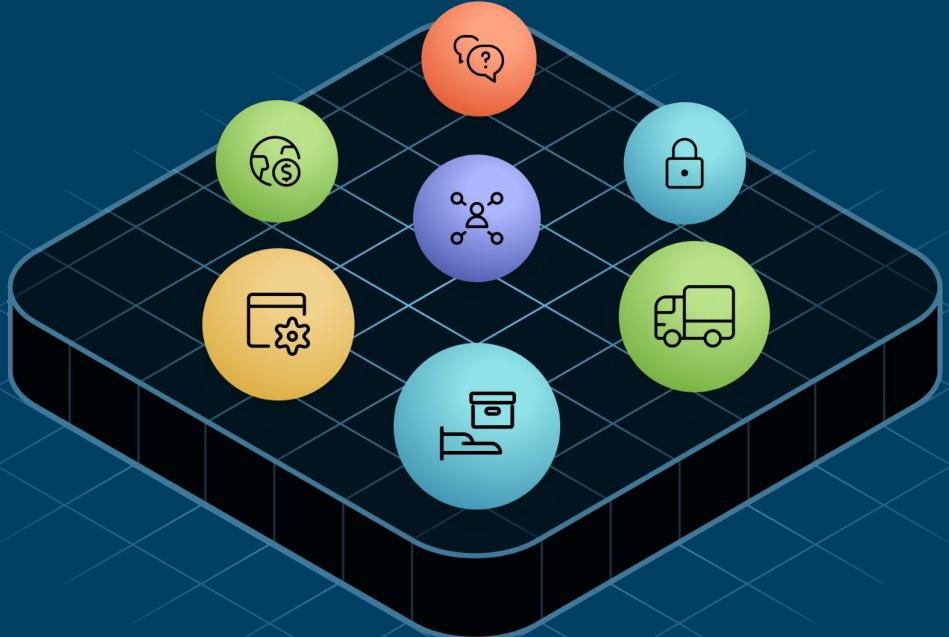


Knowledge Graphs & Digital Twins

Connecting data for smart decisions

Eliézer Zarpelão - Sr Solutions Engineer LATAM

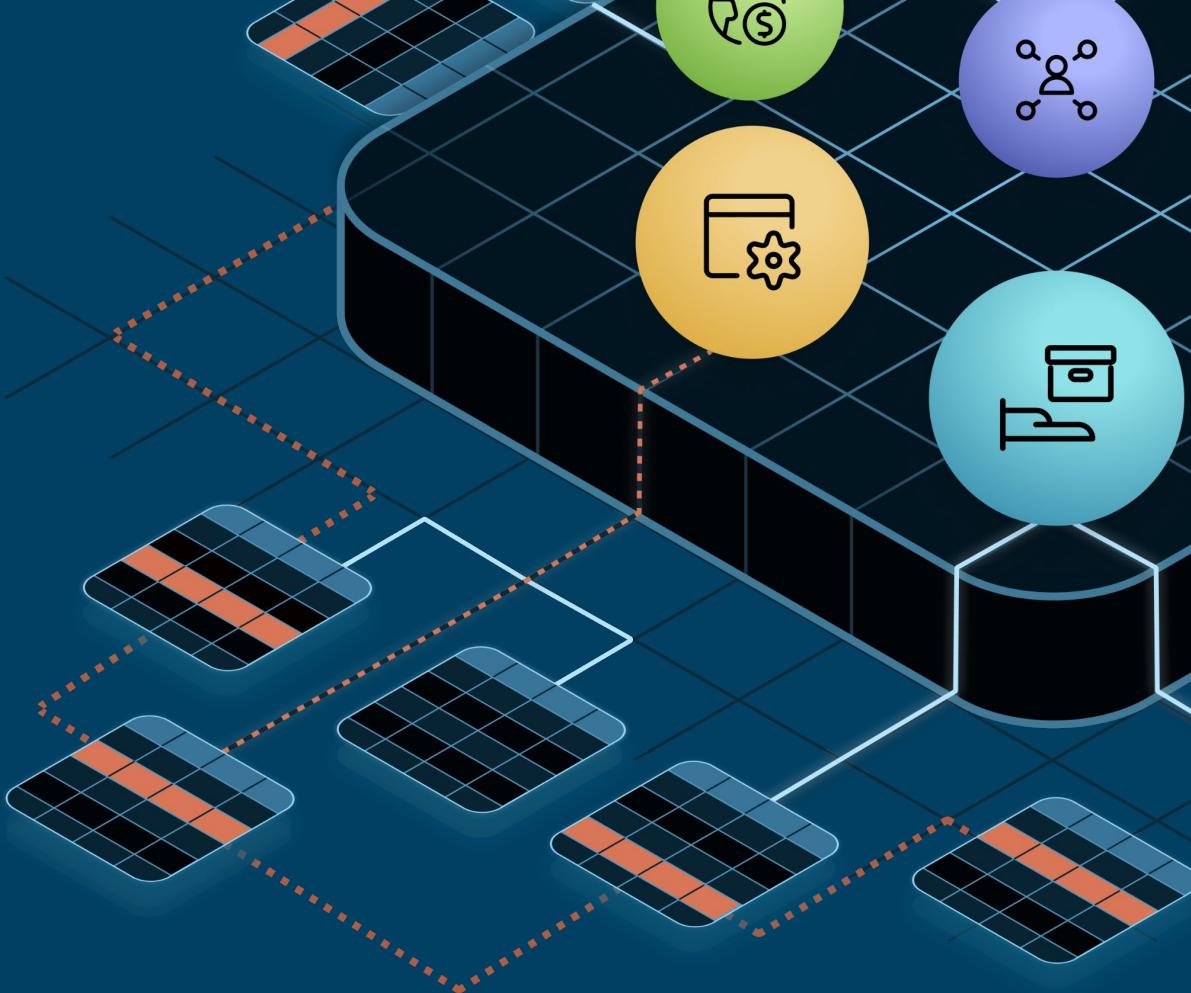
Your business is agile and dynamic



But your data
is locked in
rows and
columns



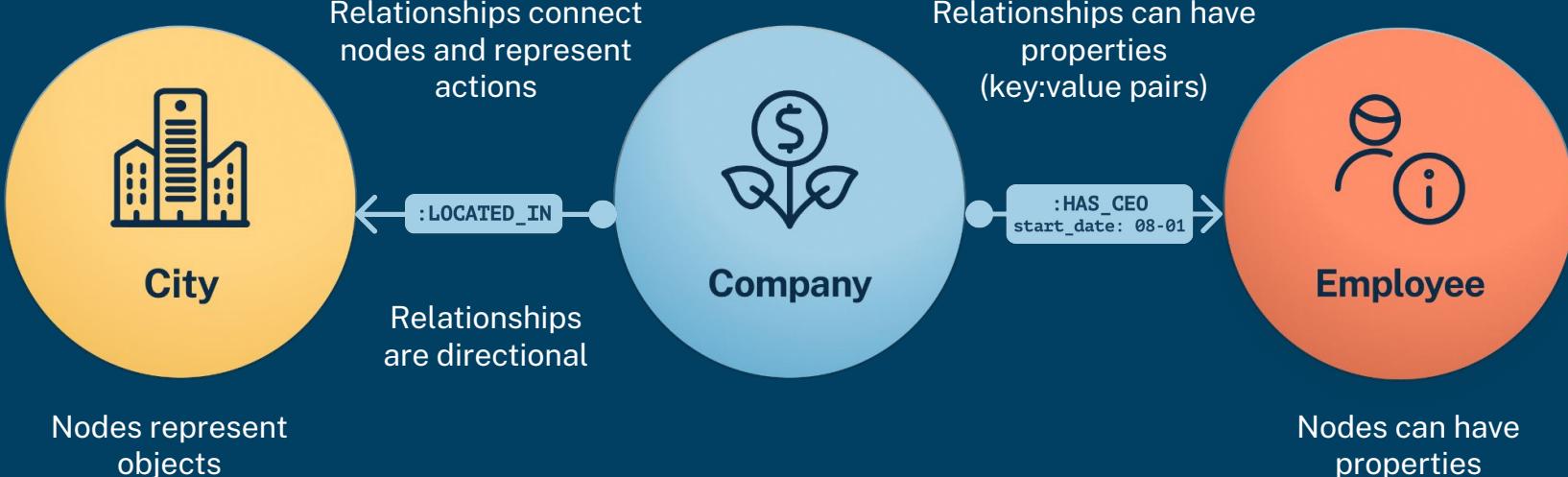
Valuable patterns are hidden in your data



