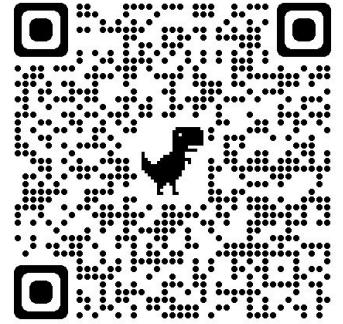




neo4j
graphsummit



Generative AI Workshop

Workshop Rules

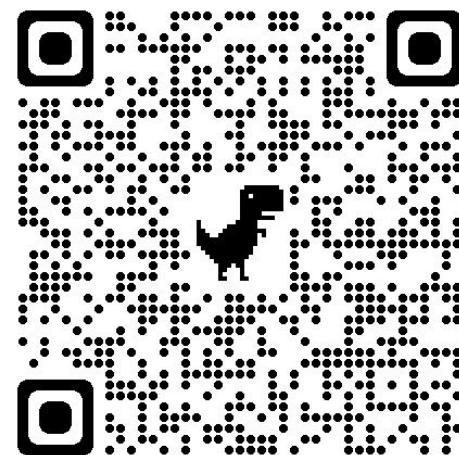
Ask questions straight away, this is an interactive session

Raise your hand if you are stuck

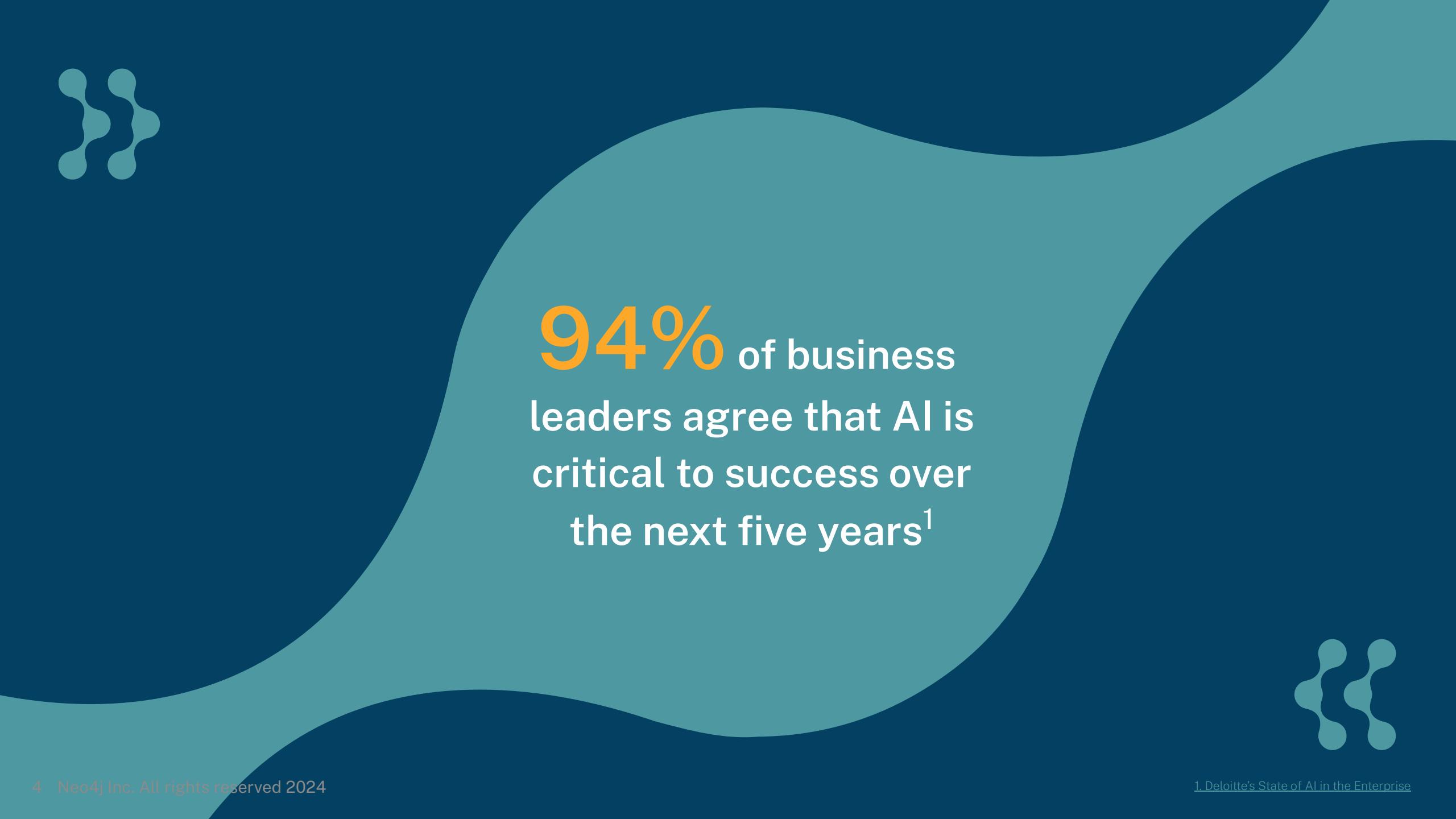
Have fun

Before We Start

- 1/ Create a **blank** Neo4j Sandbox at <https://sandbox.neo4j.com>
- 2/ Open the notebook in Colab (needs a **google account!**)



<https://github.com/neo4j-product-examples/genai-workshop>
open genai-workshop.ipynb

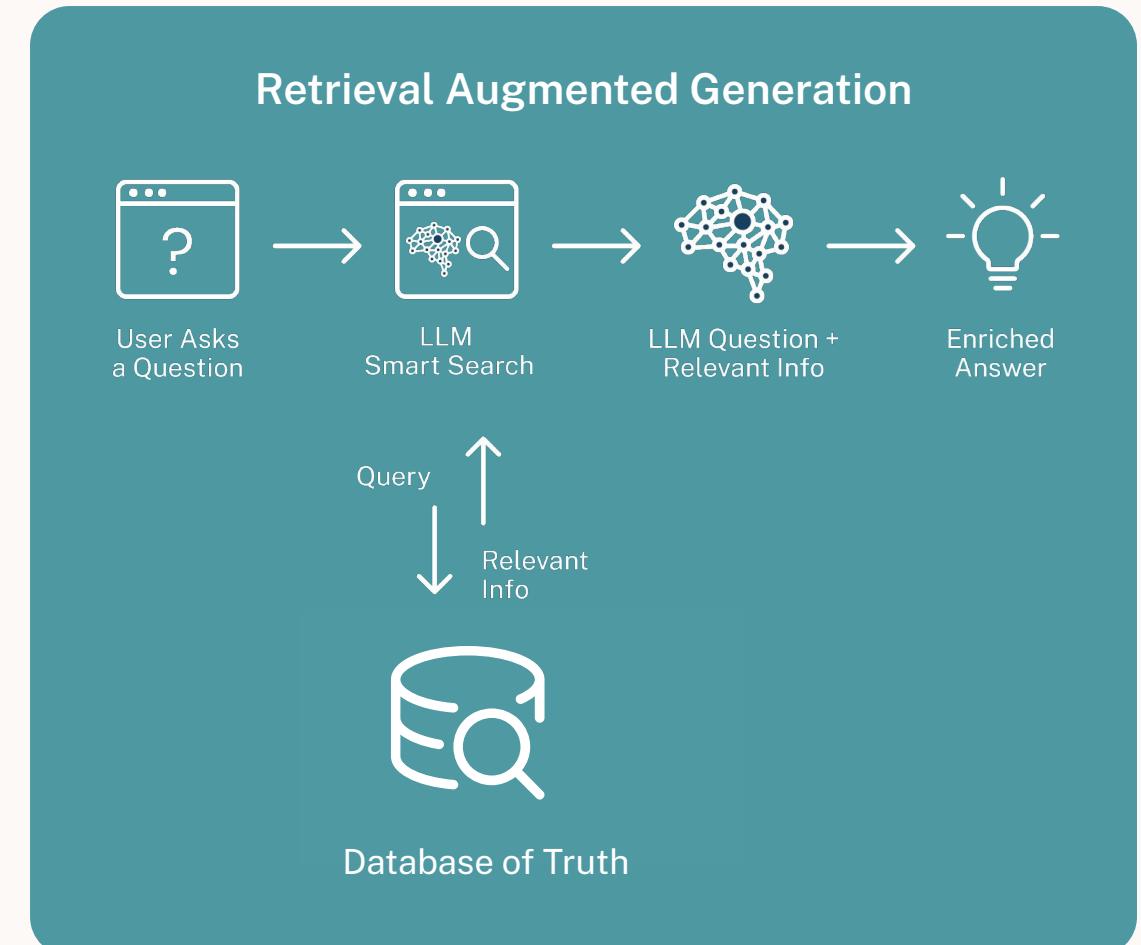


94% of business
leaders agree that AI is
critical to success over
the next five years¹

Retrieval-Augmented Generation Is Becoming an Industry Standard

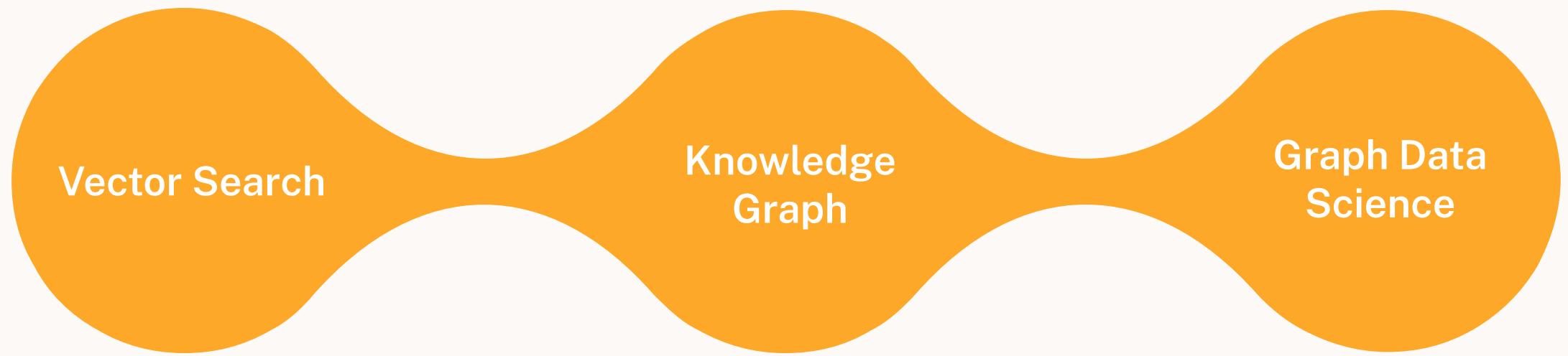
RAG augments LLMs by retrieving up-to-date, contextual external data to inform responses:

- Reduce hallucinations with verified data
- Provide domain-specific, relevant responses
- Enable traceability back to sources



RAG with Neo4j

Unify vector search, knowledge graph and data science capabilities to improve RAG quality and effectiveness



Find similar documents
and content

Identify entities
associated to content and
patterns
in connected data

Improve & enrich GenAI
insights. Discover new
relationships and entities



**Today
We are Choosing
Clothes**

This is Eva

For her birthday, Eva wants
a **Halter Neck Top**

How do you choose what to buy?



This is Eva

For her birthday, Eva wants
a **Halter Neck Top**

How do you choose what to buy?

