

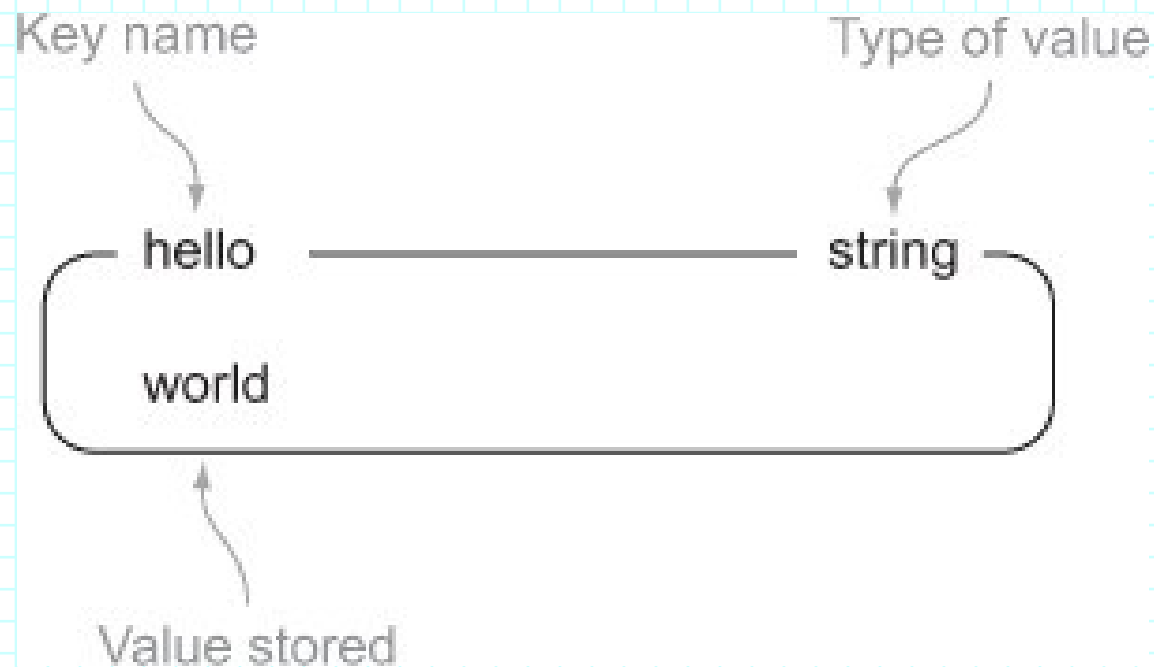
# Database Management Systems

- Key-Value Stores
- Graph Databases

*Doug Shook*

# Redis

- Key-Value pairs
  - Limited data types
- In-memory database
  - What about persistence?



- “Redis in Action”, Josiah Carlson, 2013

# Data Types

- String
- List
- Set
- Hash
- Zset

# Strings

set hello world

get hello

del hello

get hello

# Lists

```
rpush list-key item  
rpush list-key item2  
rpush list-key item
```

```
lrange list-key 0 -1
```

```
lindex list-key 1
```

```
lpop list-key
```

```
lrange list-key 0 -1
```

# Sets

```
sadd set-key item  
sadd set-key item2  
sadd set-key item3  
sadd set-key item
```

```
smembers set-key
```

```
sismember set-key item4  
sismember set-key item
```

```
srem set-key item2  
srem set-key item2
```

```
smembers set-key
```

# Hashes

```
hset hash-key sub-key1 value1  
hset hash-key sub-key2 value2  
hset hash-key sub-key1 value1
```

```
hgetall hash-key1
```

```
hdel hash-key sub-key2  
hdel hash-key sub-key2  
hget hash-key sub-key1
```

```
hgetall hash-key
```

# Zsets

```
zadd zset-key 728 member1
```

```
zadd zset-key 982 member0
```

```
zadd zset-key 982 member0
```

```
zrange zset-key 0 -1 withscores
```

```
zrangebyscore zset-key 0 800 withscores
```

```
zrem zset-key member1
```

```
zrem zset-key member1
```