Data, Meet Graph

Model your data like your
business, with a *connected view*
of *dynamic relationships*

The power of the graph model

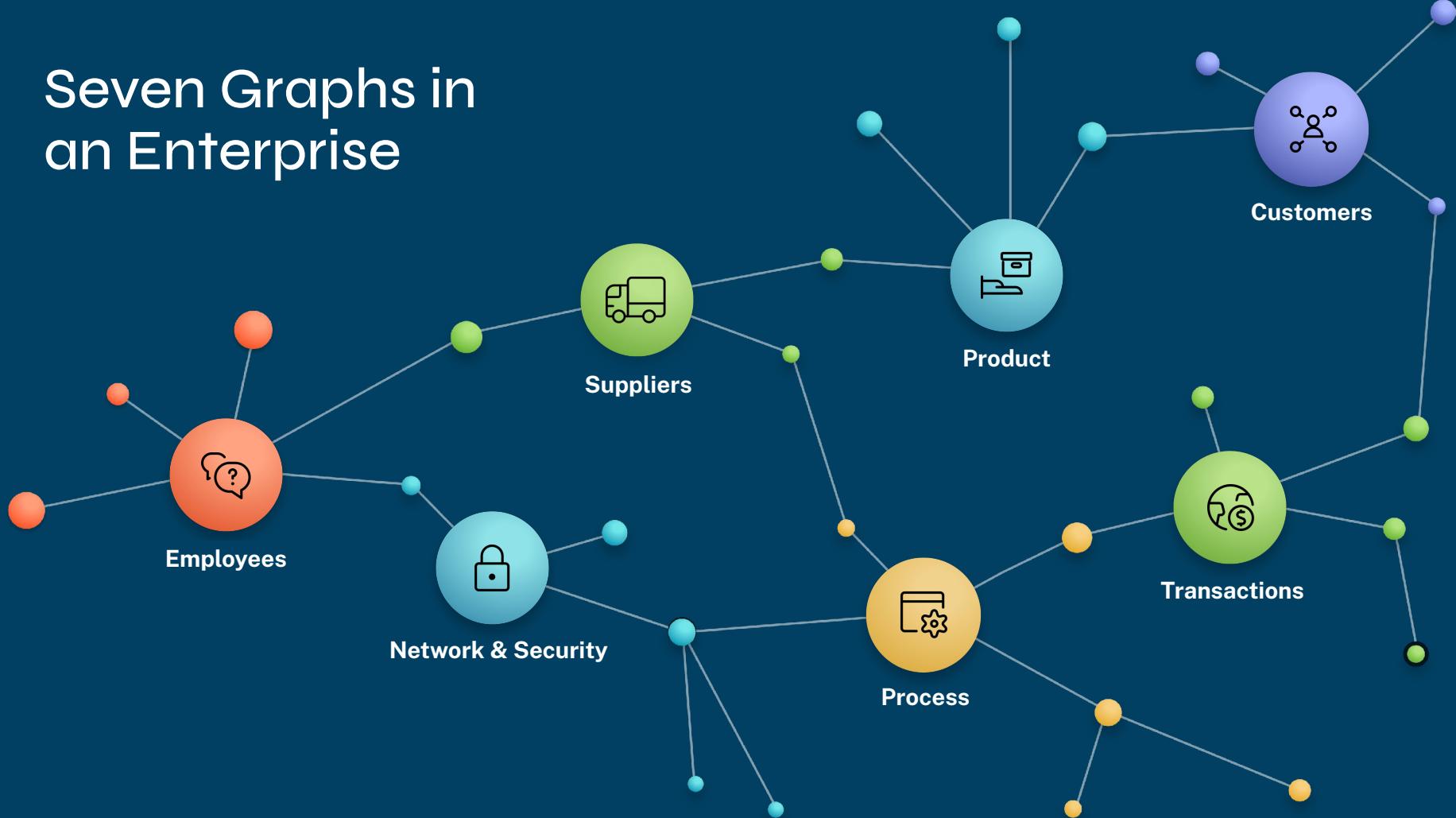


name: "Amy Peters"
date_of_birth: 1984-03-01
employee_ID: 1