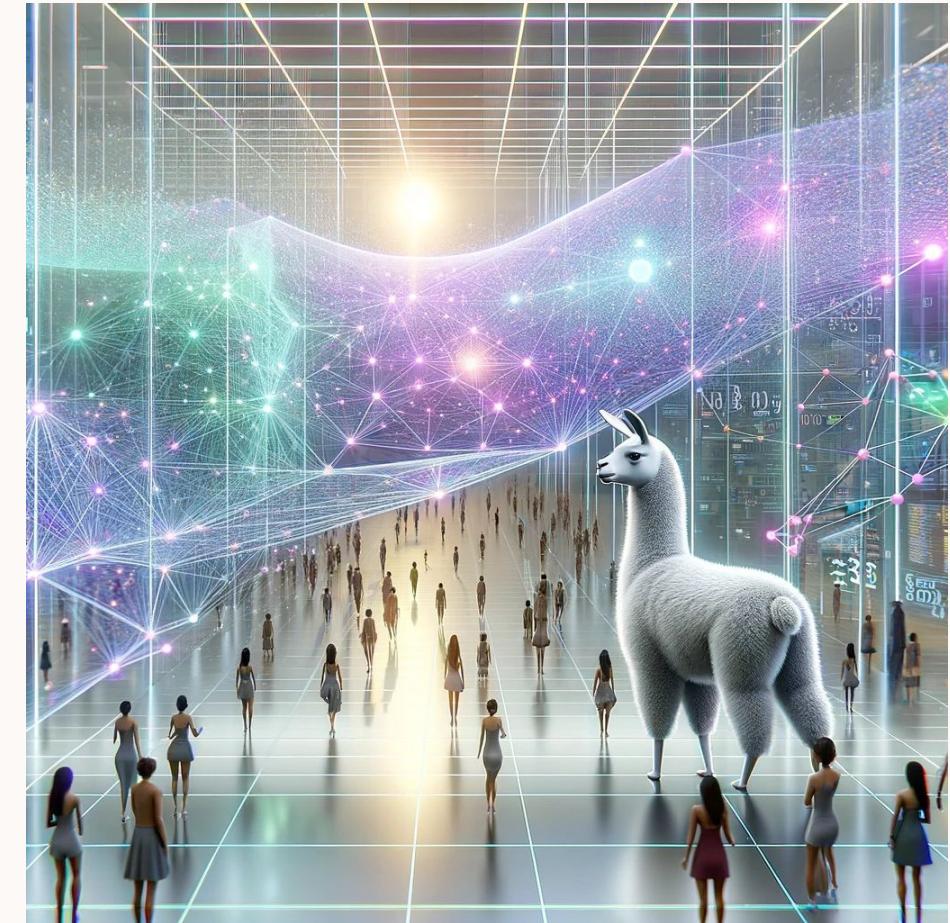
- 1/ Get a list of Halter Neck Top
- 2/ Match the Halter Neck Top for Eva
- 3/ Accessorize or add another item



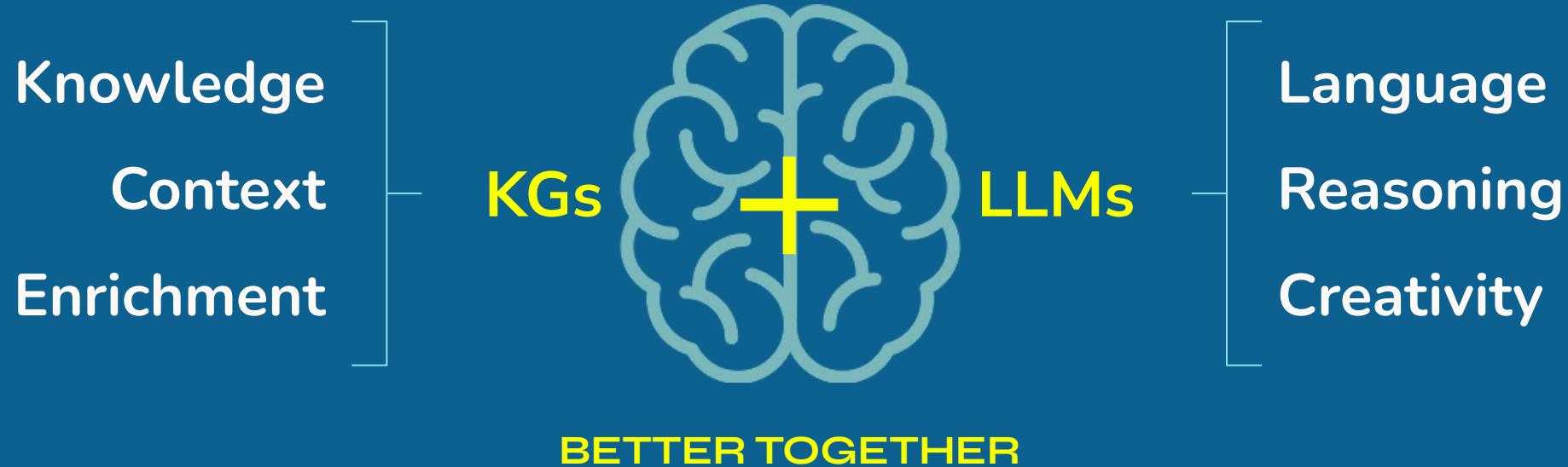
At Scale: Let's Build an AI Fashion Assistant

This Requires:

1. Data: Kaggle H&M
2. Search & Retrieval
3. Context for Personalization
4. Recommendation Engine
5. LLM Powered Content Generator



Solution: LLMs and Knowledge Graphs



We'll Build a Targeted, Personalized Content Generator



Message Generator 😊

Customer ID

Time Of Year

Customer Name

Customer Interests(s)

Clear
Submit

Dear Alex Smith,

I hope this email finds you well. As the weather gets cooler, it's the perfect time to update your wardrobe with cozy and stylish oversized sweaters. I wanted to share with you some of our top picks for this season:

1. Queen Sweater: This lightweight sweatshirt fabric sweater features ribbing around the neckline, cuffs, and hem. It's a perfect choice for a casual yet chic look. You can find it [here](#).
2. Jess oversize LS: Made from a soft jersey cotton blend, this oversized top with dropped shoulders and long sleeves is both comfortable and trendy. You can check it out [here](#).
3. Petar Sweater(1): If you're looking for an oversized top in sturdy sweatshirt fabric, this is the one for you. It has dropped shoulders and ribbing around the neckline, cuffs, and hem, with a soft brushed inside. Find it [here](#).
4. Family Crew Ladies: This sweatshirt fabric top is perfect for a cozy and relaxed look. It features dropped shoulders, long sleeves, and ribbing around the neckline, cuffs, and hem. You can find it [here](#).
5. Irma sweater: Add a touch of print to your wardrobe with this top in printed sweatshirt fabric. It has dropped shoulders, long sleeves, and ribbing around the neckline, cuffs, and hem. Check it out [here](#).

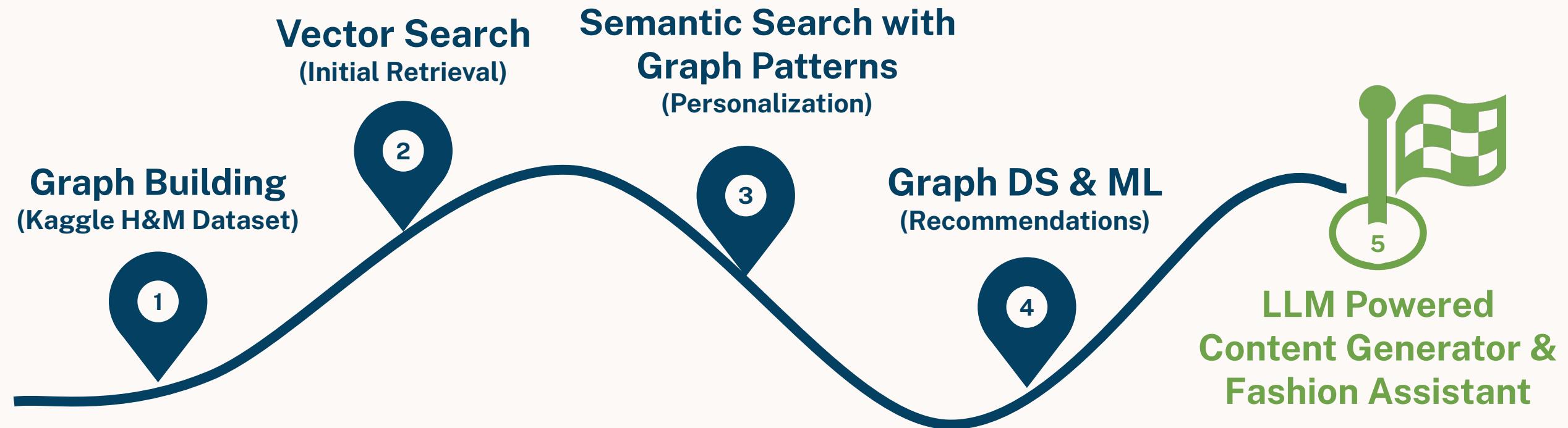
In addition to oversized sweaters, you may also be interested in:

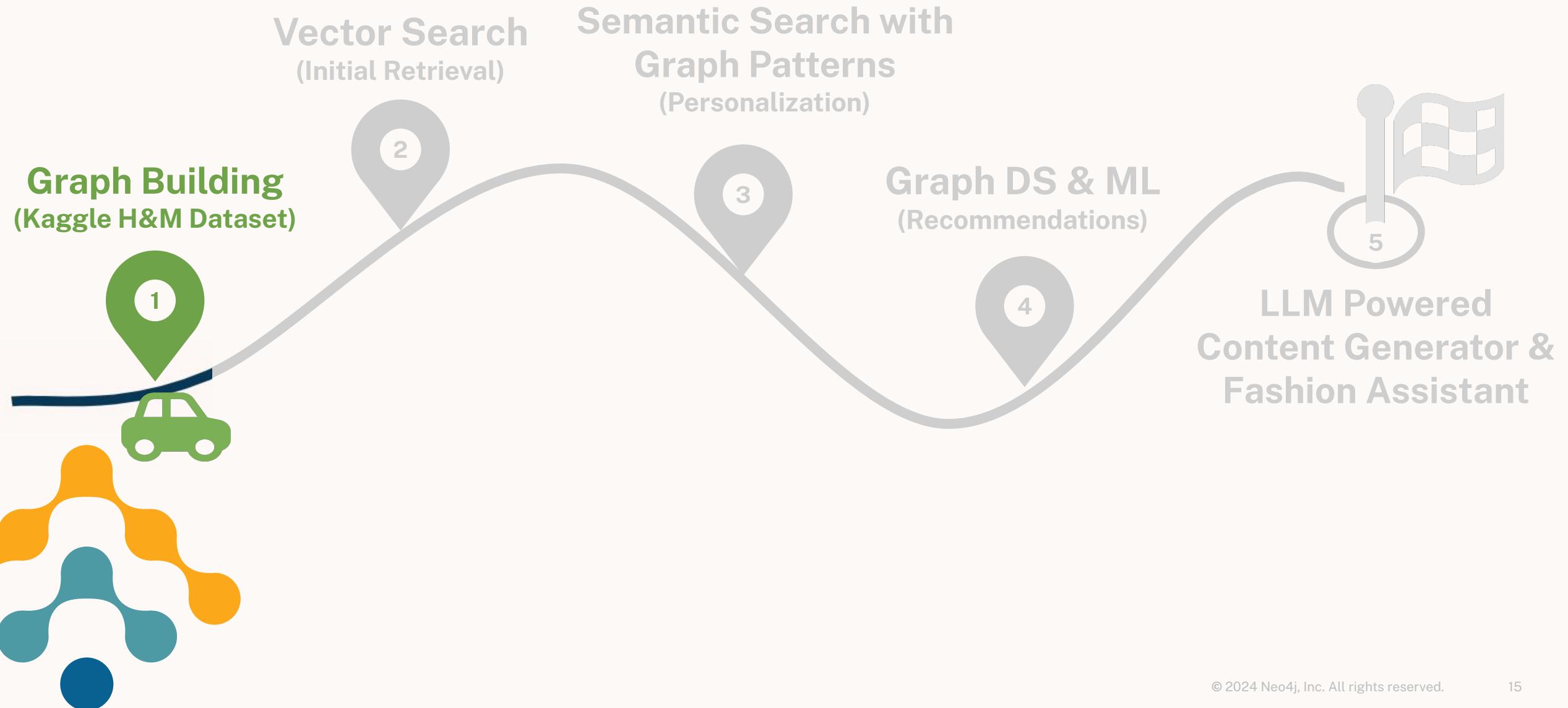
1. GABBE T-shirt: Made from soft, printed slab cotton jersey, this t-shirt features a ribbed neckline. You can find it [here](#).
2. Runar sweater: This oversized top in soft sweatshirt fabric offers a relaxed fit with low dropped shoulders, extra-long sleeves, and ribbing around the neckline, cuffs, and hem. It's perfect for a cozy

