

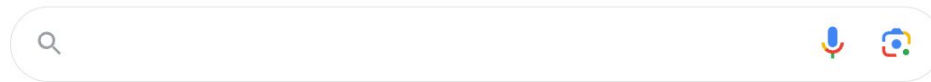
neo4j

# Transforming Healthcare With **Generative AI** and **Knowledge Graphs**



Dr. Alexander Jarasch  
Technical Consultant Pharma & Life Sciences


# The Evolution of... Web Search

The Google logo is centered on the page, featuring its characteristic multi-colored letters: 'G' in blue, 'o' in red, 'o' in yellow, 'g' in blue, 'l' in green, and 'e' in red.A white search bar with rounded corners. On the left side, there is a magnifying glass icon. On the right side, there are two icons: a microphone icon and a camera icon.

Google Search

I'm Feeling Lucky

# The Evolution of... Web Search

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# The Evolution of... Web Search

Full text Era: 1994 - 2000





## Google Launches World's Largest Search Engine



**Google Now Enables Internet Users to Search More Than 1 Billion URLs, Providing Quick and Easy Access to 560 Million Full-Text Indexed Web Pages and 500 Million Partially Indexed URLs**

**MOUNTAIN VIEW, Calif. – June 26, 2000** – Google Inc., one of the fastest growing search engines on the web, today announced it has released the largest search engine on the Internet. Google's new index, comprising more than 1 billion URLs, offers users the web's most comprehensive collection of websites, which can be easily searched with Google's fast and highly relevant search technology. Available now at [www.google.com](http://www.google.com), Google's portal and destination site customers can also license this new index for integration with their own websites.



*Google is based on a variety of innovative technologies, including sophisticated text matching and its advanced, patent-pending technology called PageRank™, which ensures that the most important results always come up first.*





# PageRank

🗨️ 42 languages ▾

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(Top)

From Wikipedia, the free encyclopedia

[Description](#)

**PageRank (PR)** is an [algorithm](#) used by [Google Search](#) to rank [web pages](#) in their [search engine](#) results. It is named after both the term "web page" and co-founder [Larry Page](#).

[History](#)

PageRank is a way of measuring the importance of website pages. According to Google:

> [Algorithm](#)

PageRank works by counting the number and quality of links to a page to determine a rough estimate of how important the website is. The underlying assumption is that more important websites are likely to receive more links from other websites.<sup>[1]</sup>

> [Variations](#)

> [Other uses](#)

[nofollow](#)

[See also](#)

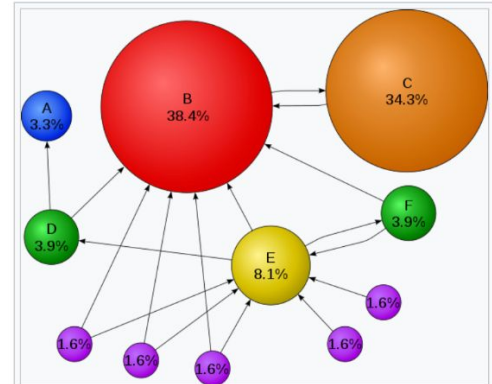
> [References](#)

[Relevant patents](#)

[External links](#)

Currently, PageRank is not the only algorithm used by Google to order search results, but it is the first algorithm that was used by the company, and it is the best known.<sup>[2][3]</sup> As of September 24, 2019, all patents associated with PageRank have expired.<sup>[4]</sup>

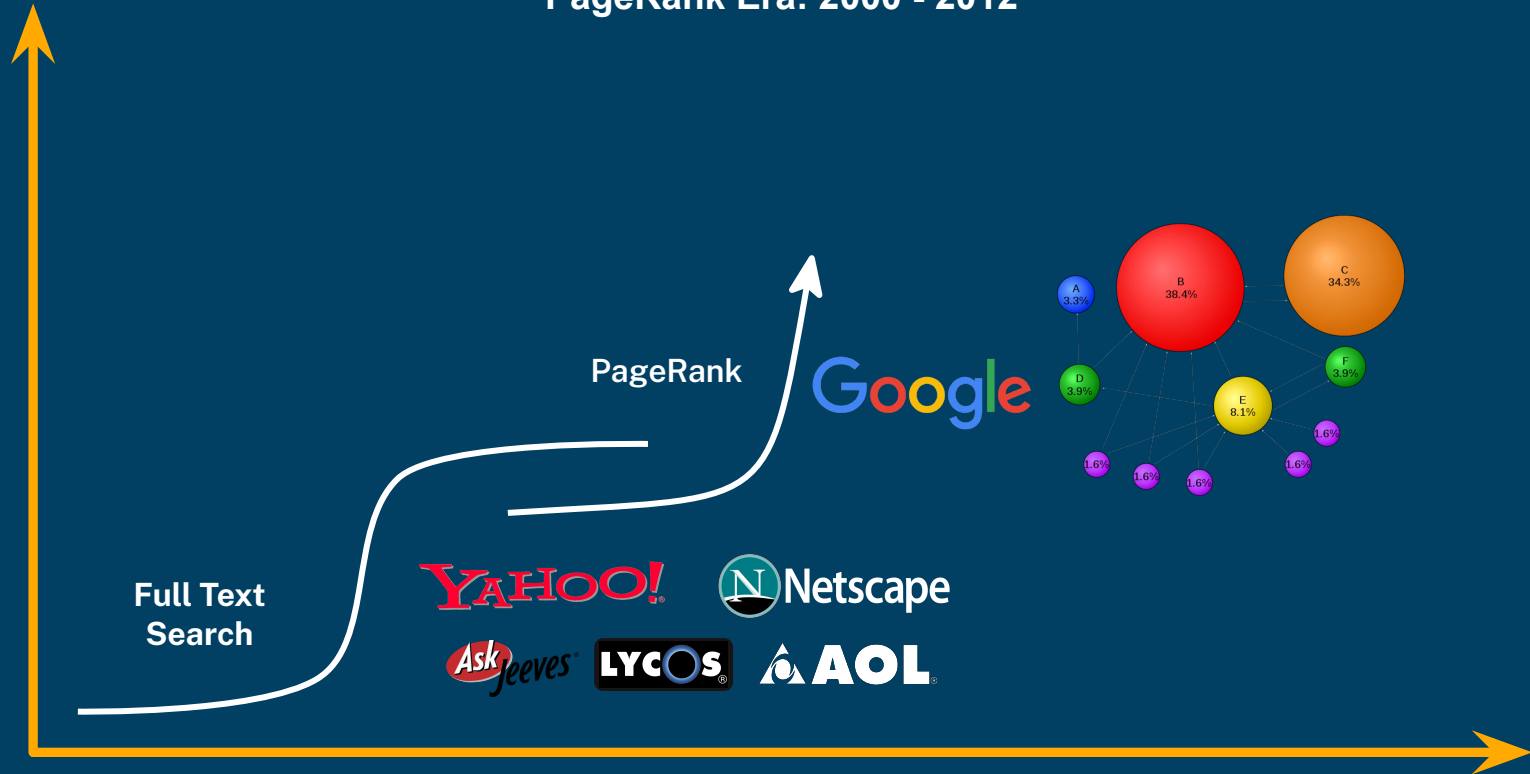
**Description** [\[edit\]](#)