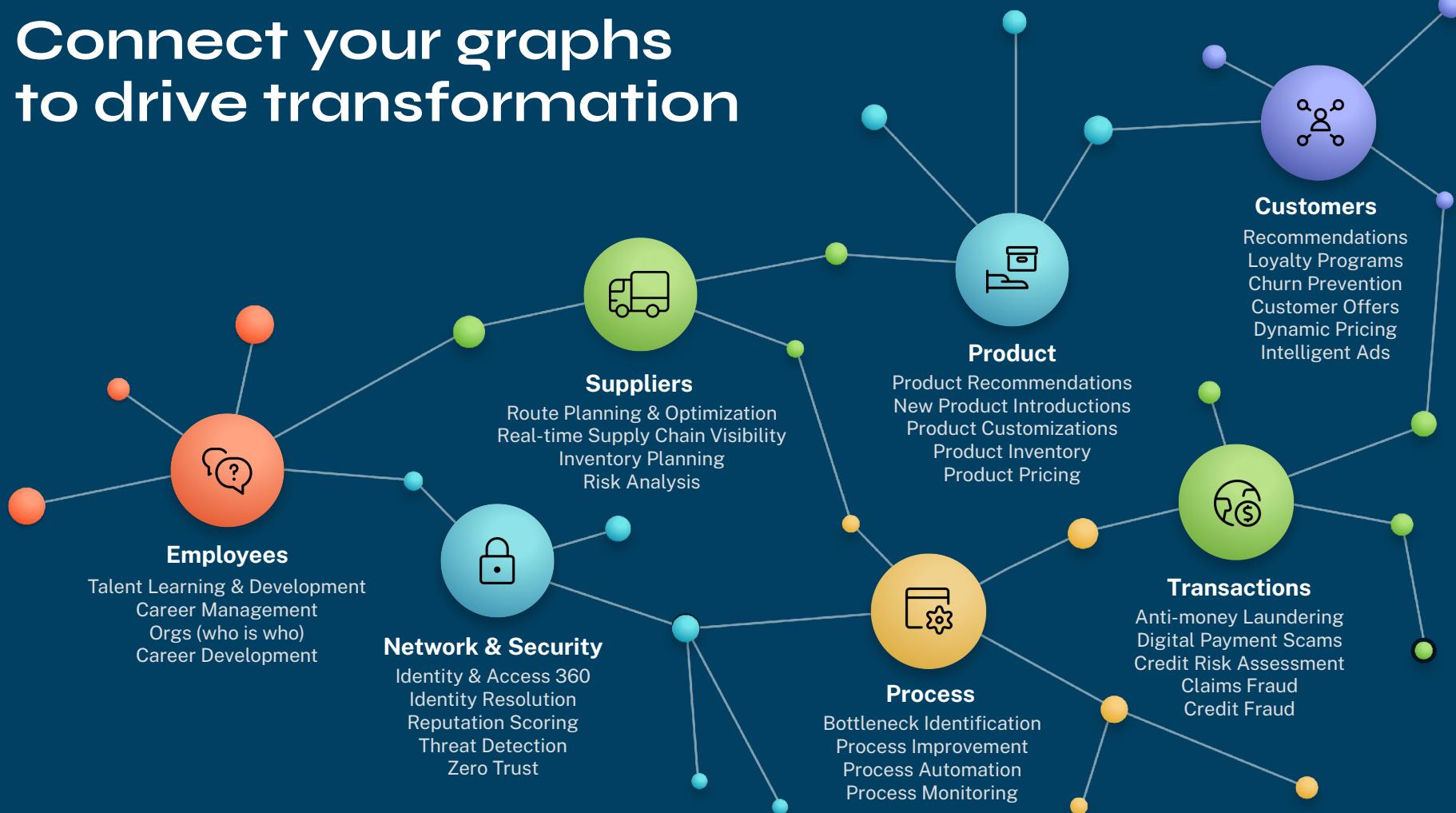
Model your data like your business



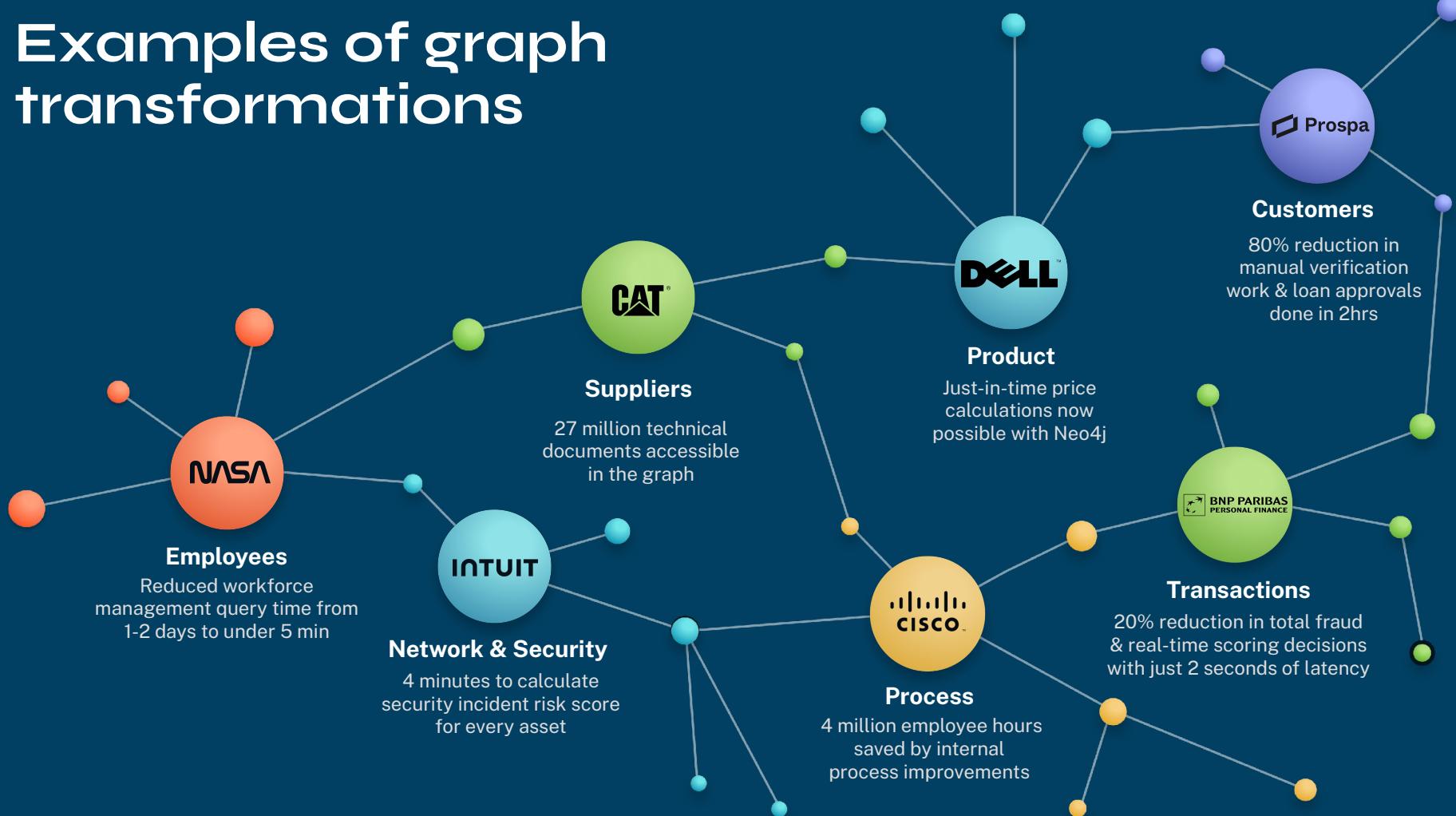
Seven Graphs in an Enterprise



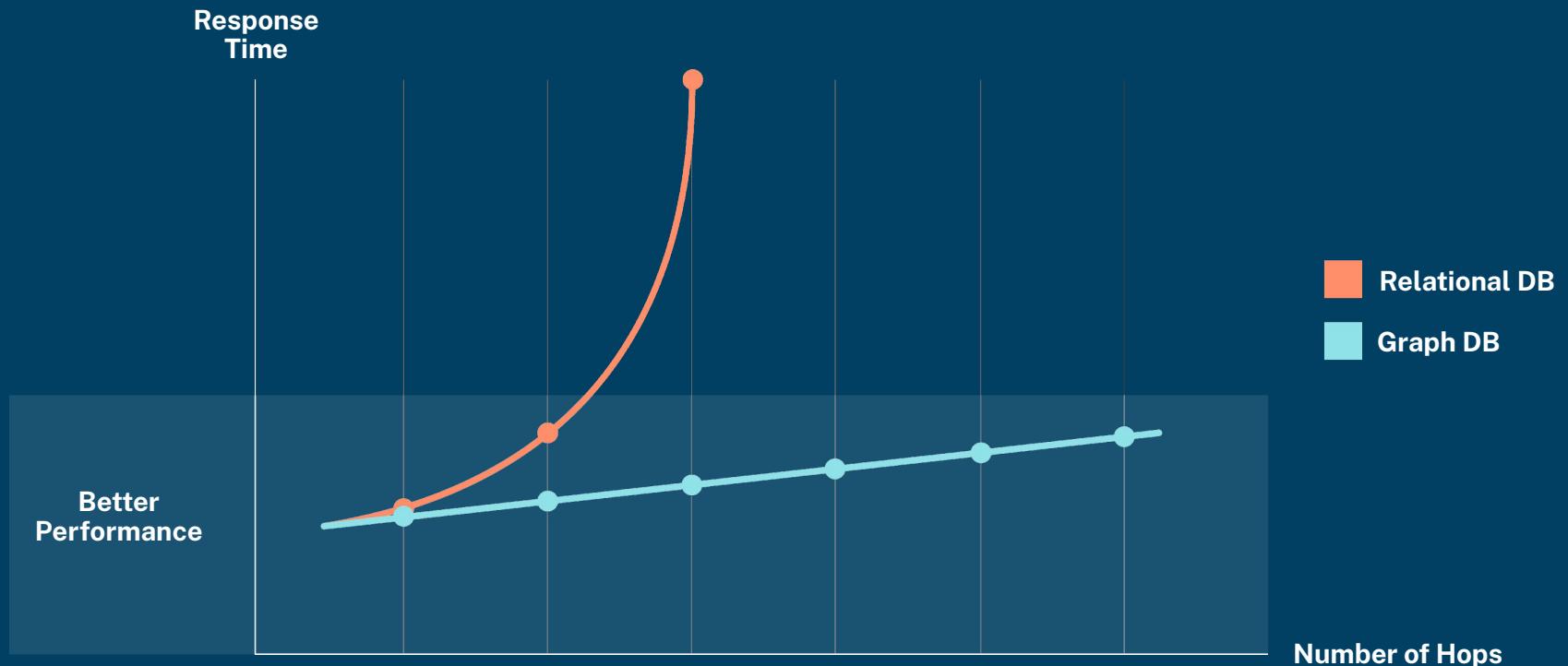
Connect your graphs to drive transformation



