Chapter 5
Graph Databases

Graph Databases

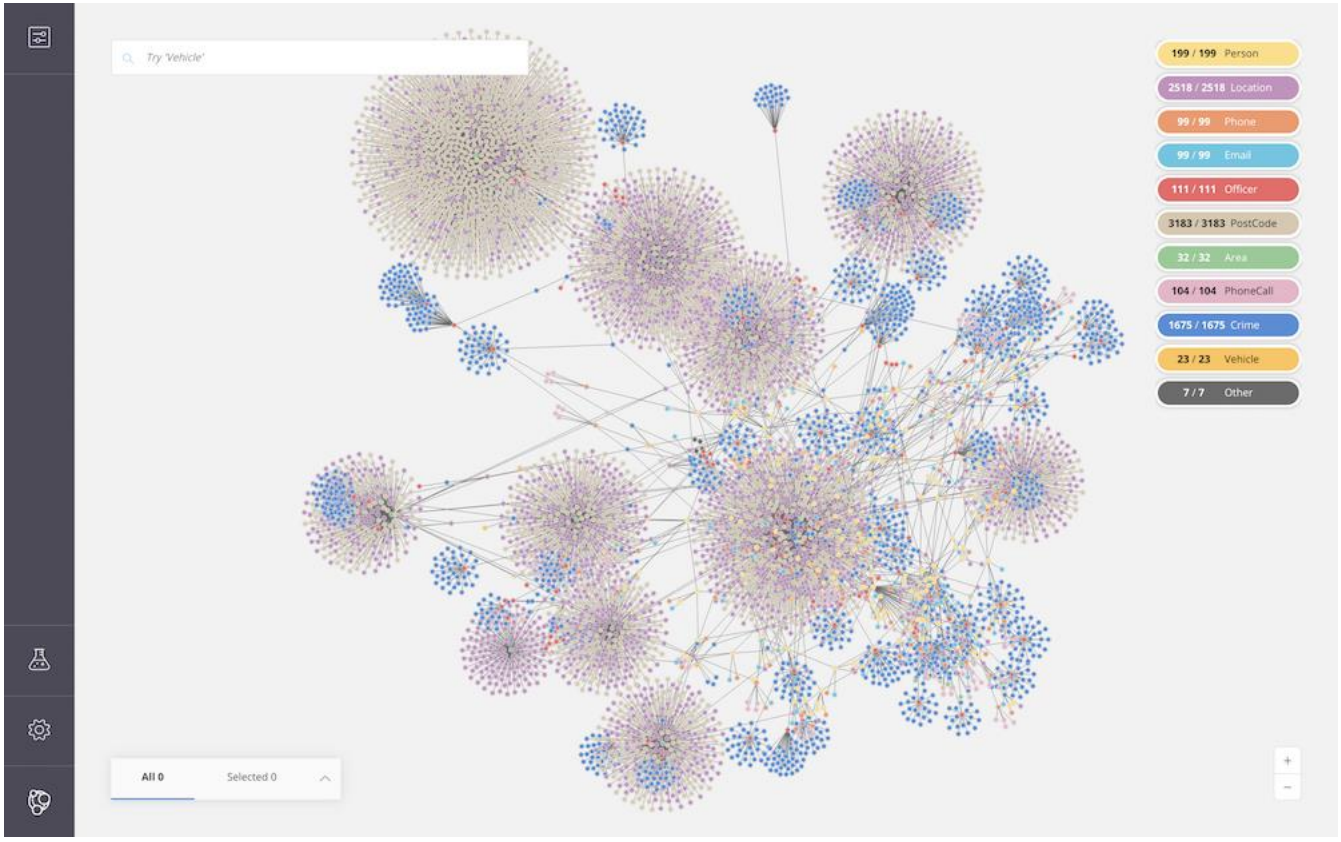
- A **graph database** stores data as **nodes (entities)** and **edges (relationships)**
- as an alternative of tables and rows.

Example: A Simple Social Network

- (Alice) -[FRIEND]-> (Bob)
- (Bob) -[FOLLOWS]-> (Charlie)

Graph Databases

- Handles **complex relationships** efficiently
- **No costly joins** – Queries run faster than SQL
- **Great for real-time <u>recommendations</u>**



Graph Databases

- Graph Databases vs. Relational Databases

Feature	Graph Database (Neo4j)	Relational Database (MySQL)
Data Model	Nodes & Edges	Tables & Rows
Query Performance	Fast for relationships	Slow for complex joins
Schema	Flexible	Fixed
Use Case	Social networks, fraud detection	Transactions, structured data

Graph Databases

Core Components of a Graph Database

1. **Node** : Represents an entity (e.g., a person, product, place).
2. **Edge** (Relationship) :Defines how nodes are connected (e.g., "FRIEND", "FOLLOWS").
3. **Property** :Stores additional information (e.g., name, age, date).

(Alice {age: 25}) - **[:FRIENDS_WITH]**-> (Bob {age: 30})
(Bob) -[**:LIKES**]-> (Product {name: "Laptop"})

Graph Databases

Neo4j: The Most Popular Graph Database

- Open-source and widely used
- Uses **Cypher Query Language (CQL)** for querying
- Strong indexing and real-time query performance

Graph Databases

Other Popular Graph Databases

1. **Amazon Neptune** – Managed cloud graph database
2. **ArangoDB** – Multi-model (Graph + Document + Key-Value)
3. **JanusGraph** – Scalable graph processing (integrates with Hadoop & Spark)

Graph Databases

Basic Cypher Queries in Neo4j

1. Creating Nodes

- CREATE (a:Person {name: "Alice", age: 25})
- CREATE (b:Person {name: "Bob", age: 30})

2. Creating Relationships

```
MATCH (a:Person {name: "Alice"}), (b:Person {name: "Bob"})
CREATE (a)-[:FRIENDS_WITH]->(b)
```

3. Indexing Nodes for Faster Queries

3. CREATE INDEX ON :Person(name)

Graph Databases

Case Studies

- **Facebook & LinkedIn** – Social networks use graphs to suggest connections
- **Amazon & Netflix** – Recommendation engines for personalized content

- **Financial Fraud Detection** – Detects suspicious transaction patterns
- **AI & Knowledge Graphs** – Google uses graphs to understand relationships

Graph Databases
RDF