Tools

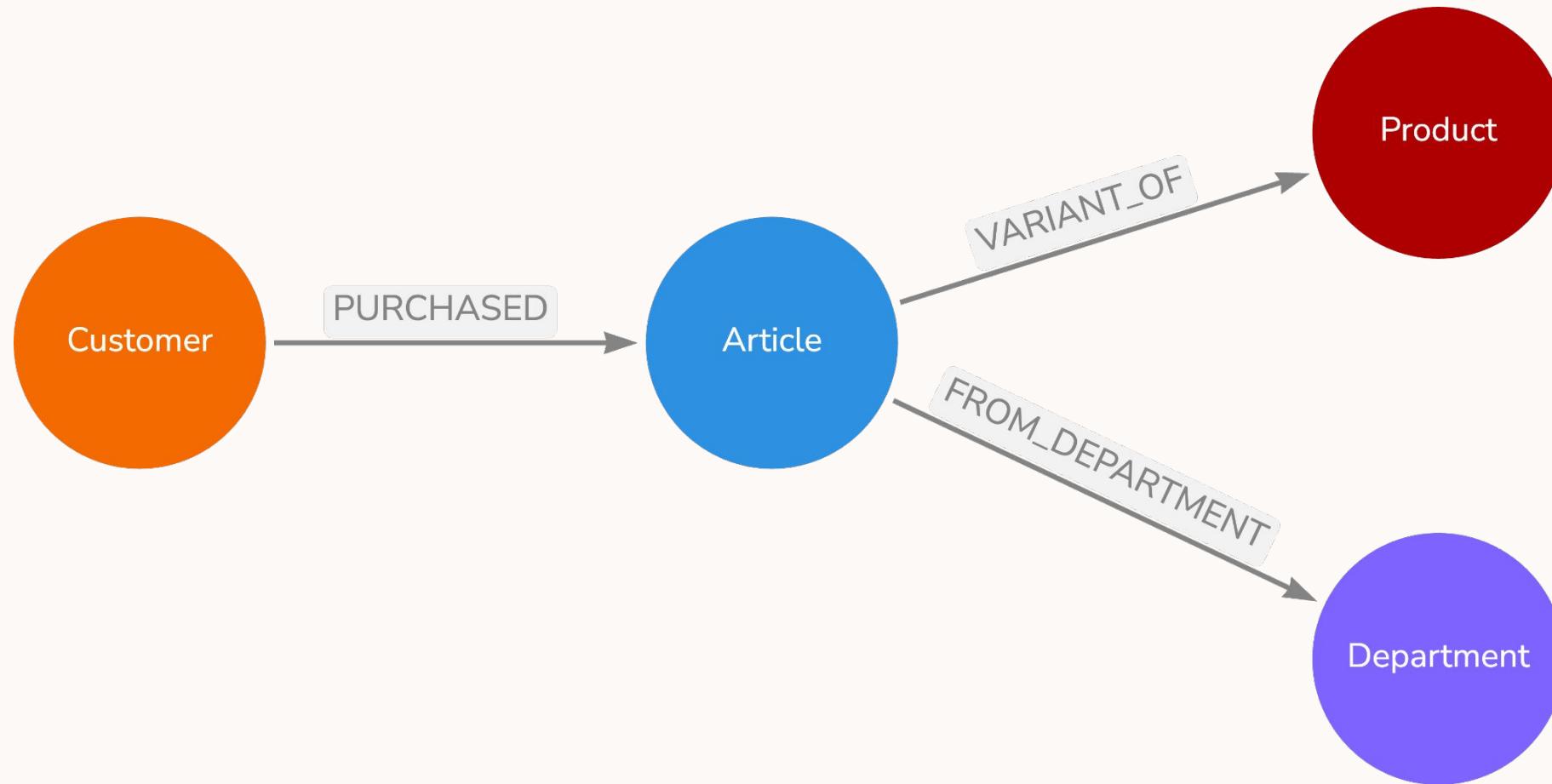


Journey

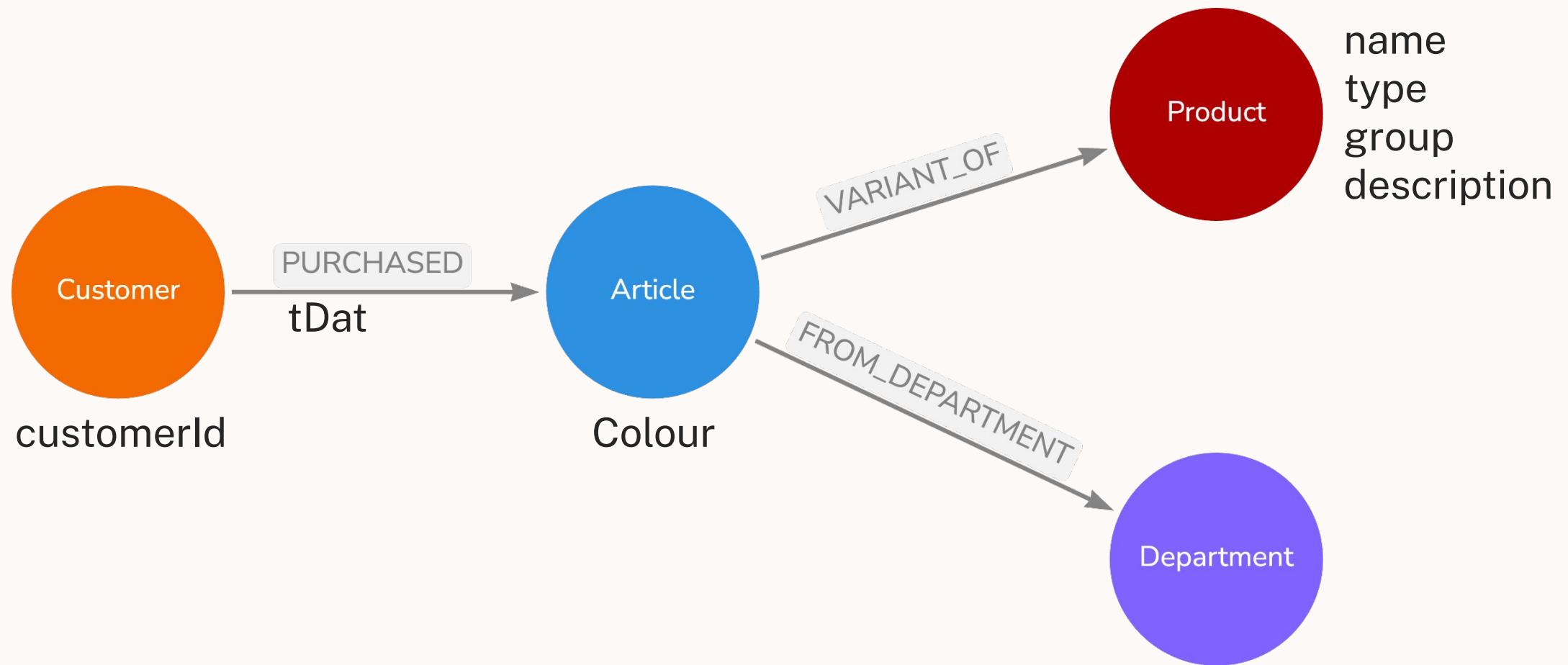




Data Model



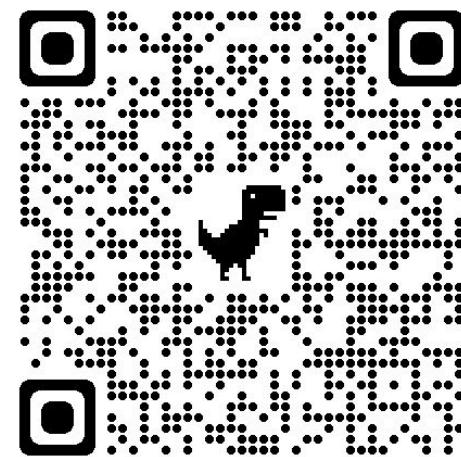
Data Model



Now We Can Start

1/ Create a Neo4j Sandbox at **<https://sandbox.neo4j.com>**

2/ Open the notebook in Colab (needs a **google account!**)



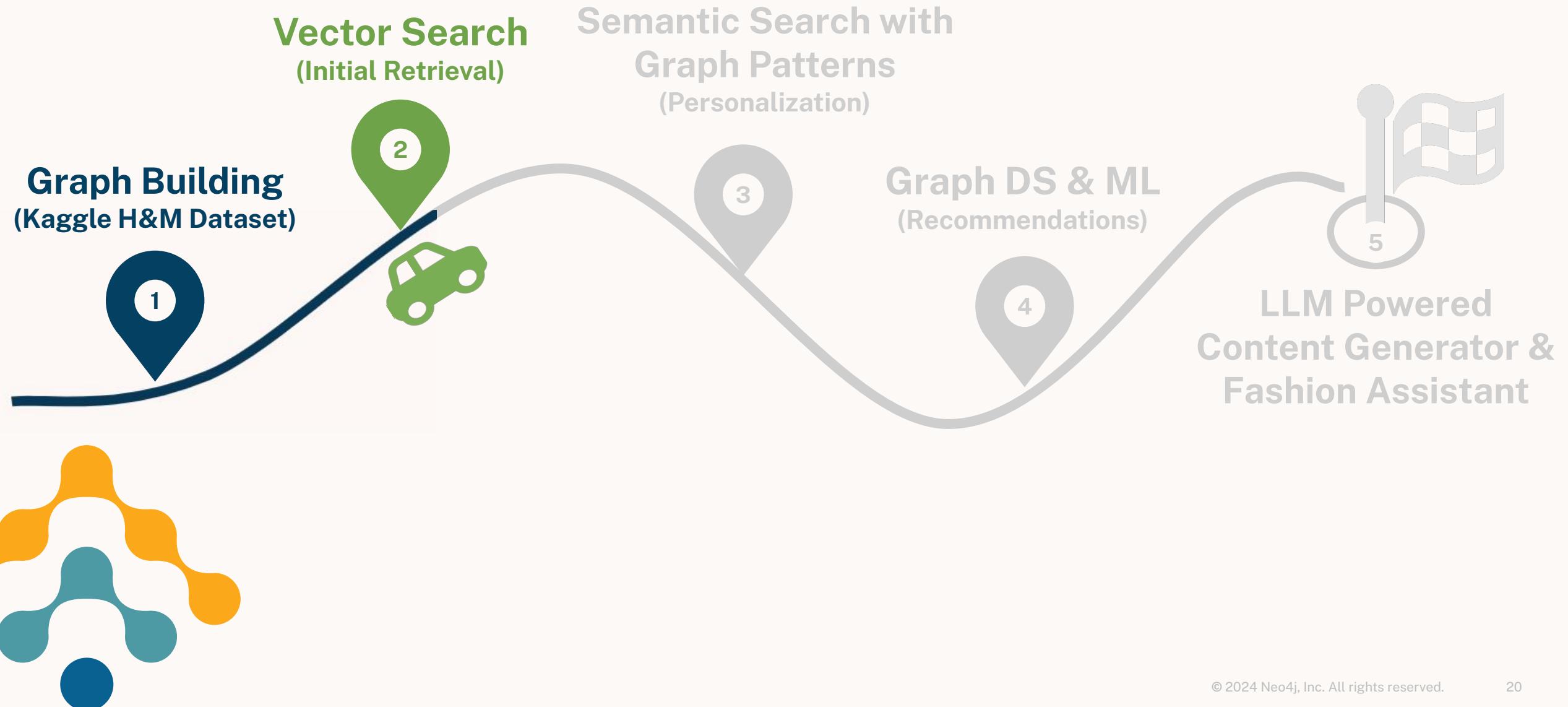
<https://github.com/neo4j-product-examples/genai-workshop>