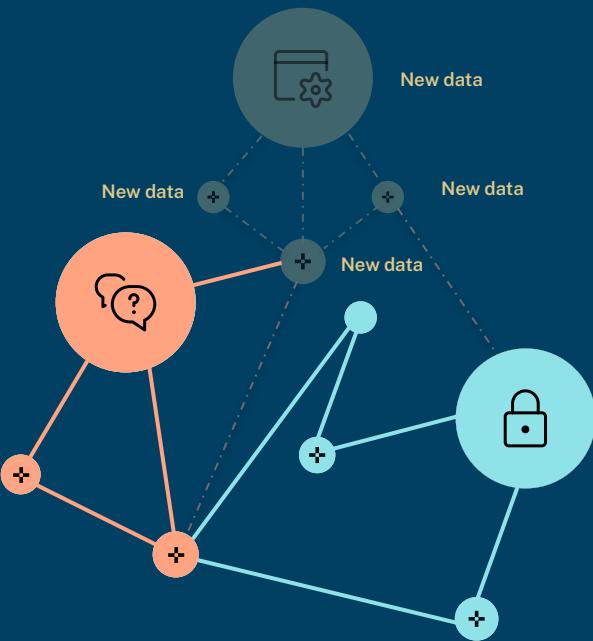
Examples of graph transformations



Graph is fast



Graph is flexible



Easily add new data without redesigning data model

Graph is insightful

What's important?

What's unusual?

What's next?



The Evolution of Data: From Raw Facts...

Foreign Keys?

ARCHITECT OF BUILDING

ID	Building	Architect
1	5	1

CITY

ID	Name	Country
101	Barcelona	2

STYLE

ID	Name
40	Modernism

Left outer joins?

FOOD OF CITY

ID	Food	City
1	1	101

FOOD

ID	Name
1	Paella

ARCHITECT

ID	Name
1	Antoni Gaudi

Joins?

COUNTRY

ID	Name
2	Spain

BUILDING

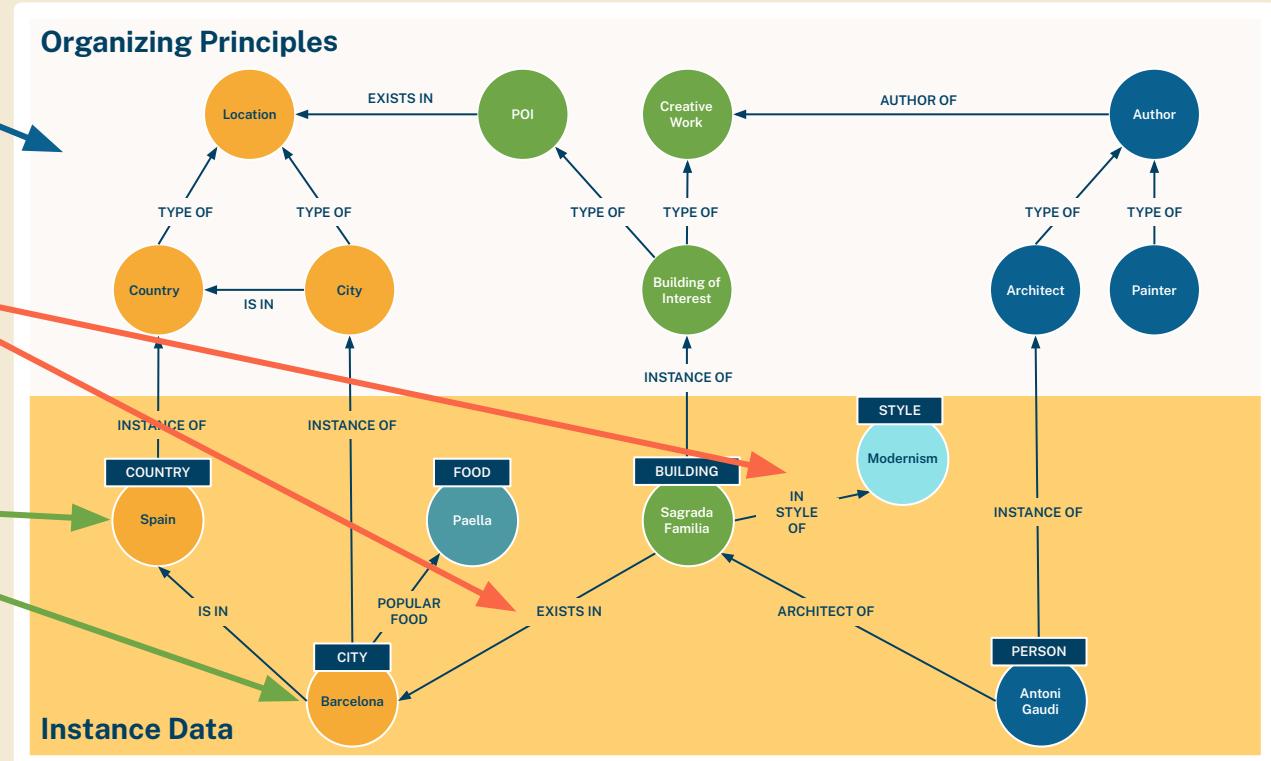
ID	Name	City
5	Sagardi Familia	101

The Evolution of Data: Deep, Dynamic Context

Organization

Relationships
(Context)

Data



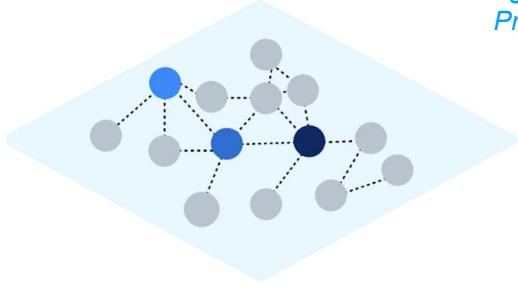
Driving Intelligence into Data with Knowledge Graphs



Data



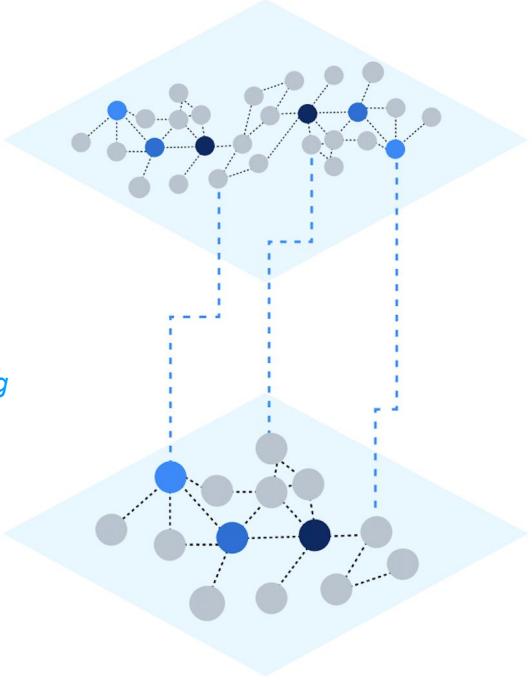
Relationships



Graph
Dynamic Context



Organizing
Principle



Knowledge Graph
Deep Dynamic Context



Knowledge Graph is a design pattern to **store, organize, and access** interrelated **data entities and semantic relationships** between different pieces of information, enabling more sophisticated **understanding and reasoning** about data.



