# Introduction to Graph Databases, Cypher and Neo4j

## WHAT IS A GRAPH DATABASE?

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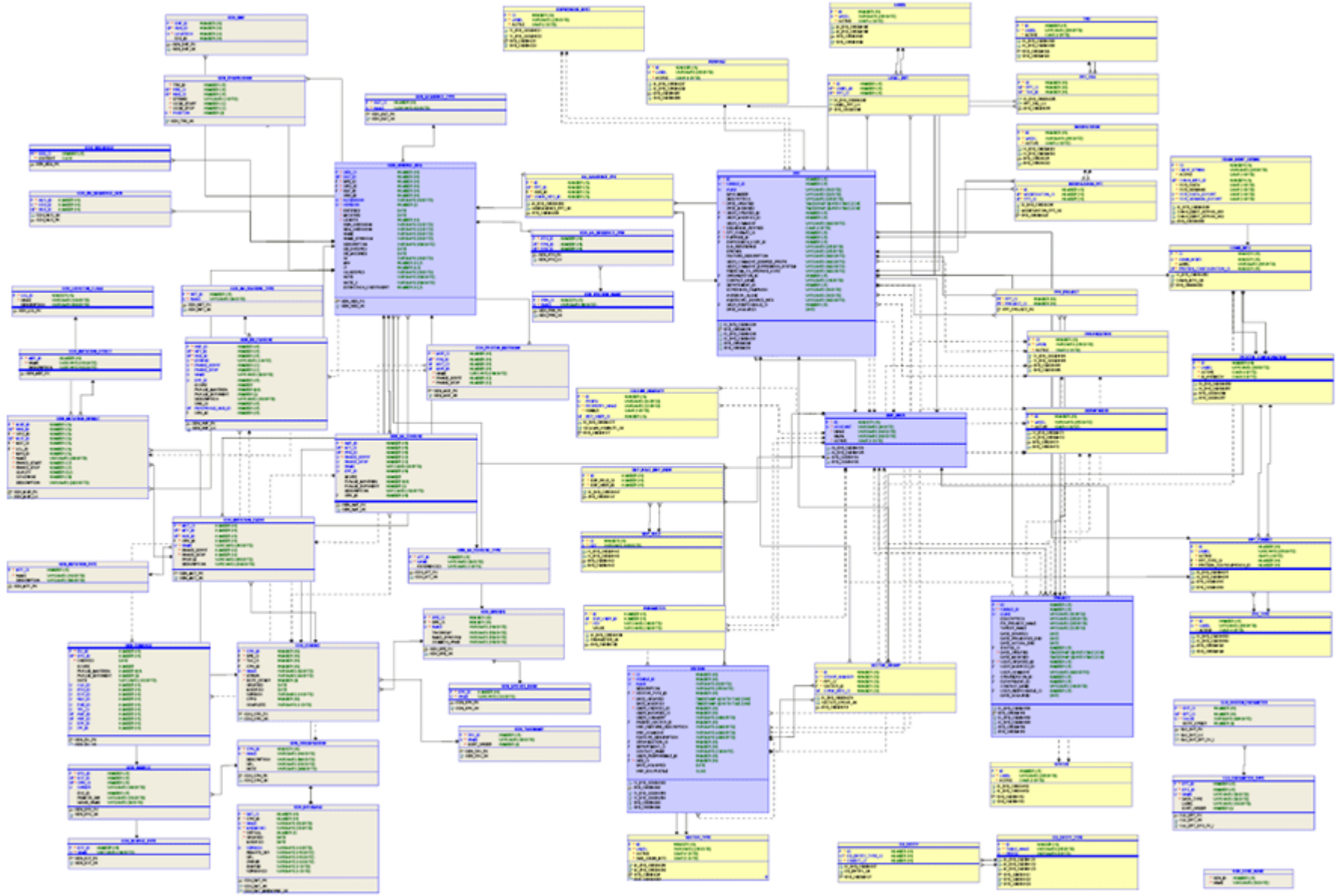
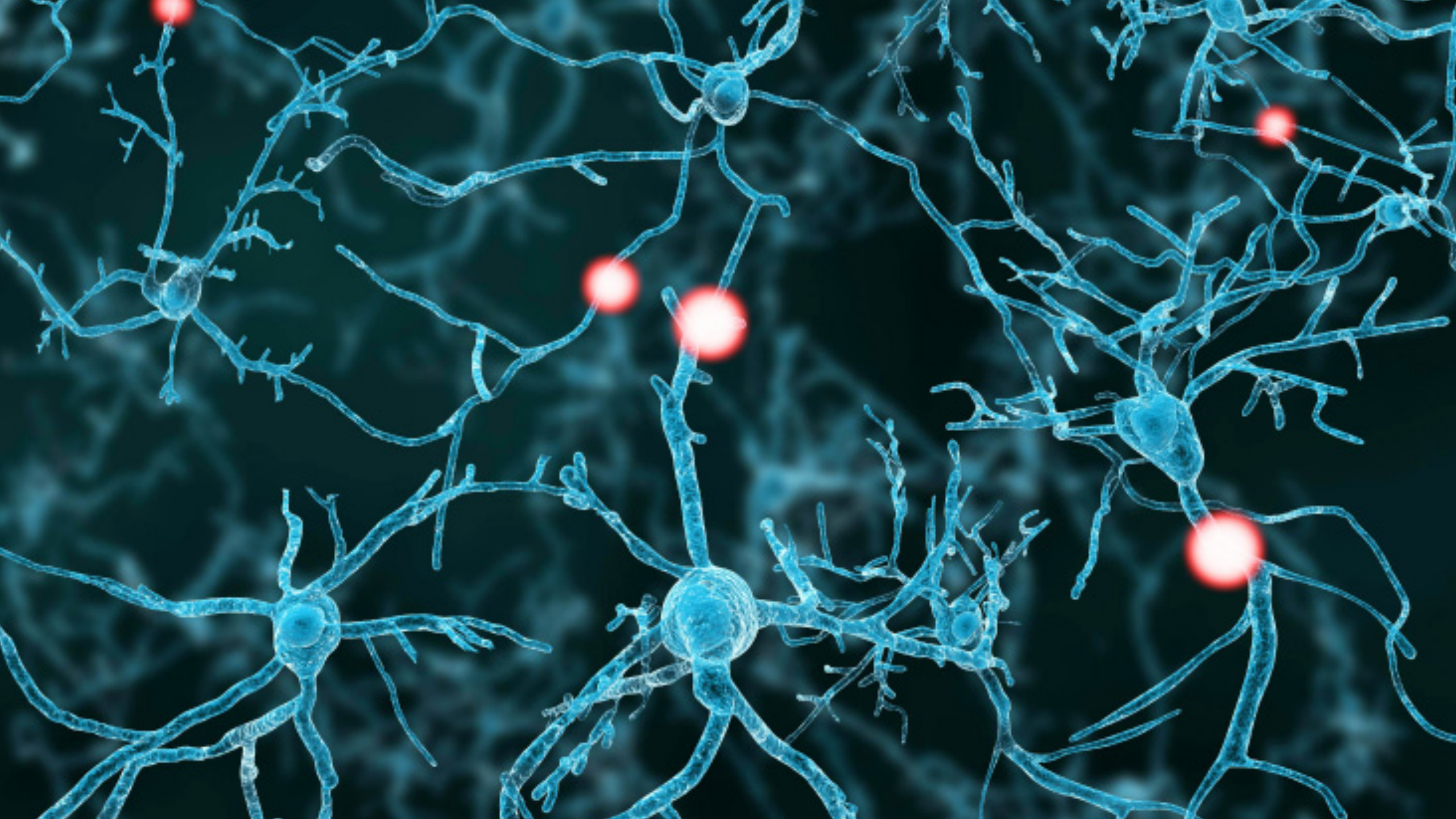