open **genai-workshop.ipynb**



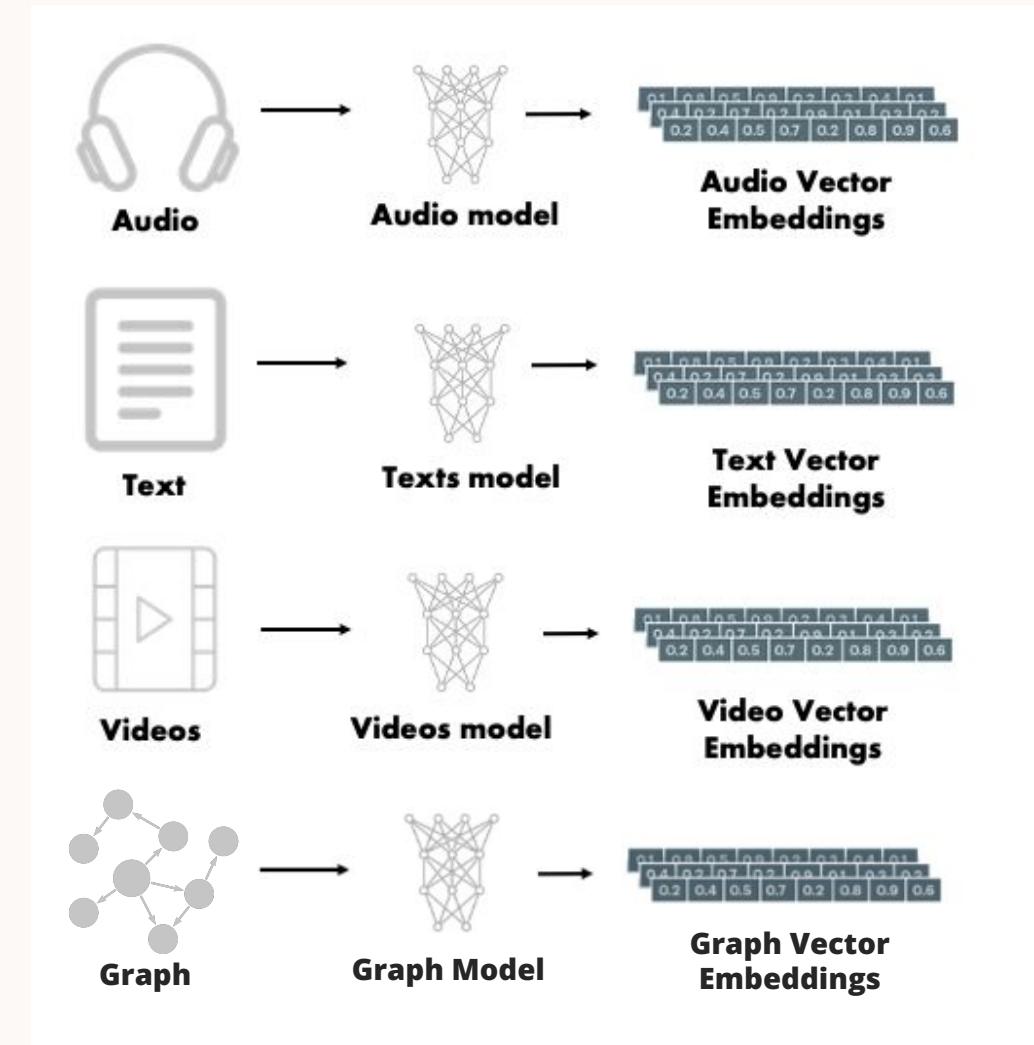
1/ Graph Building

Stop before **Vector Search**



What are Embeddings?

- A type of data compression
- Transform messy data (text, images, audio, etc.) into a compact format for ML algorithms
- Most often numeric **vectors** (a.k.a arrays) with 100s or 1000s of elements
- Preserve information such that “similar” items have proportionally “similar” embedding vectors
- Similarity is measured with vector algorithms (cosine, euclidean, etc.)



What Does “Similarity” Mean?

It Depends:

- Text Embeddings => Semantic Similarity, the meaning behind a text sequence
- Graph Embeddings => similarity in position or structure in a graph - can have semantic meaning too

What will we use embedding for?

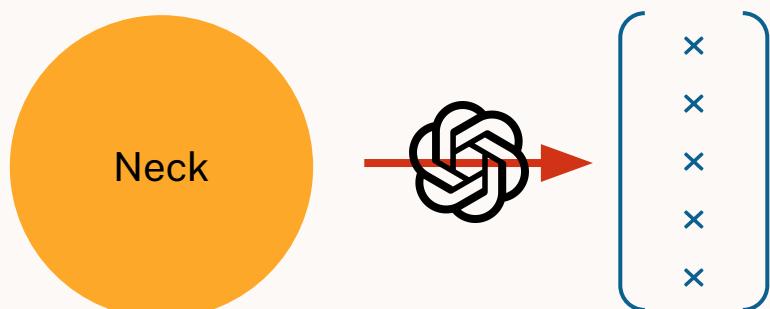
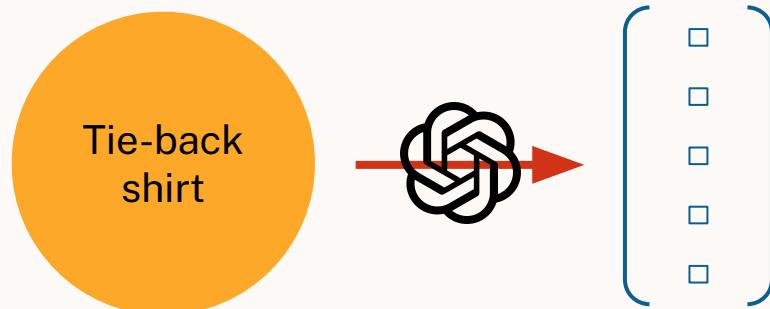
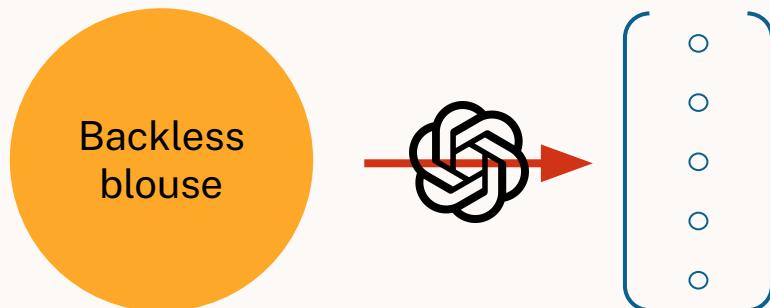
1. **(now) Vector search** using text embeddings
2. **(later) Recommendations** using graph node embeddings

Search & Vectors in Neo4j

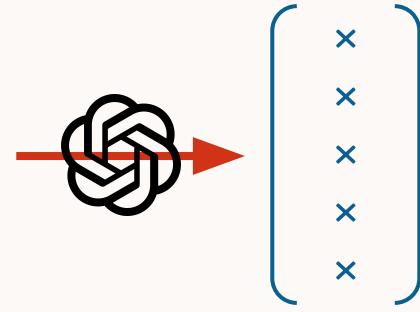
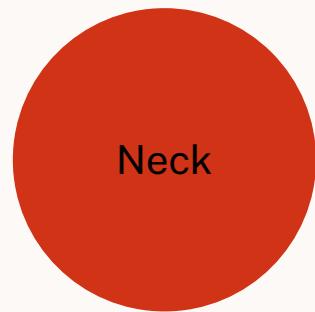
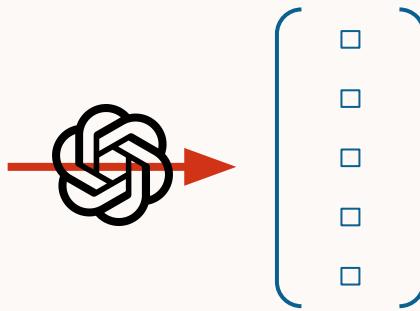
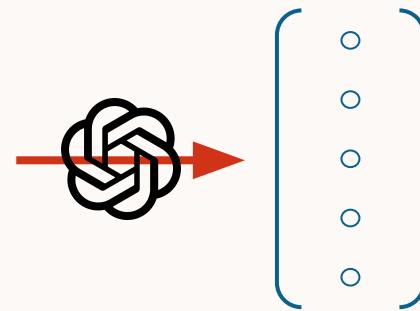
Neo4j makes search efficient through a variety of indexes including

- **Range:** General index for predicates based on equality and range. Numeric, dates, etc.
- **Point:** Predicts on geospatial points like distance bounding boxes, etc.
- **Text:** Predicates on strings like contains, ends with, etc.
- **FullText:** Text search based on tokenization and analyzers
- **Vector:** ANN (Approximate Nearest Neighbor) search on vectors

