Graphs and RAG

GRAPH RAG WITH LANGCHAIN AND NEO4J

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Manager, Developer Education at Neo4j

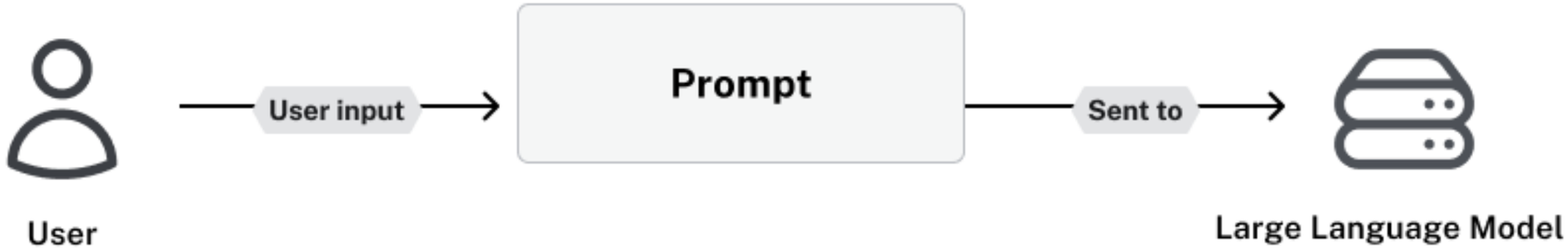
datacamp

Meet your instructor

- Manager, Developer Education at Neo4j
- Developer Education through **Neo4j GraphAcademy**
- 20+ years of software development experience
- 10+ years Neo4j experience

[1] https://graphacademy.neo4j.com

The R in RAG



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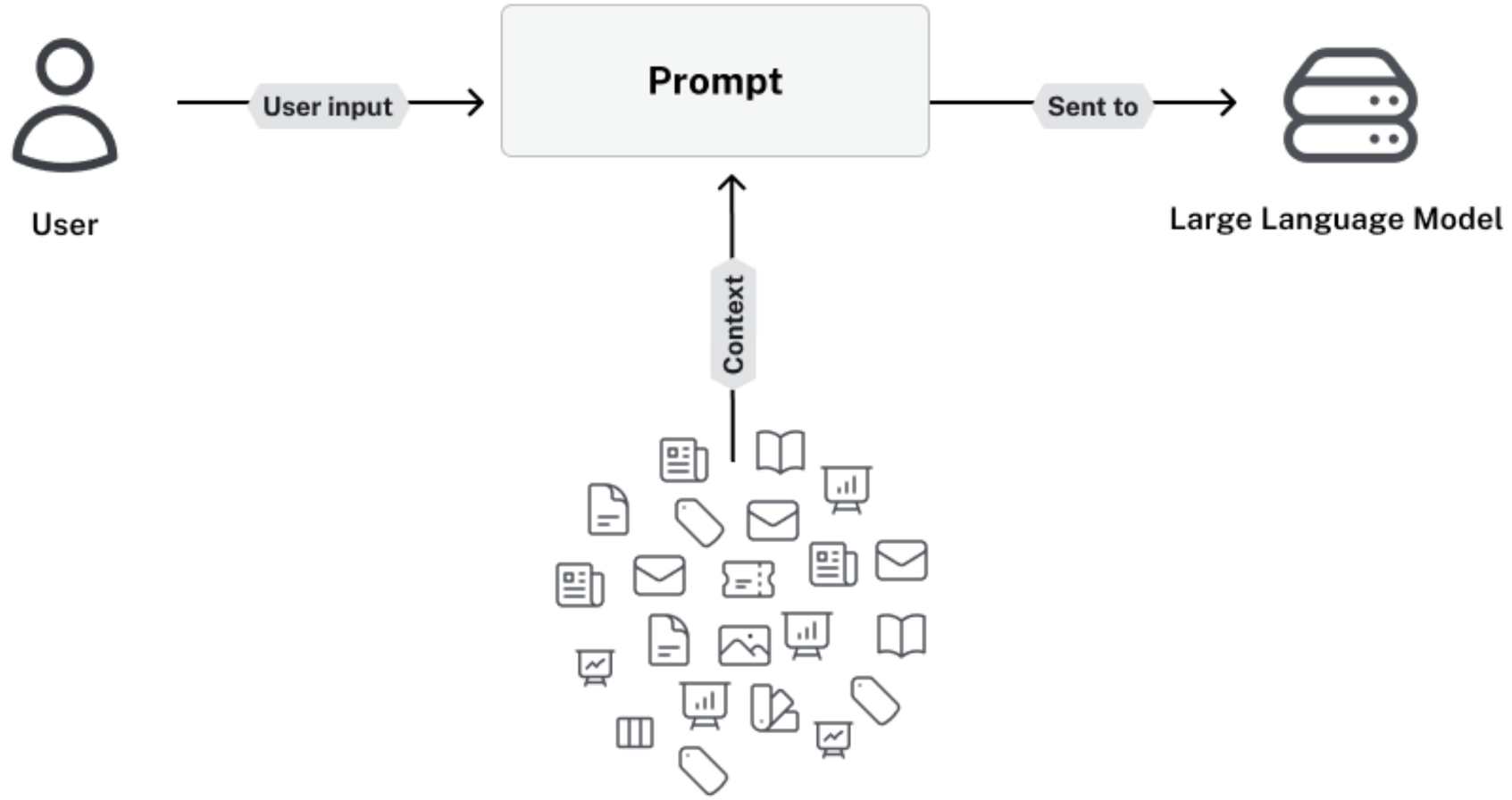
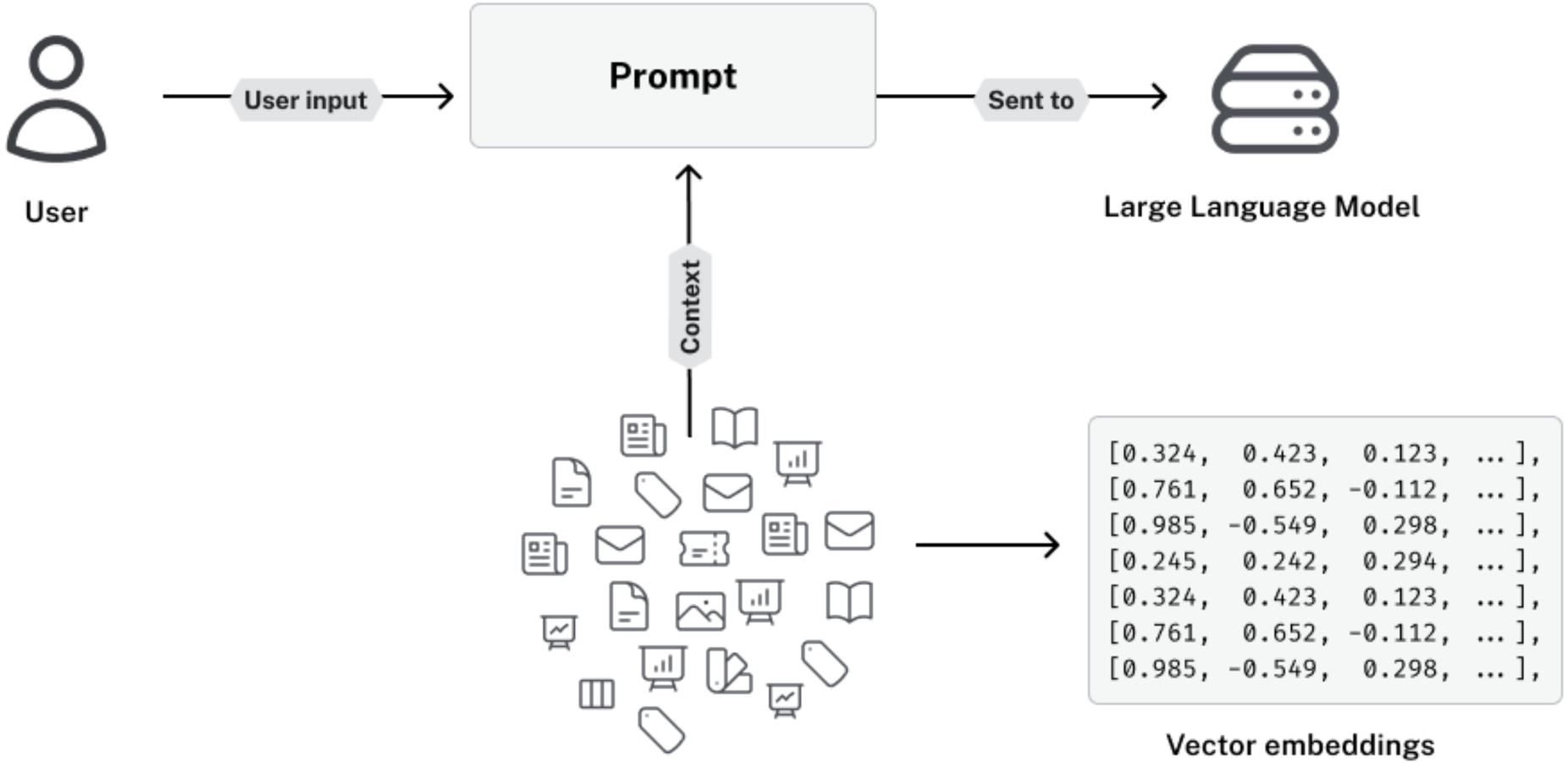

User
User input
Prompt
Sent to
Large Language Model
Context

The R in RAG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[0.324, 0.423, 0.123, ...],
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[0.985, -0.549, 0.298, ...],
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Vector embeddings

Where does semantic search fail?