# Module Overview

What is a Graph?

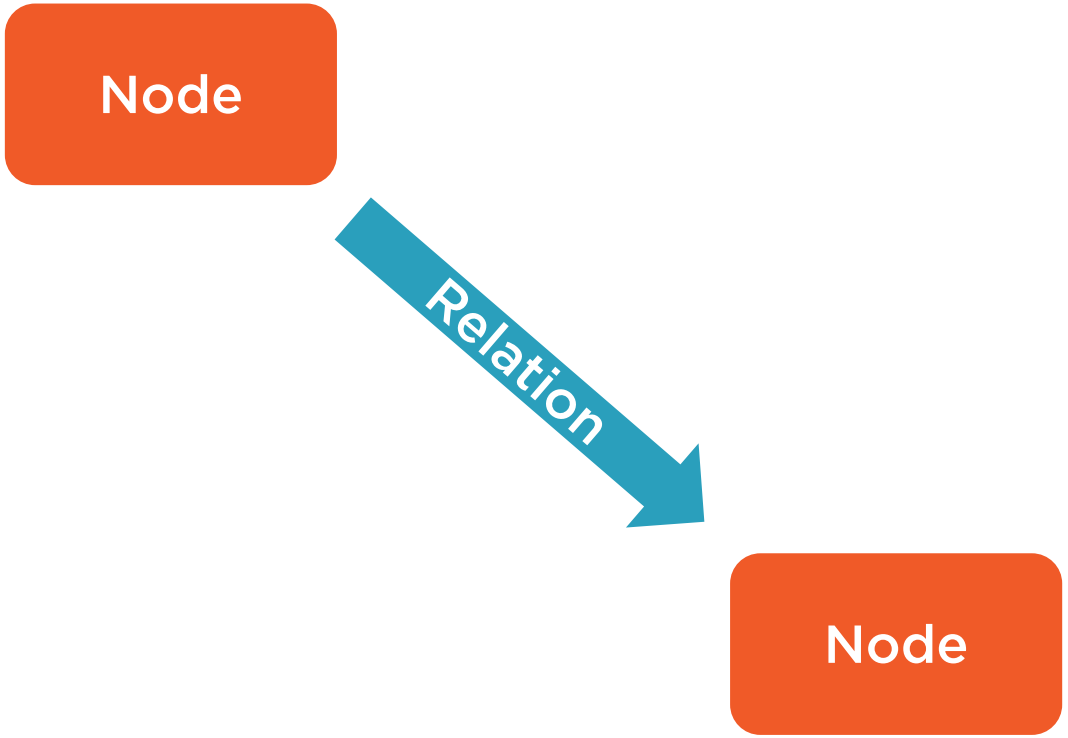
What is a Graph Database?

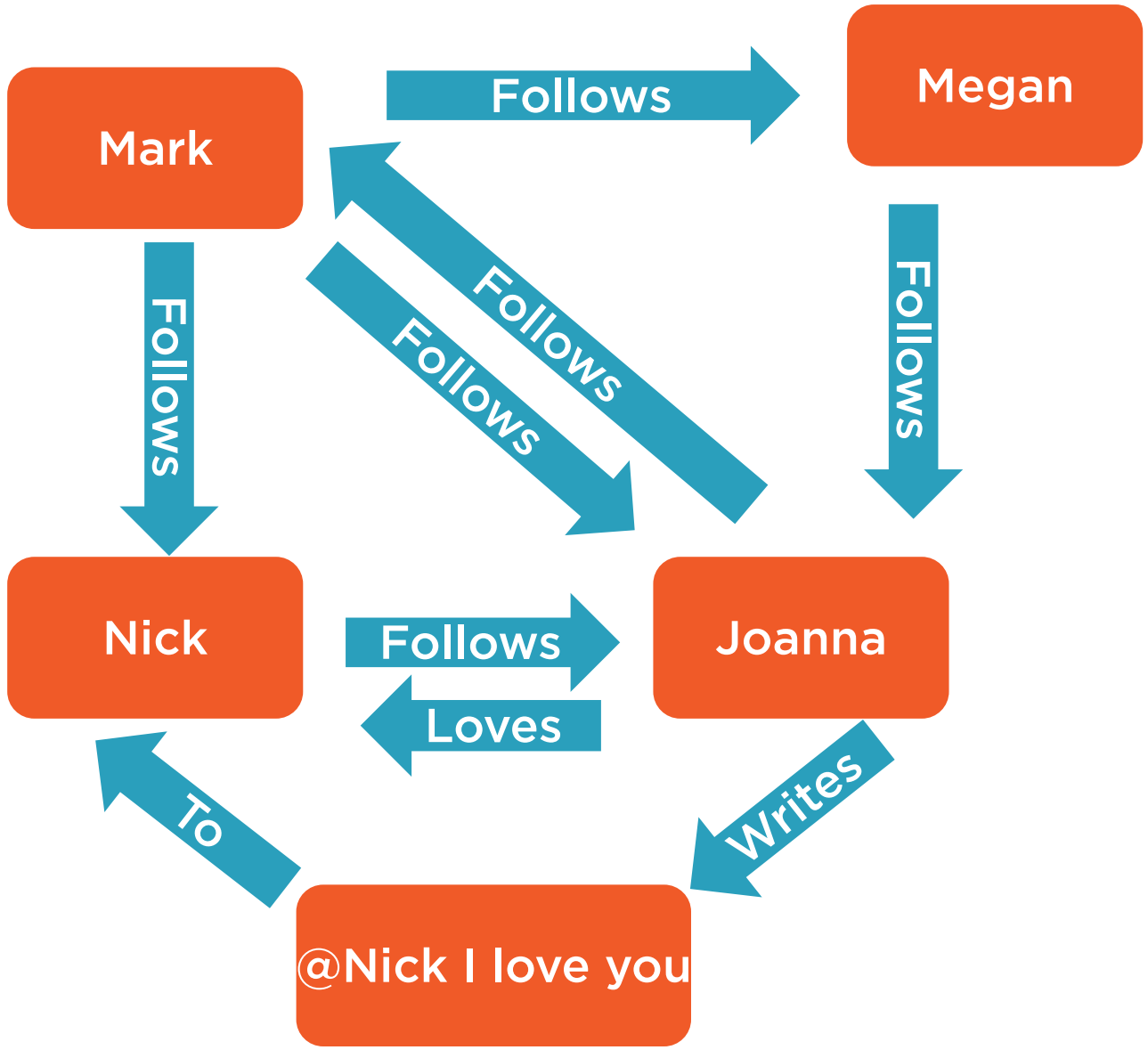
Why a Graph Database?