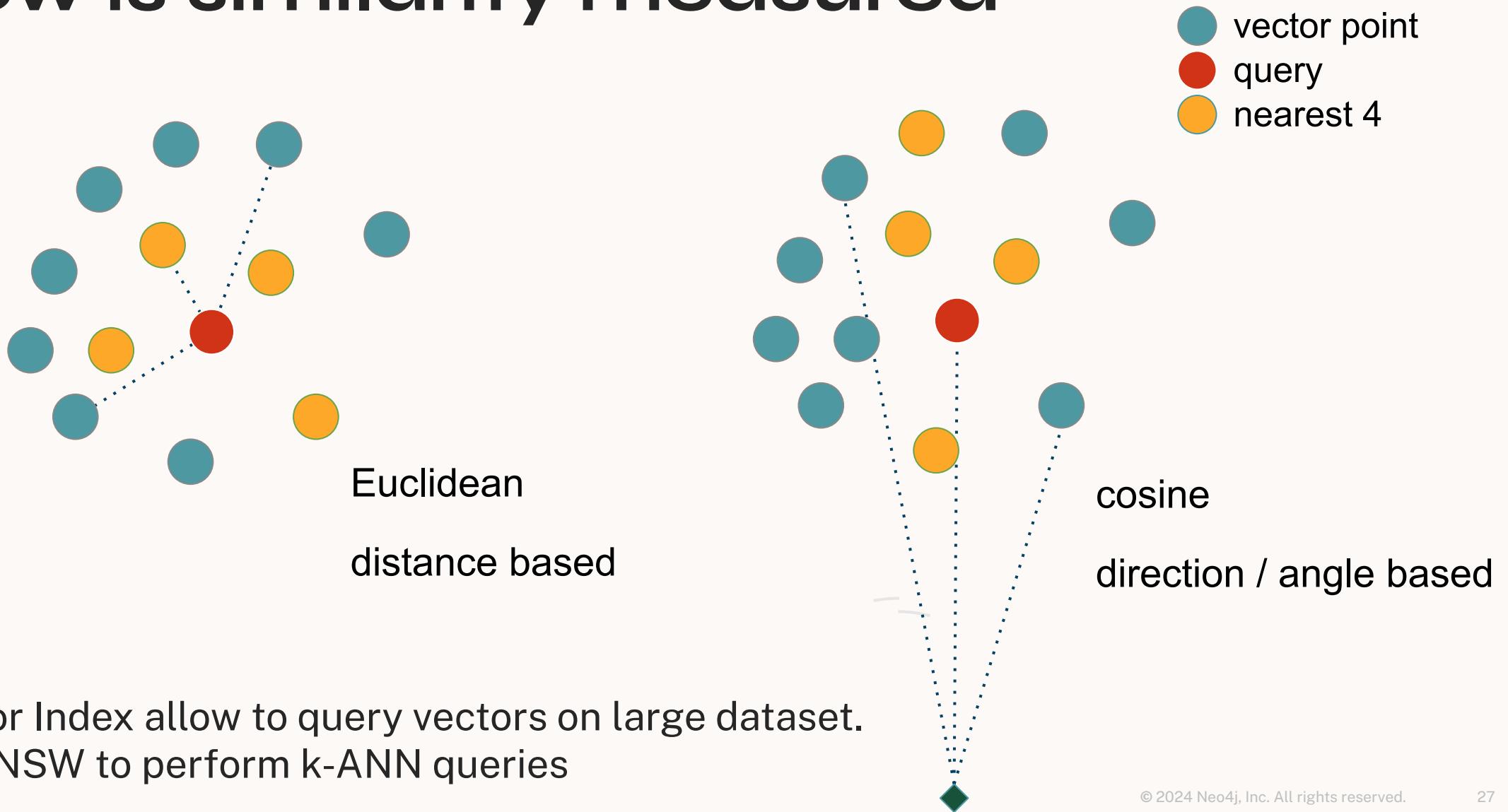
Vector search



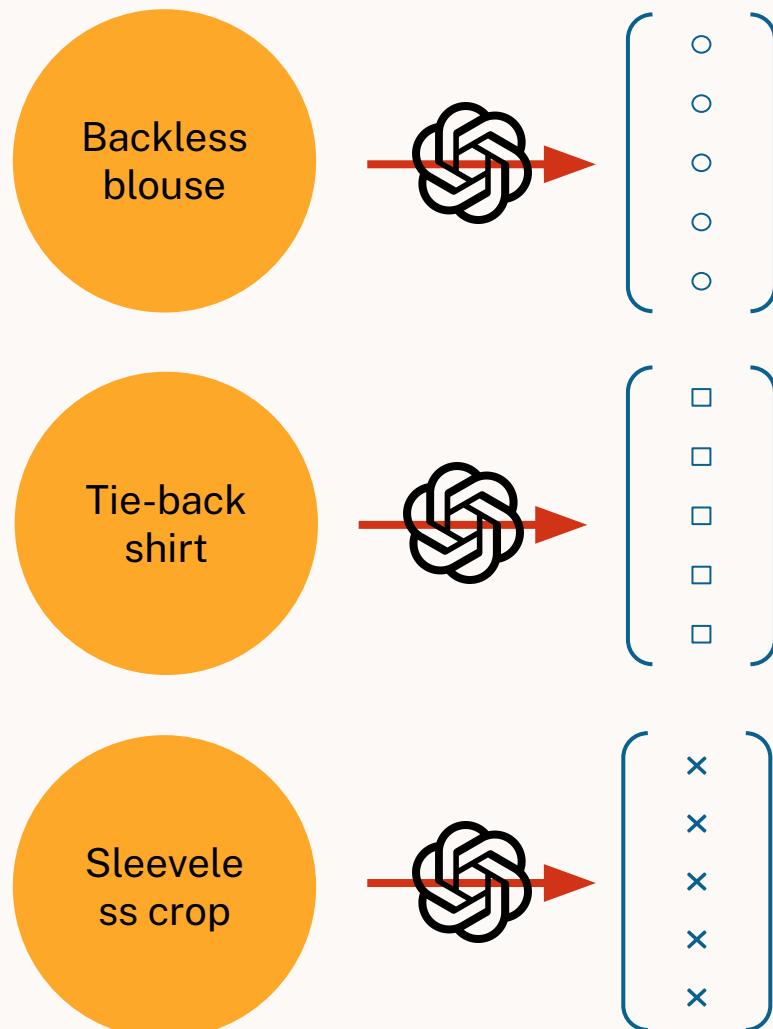
Vector search



How is similarity measured



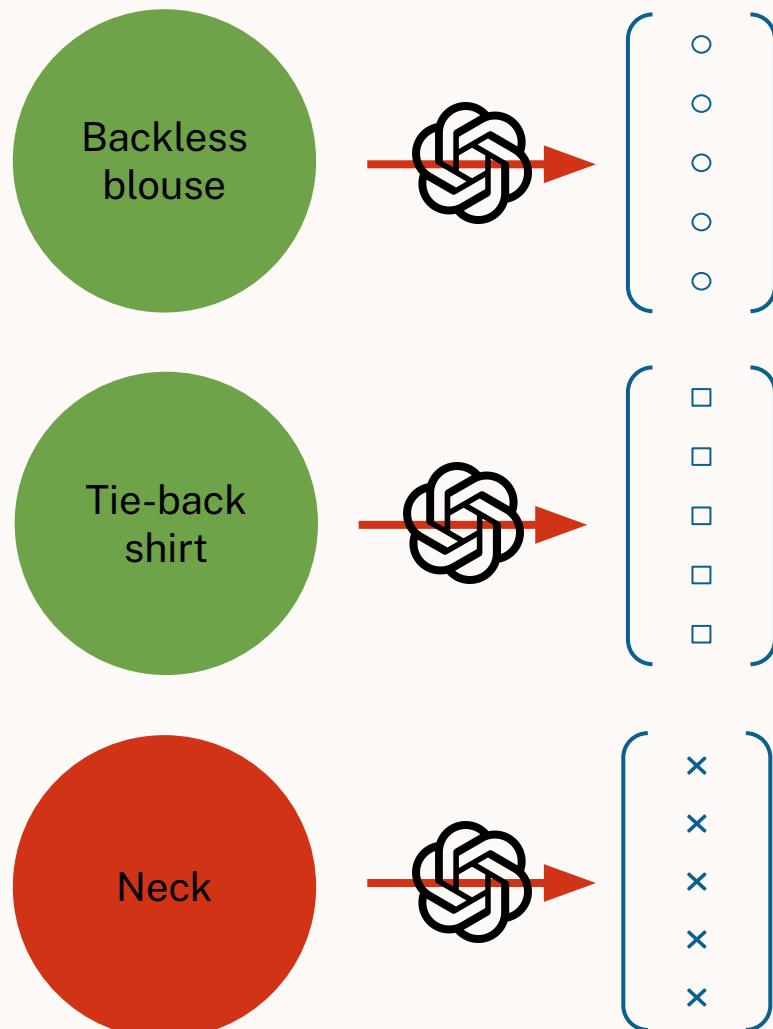
Vector search



CREATE VECTOR INDEX

`db.index.vector.queryNodes`

Vector search

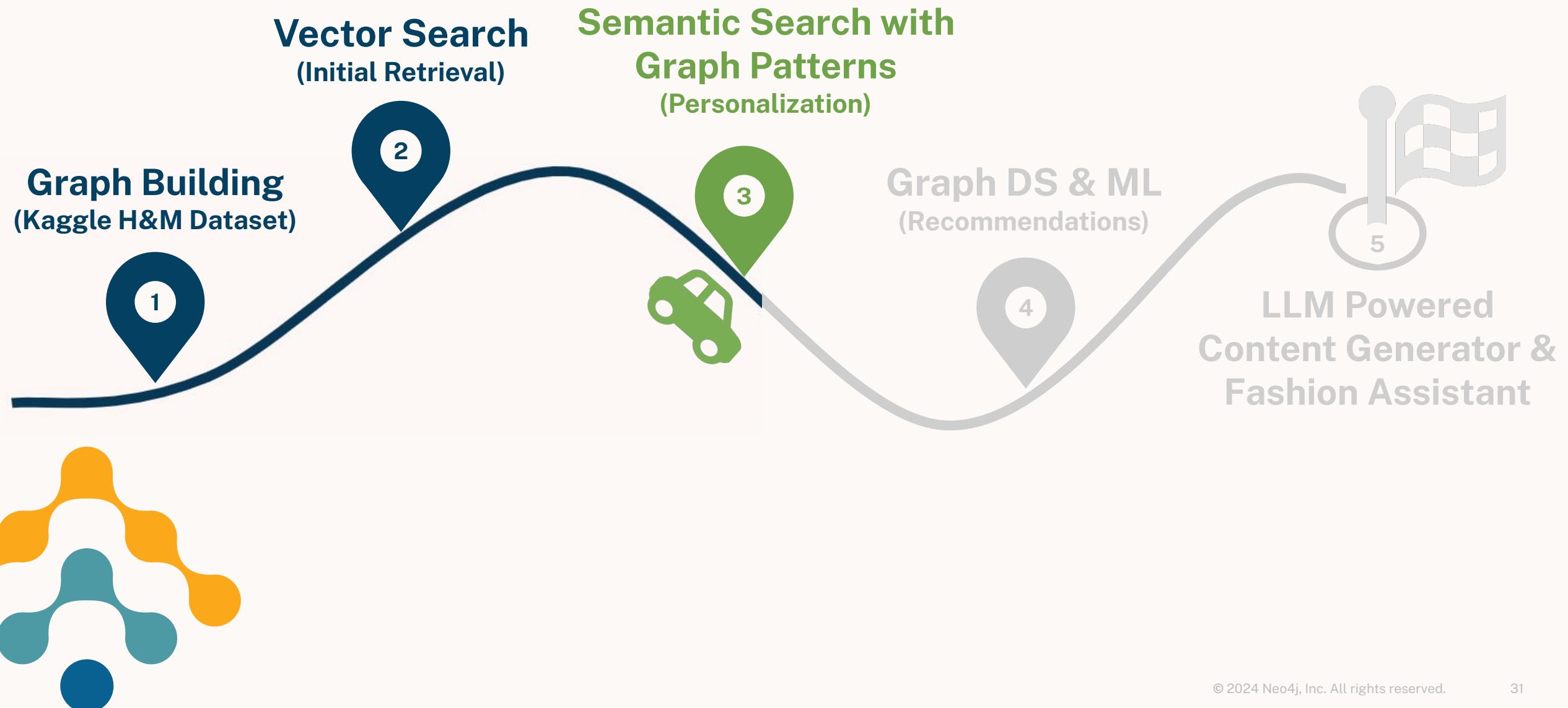


CREATE VECTOR INDEX

`db.index.vector.queryNodes`

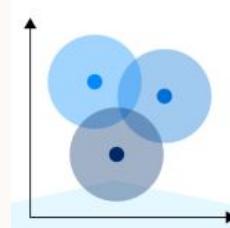
2/ Vector Search

Stop before **Semantic Search with Graph Patterns**
(Personalization)



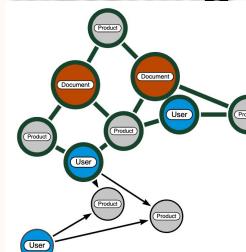
Neo4j & Semantic Search

Vector Similarity Search



Find relevant documents and content for user queries

Graph Pattern Matching



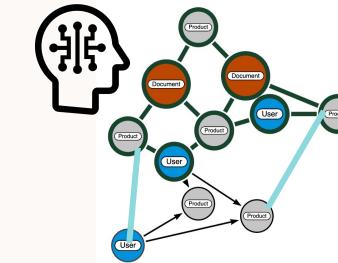
Find entities associated to content and patterns in connected data.