Vectors work well for

- Fuzzy or Open-Ended questions

Vectors are ineffective for

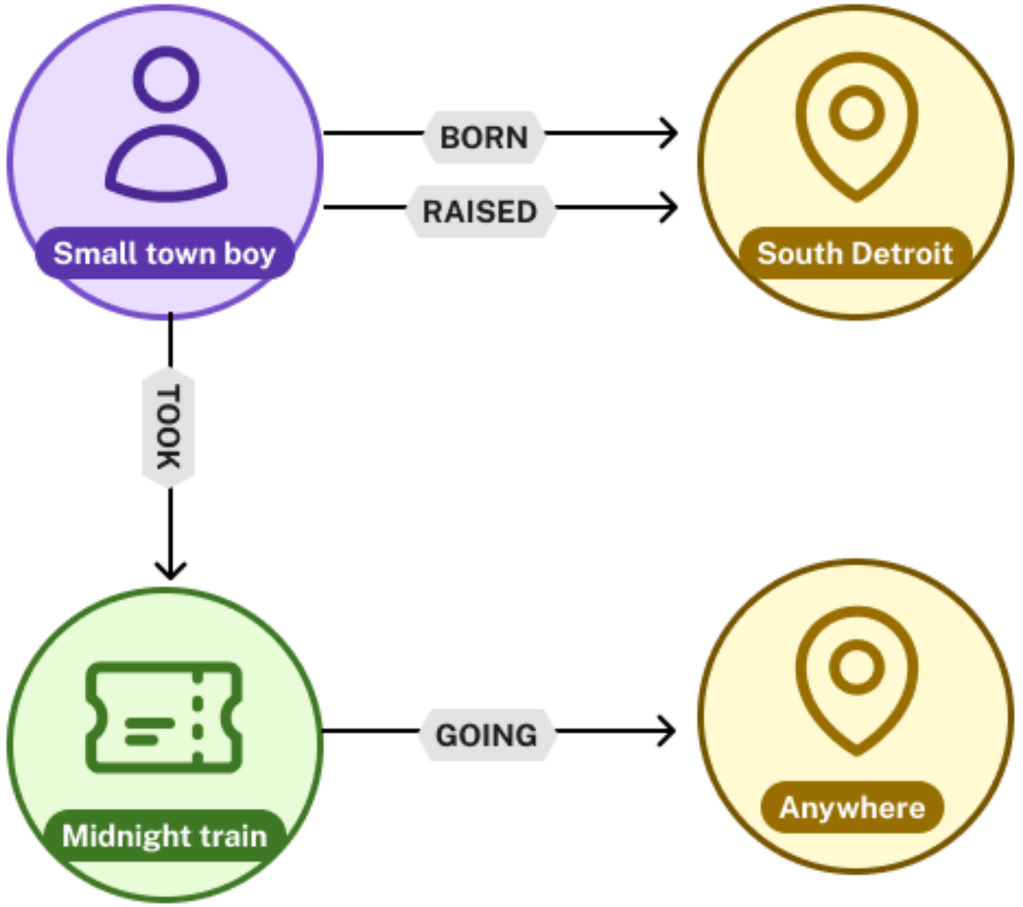
- Highly Specific or Fact-Based Questions
- Numerical or Exact-Match Queries
- Logical Queries

> *What does Paul Graham think about Generative AI?*

> *How many Generative AI Startups has Paul Graham invested in?*

Vectors vs. knowledge graphs

Text	Vector Embedding
He's just a city boy born	`[0.12, -0.34, 0.56, 0.78, ..., -0.91]`
born and raised in South Detroit	`[0.22, 0.45, -0.67, 0.11, ..., 0.33]`
He took the midnight train	`[-0.55, 0.89, 0.12, -0.44, ..., 0.67]`
going anywhere	`[0.78, -0.23, 0.45, 0.91, ..., -0.12]`



Vectors vs. knowledge graphs

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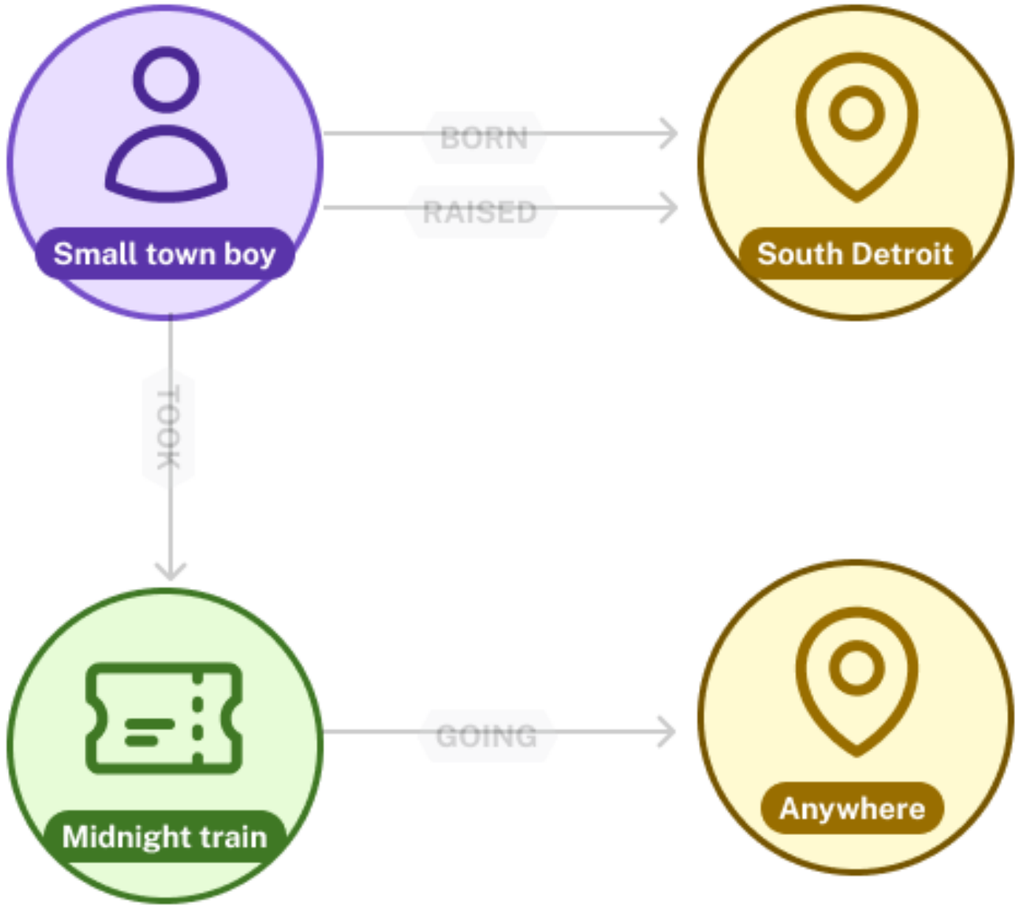

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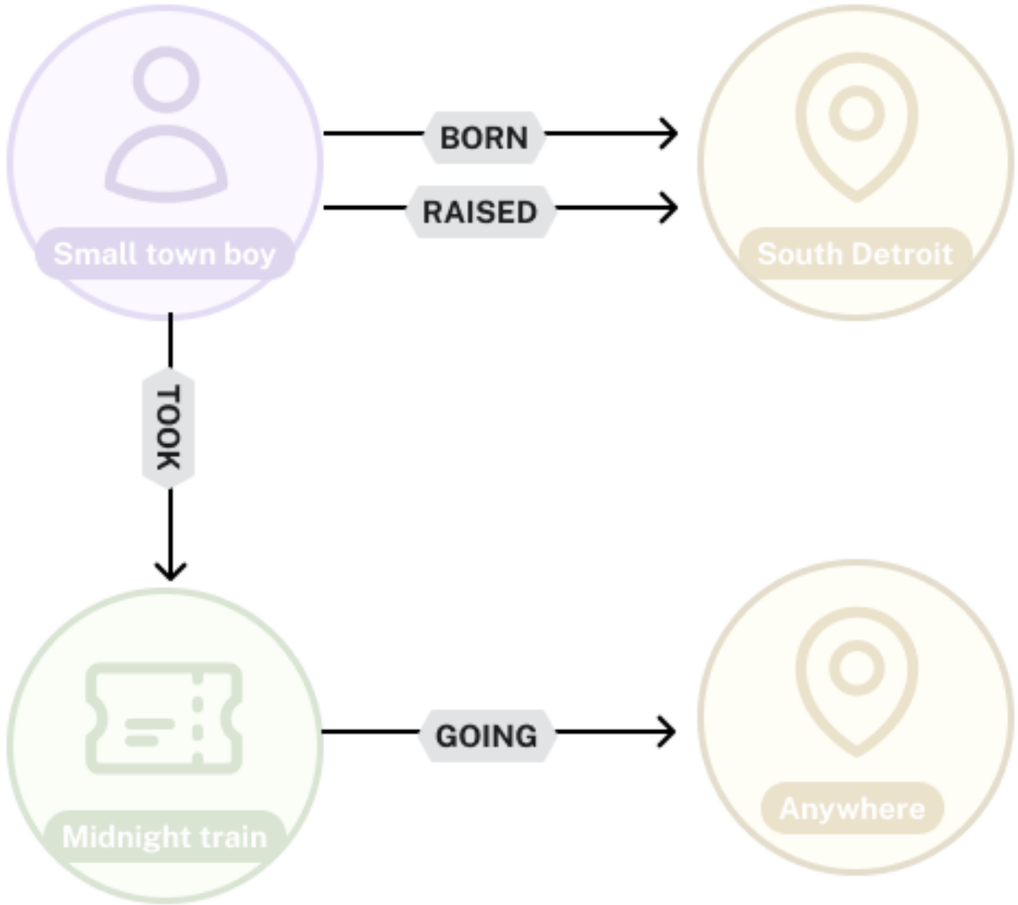


Knowledge graphs and Neo4j

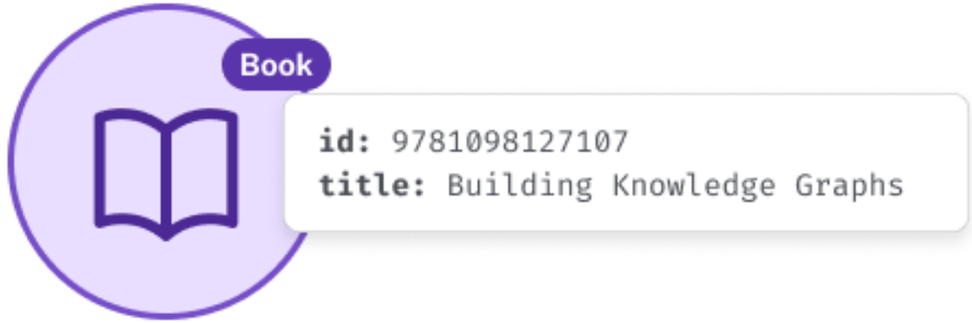
- Neo4j is the world's leading graph database
- Flexible, schema-optional
- `langchain-neo4j` LangChain integration
- **LCEL**: *LangChain Expression Language*

[1] https://db-engines.com/en/ranking/graph%20dbms

Nodes represent things

```
from langchain_neo4j.graphs.graph_document \
  import Node

book = Node(
    type="Book",
    id=f"9781098127107",
    properties={
        "title": "Building Knowledge Graphs"
    }
)
```