Knowledge Graph: Unlocking the Hidden Value in Your Data



Surface hidden insights



Gain deeper understanding



Unlock your Data

Building Knowledge Graphs: A Choice

A

RDBMS

PERSON_ID	NAME
1	Ann
2	Dan

CAR_ID	Model
1	Volvo

P1_ID	P2_ID	ON
1	2	1/Jan13

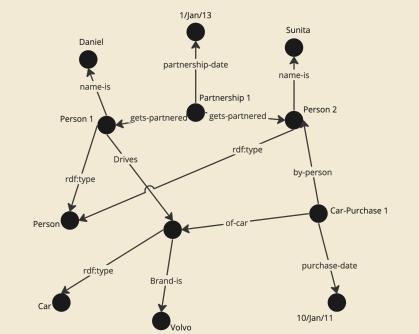
CAR_ID	DRIVER_ID
1	2

CAR_ID	OWNER_ID	SINCE
1	1	10/Jan/11

+7 foreign keys

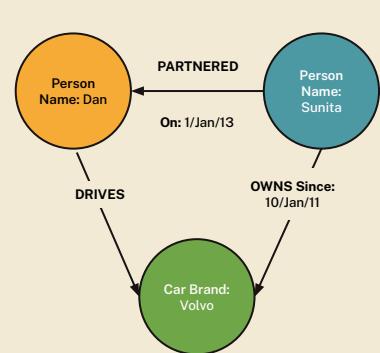
B

Triple Store



C

Property Graph (Neo4j)



How do You Decide?

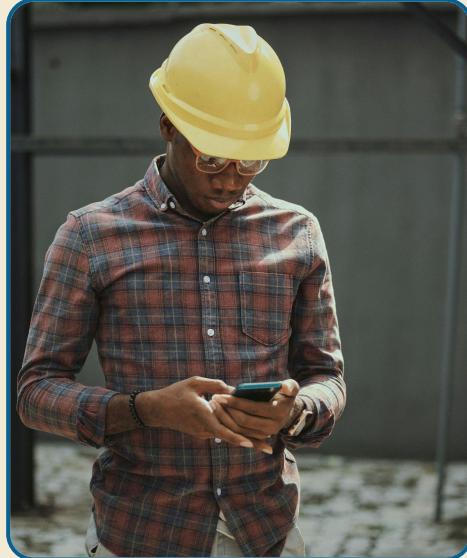
Design



Develop



Maintain/Evolve



Neo4j is THE database for Knowledge Graphs

Build your
Knowledge Graph
with Neo4j



Easy to design and simple to implement



Develop applications quickly



Agile data model that evolves with your organization

Easy to Design and Simple to Implement



Model the knowledge graph naturally and compactly with property graph model



Avoid the need for data modeling workarounds for common business scenarios



Simplify application design by holding structured, semi-structured, and unstructured data



Model Naturally and Compactly



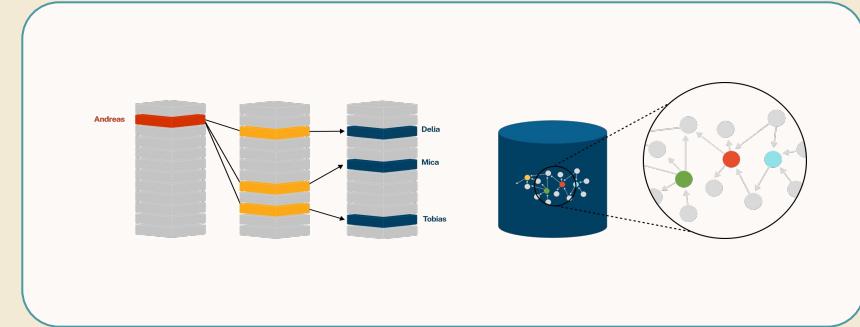
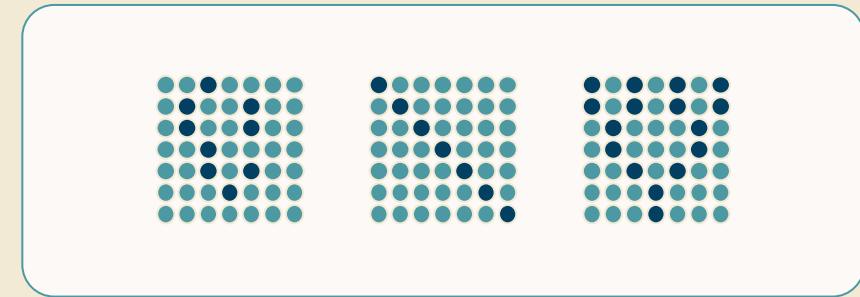
Explicitly model **relationships** and **semantics**



Unify conceptual, logical, and physical data models



Property graph models are a **fraction of the size** of triple stores



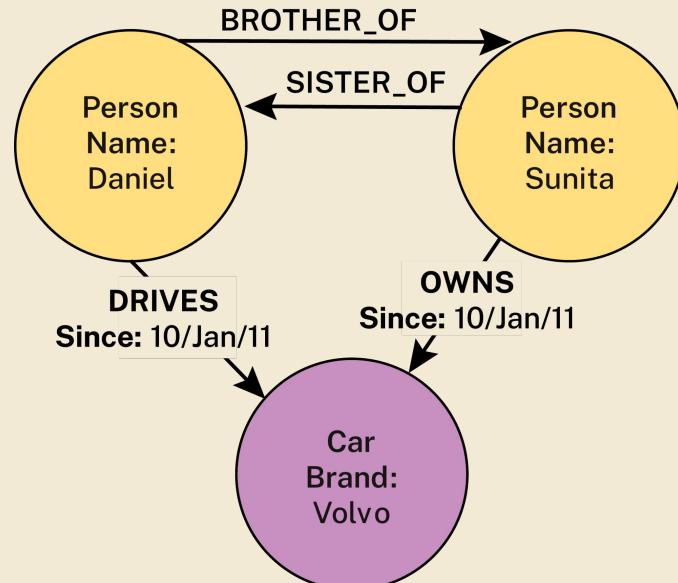
Write Fewer Lines of Code



bro-and-sis.cypher

```
1 match (d:Person {name:"Daniel"})-[:BROTHER_OF]->(a:Person {name:"Sunita"})
2 match (p)-[:DRIVES]->(c) where p in [d,a]
3 return c
```

“Which cars are driven by the siblings Sunita and Daniel?”



Cypher vs SPARQL

bro-and-sis.cypher

```
1 match (d:Person {name:"Daniel"})-[:BROTHER_OF]->(a:Person {name:"Sunita"})
2 match (p)-[:DRIVES]->(c) where p in [d,a]
3 return c
```

“Which cars are driven by the siblings Sunita and Daniel?”