Vector Search

Graph Database

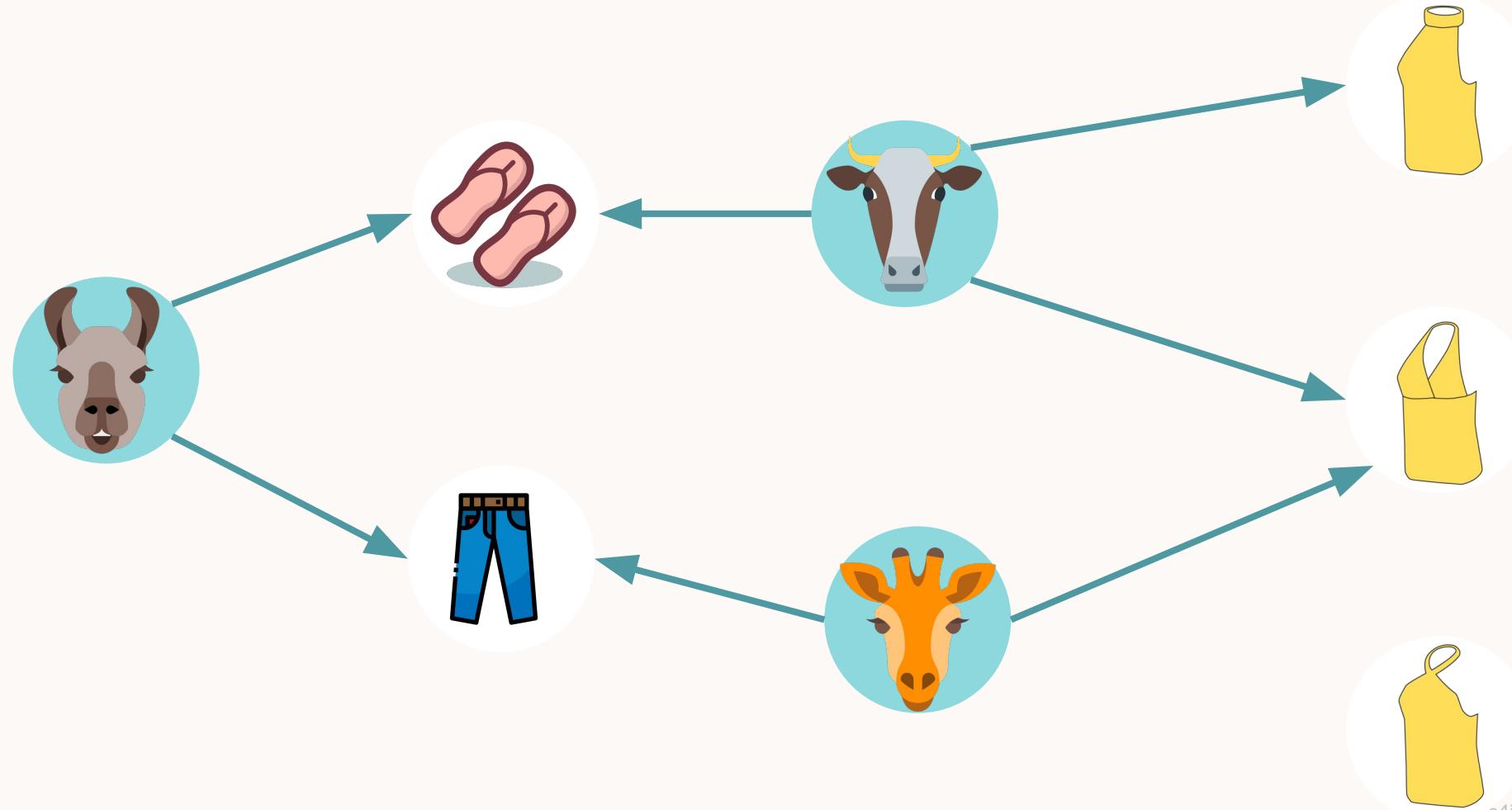


Knowledge Graph DS/ML

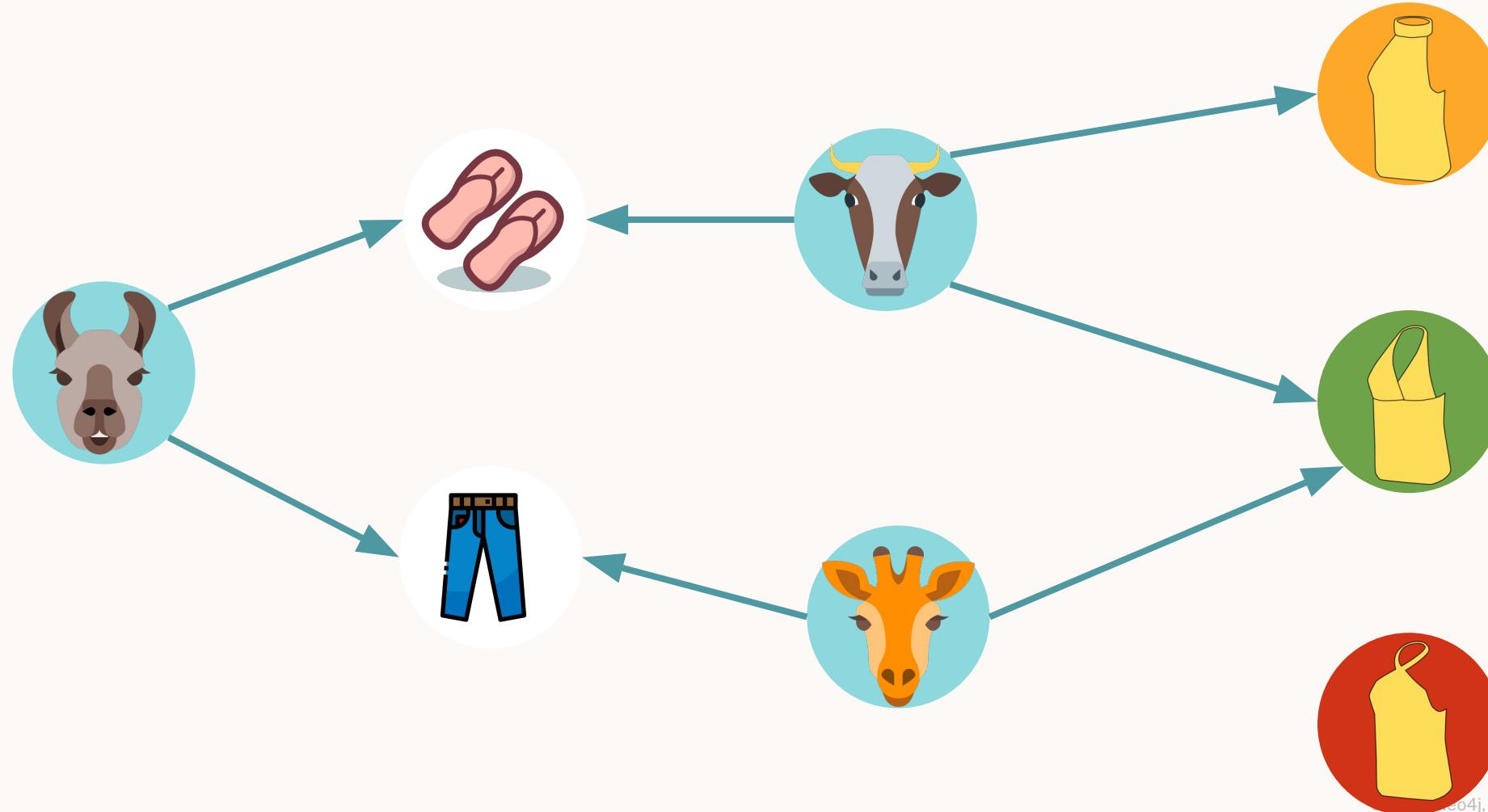


Improve search relevance & insights by enhancing a Knowledge Graph. Use graph algorithms and ML to discover new relationships, entities, and groups.