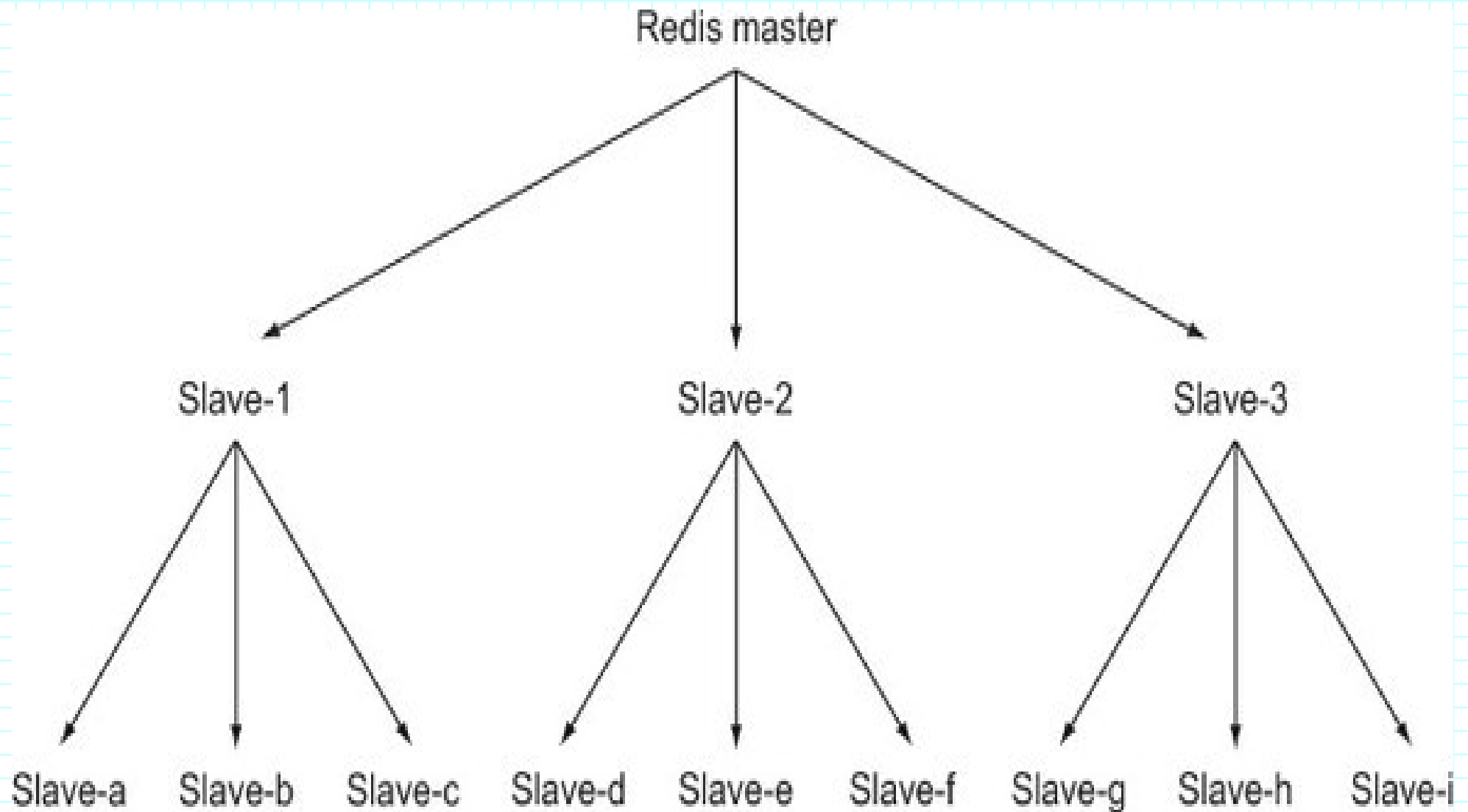
```
zrange zset-key 0 -1 withscores
```



# Persistence

- Snapshots
- Append only-log files

# Replication



# Suitable Use Cases

- Storing Session Information
- User Profiles
- Shopping Cart Data

# Example Use Case

Voting occurs after you have clicked through to read a question and any existing answers.