Relationships connect nodes

```
from langchain_neo4j.graphs.graph_document \
  import Node, Relationship

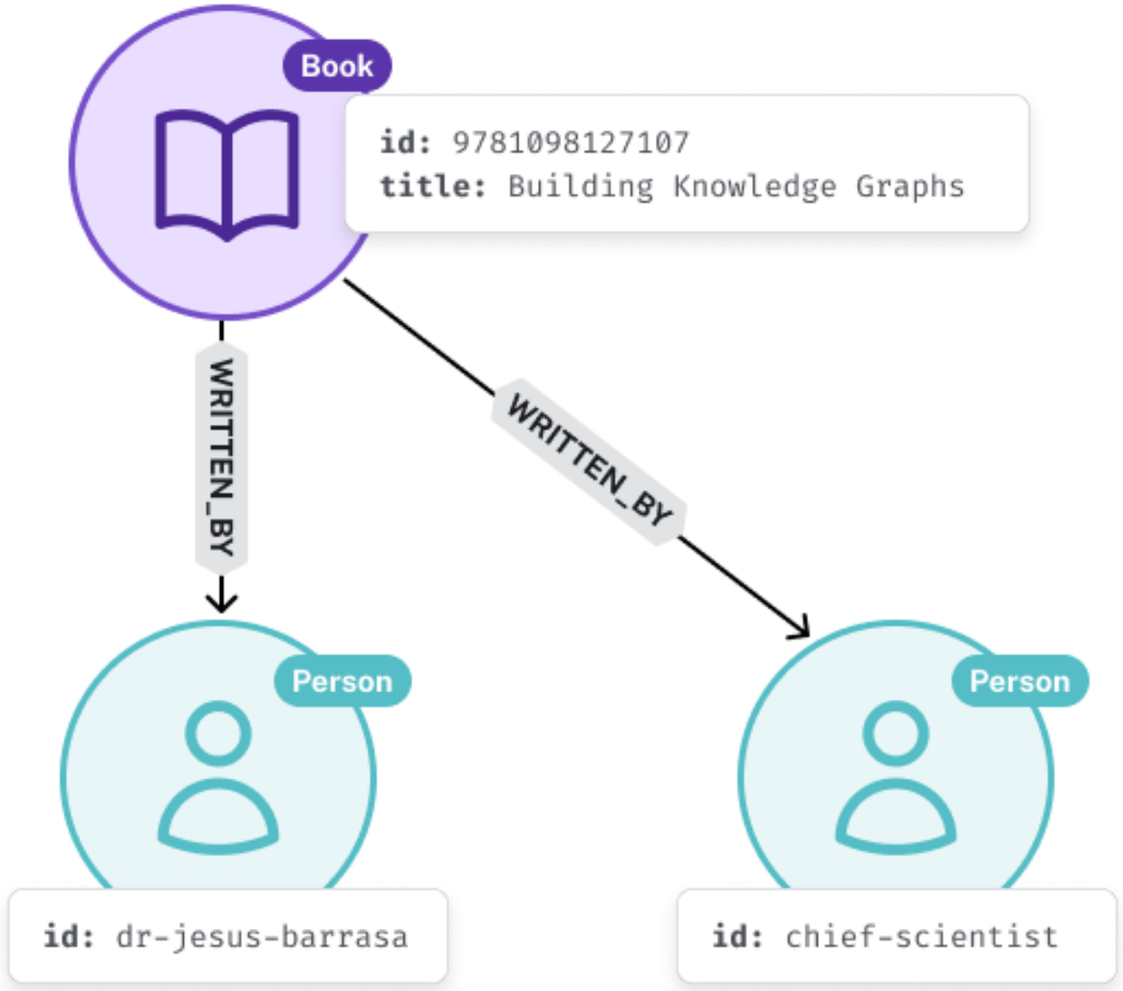
book = Node(type="Book", id=f"9781098127107")

jesus = Node(type="Person", id="dr-jesus-barrasa")
jim = Node(type="Person", id="chief-scientist")
```

```
for author in [jesus, jim]:
    relationship = Relationship(




    )
```



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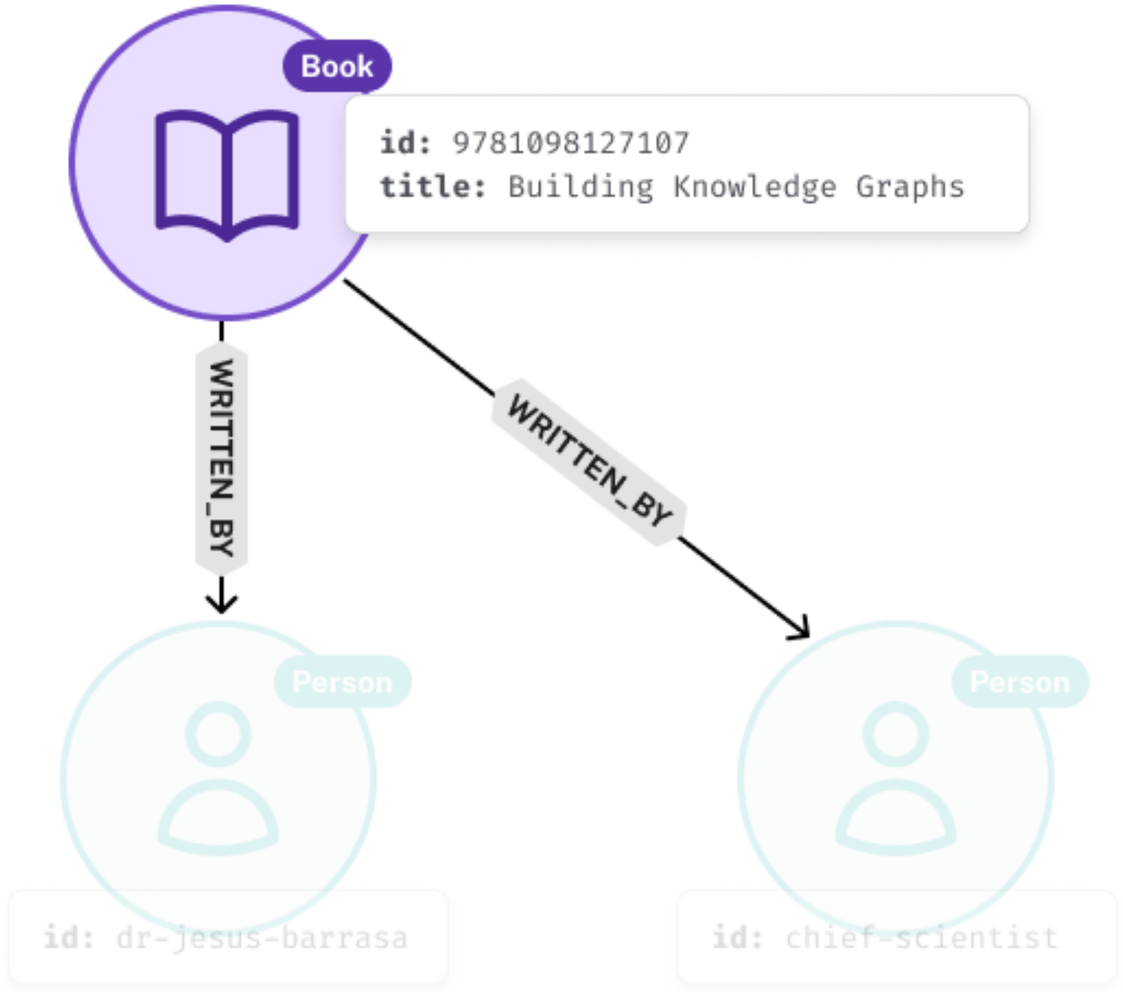
for author in [jesus, jim]:
    relationship = Relationship(
        source=book,



    )
```



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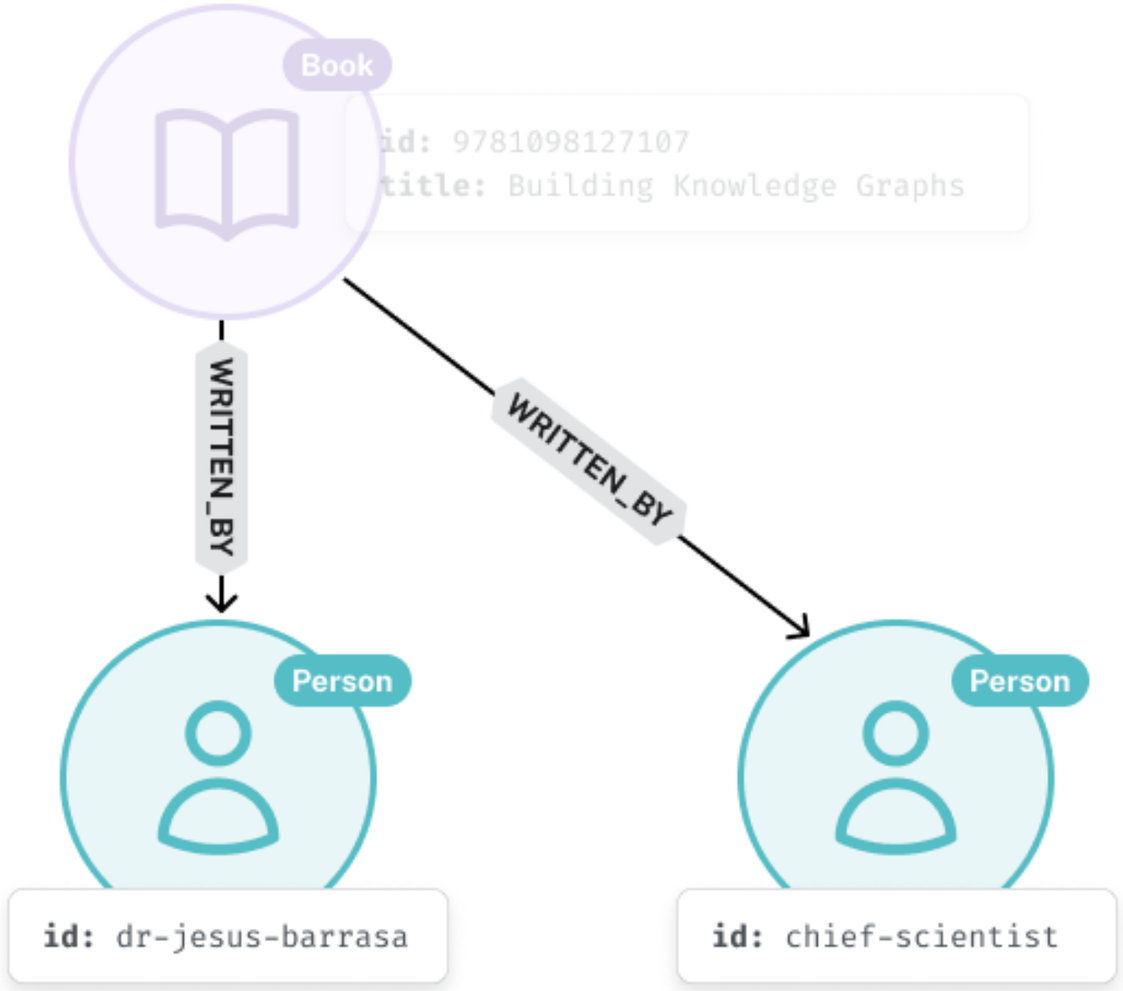
    relationship = Relationship(
        source=book,
        destination=author,



    )
```