Graph Databases vs Relational Databases

Graph Databases vs Document Databases

Examples of Graph Databases


Node
Relation
Node


Mark
Follows
Megan
Follows
Follows
Follows
Follows
Nick
Follows
Loves
Joanna
To
Writes
@Nick I love you

# Graphs

Easily extendable and expandable

Friendly to the human brain

Whiteboard compatible

A graph database is a database that uses graph structures to represent and store data

# Graph Databases

All about relationships

Performance

Flexibility

Agility

Query language

# Property Graph Model

Contains **nodes** and **relationships**

Nodes and relationships contain **properties**

Relationships are **named** and **directed** with a **start** and **end** node

# Why a Graph Database?

~~"Use a relational database for all applications"~~

"Consider the type of database for every application you're writing"

# Why a Graph Database?

Highly related data

Flexible schema

Structure and queries are brain friendly

# Graph Databases vs. Relational Databases

| Relational | Graph |
| --- | --- |
| Tables | Nodes |
| Schema with nullables | No schema |
| Relations with foreign keys | Relation is first class citizen |
| Related data fetched with joins | Related data fetched with a pattern |

# Relational Databases Advantages

**Highly structured data**

**Calculations within one table**

**Grouping of data**

# The Foreign Key System

| Customer | | |
|---|---|---|
| CustomerId | Name | City |
| 1 | Joanna | Salt Lake City |

| Order | | |
|---|---|---|
| OrderId | CustomerId | Date |
| 1 | 1 | 2015/1/1 |

| LineItem | | |
|---|---|---|
| OrderId | ProductId | Quantity |
| 1 | 1 | 5 |

| Product | | |
|---|---|---|
| ProductId | Description | Use |
| 1 | Candle | Inside |

