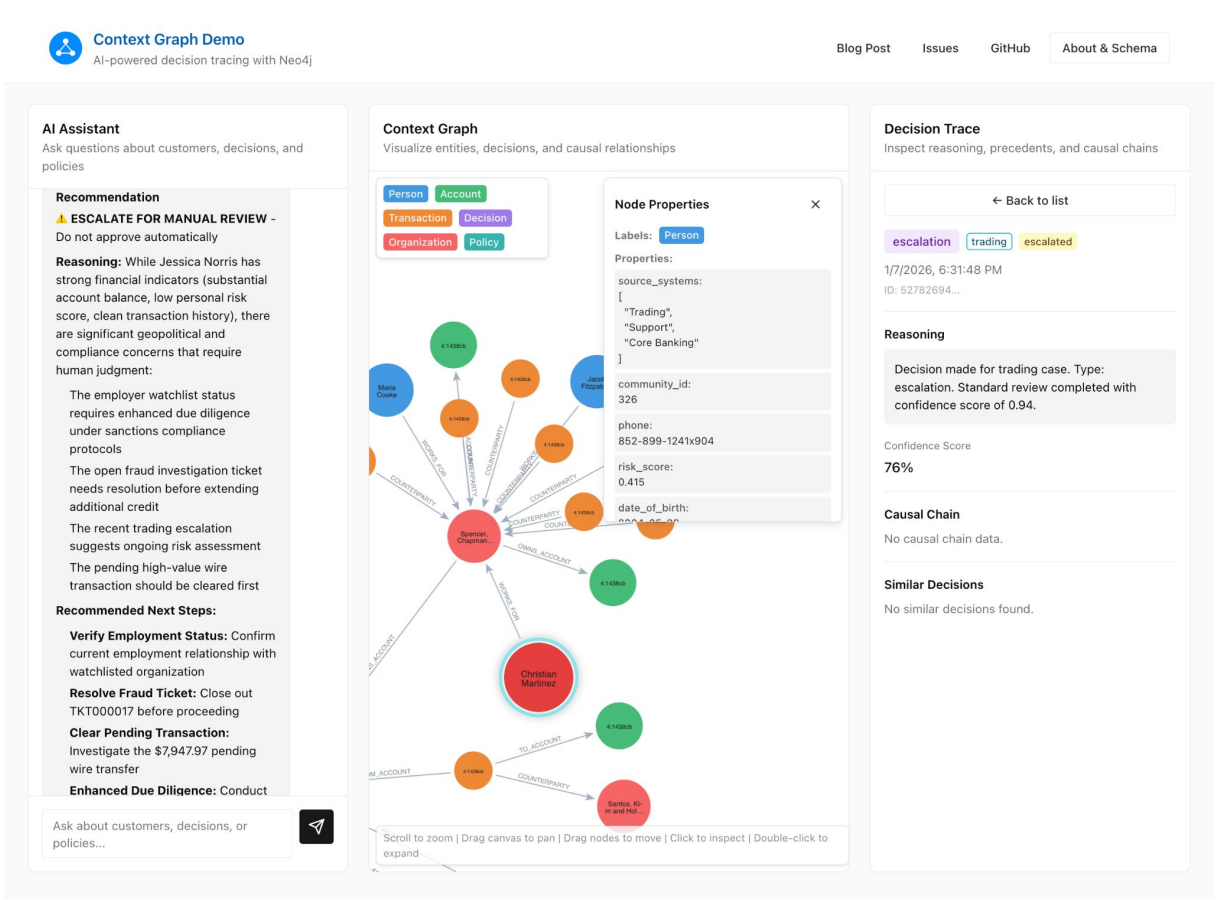
Policies applied, Risk factors, Employee reasoning