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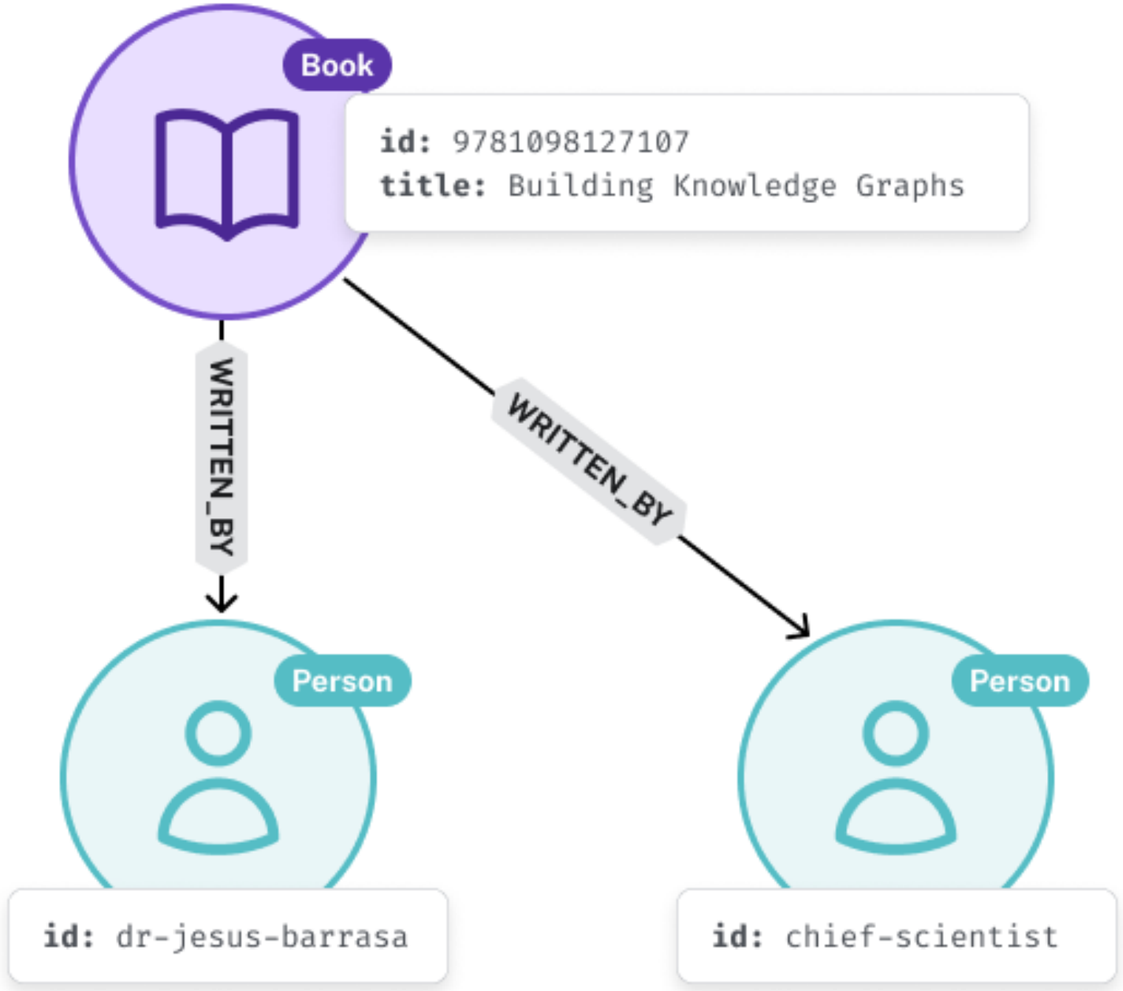
jesus = Node(type="Person", id="dr-jesus-barrasa")
jim = Node(type="Person", id="chief-scientist")
```

```
for author in [jesus, jim]:
    relationship = Relationship(
        source=book,
        destination=author,
        type="WRITTEN_BY"
        properties=dict(...)
    )
```



Connecting to Neo4j

```
from langchain_neo4j import Neo4jGraph


graph = Neo4jGraph(
    url=NEO4J_URI,
    username=NEO4J_USERNAME,
    password=NEO4J_PASSWORD
)
```

[1] https://neo4j.com/docs/getting-started/

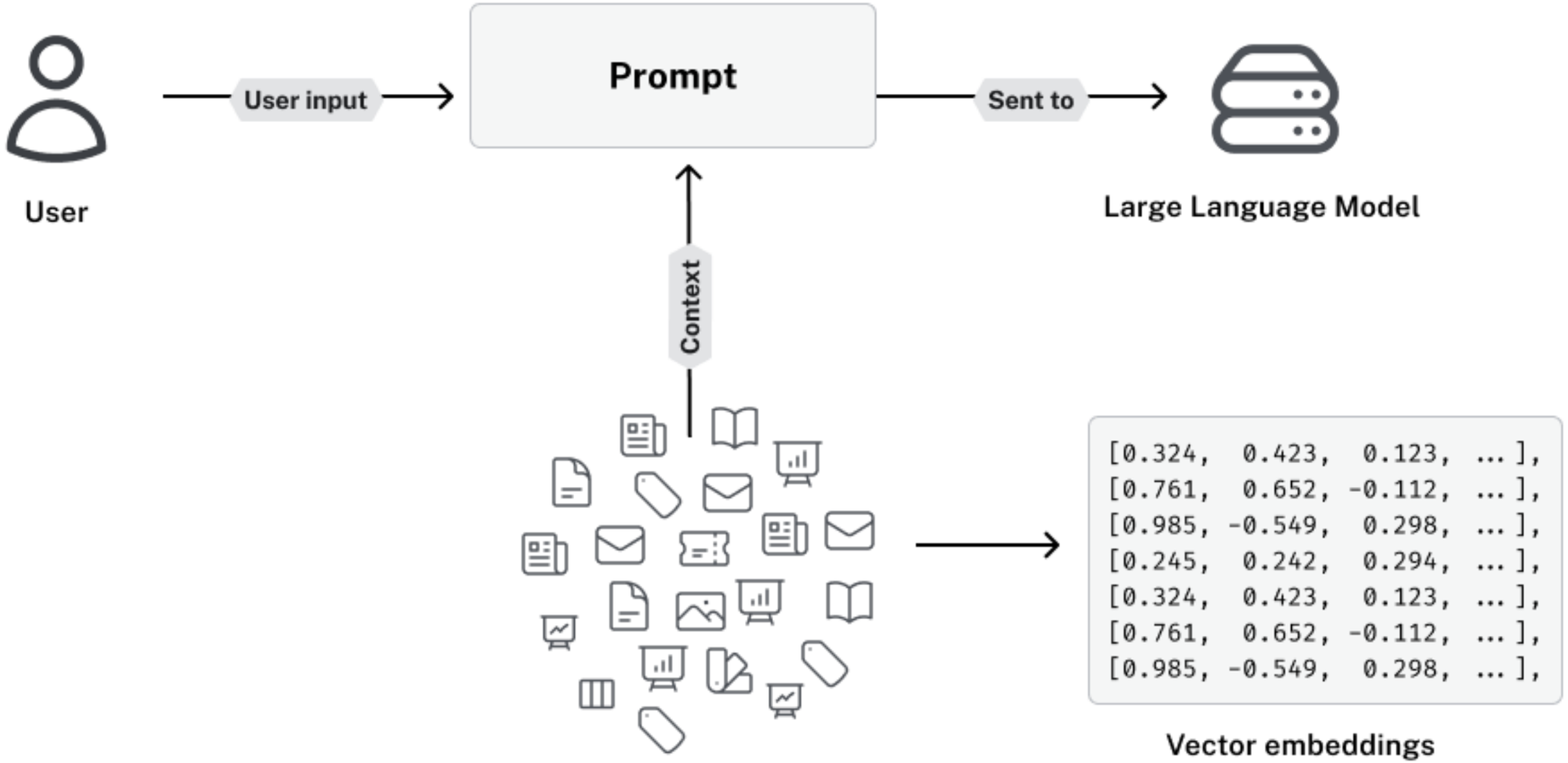
Saving graph documents

```
from langchain_neo4j.graphs.graph_document import GraphDocument

# Wrapper for Nodes and Relationships
doc = GraphDocument(
  nodes=[book, jesus, jim],
  relationships=[jesus_wrote_book, jim_wrote_book]
)