Triple stores need more lines of code than property graphs

bro-and-sis.SPARQL

```
1 prefix dbo: <http://dbpedia.org/ontology>
2 prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
3 prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
4 select ?regNo ?brand where {
5 ?p1 rdf:type dbo:Person .
6 ?p1 dbo: name ?plName.
7 ?p2 rdf:type dbo:Person .
8 ?p2 dbo: name ?p2Name .
9 ?pu rdf:type dbo:Drivership .
10 ?pu dbo:drives-via ?driver .
11 filter (?driver IN (?p1, ?p2))
12 ?pu dbo:of-car ?c.
13 ?c rdf:type dbo:Car .
14 ?c rdfs:label ?regNo .
15 ?c dbo:car-brand ?brand .
16 ?m rdf:type dbo:Brotherhood .
17 ?m dbo:brother-of ?pl.
18 ?m dbo:brother-of-via ?p2 .
19 filter(?p1Name = "Daniel") .
20 filter (?p2Name = "Sunita")
```

Cypher vs SQL

bro-and-sis.cypher

```
1 match (d:Person {name:"Daniel"})-[:BROTHER_OF]->(a:Person {name:"Sunita"})
2 match (p)-[:DRIVES]->(c) where p in [d,a]
3 return c
```

*“Which cars are driven by
the siblings Sunita and
Daniel?”*

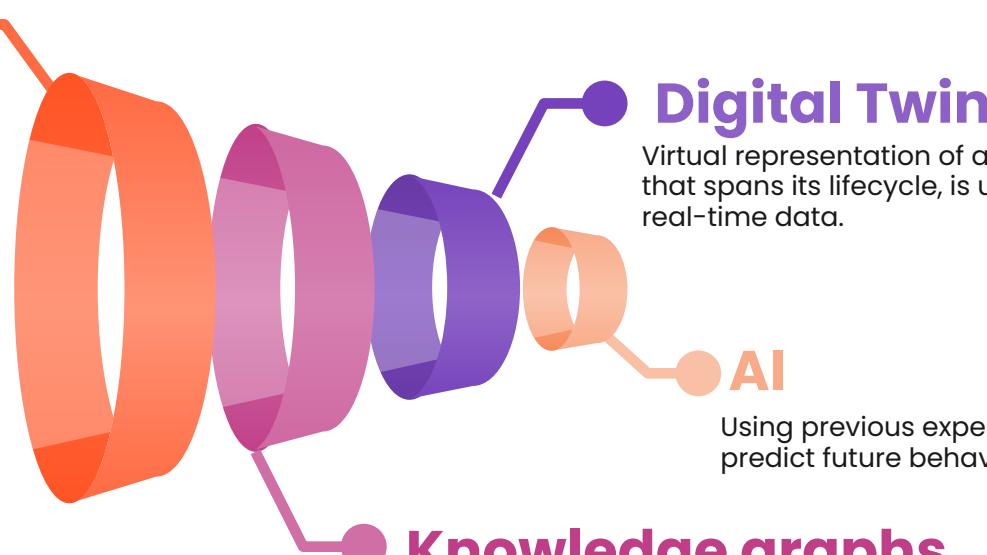
bro-and-sis.SQL

```
1 SELECT c.id, c.brand
2 FROM car c
3 INNER JOIN driver d ON (d.car = c.id)
4 INNER JOIN person p ON (d.driver = p.id)
5 INNER JOIN sibling s ON (s.person = p.id)
6 INNER JOIN person p2 ON (p2.id = s.sibling)
7 WHERE p.person_name = 'Daniel'
8 AND p2.person_name = 'Sunita'
9 AND s.type = 'BROTHER'
```

Relational Databases
need more lines of code
than property graphs

Property Graphs

The underlay for knowledge
Simple but expressive
organising principle



Digital Twin

Virtual representation of an object or system
that spans its lifecycle, is updated from
real-time data.

AI

Using previous experience (data) to
predict future behaviour

Knowledge graphs

Interlinked entities with a sophisticated
organising principle e.g. hierarchies,
taxonomies, ontologies

Digital Twins are Graphs

Home / Add on / Caterpillar D11 Bulldozer – Major Component BOM Pack

Cat D11 Bulldozer BILL OF MATERIALS



Master Data for Cat® Mining Equipment

Big Iron

Caterpillar D11 Bulldozer – Major Component BOM Pack

by Big Iron
5,395 credit(s)

A service to supply task Bill of Material (BOM) lists for your Caterpillar D11 Bulldozer. The base list includes 27x BOM lists for common remove and install tasks for your equipment. Additional BOM packs can be added to your order. A list of the BOMs included in this purchase can be viewed below.

Serial Number(s) *

Enter the serial number(s) of your equipment. If you have more than one equipment, enter all serial numbers separated by a comma. Select the number of additional serial numbers from the dropdown. BOMs for additional serial numbers will be reviewed and validated and a separate BOM sheet will be delivered. If more than 4 additional serial numbers are required contact: info@big-iron.com.au

Related Digital Twins

Related products

- Cat 330C2 Excavator BILL OF MATERIALS
- Cat 730C2 Artic Truck BILL OF MATERIALS
- Caterpillar 336D2 Excavator – Major Component BOM Pack
- Caterpillar 730C2 Articulated Haul Truck – Major Component BOM Pack

5,195 credit(s)

4,995 credit(s)

Dimensions – D11T

All dimensions are approximate.

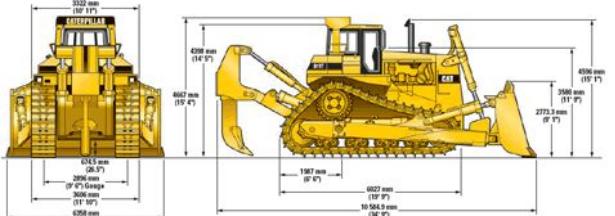
With attachments add to overall machine length:

Single-shank ripper	1850 mm	6' 1"
Single-shank ripper with push block	2190 mm	7' 2.2"
Multi-shank ripper	1915 mm	6' 3.4"
115U Dozer	2220 mm	7' 3.4"
11U Dozer	2668 mm	8' 9"

Width over trunnions 4365 mm 14' 4"

Drawbar height (centerline of clevis) from ground face of shoe 831 mm 32.7"

Note: model shown equipped with 710 mm (28") shoes.



DT Asset Nested BOM (Canonical Model)

DT Asset Documents & Drawings

DT Field Instance(s) Nested BOM (As Built)