# Partner and Vukotic's Experiment

Social network

Friends of friends structure

mySQL and Neo4j

1,000,000 people

Each with an average of 50 friends

Depth 2: Find all friends of a user's friends

Depth 3: Find all friends of friends of a user's friends

Etcetera

# Results

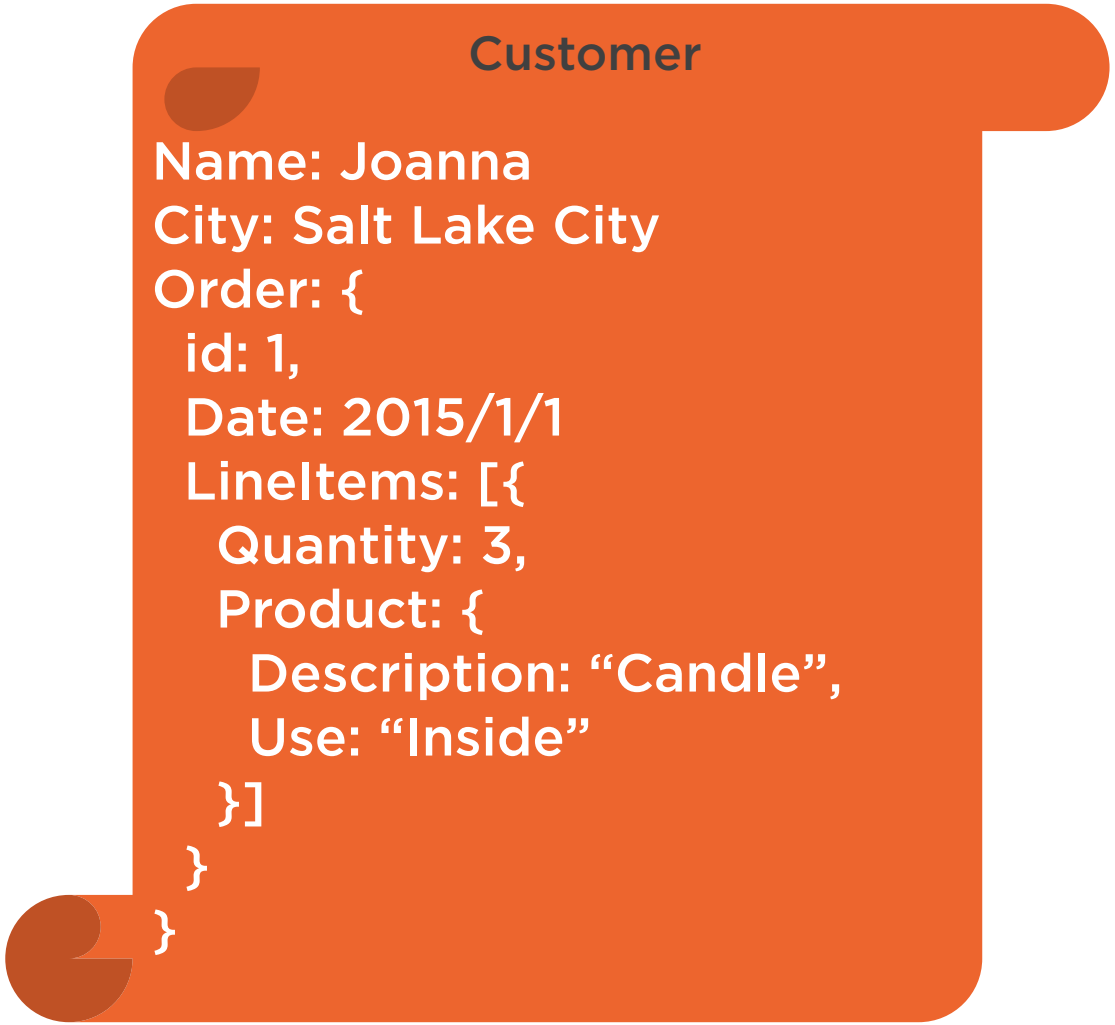
| Depth | Rel. Db (s) | Neo4j (s) | # records |
|---|---|---|---|
| 2 | 0,016 | 0,01 | ~2500 |
| 3 | 30,267 | 0,168 | ~110000 |
| 4 | 1543,505 | 1,359 | ~600000 |
| 5 | Unfinished | 2,132 | ~8000000 |

# Relational Database Normalization

Created when disk space was expensive

Normalization is encouraged

# A Document


Customer
Name: Joanna
City: Salt Lake City
Order: {
id: 1,
Date: 2015/1/1
LineItems: [{
Quantity: 3,
Product: {
Description: “Candle”,
Use: “Inside”
}]
}
}

# Document Databases

All related data in one entity

Duplication of data is OK

Copy master data

# Documents

**Customer**

```
Name: Joanna
City: Salt Lake City
Order: {
  id: 1,
  Date: 2015/1/1
  LineItems: [{
    Quantity: 3,
    Product: {
      Description: “Candle”,
      Use: “Inside”
    }]
  }
}
```