# Save nodes and relationships to the database
graph.add_graph_documents([graph_document])
```

So, what is GraphRAG?



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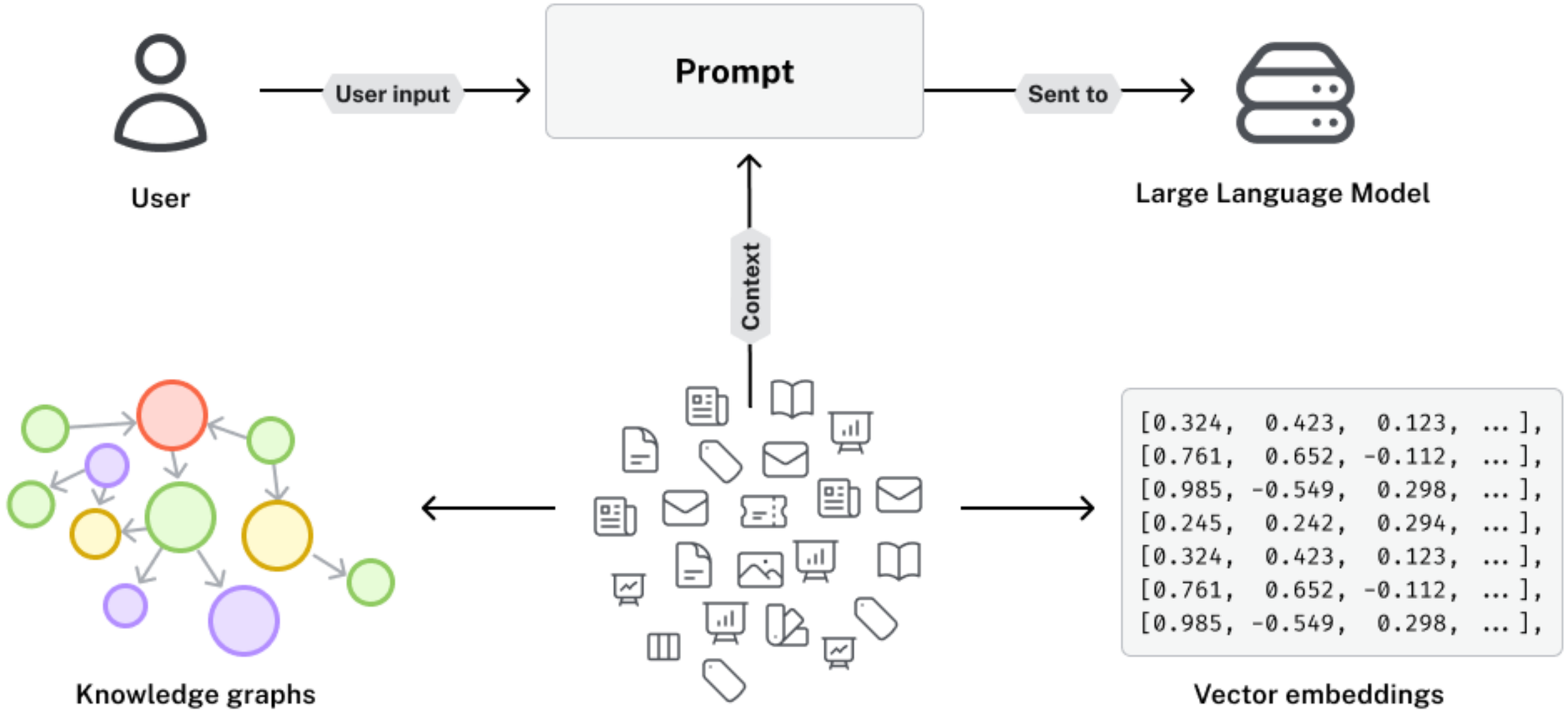

Let's practice!

GRAPH RAG WITH LANGCHAIN AND NEO4J

Querying a knowledge graph

GRAPH RAG WITH LANGCHAIN AND NEO4J

Adam Cowley
Manager, Developer Education at Neo4j

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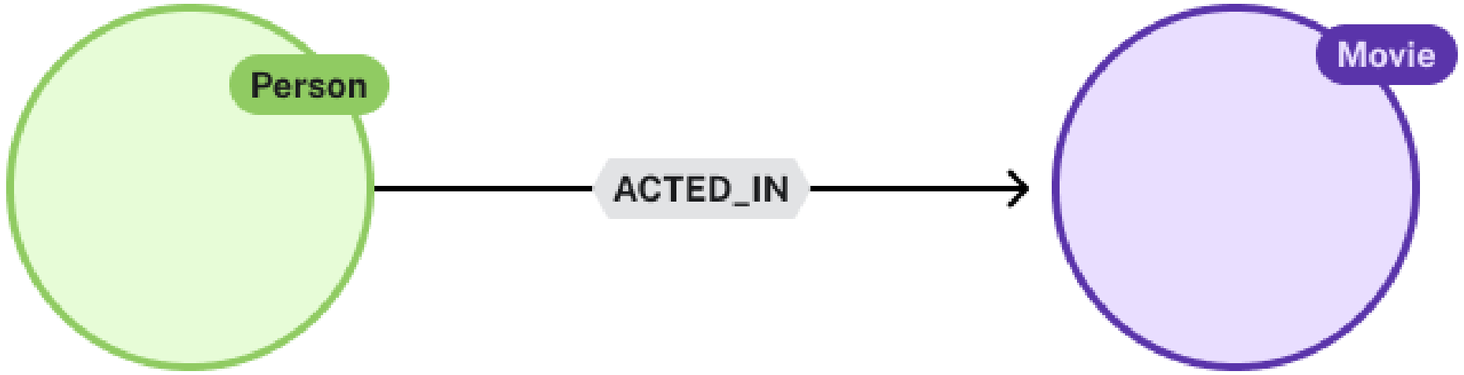
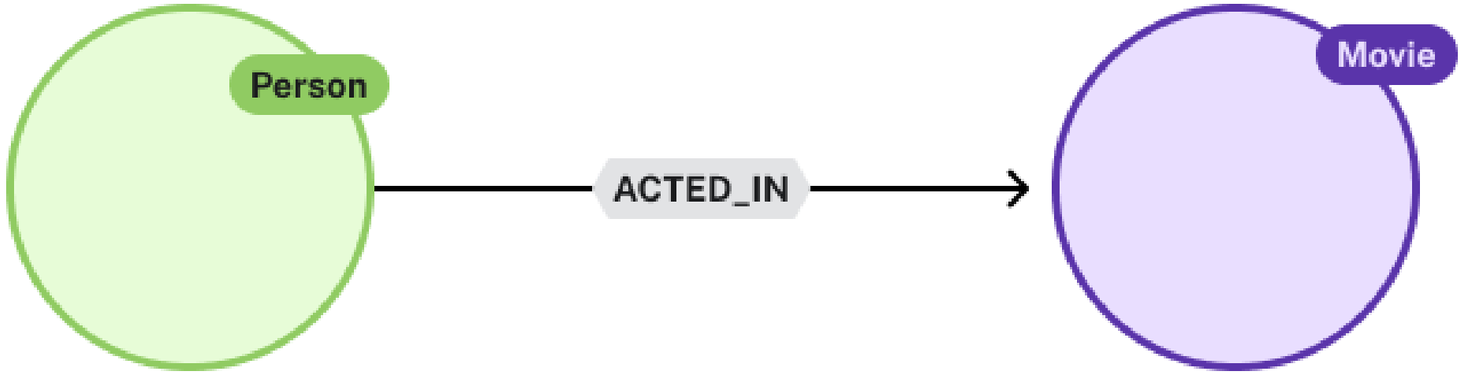
Cypher is pattern matching with ASCII-art




```
MATCH
```

Cypher is pattern matching with ASCII-art




```
MATCH (          )                    (          )
```

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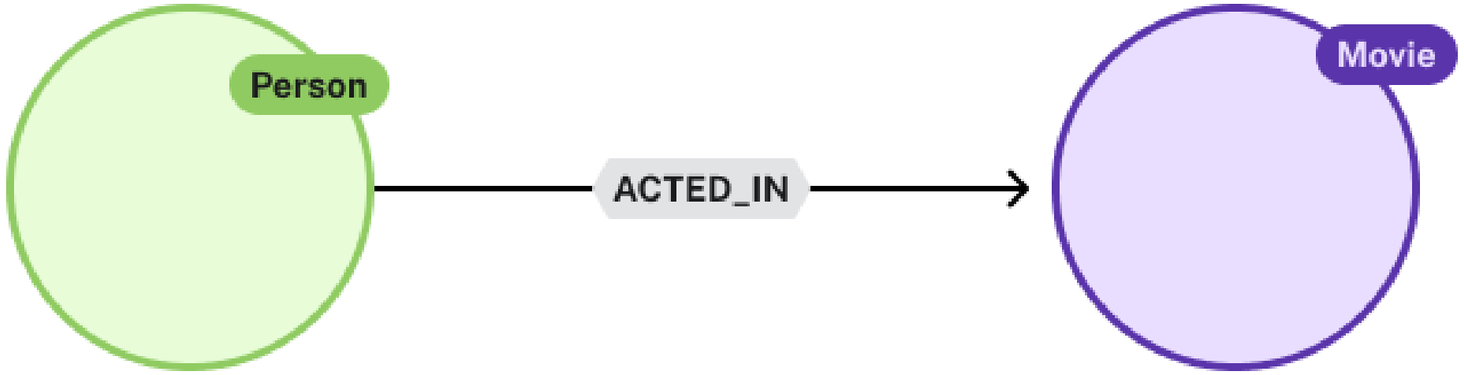
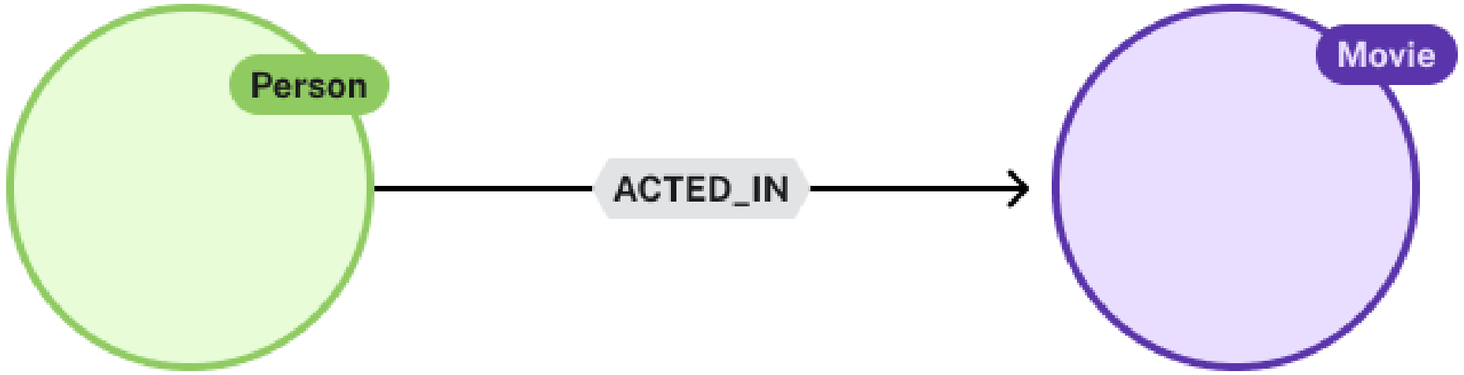


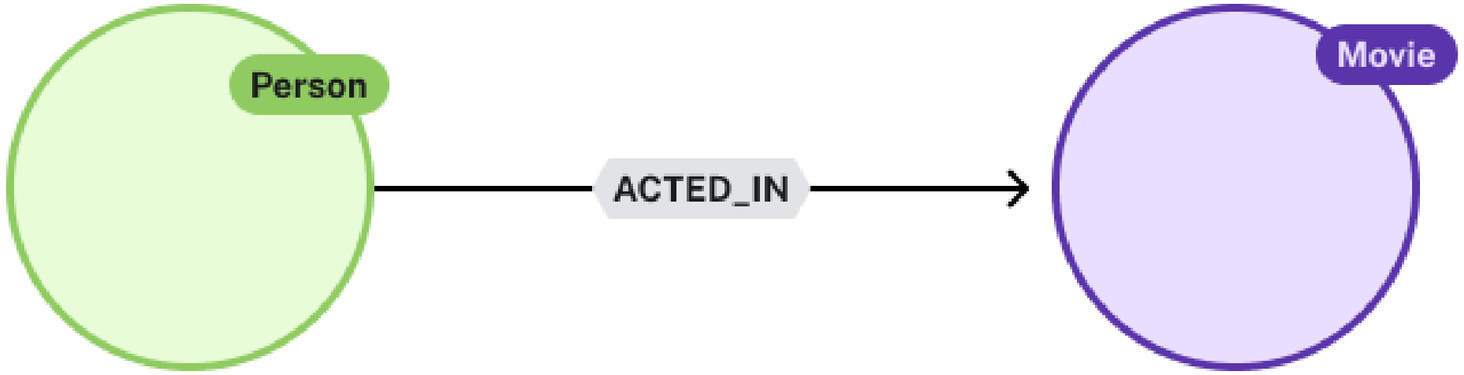