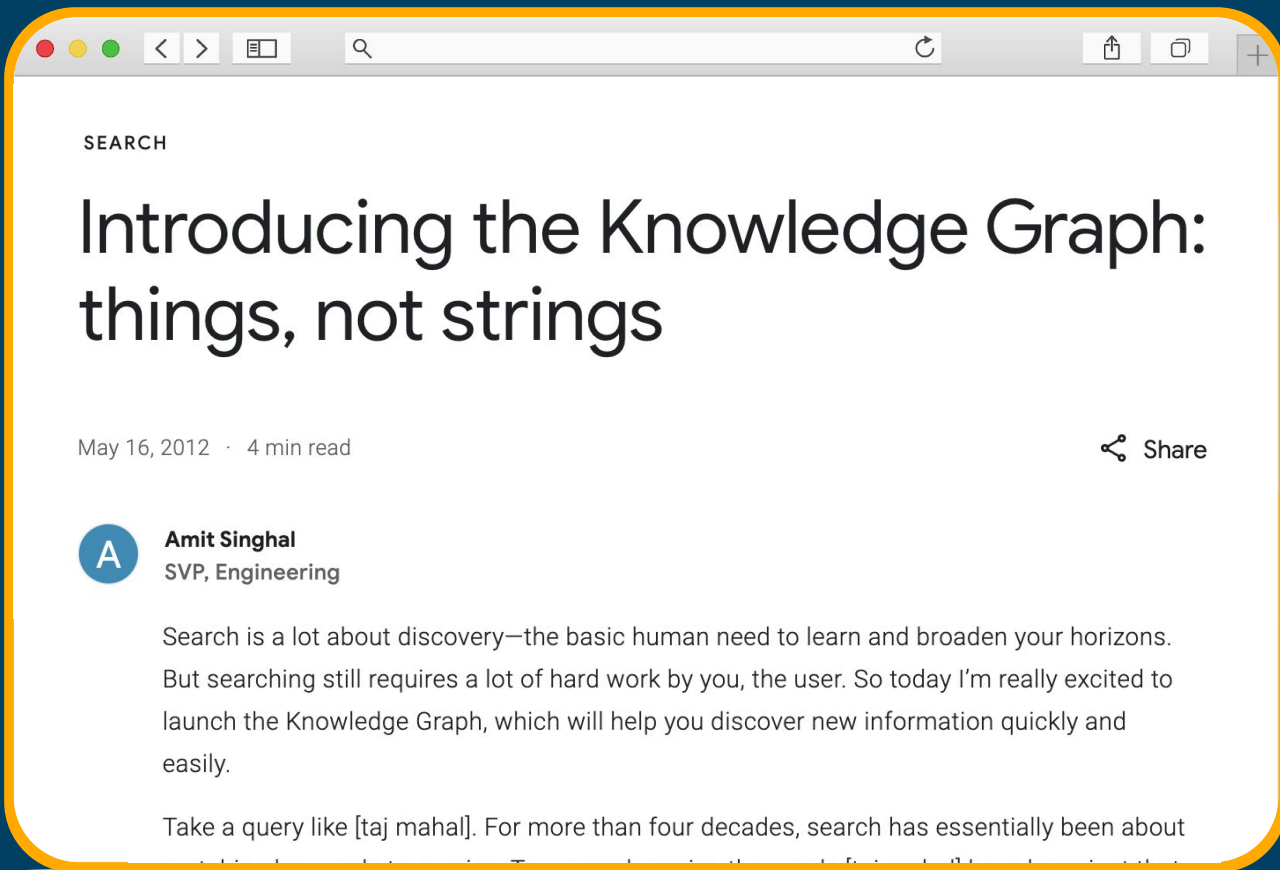


A simple illustration of the Pagerank algorithm. The percentage shows the perceived importance, and the arrows represent hyperlinks.

# The Evolution of... Web Search

PageRank Era: 2000 - 2012





**B** Bertelsmann SE & Co. KGaA  
<https://www.bertelsmann.de> › bertel... · Translate this page

### Bertelsmann in Berlin - Bertelsmann SE & Co. KGaA

Herzlich willkommen bei **Bertelsmann Unter den Linden 1**. Das Unternehmen Bertelsmann hat hier - unter klangvoller Adresse - seine deutsche ...

#### Was war da eigentlich vorher?

Jahrhundert - das Haus Unter den Linden 1 erhält allmählich Züge ...

#### Bertelsmann erleben in der ...

... Unter den Linden 1, die sich zu einem lebendigen und ...

#### „Tatort“ Unter den Linden 1

„Tatort“ Unter den Linden 1. Die Bertelsmann-Repräsentanz ...

#### Das Interieur: Ein Innenleben ...

Bertelsmann in Berlin. Das Interieur: Ein Innenleben voll ...

#### Die historische Mitte Berlins

Erste Straße, Neustädtische Allee, Lindenallee, Lindenstraße - die ...

[More results from bertelsmann.de »](#)

**B** Bertelsmann SE & Co. KGaA  
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### Bertelsmann in Berlin

Bertelsmann SE & Co. KGaA. Unter den Linden 1 10117 Berlin Germany. Tel.: +49 (0) 30

**Bertelsmann SE & Co. KGaA**

Website Directions Save Call

4,6 ★★★★★ 71 reviews ⓘ

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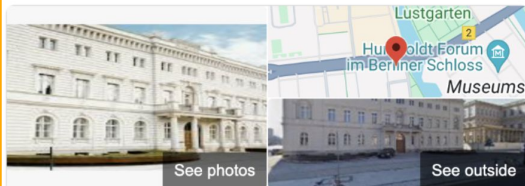


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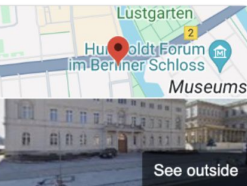
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Ask a question



### Bertelsmann SE & Co. KGaA

ann Unter den Linden 1. Das Unternehmen Bertelsmann  
- seine deutsche ...

vorher?

an Linden 1 erhält allmählich Züge ...

n der ...

tu einem lebendigen und ...

en 1

Bertelsmann-Repräsentanz ...

nleben ...

eur: Ein Innenleben voll ...

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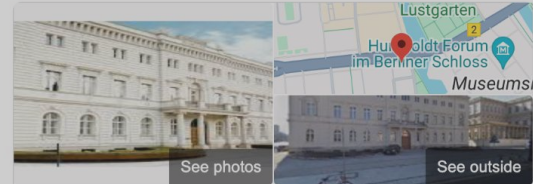
re, Lindenallee, Lindenstraße - die ...

e »

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### Bertelsmann in Berlin

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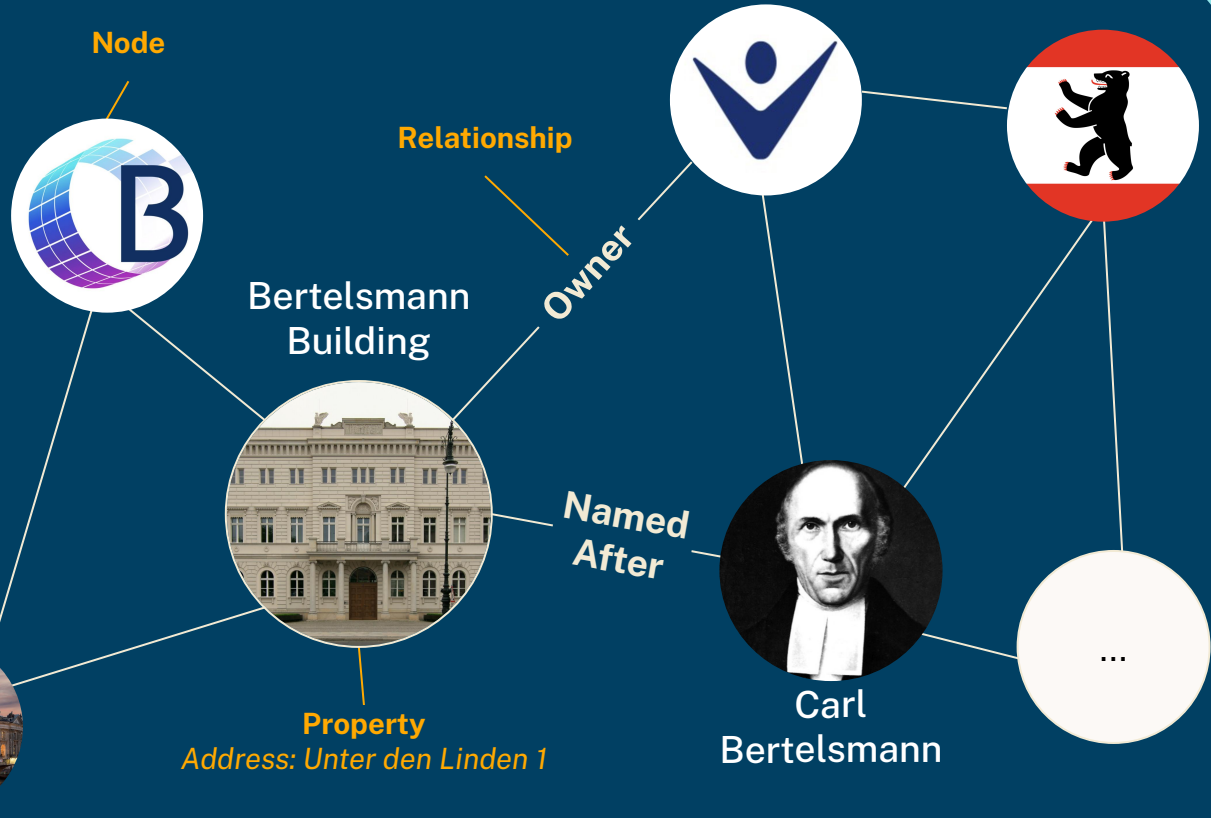
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4,6 ★★★★★ 71 reviews ⓘ  
Event venue in Berlin