Semantic search with graph pattern



Semantic search with graph pattern

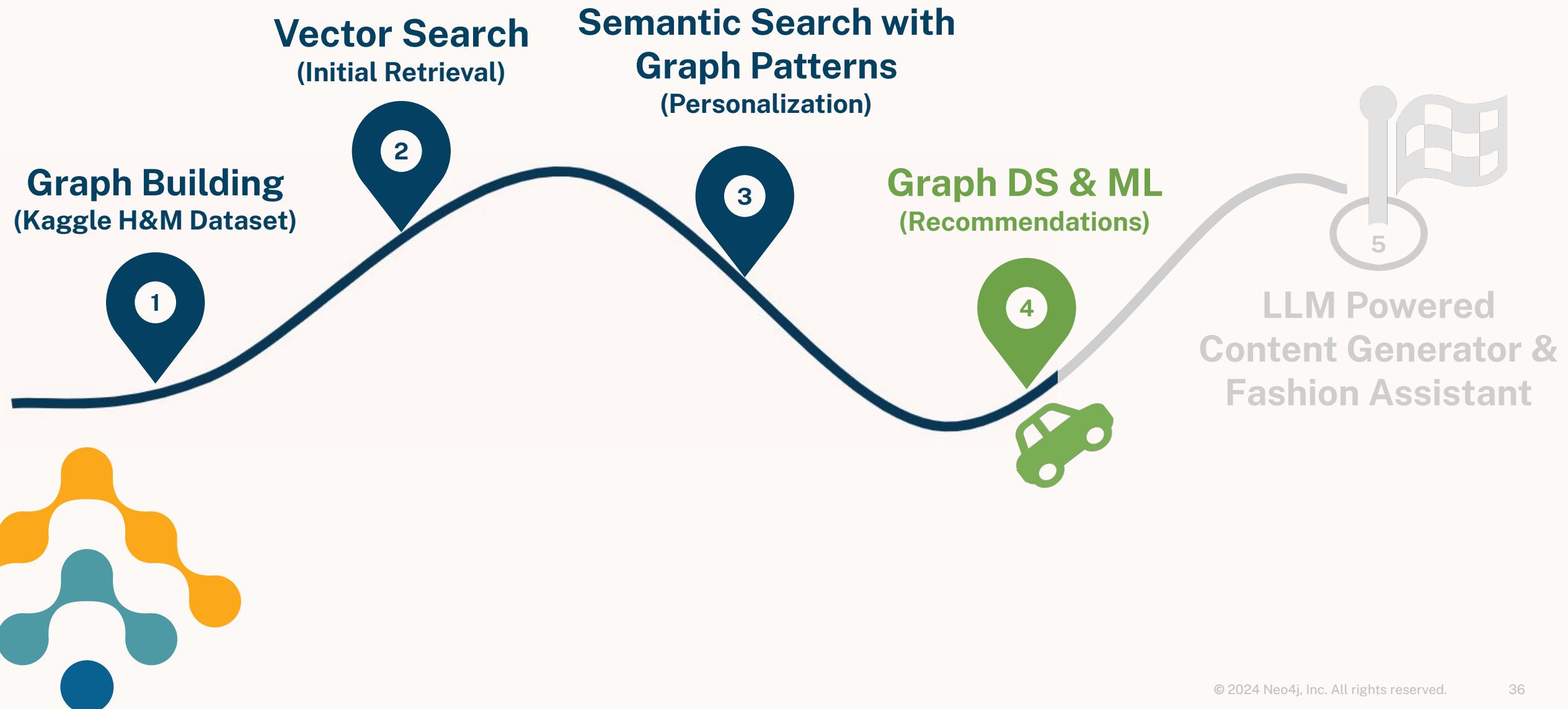




3/ Semantic Search with Graph Patterns

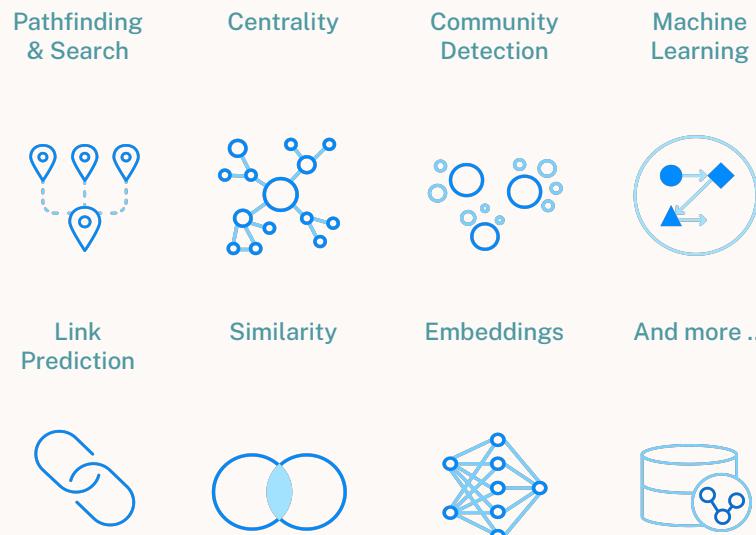
Personalization & Context

Stop before **Graph Data Science & ML (Recommendations)**



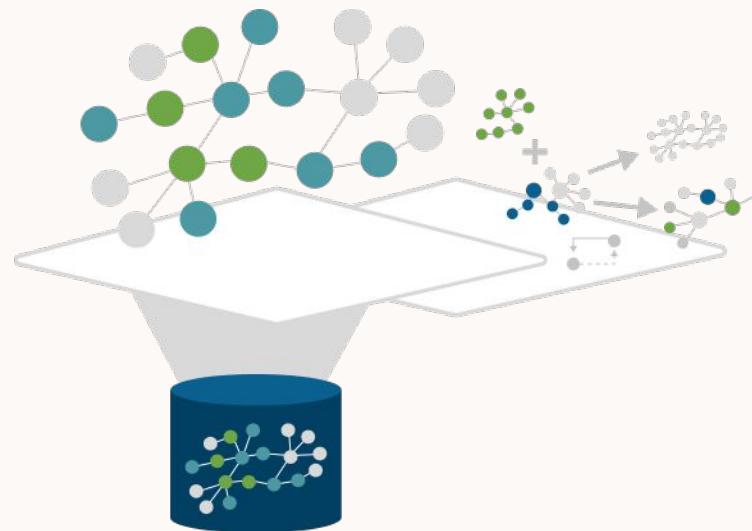
Improve Models And Answer Big Questions

The Largest Catalog of Graph Algorithms



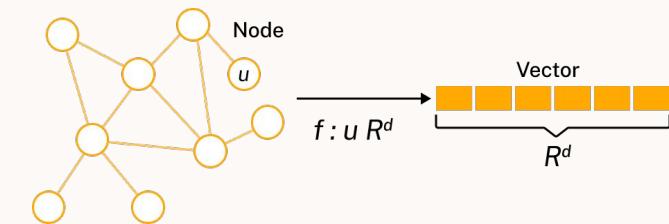
Over 65 pretuned, parallelized algorithms.

Native Graph Catalog and Analytics Workspace



Iterate fast with different data sets, models, and version trained models.

Graph Embeddings for Machine Learning



Bring the context of your connected data into a format that other pipelines can ingest.

Graph Algorithms

Version 0.1
based on neo4j Graph Data Science 2.5

by Hari Gurumoothi
@tweetofhari

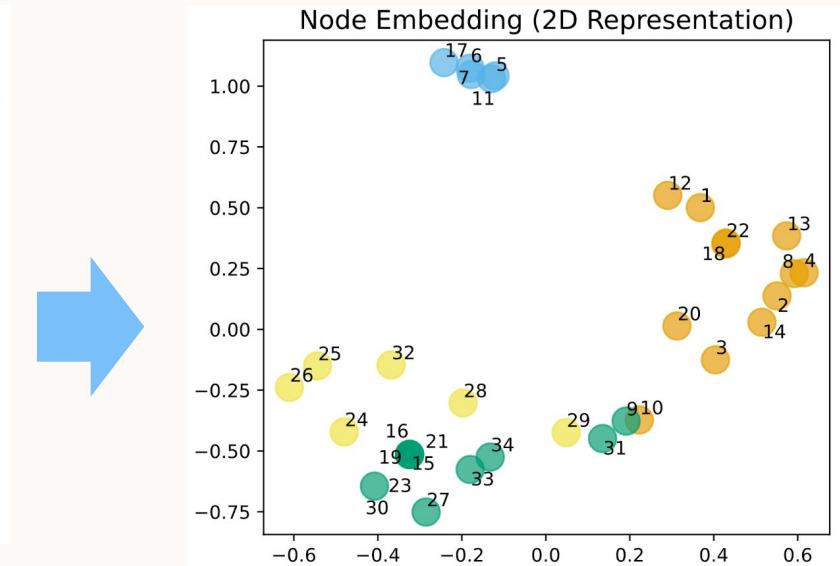
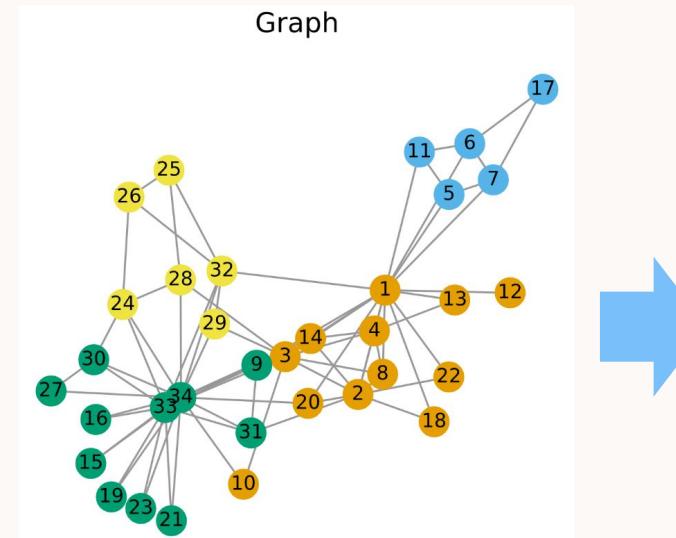
α Indicates that the feature is experimental and might be changed or removed at any time.

β Indicates that the feature is a candidate for the production-quality tier.

Lu												
Louvain												
Km	Kc	Dt	Dj									
K-Means Clustering	K-Core Decomposition	Source-Target Shortest Path	Dijkstra Single Source Shortest Path									
Tc	K1	Ds	Df									
Triangle Count	K-1 Coloring	Delta Stepping	Depth First Search									
Cm	Mm	Bf	Ys	Pr								
Conductance metric	Modularity metric	Breadth First Search	Yen's Shortest Path	Page Rank								
Mo	Sc	As	Bp	Ar	Cc	Ja						
Modularity Optimization	Strongly Connected Components	A* Shortest Path	Bellman-Ford Short Path	Article Rank	Closeness Centrality	Jaccard Similarity						
Lp	Lc	Ms	Rw	Bc	Dc	Op	Ed	Cn	Ad	Hg		
Label Propagation	Local Clustering Coefficient	Minimum Spanning Tree	Random Walk	Betweenness Centrality	Degree Centrality	Overlap Similarity	Euclidean Distance	Common Neighbors	Adamic Adar	HashGNN		
Le	Wc	Md	Mw	Ce	Ec	Co	Kn	Pa	Tn	Nv	Lo	
Leiden	Weakly Connected Components	Minimum Directed Steiner Tree	Min Weight k-Spanning Tree	CELF	Eigenvector Centrality	Cosine Similarity	K-nearest Neighbors	Preferential Attachment	Total Neighbors	Node2Vec	Longest Path	
Sp	Ak	Ap	Ld	Hi	Hc	Pe	Ns	Ra	Sc	Gs	Ts	
Speaker-Listener LP	Approx. Max. k-cut	All Pairs Shortest Path	Longest Path for DAG	HITS	Harmonic Centrality	Pearson Similarity	Node Similarity	Resource Allocation	Same Community	GraphSAGE	Topological Sort	
Community Detection	Path Finding & Search			Centrality	Similarity			Topological Link Prediction	Node Embeddings		DAG Algorithms	

Node Embeddings

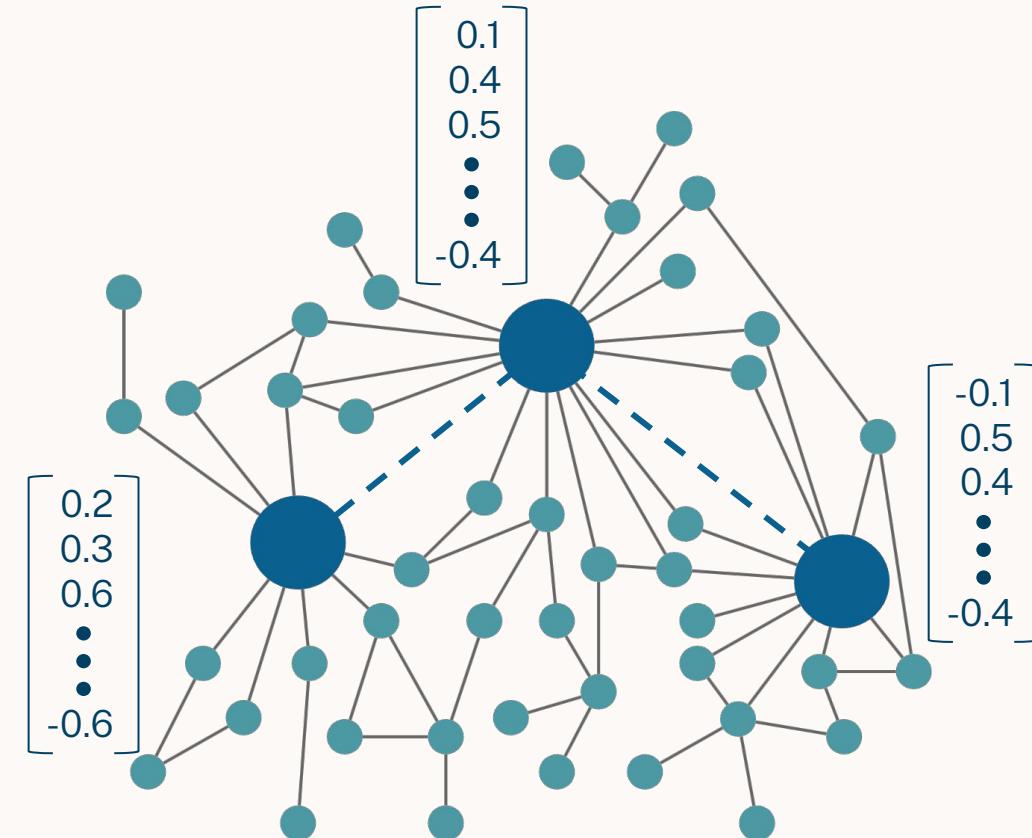
The representation of nodes as low-dimensional vectors that summarize their graph position, the structure of their local graph neighborhood as well as any possible node features



