Elizabeth Fuentes Leone

Developer Advocate

elifuentes.tech

elifuentes.tech

When RAG Hallucinates Numbers

Graph-RAG for Precise Answers

Based on: MetaRAG (arxiv 2509.09360) and RAG-KG-IL (arxiv 2503.13514)

6 Techniques to Stop AI Agents from Failing

This talk is part of a series covering production patterns for reliable AI agents:

01 **Graph-RAG**

Knowledge graphs for grounded answers

02 **Semantic Tool Selection**

FAISS filtering to reduce tokens and errors

03 **Multi-Agent Validation**

Executor, Validator, Critic pipeline

04 **Neurosymbolic Guardrails**

Hard rules the LLM cannot bypass

05 **Agent Control Steering**

Self-correction instead of failure

06 **Production Deployment**

MCP Gateway, serverless, observability

Today: Graph-RAG for Precise Answers

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Your RAG Agent Seems Smart...

...until you ask it to count something.

"How many hotels have a swimming pool?"

RAG says: "approximately 45-50"

Reality: 133

Fabricated Statistics

Invents counts and averages from 3 retrieved chunks

Incomplete Retrieval

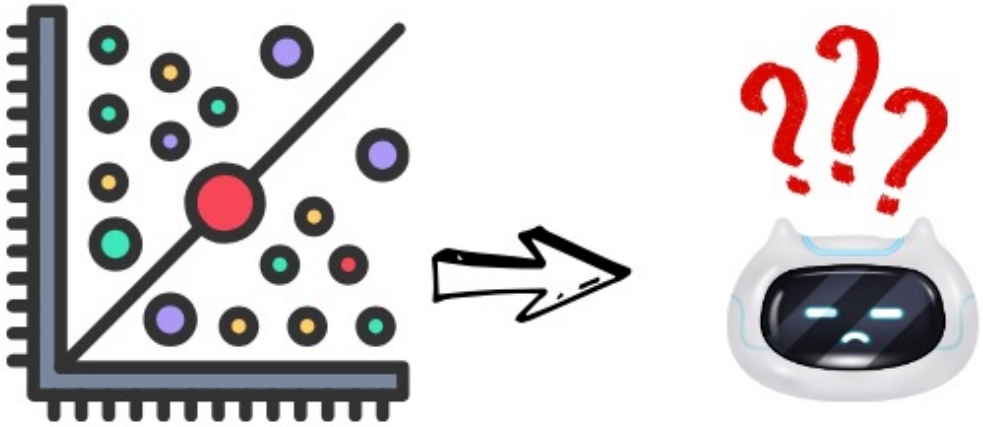
Sees 3 of 300 documents, generalizes from fragments

? Out-of-Domain Fabrication

Vector search always returns results, even for Antarctica

RAG vs Graph-RAG: The Fundamental Difference

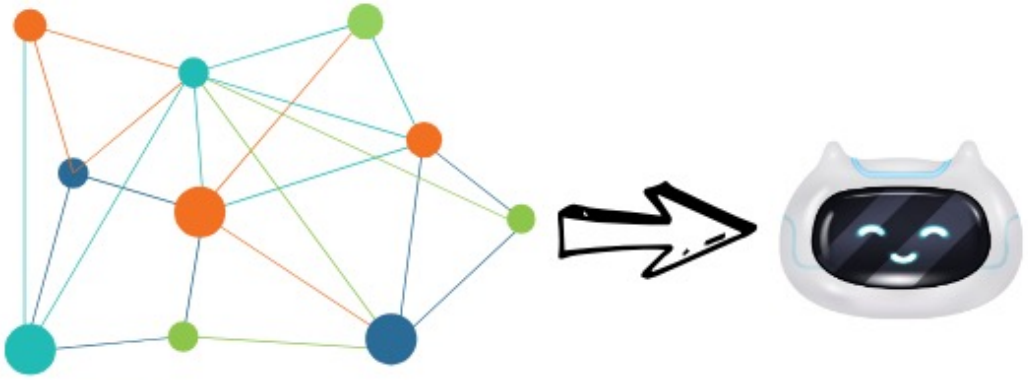
Agentic RAG



Test → Performance

Multi-step reasoning → ❌ Cannot aggregate
Comparative queries → ⚠️ May hallucinate stats
Exact counts → ❌ Partial results only
Out-of-domain → ⚠️ Returns similar results