**Located in:** Alte Kommandantur  
**Address:** Unter den Linden 1, 10117 Berlin  
**Hours:** Open 24 hours ▾  
**Phone:** 05241 800

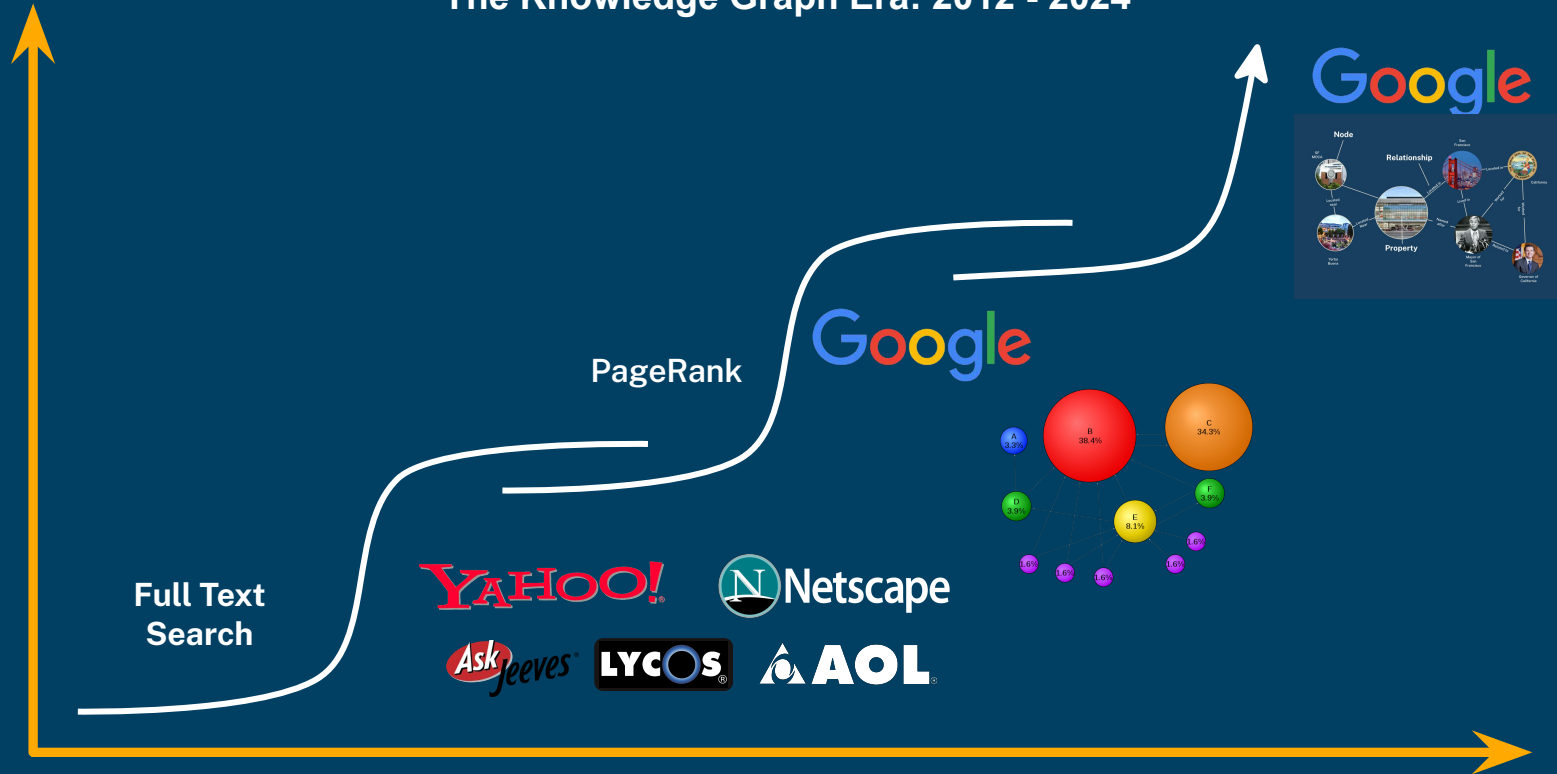
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**Questions & answers**  
Be the first to ask a question