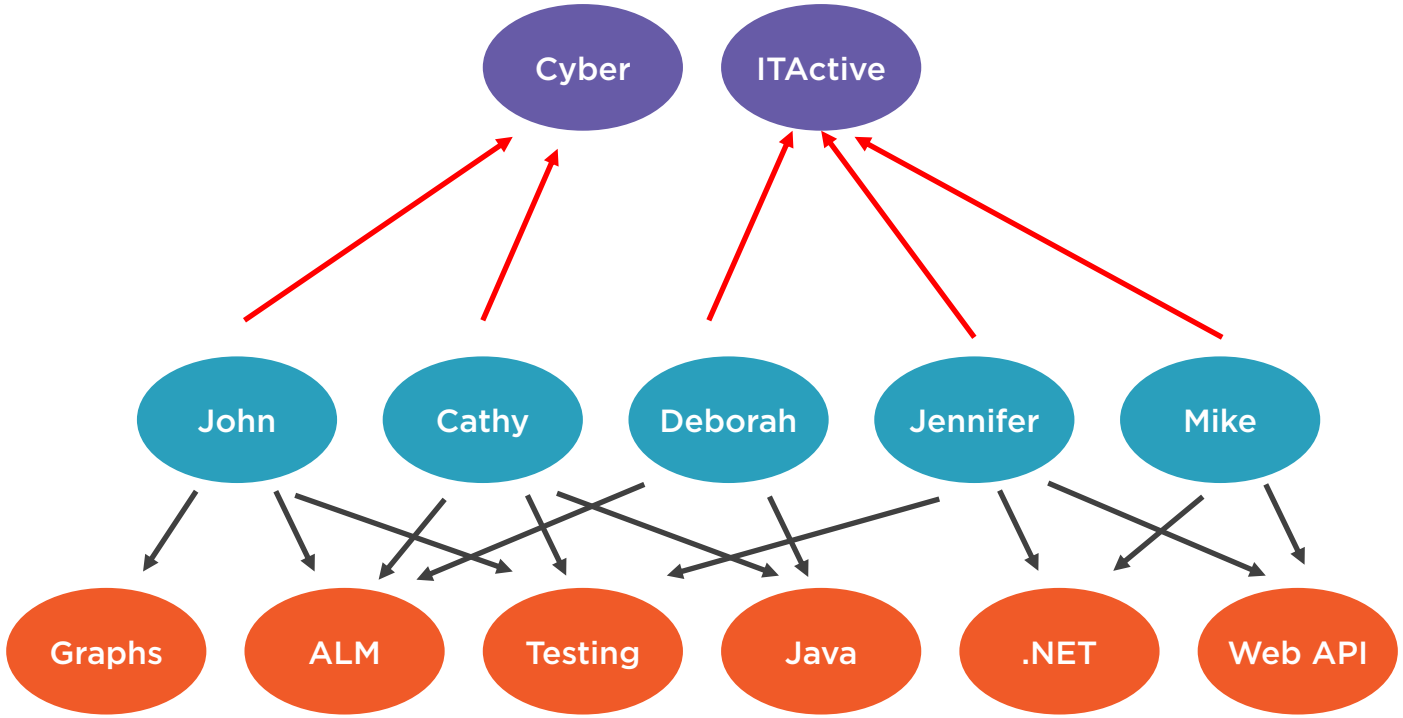
**Customer**

```
Name: Peter
City: Dallas
Order: {
  id: 2,
  Date: 2015/2/1
  LineItems: [{
    Quantity: 2,
    Product: {
      Description: “Matches”,
      Use: “Inside”
    }]
  }
}
```