The screenshot shows the Stack Overflow homepage with a list of questions. The questions are sorted by 'week'. The first question is 'Unnecessary curly braces in C++?' with 67 votes and 13 answers, asked yesterday by Ira Baxter. The second question is 'Why is 0 + 1 = 2? [closed]' with 21 votes and 9 answers, asked yesterday by interjay. The third question is 'Different results with Java's digest versus external utilities' with 84 votes and 1 answer, asked 2 days ago by Jon Skeet. The fourth question is 'What happens if I define a 0-size array in C/C++?' with 27 votes and 6 answers, asked yesterday by Matthieu M. The fifth question is 'what does the error mean when I am compiling c++ with g++ compiler?' with 27 votes and 6 answers, asked Mar 13 at 21:40 by Rafal Rawicki.

| Question  | Votes | Answers | Asked           | Author        |
|---|-------|---------|-----------------|---------------|
| Unnecessary curly braces in C++?                                    | 67    | 13      | yesterday       | Ira Baxter    |
| Why is 0 + 1 = 2? [closed]  | 21    | 9       | yesterday       | interjay      |
| Different results with Java's digest versus external utilities      | 84    | 1       | 2 days ago      | Jon Skeet     |
| What happens if I define a 0-size array in C/C++?                   | 27    | 6       | yesterday       | Matthieu M.   |
| what does the error mean when I am compiling c++ with g++ compiler? | 27    | 6       | Mar 13 at 21:40 | Rafal Rawicki |

# Example Use Case

| article:92617 — hash |   |
|----------------------|---|
| title                | Go to statement considered harmful                    |
| link                 | <a href="http://goo.gl/kZUSu">http://goo.gl/kZUSu</a> |
| poster               | user:83271  |
| time                 | 1331382699.33   |
| votes                | 528   |

# Example Use Case

| time:          | zset          |
|----------------|---------------|
| article:100408 | 1332065417.47 |
| article:100635 | 1332075503.49 |
| article:100716 | 1332082035.26 |

A time-ordered ZSET of articles

| score:         | zset          |
|----------------|---------------|
| article:100635 | 1332164063.49 |
| article:100408 | 1332174713.47 |
| article:100716 | 1332225027.26 |