# The Evolution of... Web Search

The Knowledge Graph Era: 2012 - 2024





# Google I/O '24 Keynote

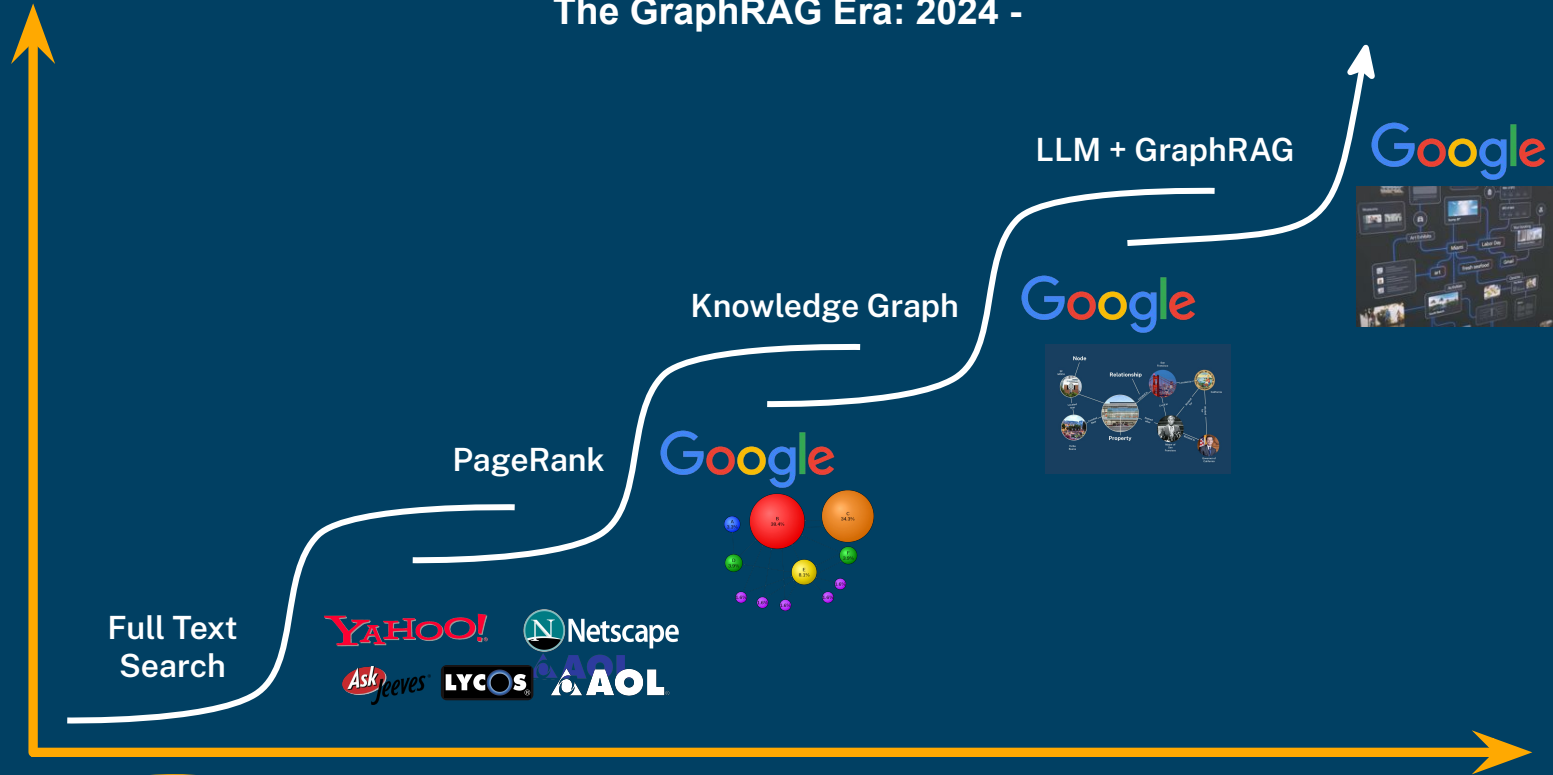


# Google I/O '24 Keynote



# The Evolution of Web Search

The GraphRAG Era: 2024 -



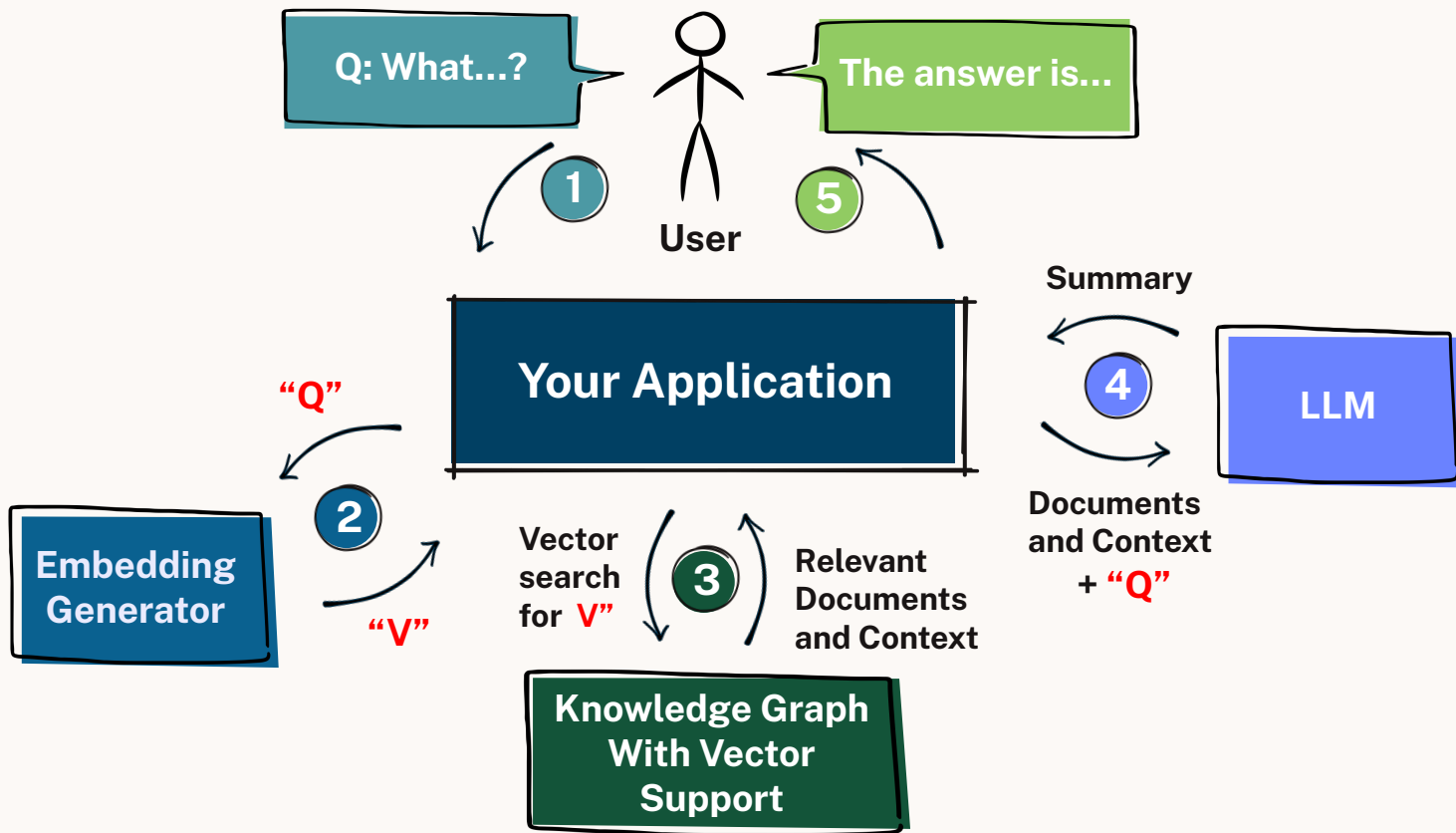


# Introduction to GraphRAG

# What IS GraphRAG?

**Very Simple.**

GraphRAG is **RAG where the R path includes a Knowledge Graph.**



# Context makes the Difference

Neo4j knowledge graphs supply the LLM with information about your company so answers are specific to your business, giving more context for more accurate responses.

Role-Based  
Access Control

## Your Enterprise Knowledge Graph



According to the **context Disease** here AD refers to 'Alzheimer's Disease'

According to the **context Protein** here AD refers to 'Alcohol Dehydrogenase'

According to the **context XYZ** here AD refers to 'Something else'