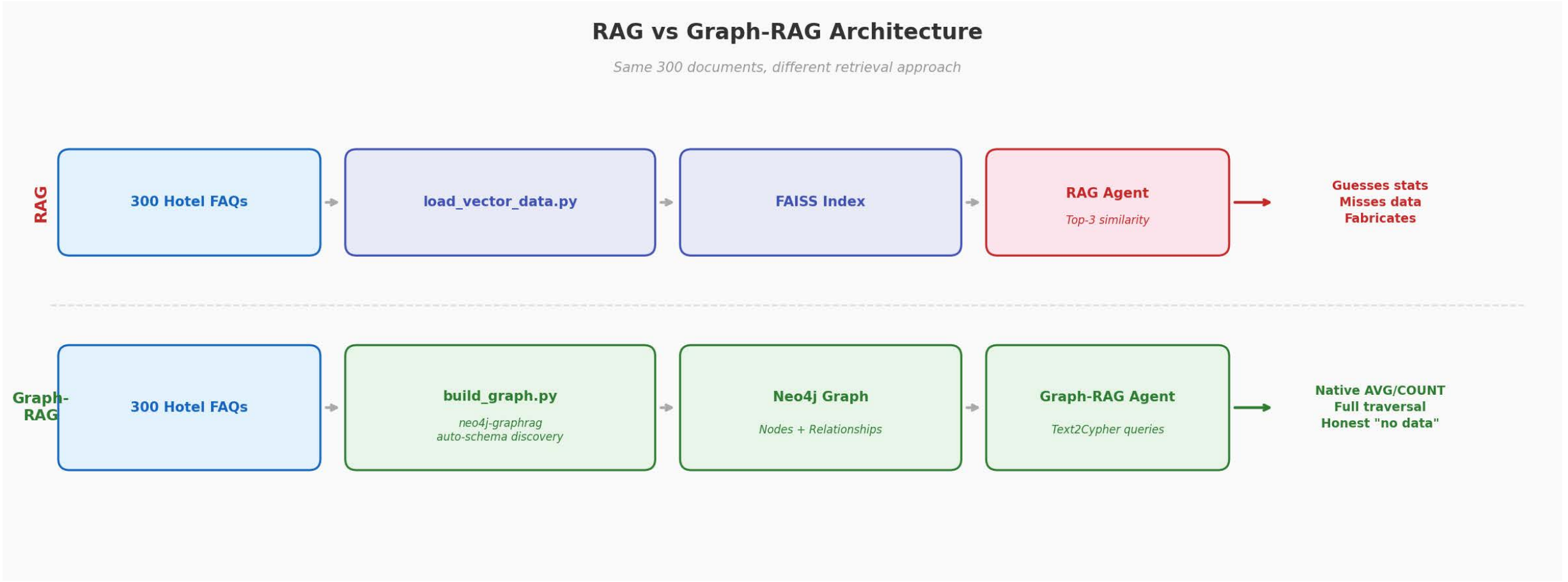
Agentic Graph-RAG



Test Performance

Multi-step reasoning → ✅ Uses relationship traversal
Comparative queries → ✅ Precise aggregation
Exact counts → ✅ Complete filtering
Out-of-domain → ✅ Explicit failure