```
MATCH ( :Person)                    ( :Movie)
```

Cypher is pattern matching with ASCII-art



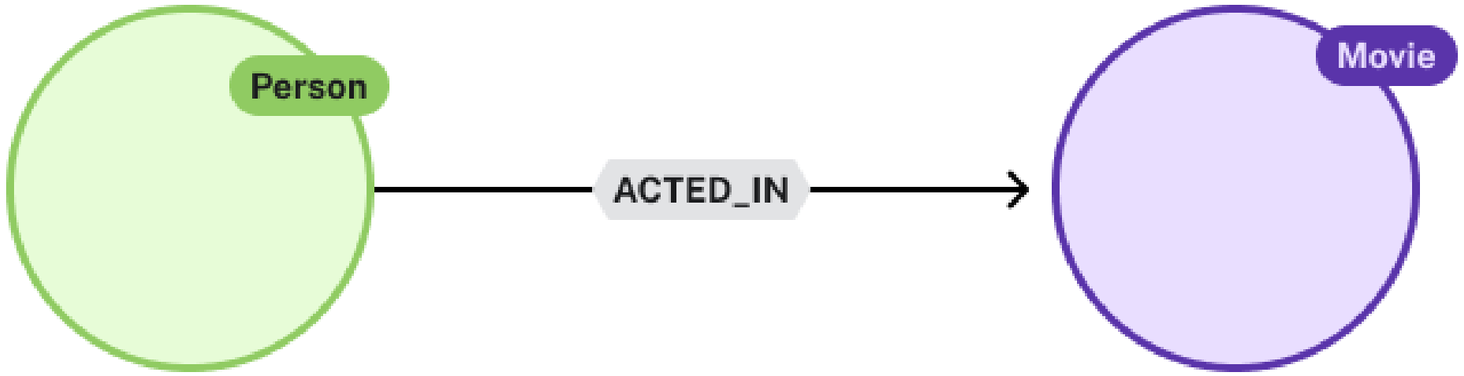

```
MATCH ( :Person)-                ->( :Movie)
```

Cypher is pattern matching with ASCII-art



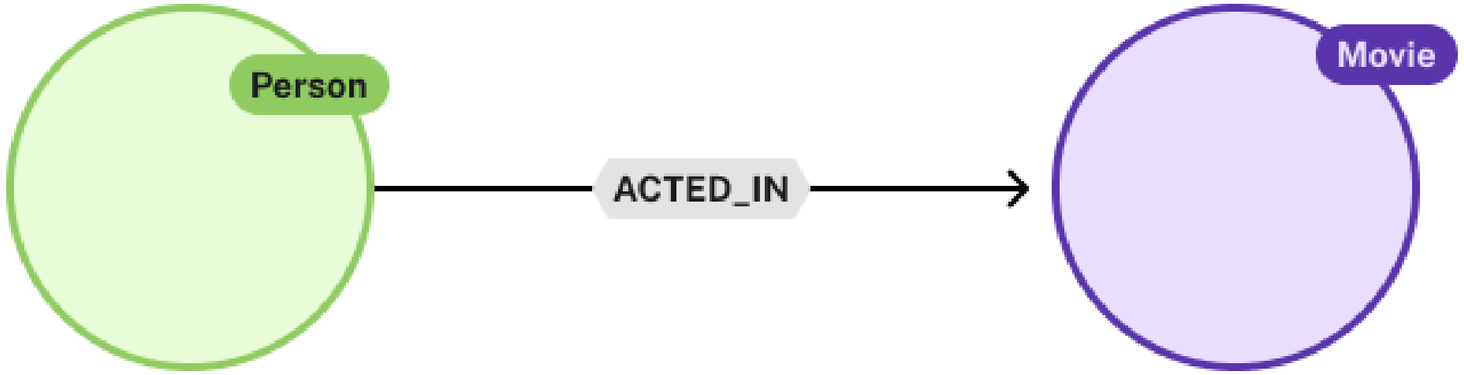

```
MATCH ( :Person)-[ :ACTED_IN]->( :Movie)
```

Cypher is pattern matching with ASCII-art



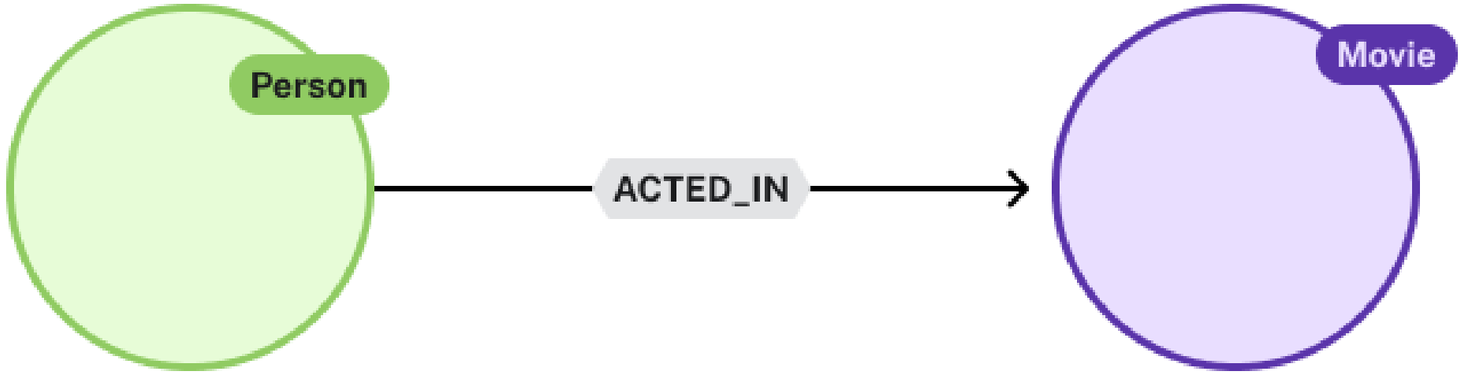

```
MATCH (a:Person)-[r:ACTED_IN]->(m:Movie)
```

Filtering results



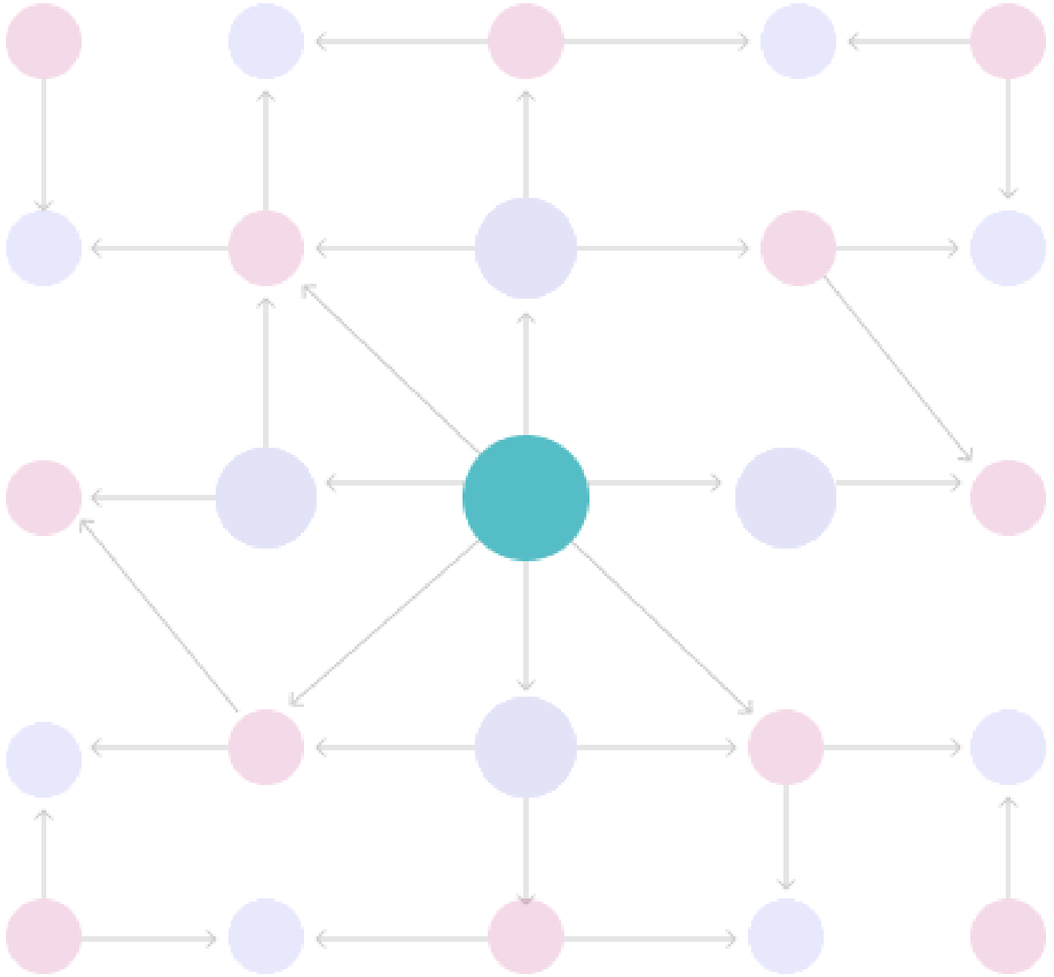

```
MATCH (a:Person)-[r:ACTED_IN]->(m:Movie)
WHERE a.name = 'Tom Hanks'
```

Controlling outputs




```
MATCH (a:Person)-[r:ACTED_IN]->(m:Movie)
WHERE a.name = 'Tom Hanks'
RETURN a.name, m.title AS movieTitle, r.roles AS roles
```

How Cypher works



The CREATE clause

The `CREATE` clause creates a pattern in the graph

```
CREATE (p:Person {name: "Adam"})
CREATE (c:Company {name: "Neo4j"})
CREATE (p)-[:WORKS_FOR]->(c)
```

The MERGE Clause

The `MERGE` clause will find *or create* a pattern in the graph

```
MERGE (p:Person {name: "Adam"})
MERGE (c:Company {name: "Neo4j"})
```

Cypher statements in LangChain

```python
from langchain_neo4j import Neo4jGraph


graph = Neo4jGraph(url=NEO4J_URI, username=NEO4J_USERNAME, password=NEO4J_PASSWORD)
```