**So...How to build a  
Knowledge Graph?**

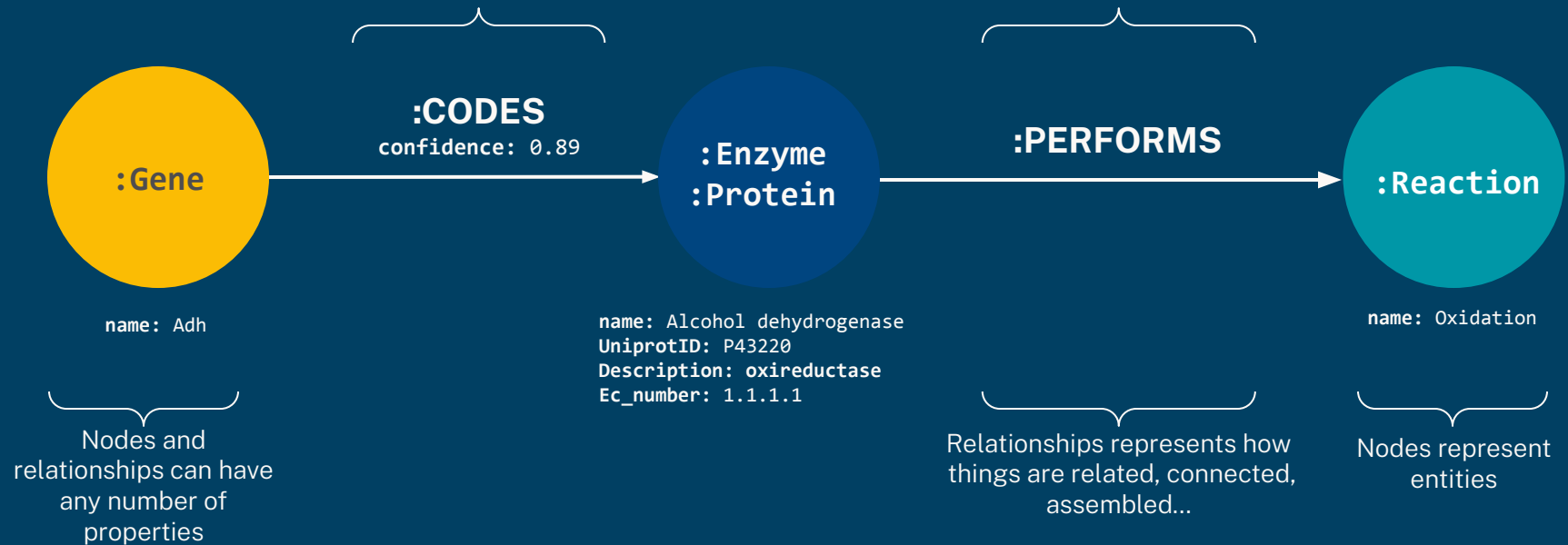


# Our Data is **connected** by Definition

Nodes can have zero or more labels

Relationships have a type

Relationships are directional



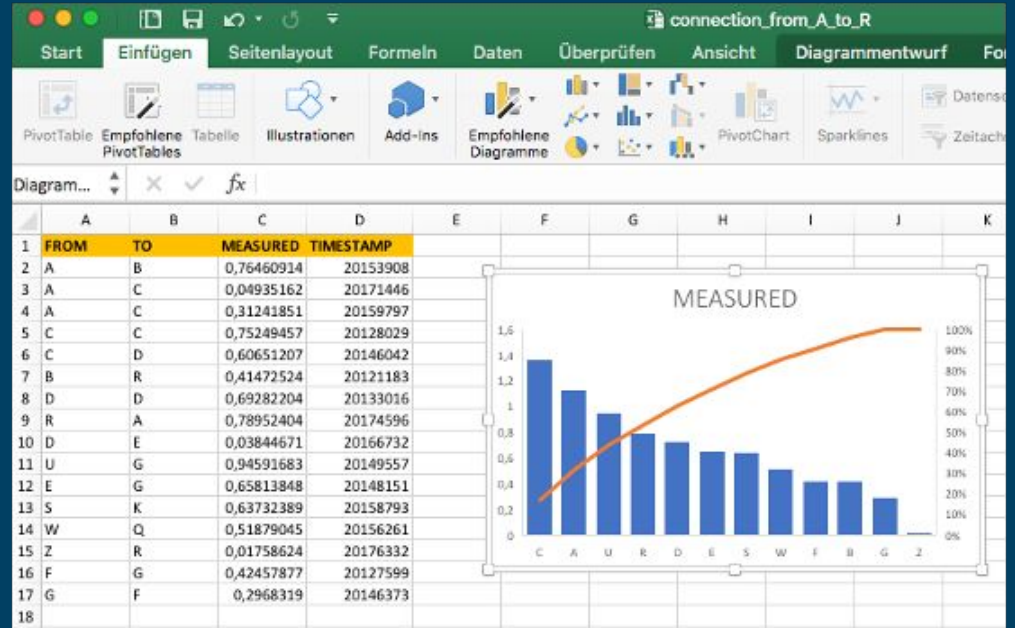
Are human T2D genes regulating the same metabolites which in turn are also regulated in a diabetic pig model?

Same question, but from a data-point-of-view:

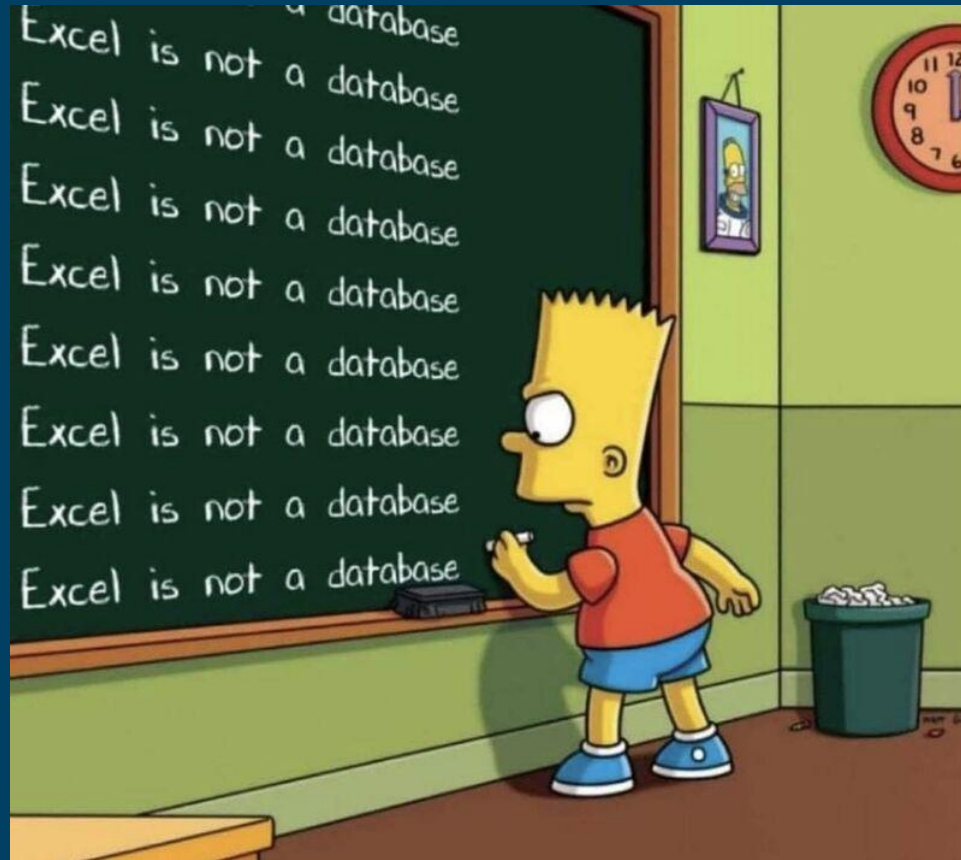
**Is A connected to R?**

> 90%

of the Data is captured  
in relational  
databases



# Side Note



# The **Problem** with Relational Data Architecture

**Stifles Innovation**

Forces business entities into a rigid, tabular format

**Hinders Agility**

Limits flexibility to adapt as business needs change

**Adds Complexity**

Requires complex joins and data pipelines to connect siloed data

**Delays  
Decision-Making**

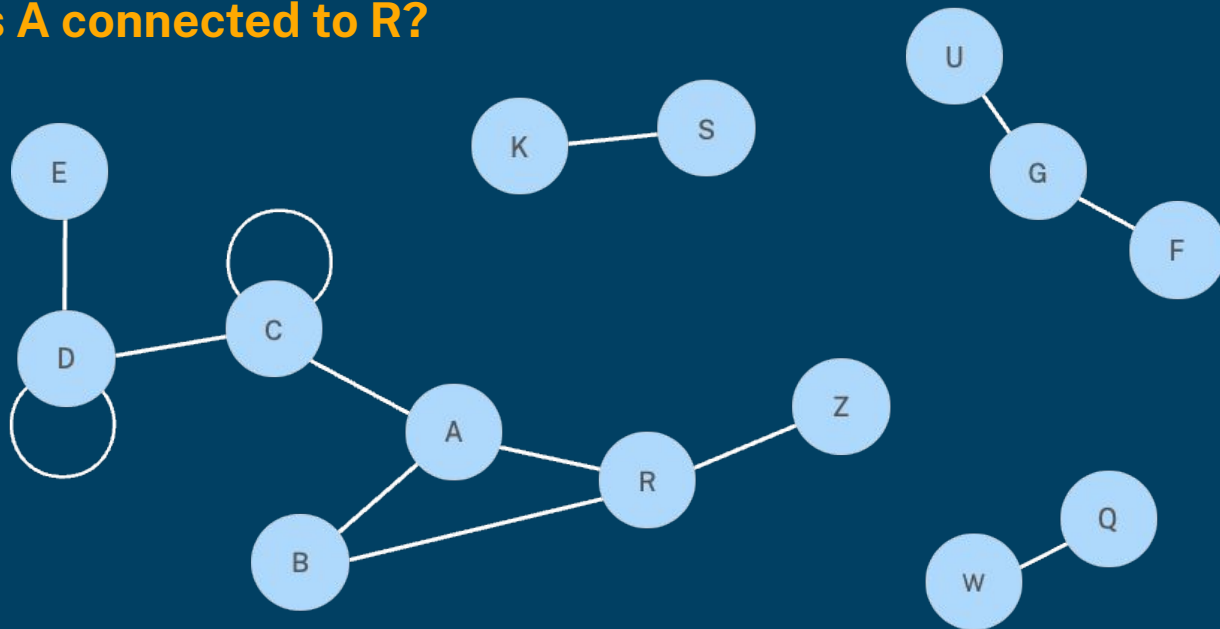
Slows time-to-insight and hinders agility

Are human T2D genes regulating the same metabolites which in turn are also regulated in a diabetic pig model?