DT Field Instance Sensor Data

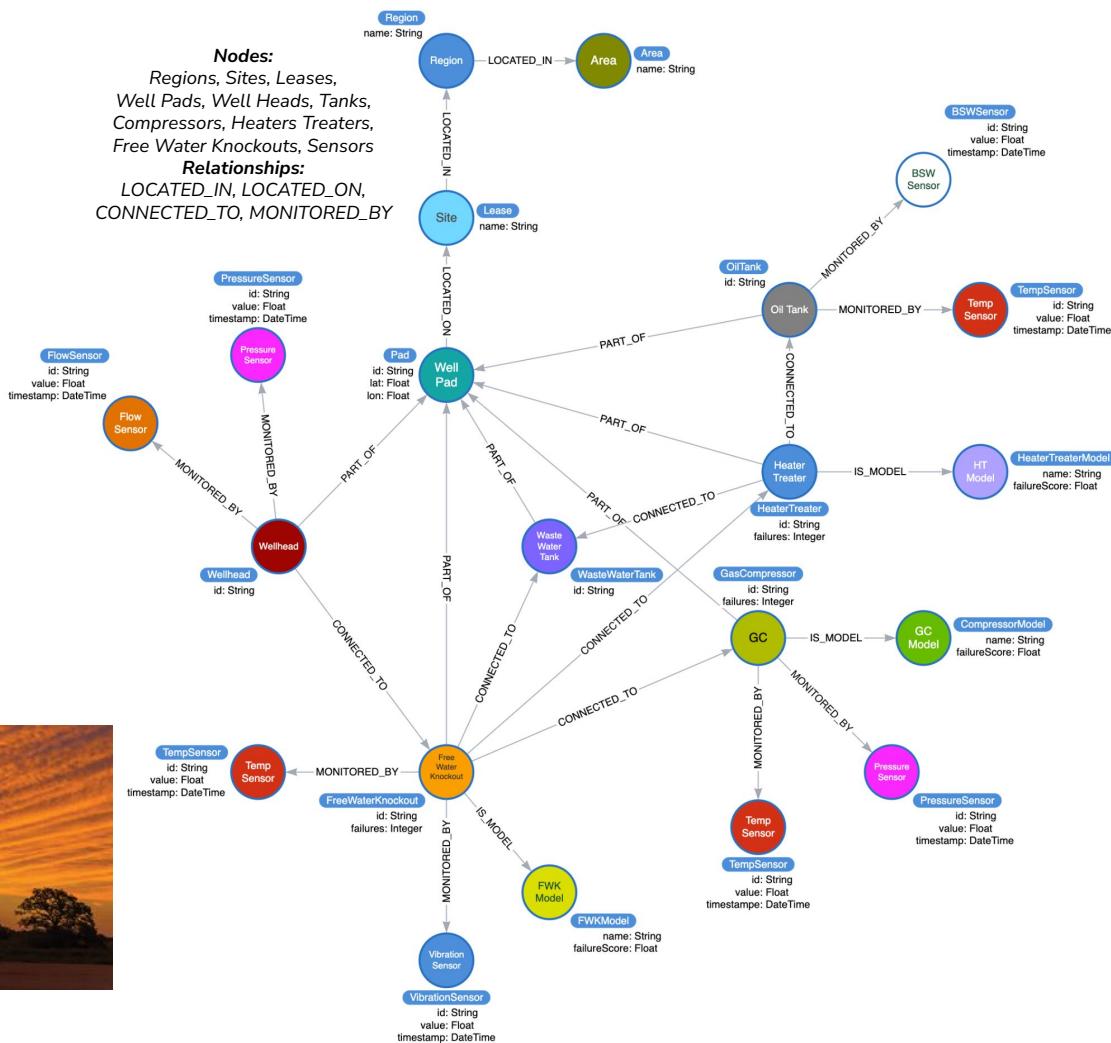
DT Field Instance Metadata

DT Field Instance Extended Data

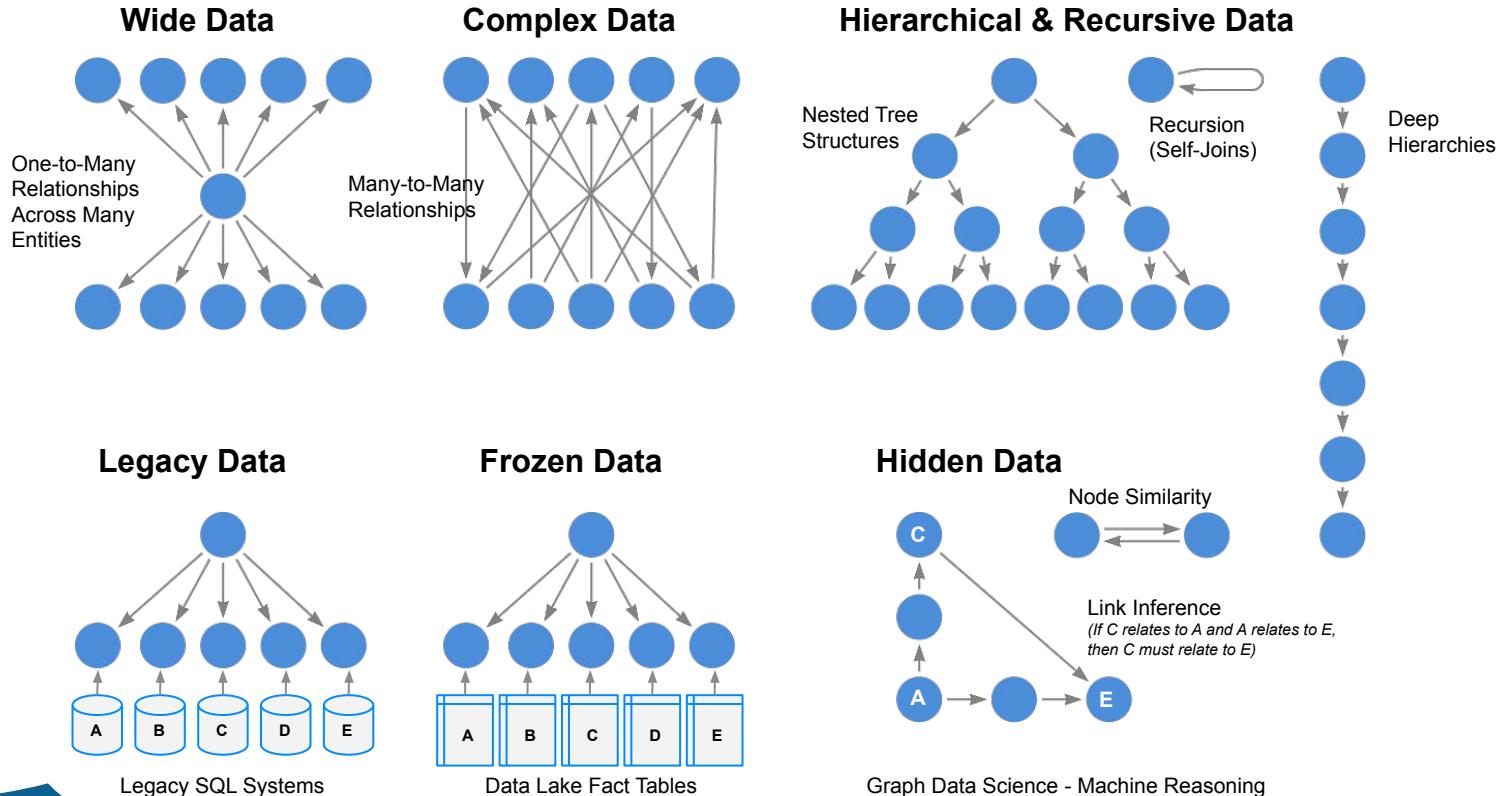


Real World Fidelity

- Neo4j's flexible graph data model easily handles complex relationships and addition of new data sources
 - Provides holistic “360°” view of assets, processes & related data with full spatial support
 - Quickly traverse the network to understand dependencies, co-location, performance, history
 - Scales to billions of nodes and relationships