A score-ordered ZSET of articles

# Example Use Case

voted:100408 ————— set

user:234487

user:253378

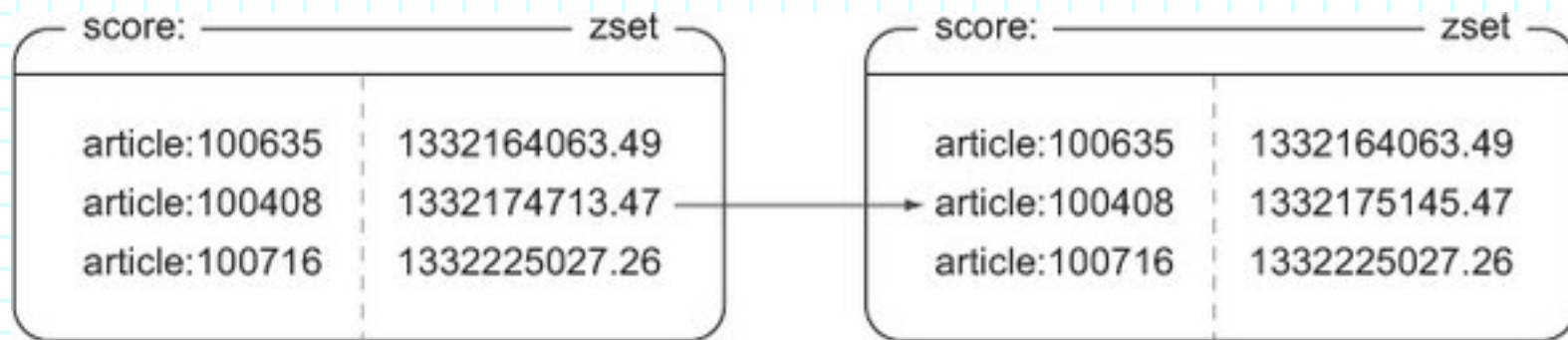
user:364680

user:132097

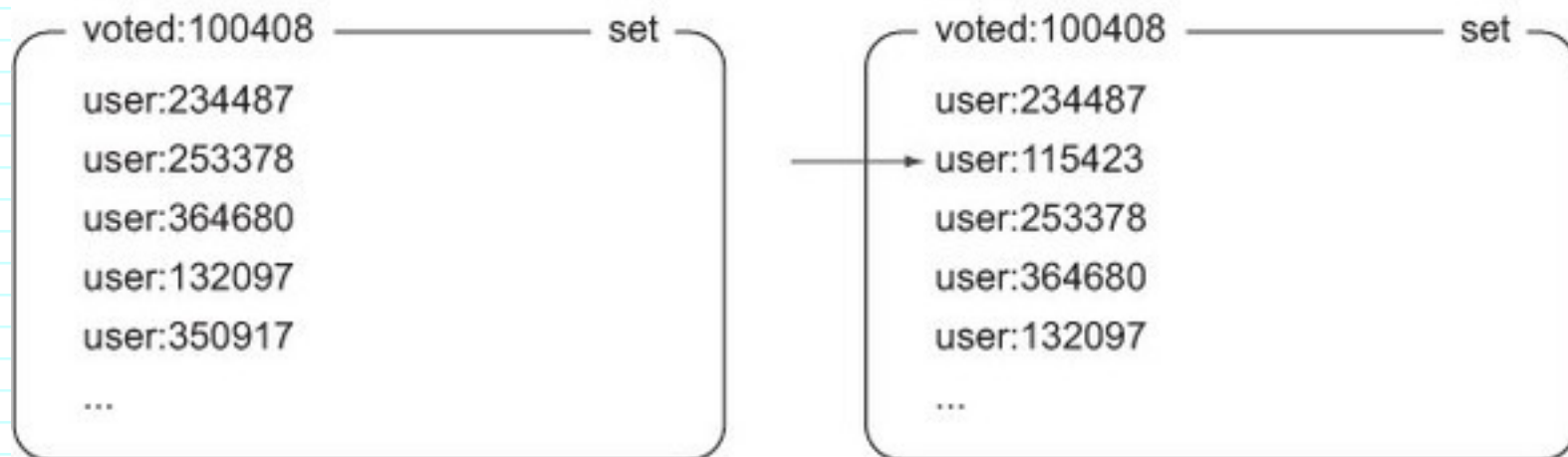
user:350917

...

# Example Use Case



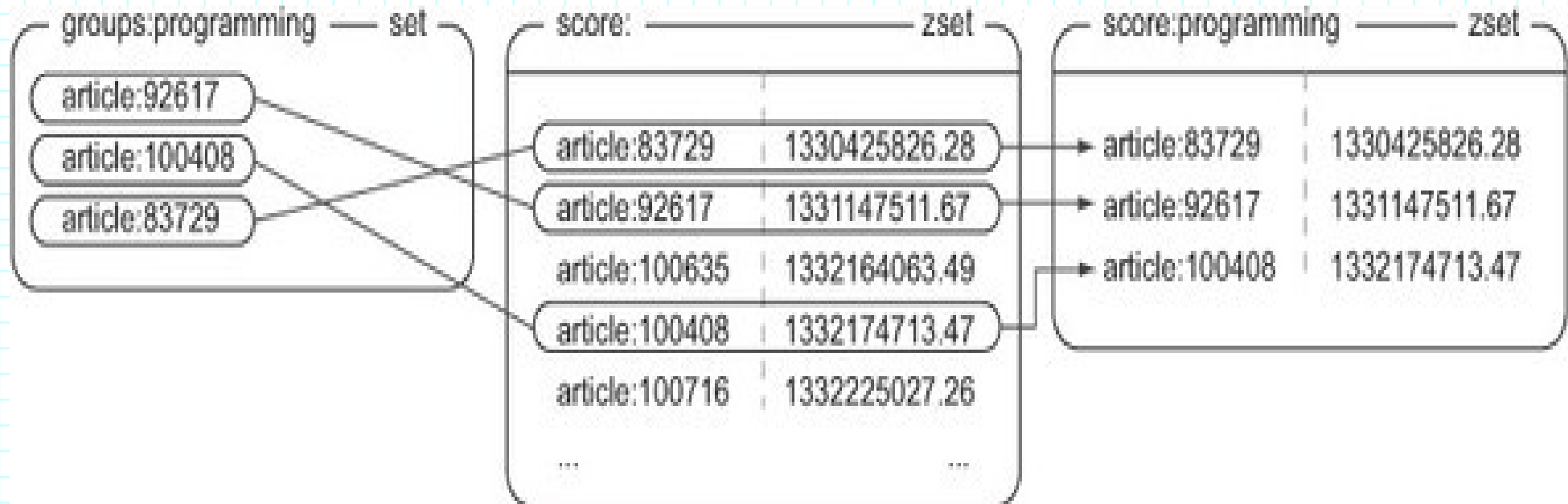
Article 100408 got a new vote, so its score was increased.