```python
# Execute a Cypher statement
graph.query(
    "MATCH (p:Person {name: $name}) RETURN p",
    {"name": "Your name"}
)
```

[1] Cypher injection: https://neo4j.com/developer/kb/protecting-against-cypher-injection/

Let's practice!

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Text-to-Cypher Graph RAG with Neo4j

GRAPH RAG WITH LANGCHAIN AND NEO4J

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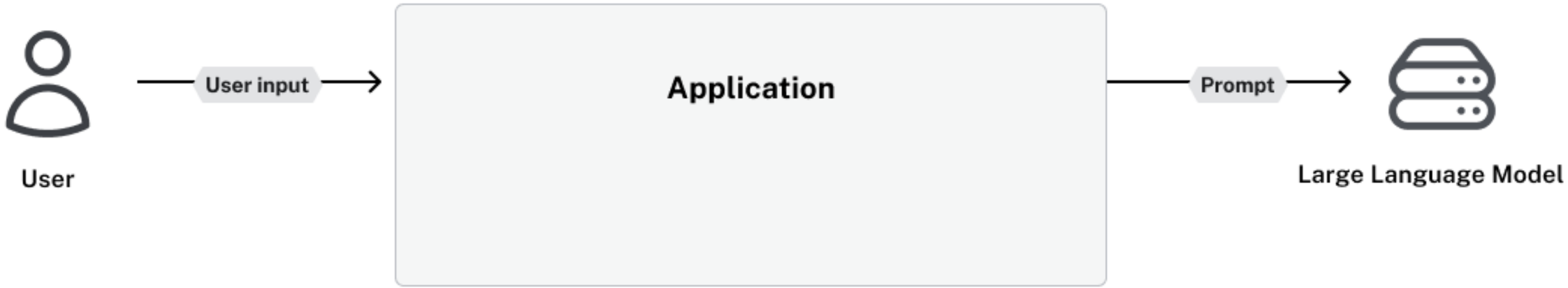
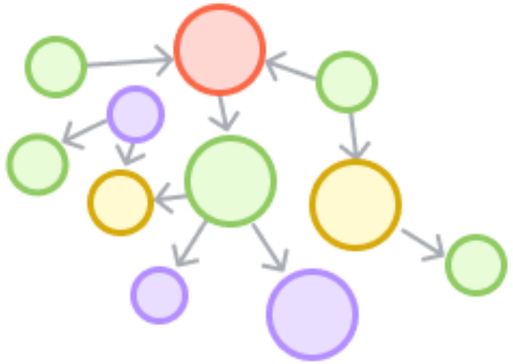
Converting natural language to Cypher





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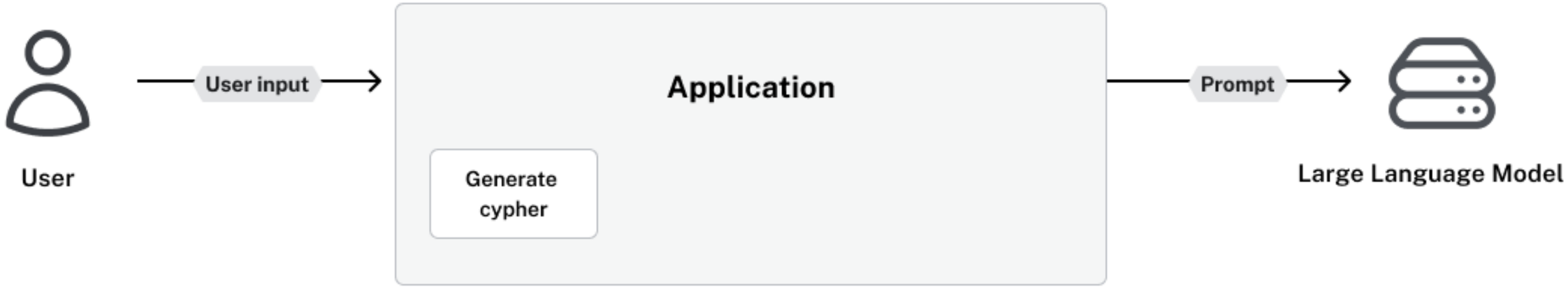

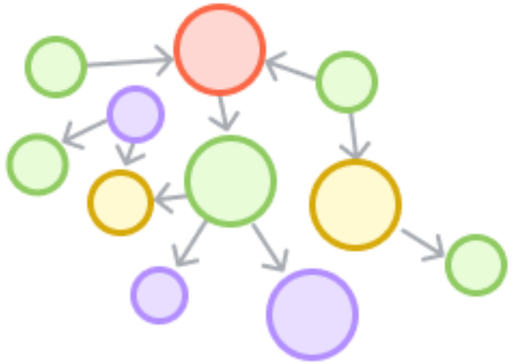

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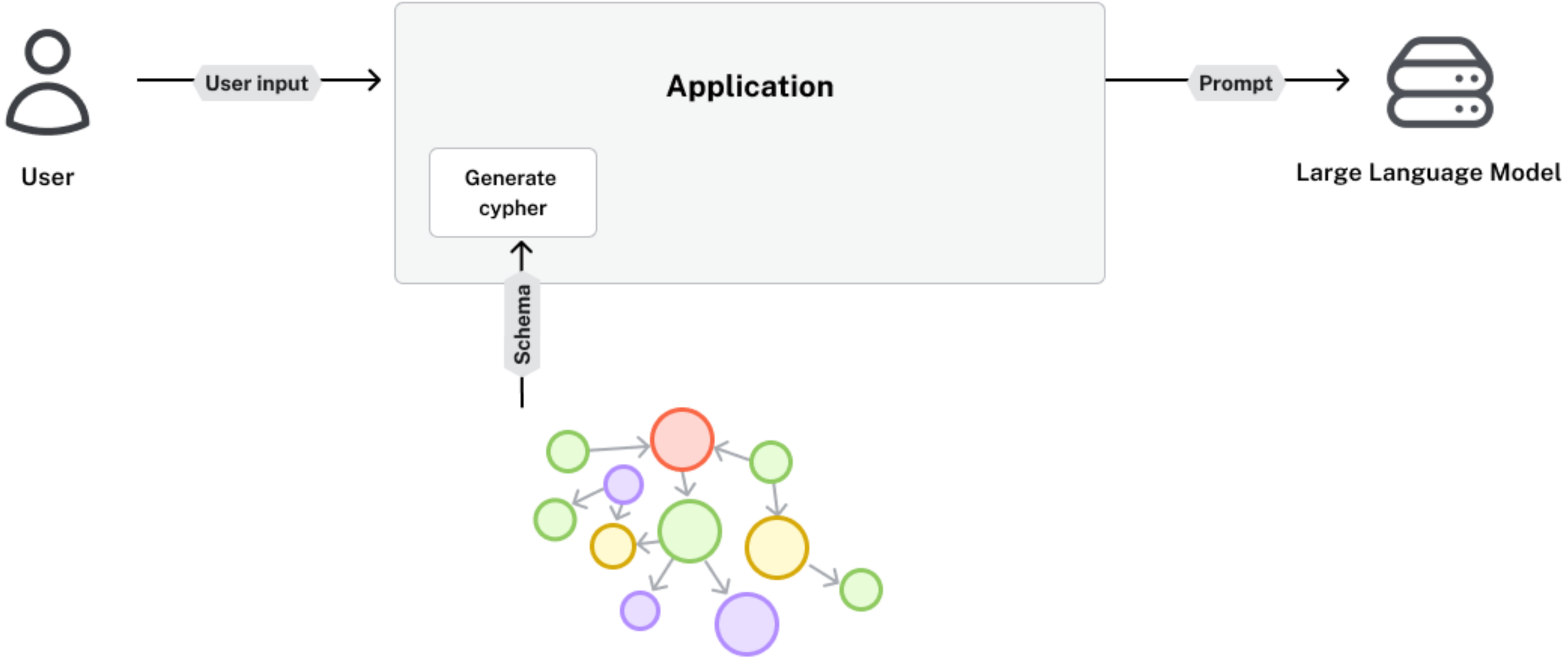

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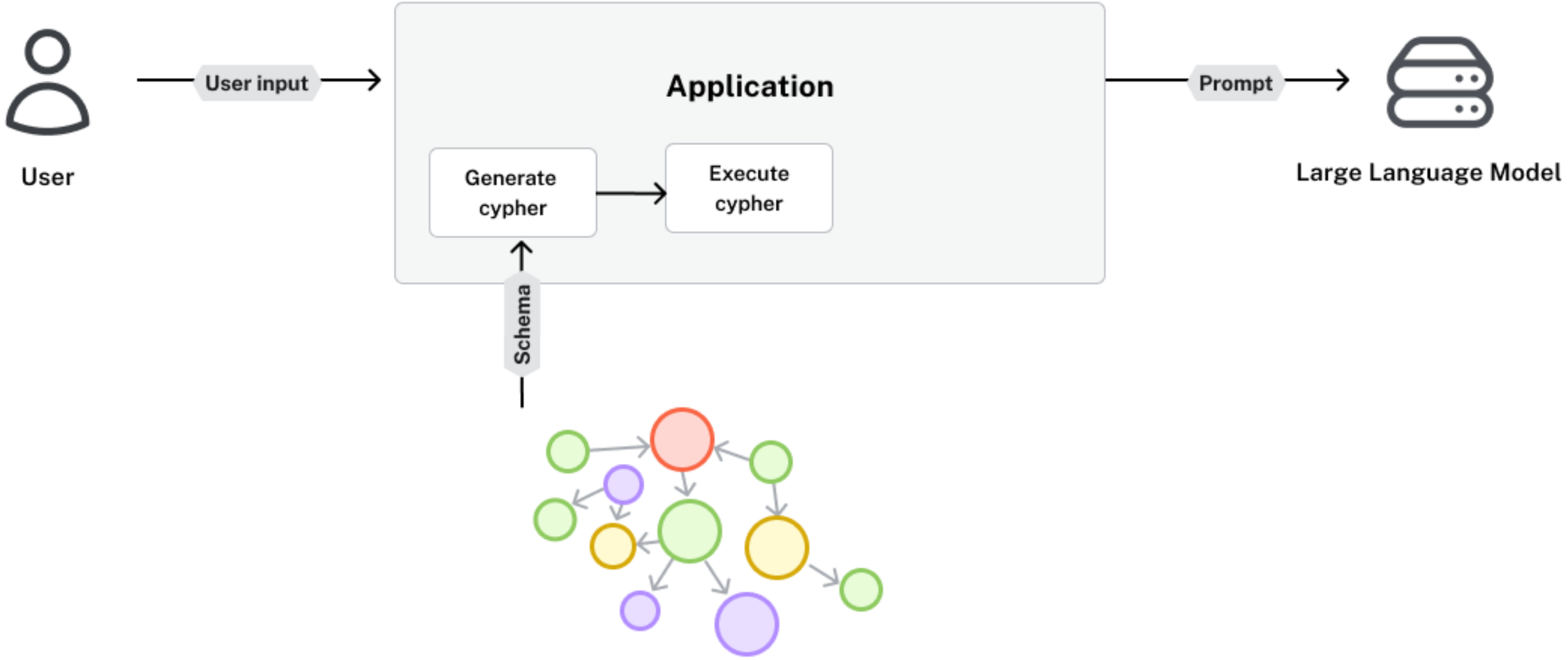

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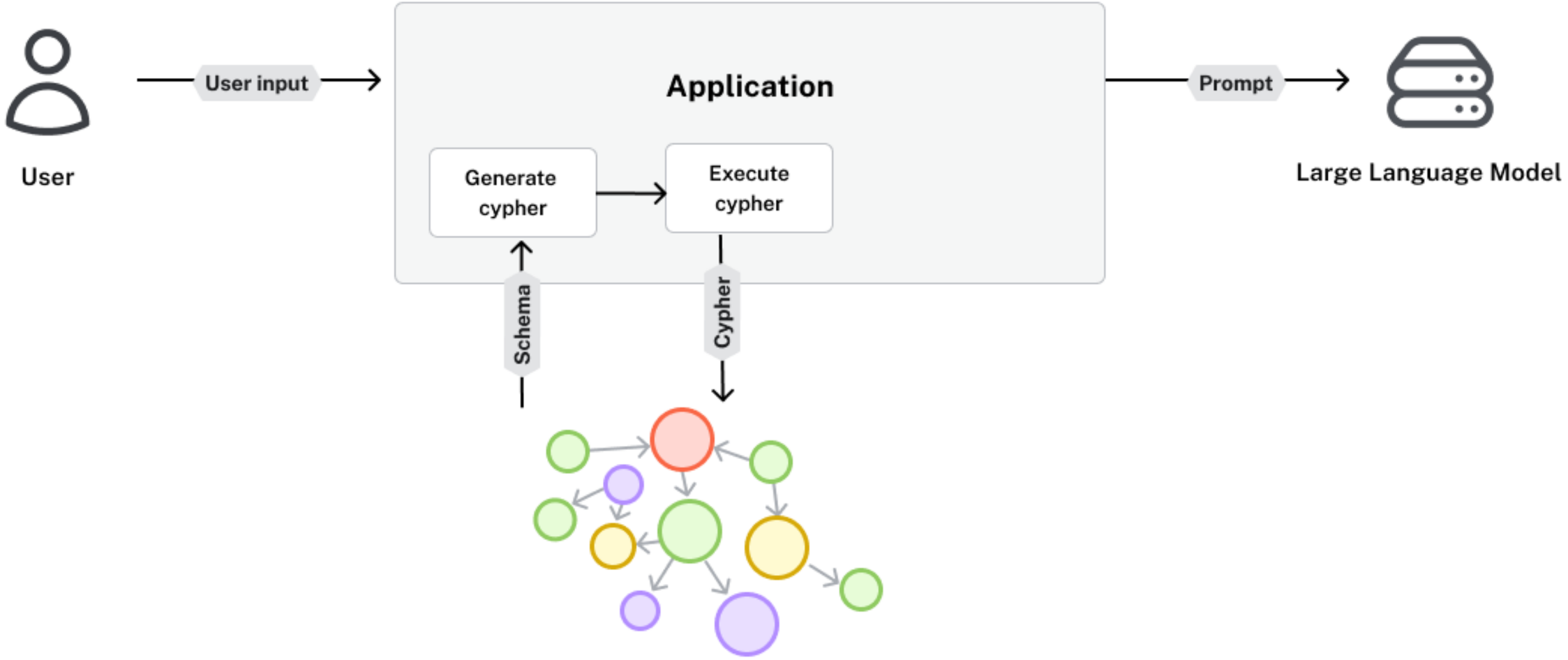

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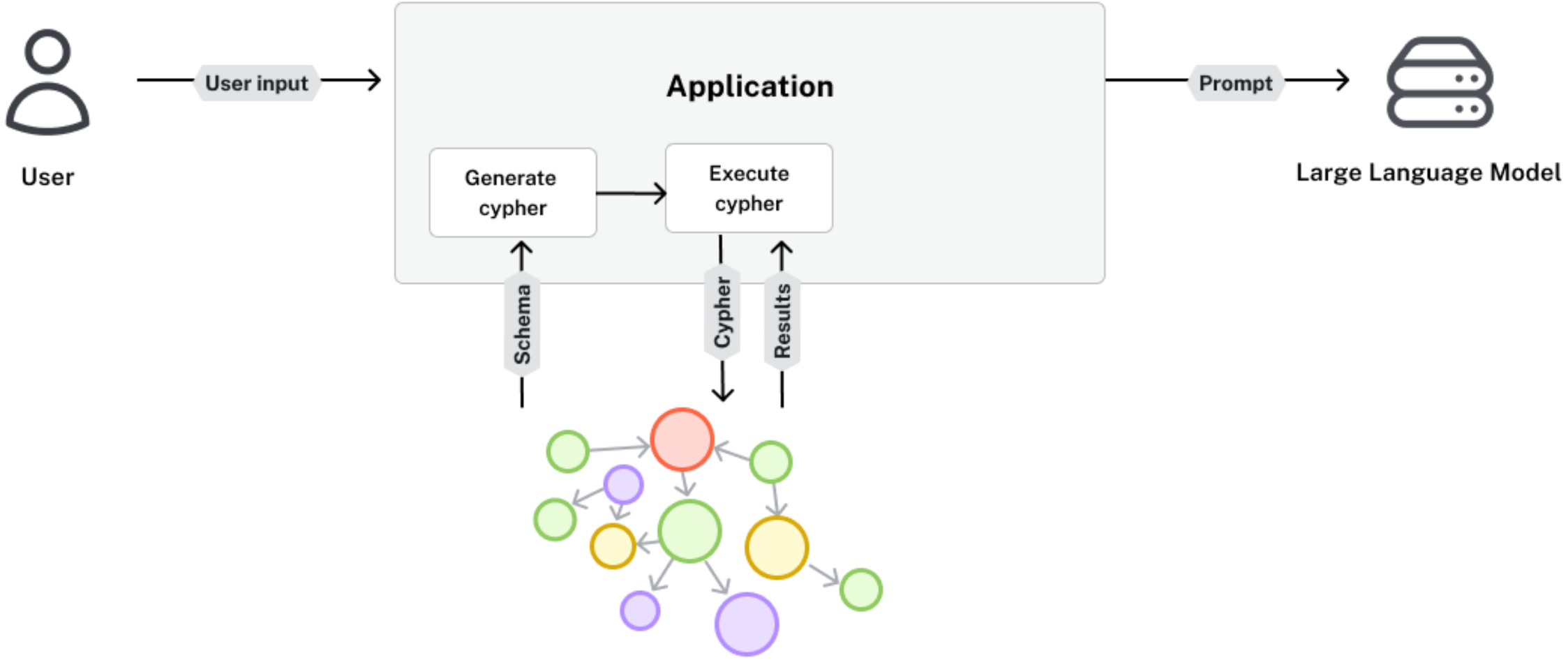

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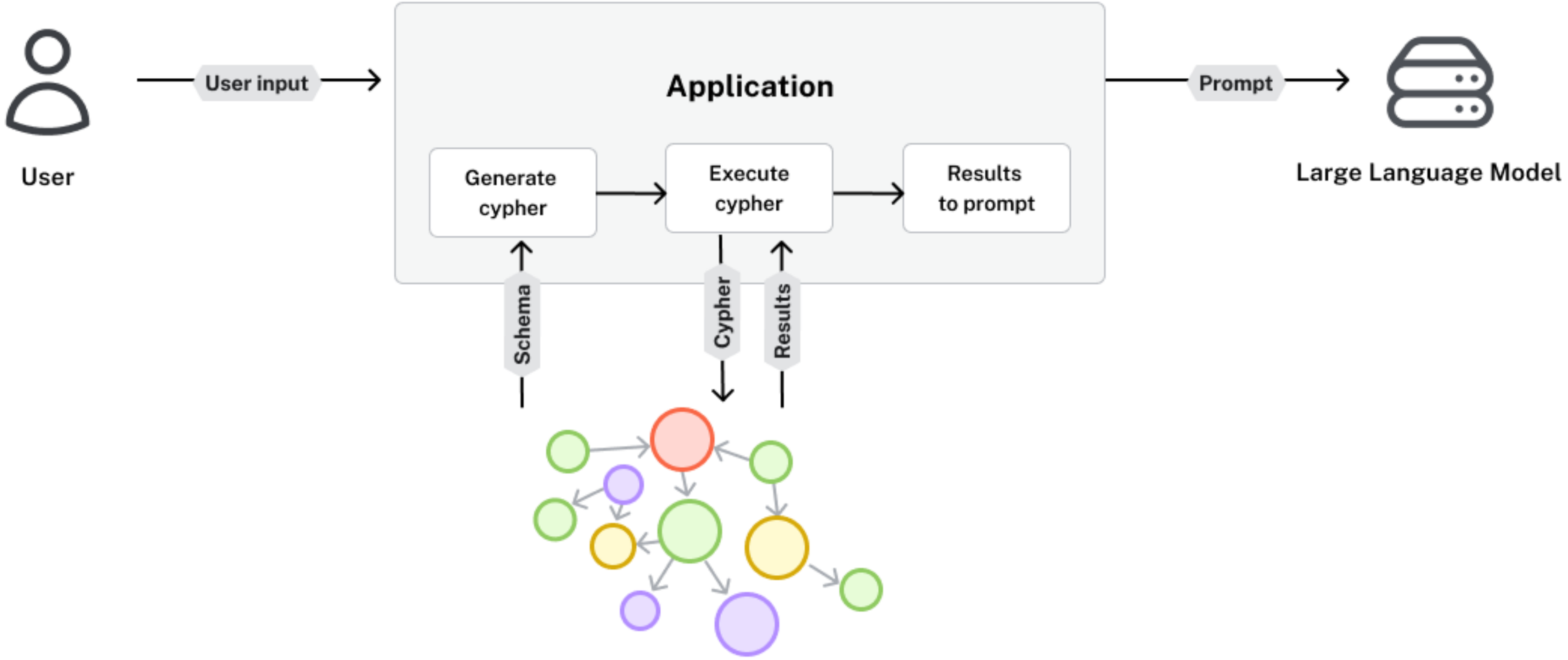

Building a text-to-Cypher chain