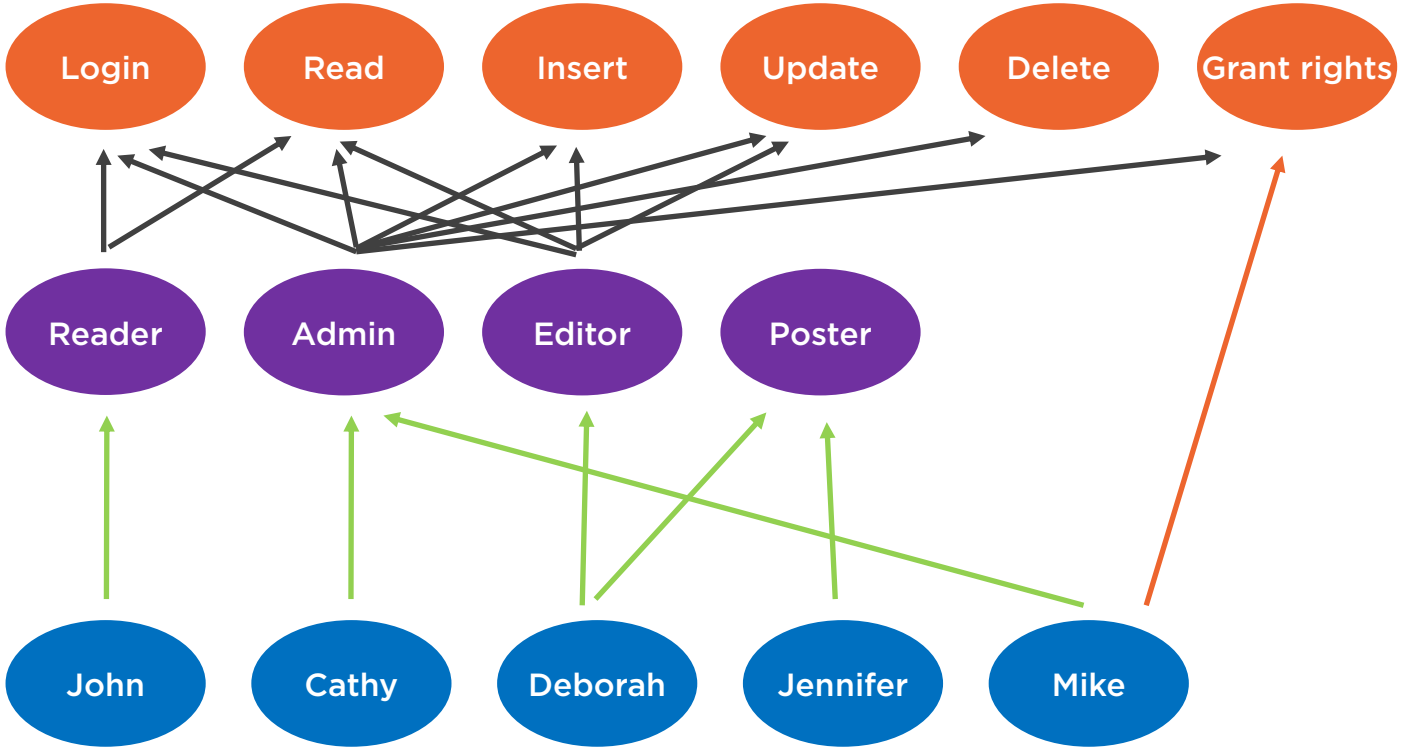
# Graph Databases vs. Document Databases

| Document | Graph |
| --- | --- |
| Document | Node |
| No schema | No schema |
| Relations with "foreign keys" or embedded | Relation is first class citizen |
| Related data fetched with joins or embedded | Related data fetched with a pattern |