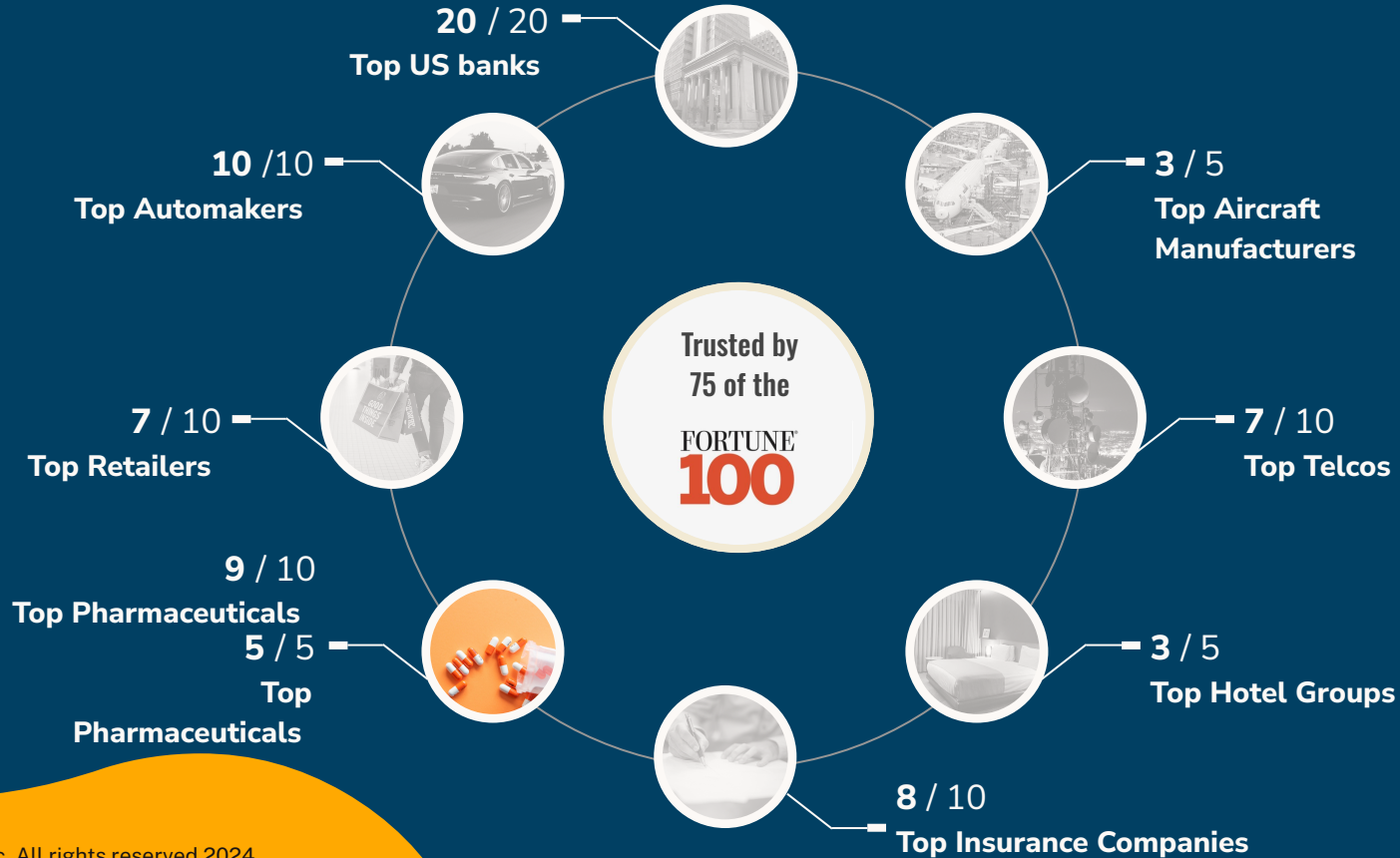
Same question, but from a data-point-of-view:

**Is A connected to R?**

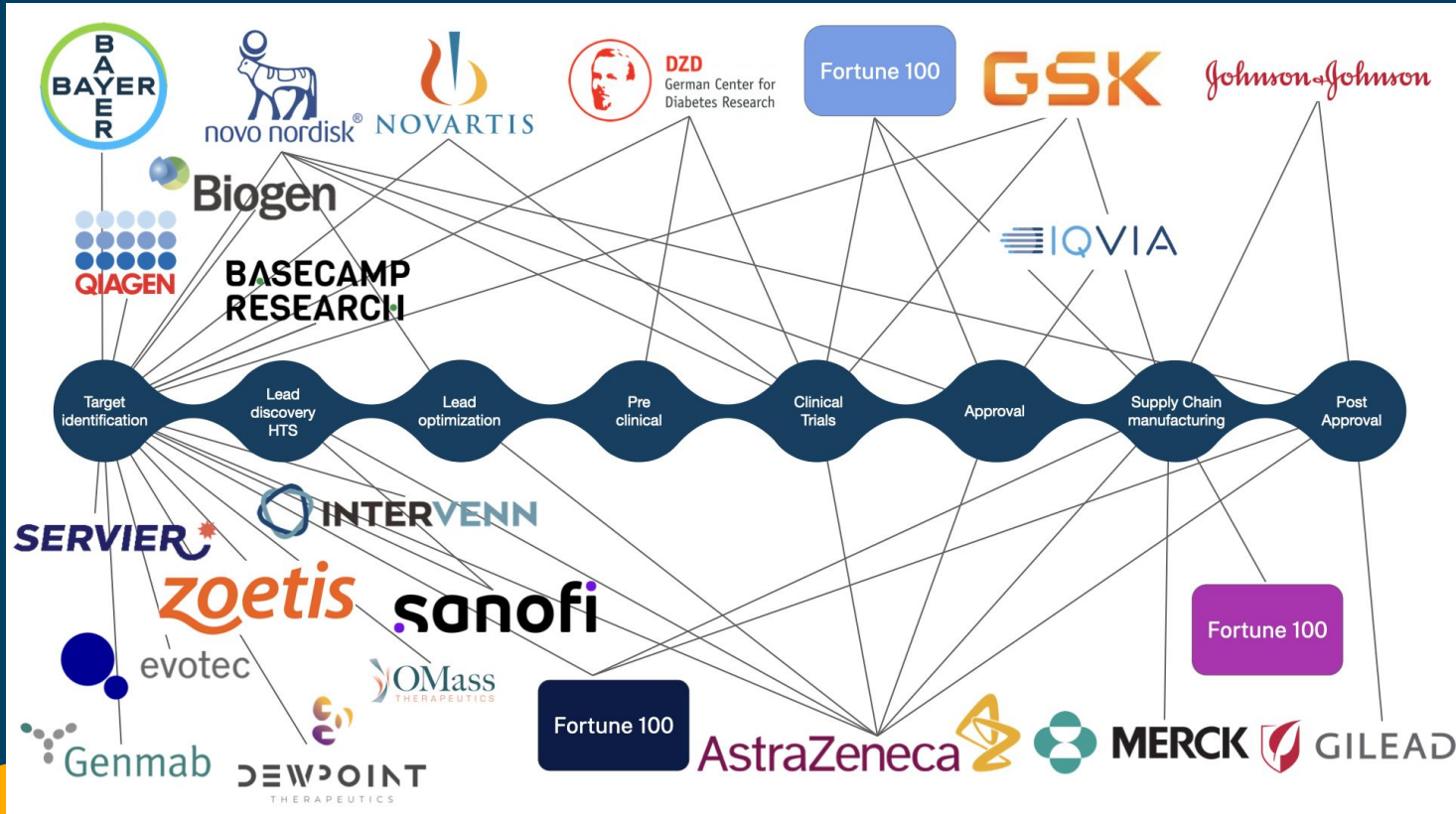
Same data in  
**Graph** format



# Industry Leaders **choose Graph**



# Use Cases for the **entire** Drug LifeCycle



# Use Cases in Biotech and Chemical Industries

BASECAMP  
RESEARCH



syngenta

**BASF**  
We create chemistry



Formulation

Synthesis

Supply Chain  
Risk  
Mitigation

Strain  
lineage

Feedstock

Repurposing

Chemical  
Reactions

Stereo  
Specificity

Bill of  
Material

Track  
&  
Trace

Process  
Management

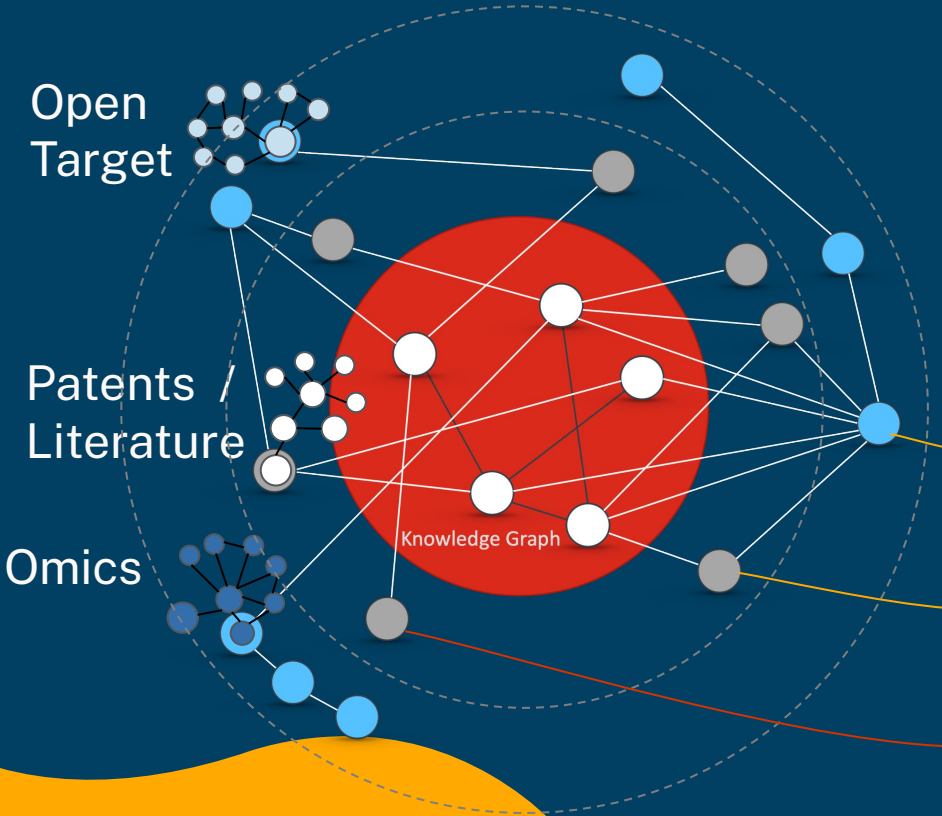
Competitive  
Intelligence



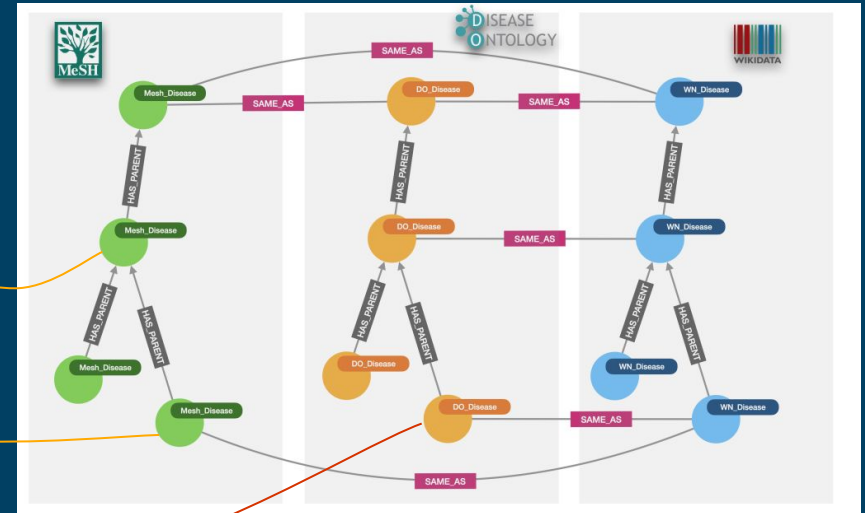
# Integrates with **All** Your Data



# Connect Data + Metadata + Ontologies



## Internal & External Ontologies



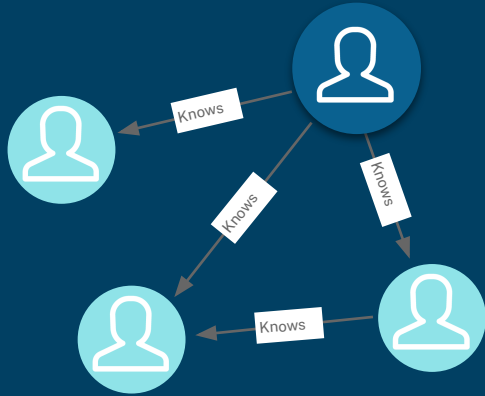
Ontology 1  
(external)

Ontology 2  
(internal)

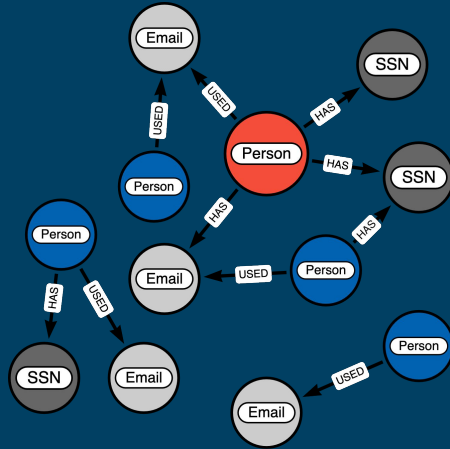
Terminology 1  
(internal)

# Enable Customers to Make Sense of Data Relationships

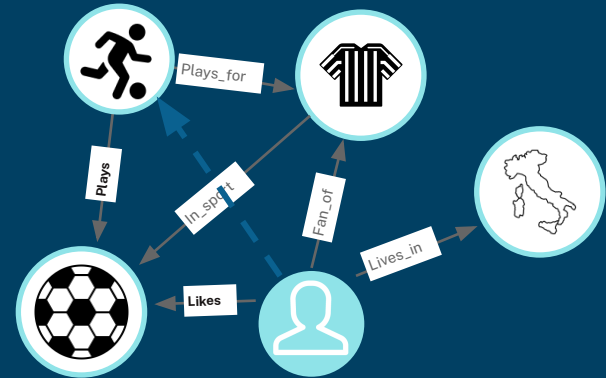
What's important?



What's unusual?



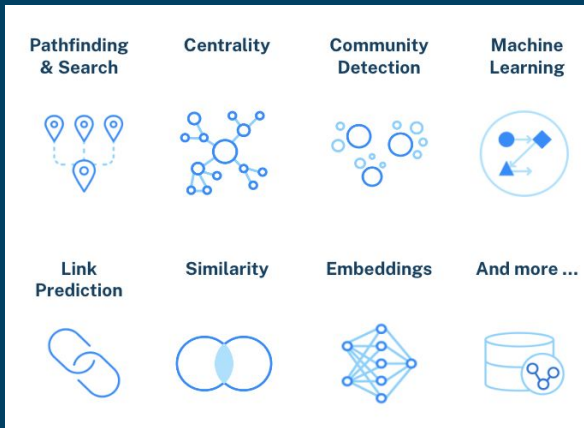
What's next?



Explore the hidden patterns and features in your data

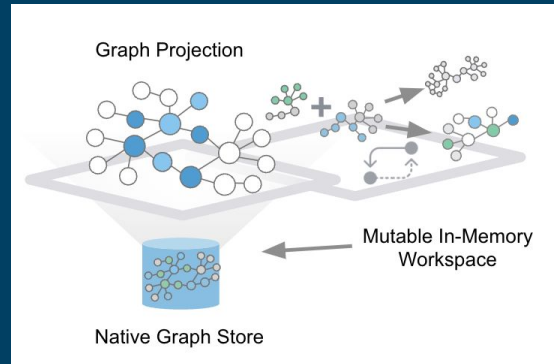
# Enable Customers to Make Sense of Data Relationships

## The Largest Catalog of Graph Algorithms



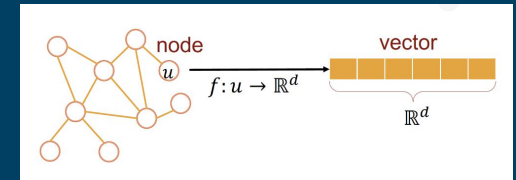
Over 45 pretuned, parallelized algorithms.

## Native Graph Catalog and Analytics Workspace



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

## Graph Vector Embeddings for Gen AI



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



# Use Case

## AstraZeneca

BIKG - Biological Insights Knowledge Graph

CIKG - Competitive Intelligence Knowledge  
Graph

# AstraZeneca

Uncovering new  
**molecular relationships**  
**in enormous datasets**  
for accelerated drug  
discovery was a daunting  
task for AstraZeneca.