Same Data, Different Architecture

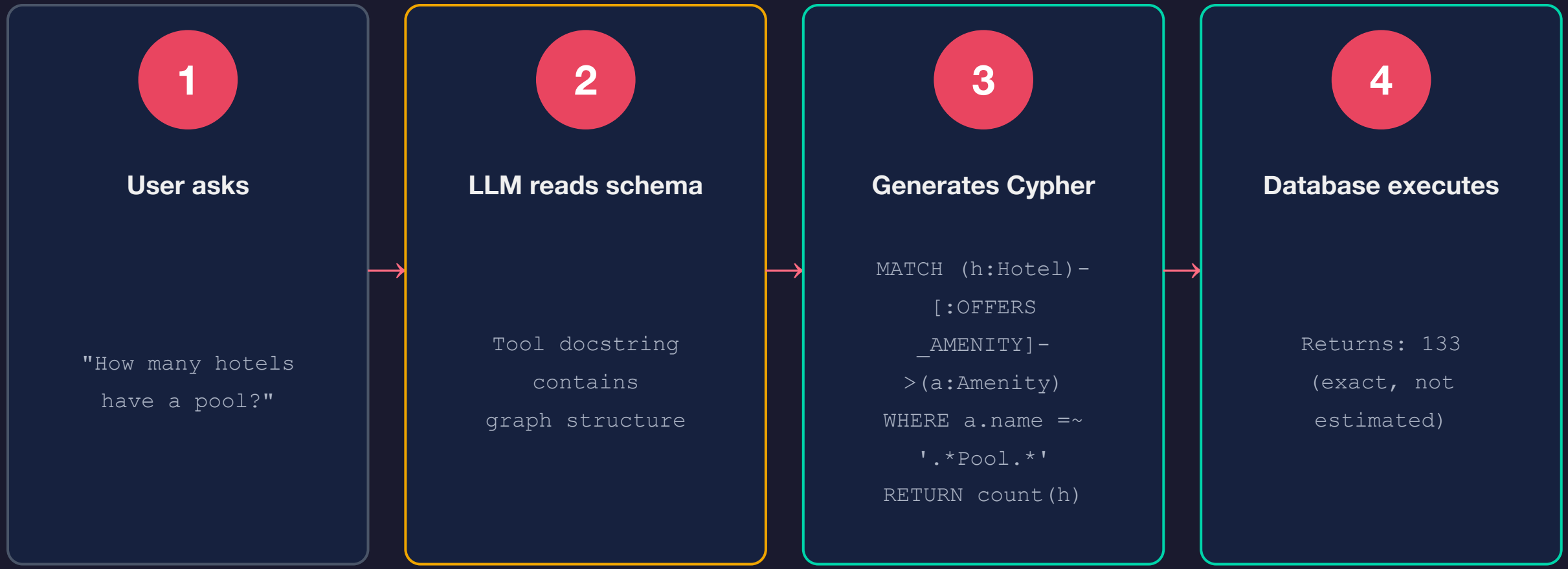


Both agents receive the same 300 hotel FAQ documents and the same queries.

Auto-Generated Knowledge Graph

No manual schema design. neo4j-graphrag discovers entities automatically.

Text2Cypher: Natural Language to Precise Queries



The LLM cannot fabricate: the database either has the data or it doesn't.

Demo Time

4 queries. Same data. RAG vs Graph-RAG.

Test 1: Aggregation

"What is the average guest rating across all hotels in Paris?"

RAG

4.7

Manually calculated from
2 retrieved documents

Graph-RAG

4.7

Native AVG() in Cypher
Database-level computation

Same answer, different reliability. RAG got lucky with 2 docs.

Test 2: Precise Counting

"How many hotels have a swimming pool as an amenity?"

RAG

"I don't have the data"

Only sees 3 of 300 documents.
Cannot count across full dataset.

Graph-RAG

133

Exact COUNT via Cypher.
Complete filtering across all nodes.

Vector similarity fundamentally cannot count.

Test 3: Multi-Hop Reasoning

"What are the room types and prices for the highest rated hotel?"

RAG

Found 1 hotel but no rooms

Cannot traverse relationships.
Rating and rooms are in
different text chunks.

Graph-RAG

Complete room data

Traversed Hotel -> Room nodes.
ORDER BY guestRating DESC
LIMIT 1 + relationship traversal.

Knowledge graphs preserve relationships that chunking destroys.

Test 4: Out-of-Domain Detection

"Tell me about hotels in Antarctica"

RAG

HALLUCINATED

- Research Stations
- Expedition Cruises
- Specialized Lodges

None of these exist in the dataset.