Blog: neo4j.com/blog/agentic-ai/hands-on-with-context-graphs-and-neo4j/

Context Graph Demo

https://context-graph-demo.vercel.app/



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CONTEXT GRAPHS | FINANCIAL SERVICES | NEO4J + GDS

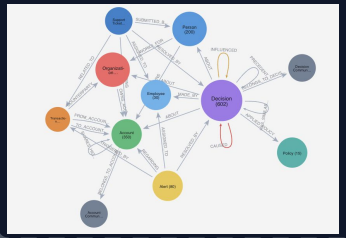
Context Graph Demo

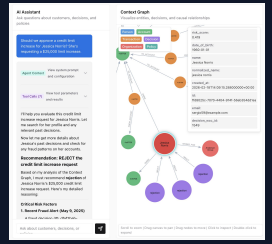
AI-Powered Decision Tracing for Financial Institutions

context-graph-demo.vercel.app

github.com/johnymontana/context-graph-demo

neo4j.com/blog/.../hands-on-with-context-graphs-and-neo4j





Architecture

Next.js UI
Chakra UI v3
NVL Graphs

FastAPI + SDK
Claude Agent
10 MCP Tools

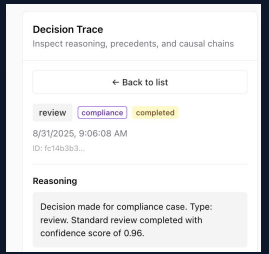
Neo4j + GDS
Vector Search
FastRP / KNN

Sample Data: 200 persons · 350 accounts · 2K transactions · 600 decisions · 50 orgs · 15 policies

How GDS Powers the Agent's 10 MCP Tools

`find_precedents` — FastRP + Vector — Hybrid semantic + structural	`find_similar_decisions` — FastRP + KNN — Structural decision matching	`detect_fraud_patterns` — Node Similarity — Neighborhood pattern matching
`find_decision_community` — Louvain — Decision cluster detection	`get_causal_chain` — Path traversal — Cause → effect tracing	`record_decision` — FastRP mutate — Index new decisions

KEY INSIGHT: Hybrid search combines semantic similarity (text embeddings) with structural similarity (FastRP graph embeddings) — meaning + context, not just meaning alone.



Demo Scenarios

1. **Credit Decision + Precedent Lookup** FastRP similar decisions → precedents → trace
2. **Fraud Pattern Detection** Node Similarity vs. fraud typologies → risk score
3. **Exception Request + Audit Trail** Causal chain → justification & policy links

Going Forward: Industry-Specific Examples

NOW	**Financial Services**	Credit, fraud, trading exceptions (current demo)
NEXT	**Healthcare & Life Sci**	Clinical trial decisions, treatment precedents
NEXT	**Manufacturing**	Engineering systems, digital twin, supply chain management
LATER	**Government & Defense**	Policy enforcement, grant decisions, audit

How the Agent Traces Decision History

REJECT or ESCALATE — grounded in institutional knowledge, not just a credit score

1 **Query Context Graph**

Agent retrieves Jessica's full profile: accounts, transactions, employer, risk tier

2 **Trace Decision History**

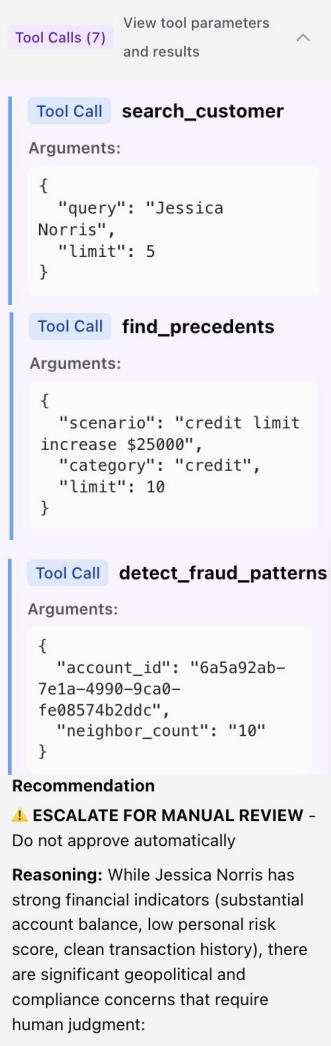
Past fraud flag (April 2025), compliance rejections, velocity check failures

3 **Hybrid Search**

Semantic similarity (text embeddings) + structural similarity (FastRP graph embeddings)

4 **Recommendation**

31 nodes · 30 relationships · Jessica's complete context in a single graph traversal



Hybrid Search: Vector + Graph

Neo4j GDS provides algorithms impossible in relational databases

Text Embeddings

Semantic similarity — what does the text mean?