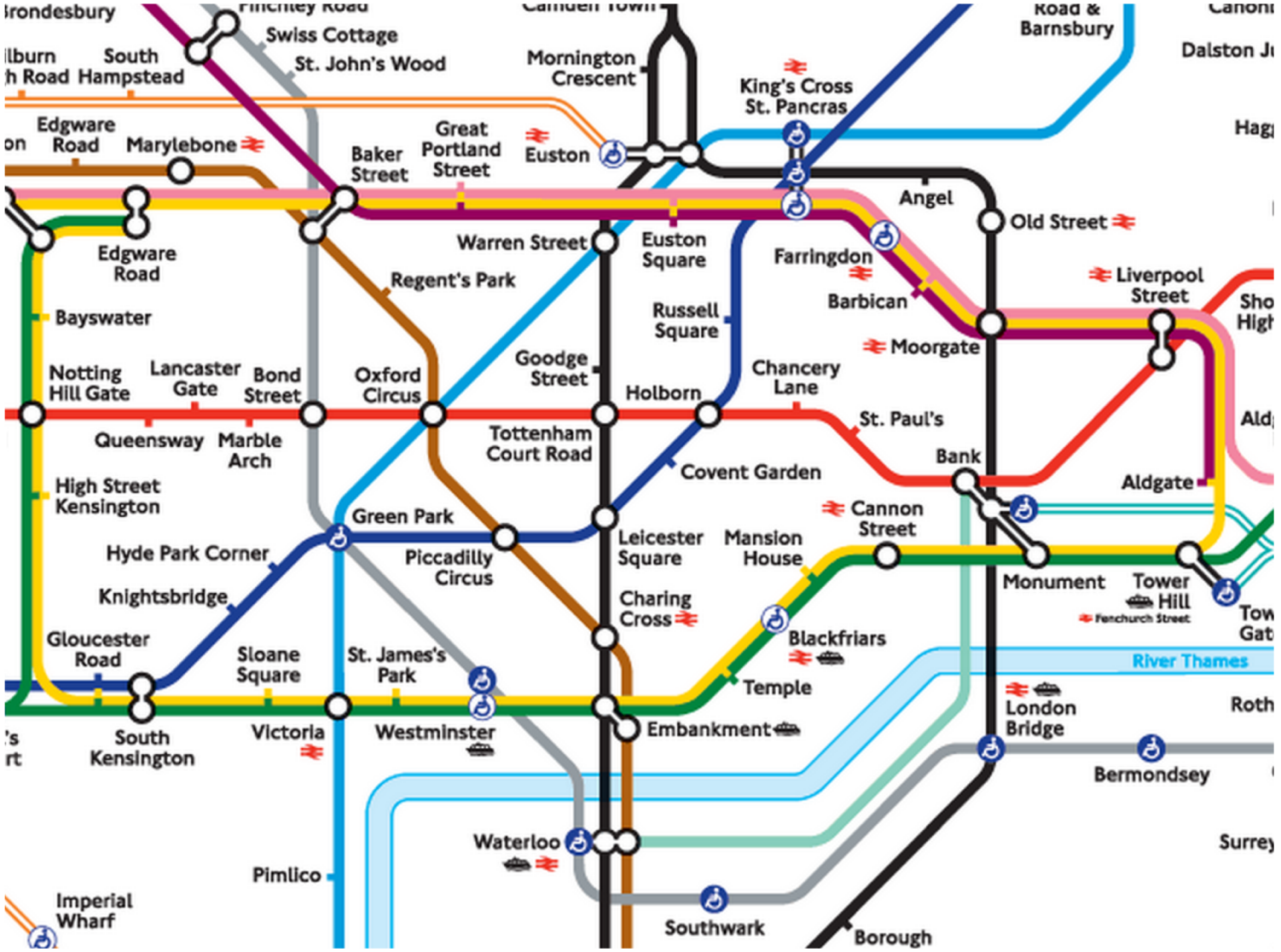
# A Social Graph



# Security


Login
Read
Insert
Update
Delete
Grant rights
Reader
Admin
Editor
Poster
John
Cathy
Deborah
Jennifer
Mike

# Logistics


Swiss Cottage
St. John's Wood
South Hampstead
Mornington Crescent
King's Cross St. Pancras
Edgware Road
Marylebone
Great Portland Street
Euston
Baker Street
Angel
Old Street
Warren Street
Euston Square
Farringdon
Liverpool Street
Regent's Park
Barbican
Bayswater
Russell Square
Moorgate
Goodge Street
Chancery Lane
Notting Hill Gate
Lancaster Gate
Bond Street
Oxford Circus
Holborn
St. Paul's
Queensway
Marble Arch
Tottenham Court Road
Bank
Covent Garden
High Street Kensington
Aldgate
Green Park
Cannon Street
Leicester Square
Mansion House
Hyde Park Corner
Piccadilly Circus
Monument
Tower Hill
Knightsbridge
Charing Cross
Fenchurch Street
Gloucester Road
Sloane Square
St. James's Park
Blackfriars
River Thames
Temple
London Bridge
South Kensington
Victoria
Westminster
Embankment
Bermondsey
Waterloo
Pimlico
Imperial Wharf
Southwark
Borough

# Summary

A graph is a collection of nodes connected by relationships

Graph databases are flexible and performant with highly related data

All database types have their place

Relational databases great for tables

Document databases great to store objects

Graph databases great in many scenarios with related data