# Let's build bridges to connect "siloes" of interest...



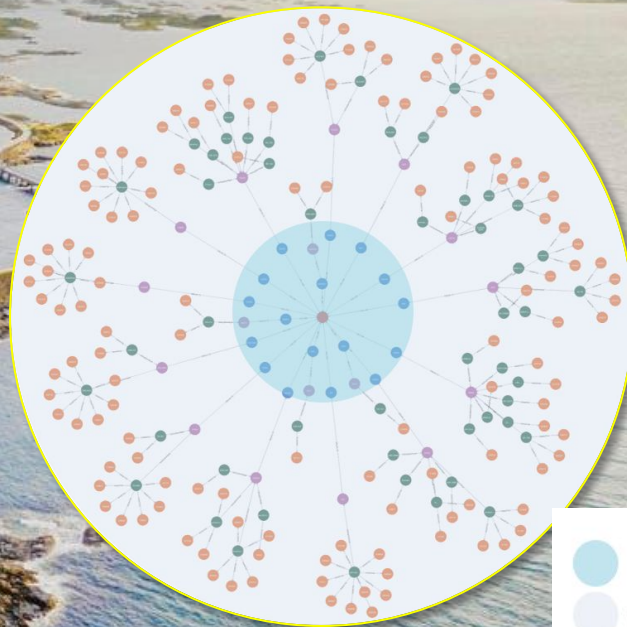
"Find all **genes** in BIKG linked with a specific **disease**, and then all **trials** in CIKG that are testing **drugs targeting those genes**"

BIKG

Biological Insights  
Knowledge Graph

CIKG

Competitive Intelligence  
Knowledge Graph



BIKG  
 CIKG

The diagram shows the resulting subgraph for the federated query that answers the question





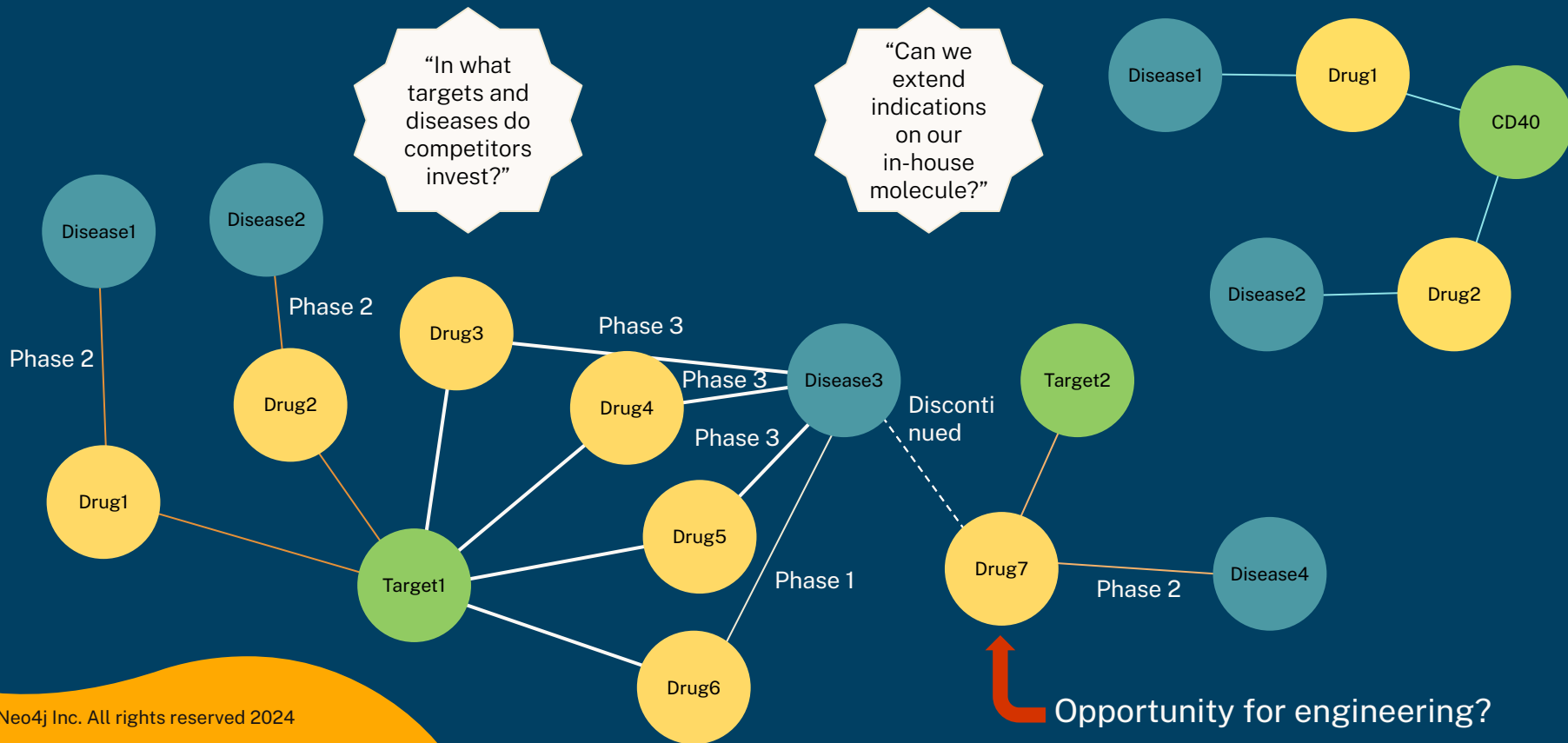
# Use Case

## Danish Biotech Company

Drug Repurposing



# Data from Clinical Trials



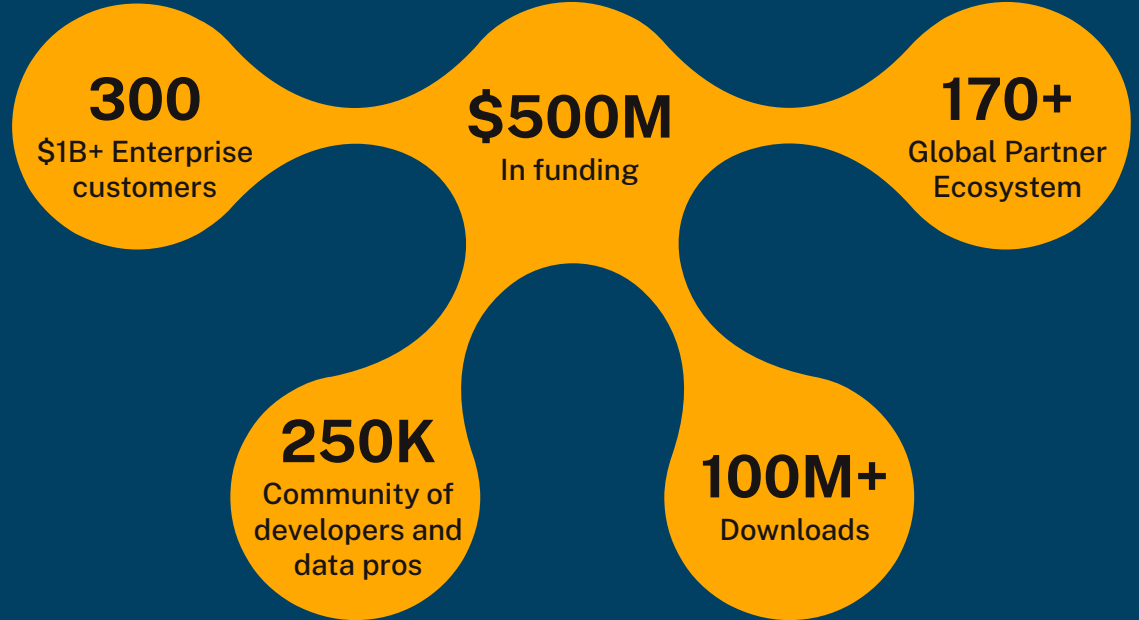


Who is Neo4j



Creator of the  
**market category**

Continued market  
**leader**



# Neo4j: For Applications **and** Analytics

## Intelligent Applications

Graph Transactions,  
Storage & Querying



neo4j



## Intelligent Modeling

Graph Analytics, ML,  
& Data Science

(graph)-[are]->(everywhere)

[alexander.jarasch@neo4j.com](mailto:alexander.jarasch@neo4j.com)