Finds decisions with similar descriptions, rationale, and risk factors. "Fraud rejection" matches "suspicious activity alert."

Graph Embeddings (FastRP)

Structural similarity — how is this node connected?

Finds decisions involving customers with similar account structures, employer types, and transaction patterns.

Combined: find precedent decisions from structurally AND semantically similar situations

Where do I learn more?

GraphRAG from Research Community

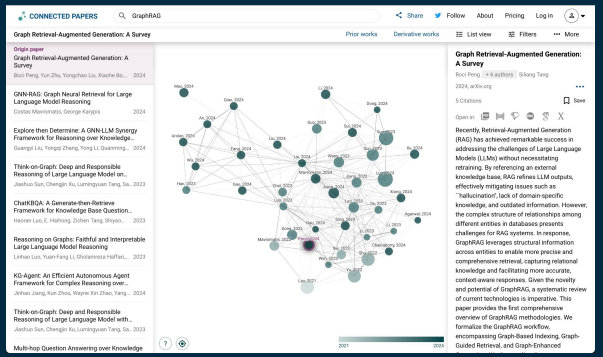
GraphRAG with GNN+LLM

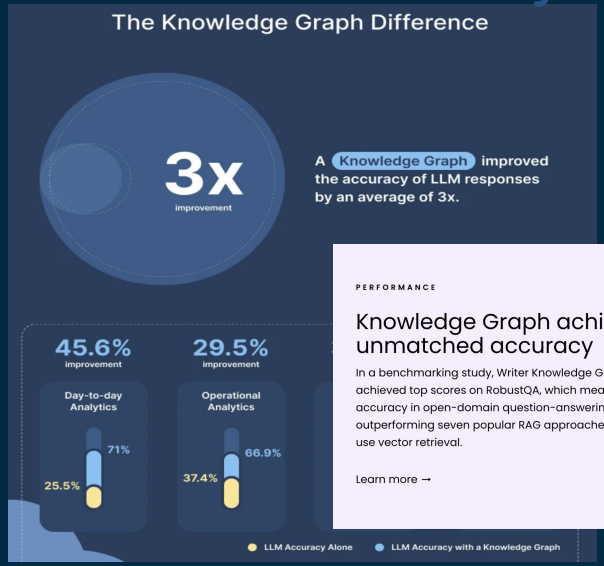
Brian Shi | Alfred Clemedtson | Zach Blumenfeld

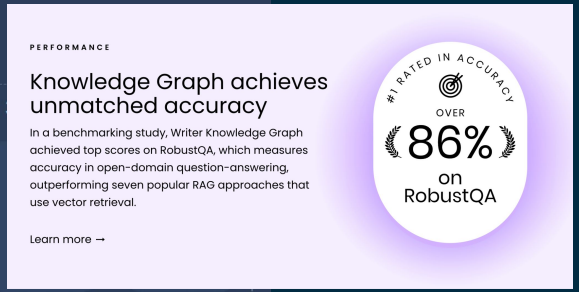
Experiments: G-retriever with STaRK-Prime

Method	Hits@1	Hits@5	Recall@20	MRR
Pipeline*	**32.09**	**48.34**	**47.85**	**38.48**
G-Retriever	32.27 ± 0.3	37.92 ± 0.2	27.16 ± 0.1	34.73 ± 0.3
Subgraph Pruning**	12.60	31.60	35.93	20.96
Baseline	15.57	33.42	39.09	24.11

*Pipeline adds nodes in subgraph context to G-retriever output.
**Frozen LLM. No fine-tuning.