Since user 115423 voted on the article, they are added to the voted SET.



# Example Use Case



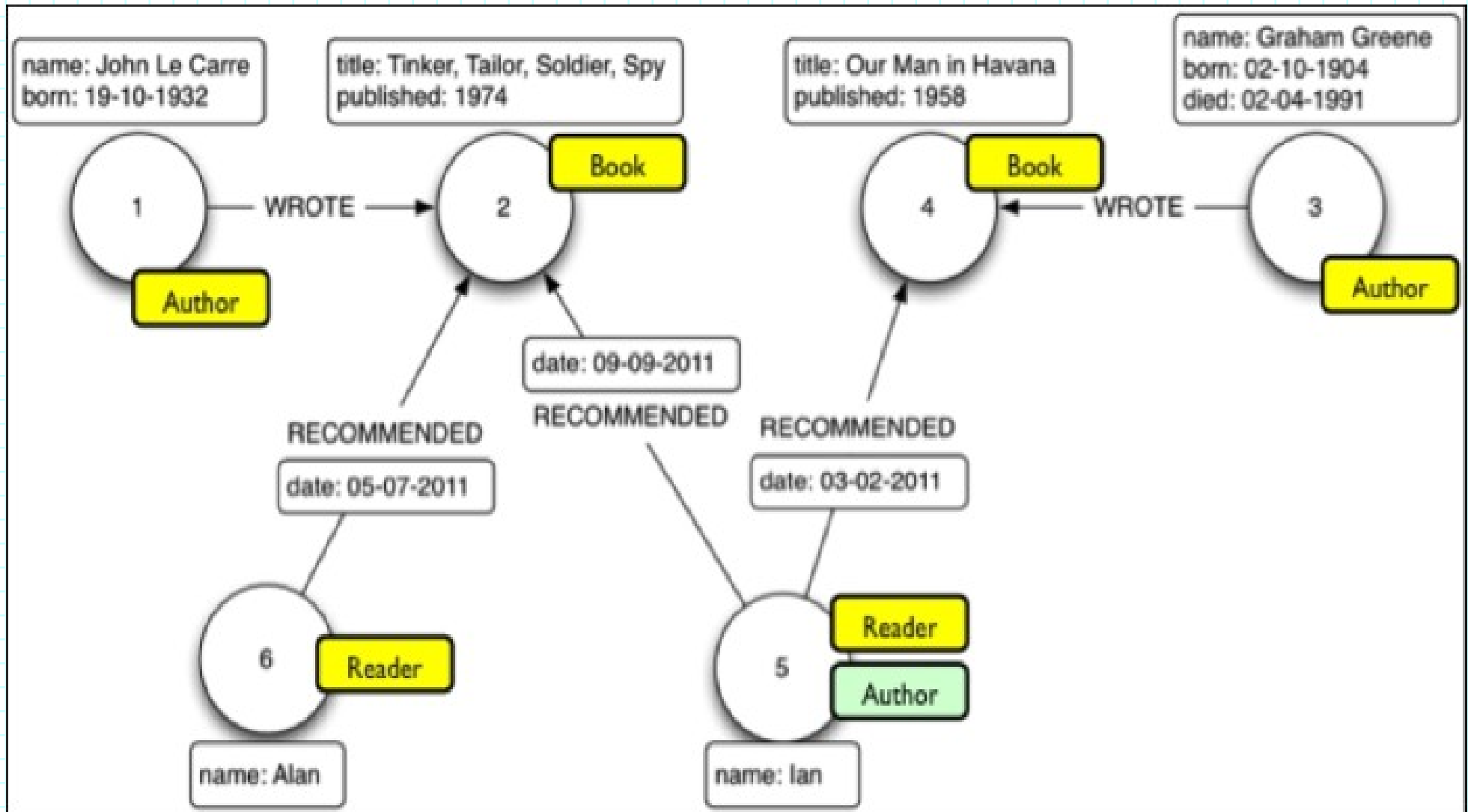
# When Not to Use

- Relationships between data sets
- Multioperation transactions
- Query by data
- Operation by sets