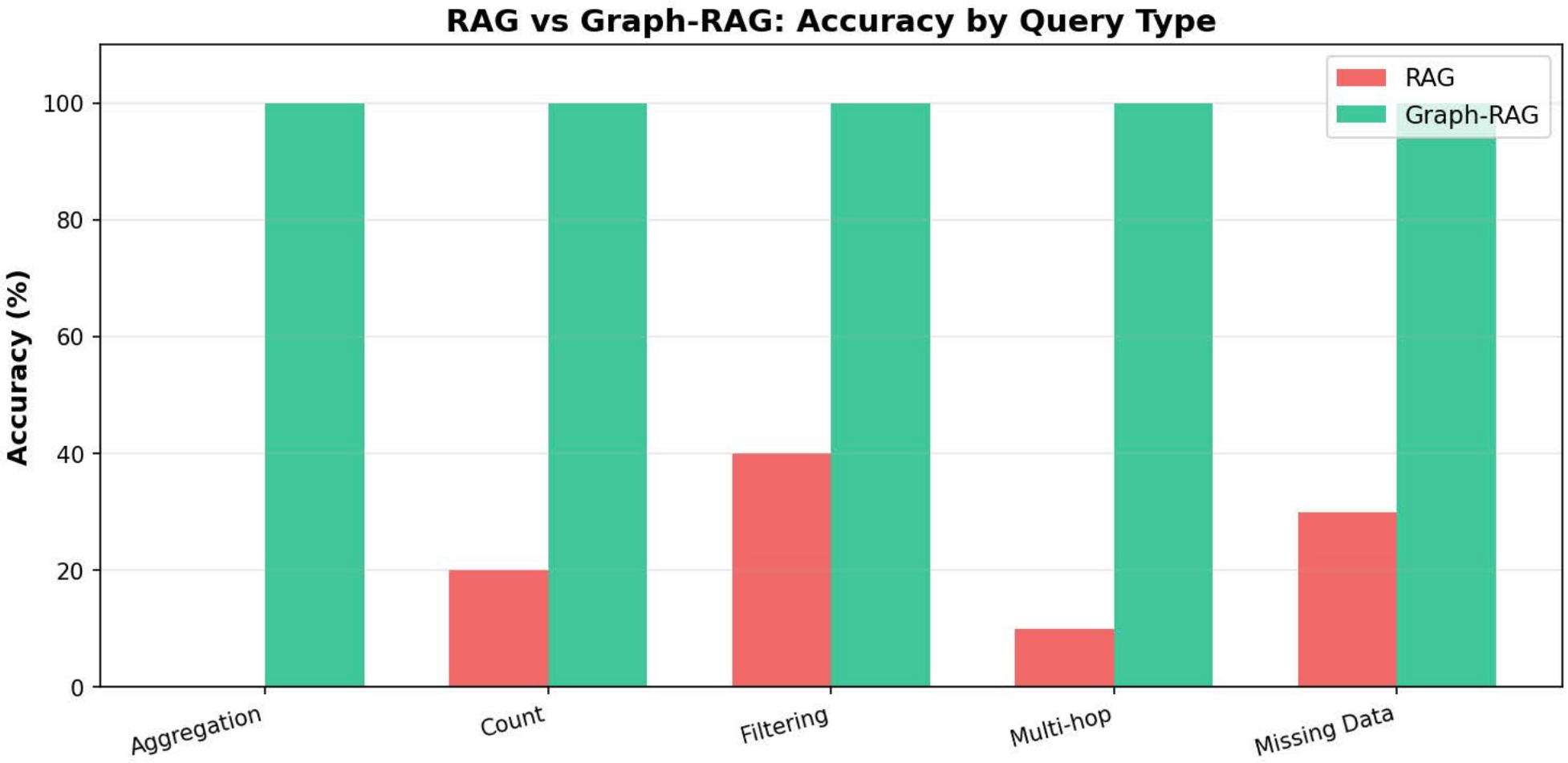
Graph-RAG

"No hotels listed in Antarctica"

Returns empty result set.
Honest failure, not fabrication.

RAG always returns something. Graph-RAG returns empty when data doesn't exist.

RAG vs Graph-RAG: Accuracy by Query Type



Graph-RAG: 100% across all query types. RAG: 0-40%.

Production Patterns

1 @tool Decorator

Wrap Cypher queries as agent tools.
Schema in docstring grounds the LLM.

2 Hybrid Architecture

Vector search for open-ended questions.
Graph for structured queries (counts, filters).

3 Performance

Graph build: one-time cost.
Query accuracy: deterministic, auditable.

4 Error Handling

Empty results = honest "no data".
No silent fabrication.

When to Use RAG vs Graph-RAG

Use Graph-RAG

- ✓ Precise queries (exact counts, filters)
- ✓ Aggregations (AVG, SUM, COUNT)
- ✓ Multi-hop reasoning (relationships)
- ✓ Structured data with clear schemas
- ✓ Verifiable, auditable results

Use RAG

- Semantic search (similar concepts)
- Unstructured text (articles, docs)
- Fuzzy matching (approximate)
- Simple retrieval (Q&A lookups)
- No graph infrastructure needed

Key Takeaways

1. Implement Graph-RAG with Neo4j and auto entity extraction for any document set
2. Apply Text2Cypher query generation for precise, unfabricable answers
3. Build a concrete decision framework for when to use RAG vs Graph-RAG
4. Design hybrid architectures: Graph-RAG for structured, RAG for unstructured
5. Evaluate open-source tools adaptable to any domain with structured data

Resources

Code	github.com/elizabethfuentes12/why-agents-fail-sample-for-amazon-agentcore
Paper	MetaRAG: Meta-analysis of RAG failure modes (arxiv 2509.09360)
Paper	RAG-KG-IL: RAG with Knowledge Graph Integration (arxiv 2503.13514)
Blog	dev.to/aws/rag-vs-graphrag-when-agents-hallucinate-answers

Thank You!

Elizabeth Fuentes Leone

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Blog & Socials

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Resources

bit.ly/4uYWb0R