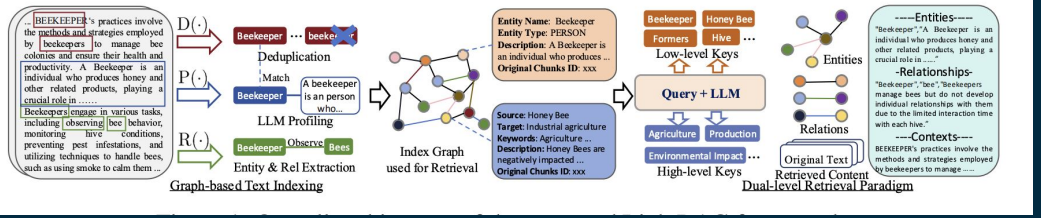
We have presented **GraphRAG**, a RAG approach that combines knowledge graph generation and query-focused summarization (QFS) to support human sensemaking over entire text corpora. Initial evaluations show **substantial improvements** over a vector RAG baseline for **both the comprehensiveness and diversity of answers**, as well as favorable comparisons to a global but graph-free approach

Model	Prompt tuning	Fine-tuning	WebQSP F_1 Score ↑	WebQSP Hit@1 ↑	WebQSP Recall ↑	ExplaGraphs Acc ↑
Baselines						
LLM only	✗	✗	0.2555	0.4148	0.2920	0.3394
LLM$_{LoRA}$	✗	✓	0.4295	0.6186	0.4193	0.8927
Compared Retrievers						
BM25	✗	✗	0.2999	0.4287	0.2879	0.6011
MiniLM-L12-v2	✗	✗	0.3485	0.4730	0.3289	0.6011
LaBSE	✗	✗	0.3280	0.4496	0.3126	0.6011
mContriever-Base	✗	✗	0.3172	0.4453	0.3047	0.5866
E5-Base	✗	✗	0.3421	0.4705	0.3254	0.6011
G-Retriever	✓	✗	0.4674	0.6808	0.4579	0.8825
G-Retriever$_{LoRA}$	✓	✓	0.5023	0.7016	0.5002	0.9042
Our Retrieval Approach						
GRAG	✓	✗	0.5022	0.7236	0.5099	0.9223
Δ_{LLM}			↑ 96.56%	↑ 74.45%	↑ 74.62%	↑ 171.74%
GRAG$_{LoRA}$	✓	✓	**0.5041**	**0.7275**	**0.5112**	**0.9274**
Δ_{LoRA}			↑ 17.37%	↑ 17.60%	↑ 21.92%	↑ 3.89%

graphrag.com/appendices/research

Retrieval-Augmented Generation with Knowledge Graphs for Customer Service Question Answering

in BLEU. Our method has been deployed within LinkedIn's customer service team for approximately six months and has reduced the median per-issue resolution time by 28.6%.



NODES AI 2026

The largest technical community gathering dedicated to Graph + AI

CONFERENCE DATE

April 15, 2026 - Leonhard Euler's Birthday

PRE-EVENT

Five 2 hour AI workshops
March 5, 11, 17, 26 and 31

EVENT

- One day free online conference
- Live technical sessions from community experts
- From: 10:00 am ET /4:00 pm CET
  To: 5:00 pm ET / 11:00 pm CET

AI-FOCUSED SESSIONS IN THREE TRACKS

- Knowledge Graphs and GraphRAG
- Graph Memory and Agents
- Graph + AI in Production

WHO SHOULD PARTICIPATE

Anyone interested in Graphs + AI

REGISTER: neo4j.com/nodes-ai


YOU ARE CLEAR TO DO WHATEVER..
© MONTE WOLVERTON
caglecartoons.com


Ground
Controller
Dances To Work
Amazing Dance

Thank you!

Nyah.Macklin@neo4j.com

Nyah Macklin

linkedin.com/in/nyahmacklin