```
prompt = SystemPromptTemplate.from_template("""
You are an expert Neo4j developer. Use the following database schema to write
a Cypher statement to answer the user's question...

Schema: {schema}
Question: {question}
""", partial_variables={"schema": graph.schema})

# Compile the chain
cypher_chain = cypher_prompt | llm | StrOutputParser()

# Invoke the chain
cypher_chain.invoke({"question": "Who wrote Building Knowledge Graphs?"})
```

```
MATCH (b:Book {title: "Building Knowledge Graphs"})-[:WRITTEN_BY]->(a:Author) ...
```

```
QA_PROMPT = "You are a helpful assistant. Use the data retrieved from the graph to answer the user's question. Data: {context}"

answer_prompt = ChatPromptTemplate.from_messages([
    SystemMessagePromptTemplate.from_template(QA_PROMPT),
    HumanMessagePromptTemplate.from_template("Question: {question}")
])
```

```
cypher_qa_chain = (
  # Generate and execute the Cypher to get results
  {
    "question": RunnablePassthrough()
    "context": text_to_cypher_chain | RunnableLambda(lambda cypher: graph.query(cypher)),
  }
  # Format prompt and pass to LLM
  | answer_prompt | answer_llm | StrOutputParser()
)

res = cypher_qa_chain.invoke({"question": "Who wrote Building Knowledge Graphs?"})
```

```
Building Knowledge Graphs was written by Dr Jesus Barrasa and Dr Jim Webber...
```

Let's practice!

GRAPH RAG WITH LANGCHAIN AND NEO4J