1	0.91
0	0.43
0	1
0	0.65
1	1.10
0	0.50
1	0.57
1	0.91
0	0.89
0	0.14
1	1.09
⋮	⋮
0	0.91
1	1.01
0	0.06
0	0.75
0	0.01
1	1.40

K-Nearest Neighbor (KNN) w/ Node Embeddings

*Draw connections between
highly interconnected nodes
and/or those that have similar
roles in the graph*

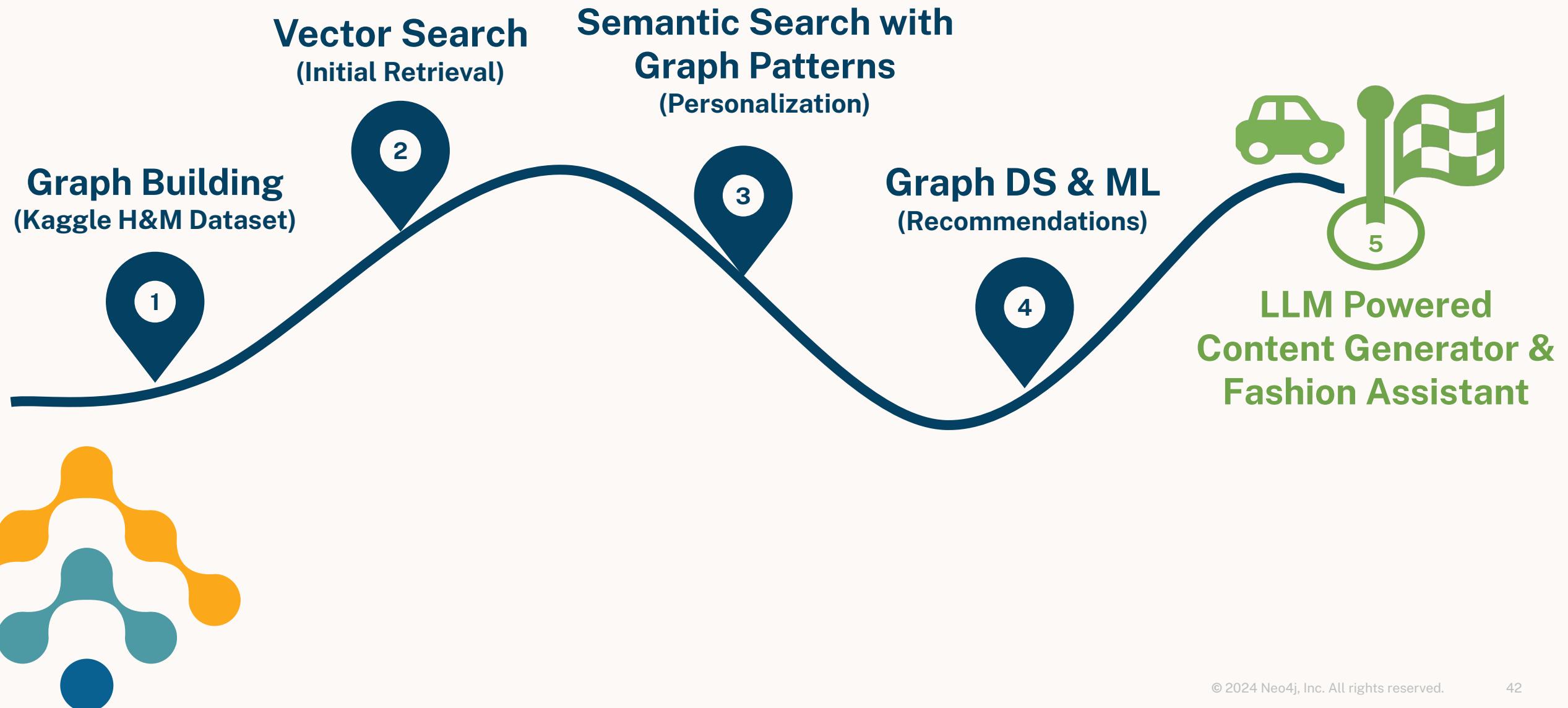




4/ Graph Data Science & ML

Recommendations

Stop before LLM Powered Content Generator

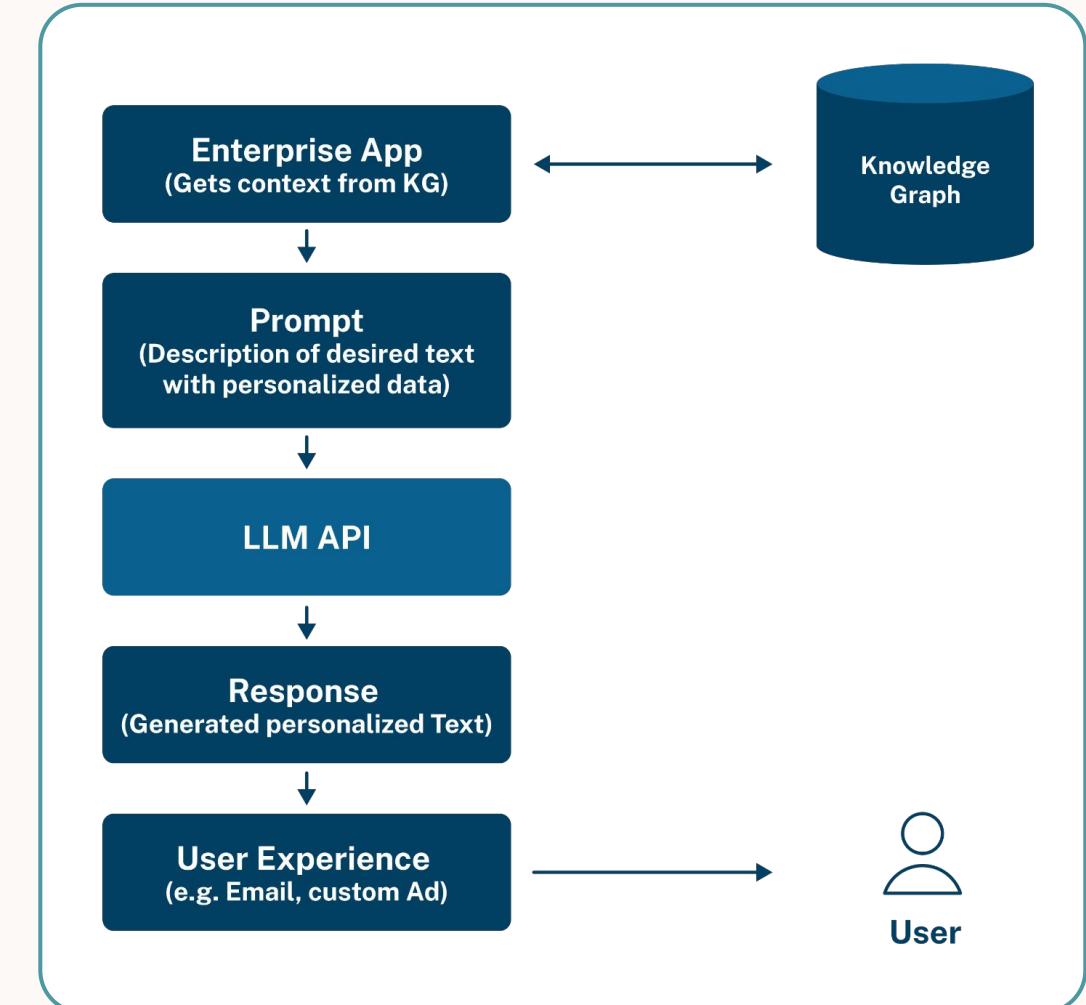


Online Retailers uses LLM and Knowledge Graph for Hyper-Personalized Customer Experiences

 **Challenge:** Scale generation of hyper-personalized customer experiences

 **Solution:** LLM application, backed by customer knowledge graph with their preferences, purchase history and other contextual data, to generate hyper-personalized email templates. LLM generates customizes email body based on customer's unique context from Knowledge Graph

 **Impact:** Transform customer experiences through natural language personalization



Prompting the LLM

You are a personal assistant named Sally for a fashion, home, and beauty company called HRM.

write an email to **{customerName}**, one of your customers, to promote and summarize products relevant for them given the current season / time of year: **{timeOfYear}**.

Please only mention the products listed below. Do not come up with or add any new products to the list.

Each product comes with an https `url` field. Make sure to provide that https url with descriptive name text in markdown for each product.

Relevant Products:

{searchProds}

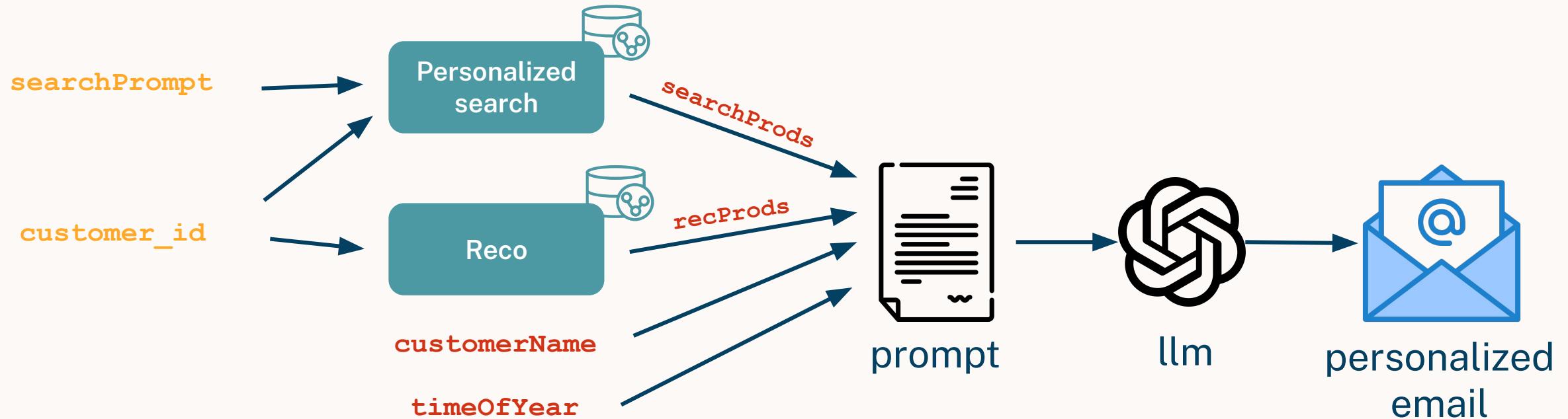
Customer May Also Be Interested In the following

(pick items from here that pair with the above products well for the current season / time of year: **{timeOfYear}**).

prioritize those higher in the list if possible):

{recProds}

Langchain Chain



```
{  
  searchProds: searchPrompt | personalizedSearch (customer_id)  
  recProds:  
  customerName  
  timeOfYear}
```

prompt | llm | OutputParser



4/ LLM Powered Fashion Assistant

LLM For Generating Grounded Content

Real-World GenAI Breakthroughs Powered by Neo4j



Leveraging AI
for customized
content at scale



Integrating AI with
knowledge graphs for
smarter supply chain
management



Merging structured
and unstructured data
for efficient operations



Converting vast amounts
of unstructured data into
actionable knowledge

1,700+ Organizations Use Neo4j

Banking & Financial Services



Technology



Telecommunications



Energy



dun & bradstreet, Santander

THRIVENT
FINANCIAL®

UBS, WESTERN UNION WU

MetLife

BNP PARIBAS
PERSONAL FINANCE

ZURICH

CA

dun & bradstreet

Santander

THRIVENT
FINANCIAL®

citrix

precisely

E-Commerce



Health & Life Sciences





Thank you!