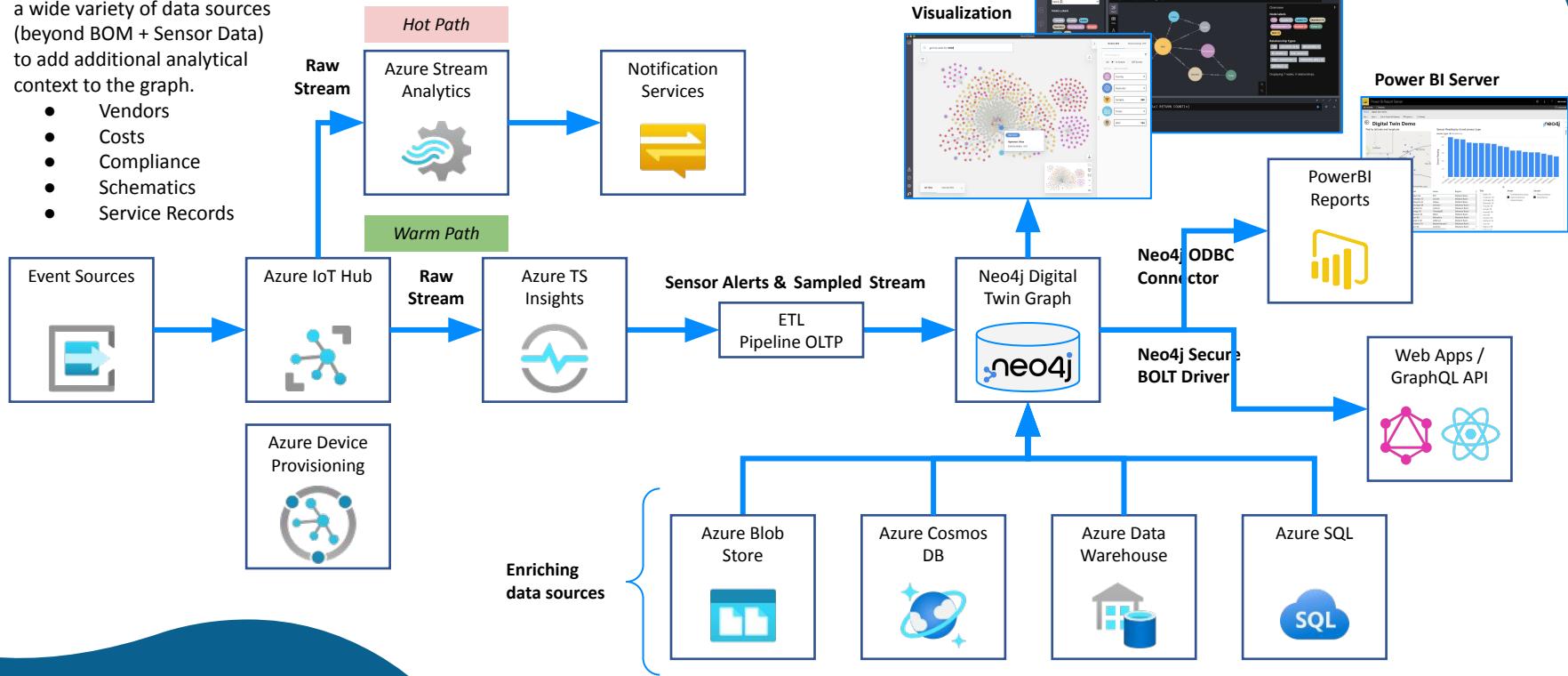
Graphs Naturally Support Digital Twin Data



Example Neo4j Digital Twin Architecture

Neo4j Digital Twin integrates a wide variety of data sources (beyond BOM + Sensor Data) to add additional analytical context to the graph.

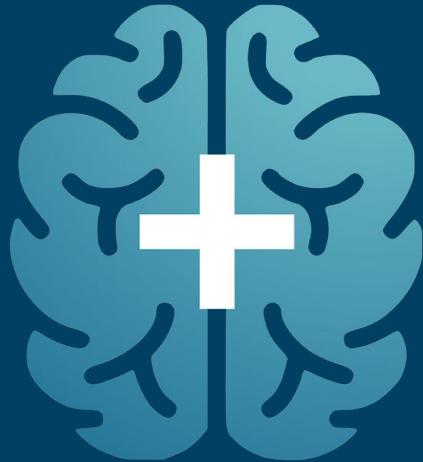
- Vendors
- Costs
- Compliance
- Schematics
- Service Records



+ Knowledge graphs unlock GenAI

KGs

Knowledge
Facts
Context



GenAI

Language
Statistics
Creativity

Accurate
Contextual
Explainable

Why Neo4j?

Up to
512GB
Vertical scaling



Unified DB for analytical
& operational workloads

Guaranteed
99.95%
Uptime SLA

100s
TB Graphs
with sharding



A



Any cloud.
Any workload

Graph is enterprise-grade and fully managed

Integrations with



Encrypted data



SOC2
Type 2



HIPAA
compliant

65+

Graph
algorithms



11 / 11
Financial Services



3 / 3
Automakers



3 / 3
Aerospace & Defense



6 / 7
Retailers



4 / 4
Telcos



5 / 5
Pharmaceuticals



12 / 12
Technology & Software



13 / 16
Insurance Companies

Trusted by
84 of the
**FORTUNE
100**



AIRBUS



AVIVA



Boston
Scientific



CATERPILLAR®



citibank



DAIMLER

DB BAHN

Deloitte.

Discovery

El Corte Inglés

FUJITSU

1,700+ Customers
Worldwide

intuit

LEVI STRAUSS & CO.

LOCKHEED MARTIN

lyft



Microsoft

NASA

NORDSTROM

NOVARTIS



pitney bowes

SAMSUNG

Santander

Staples

Thomson
Reuters

UBS

U.S. ARMY

verizon^v



Walmart

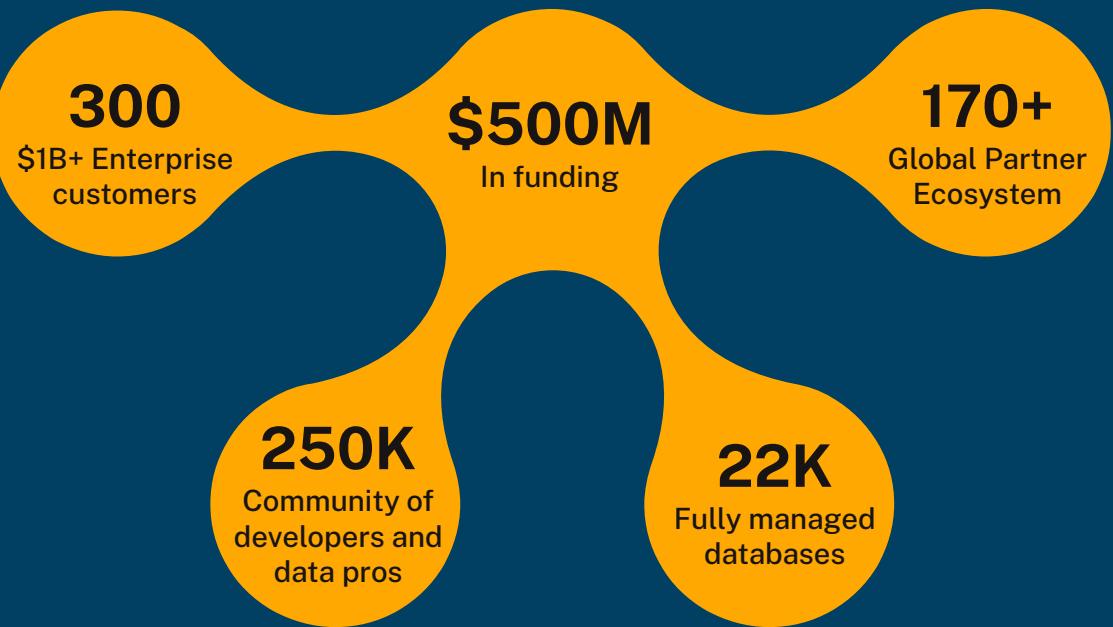
Western Union

ZURICH[®]



Creator of the
market category

Continued market
leader



Demo

Thank You

eliezer.zarpelao@neo4j.com

eliezer.zarpelao@gmail.com

<https://www.youtube.com/@eliezerzarpelao>

<https://github.com/elizarp>

<https://www.linkedin.com/in/eliezerzarpelao/>