# When Not to Use

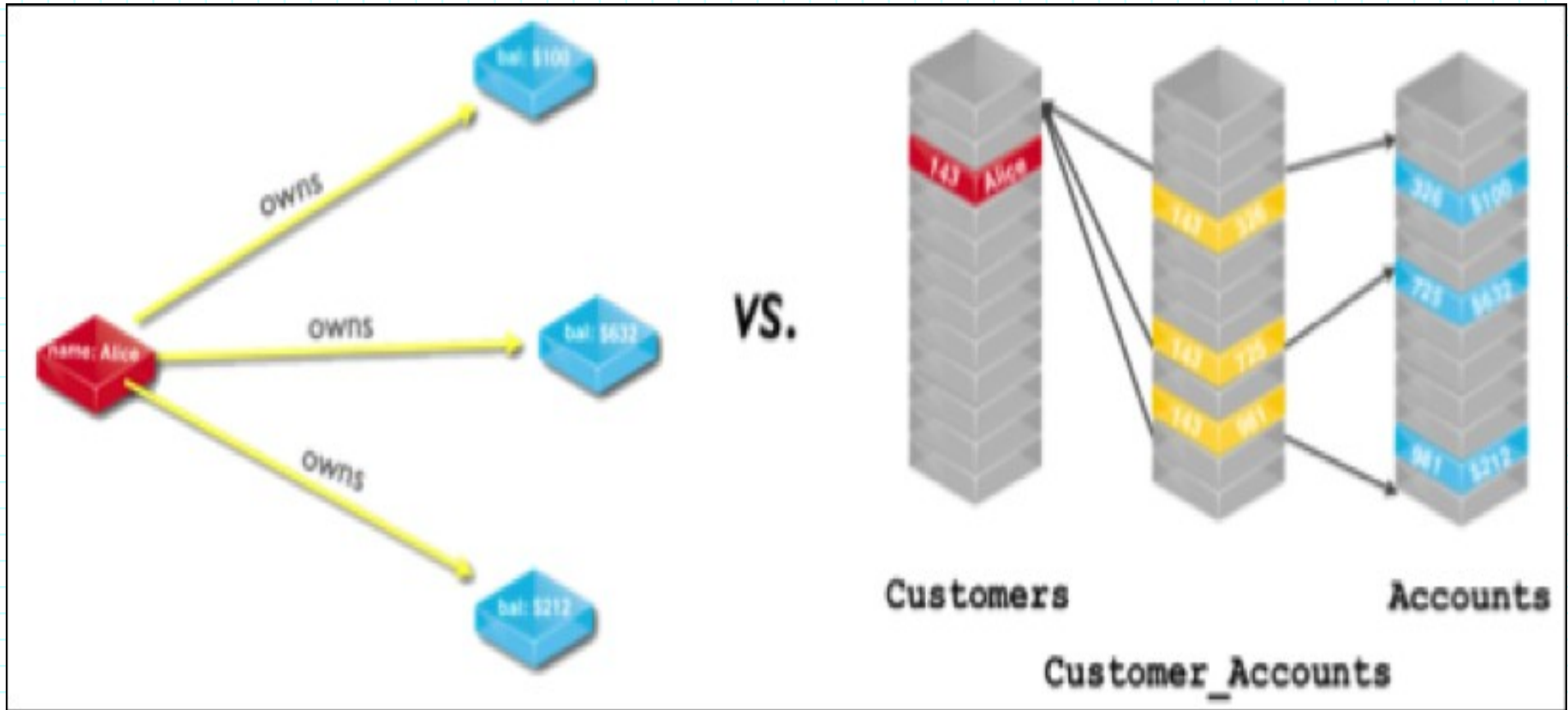
- Relationships between data sets
- Multioperation transactions
- Query by data
- Operation by sets

# Neo4J Data Model – Data Constructs



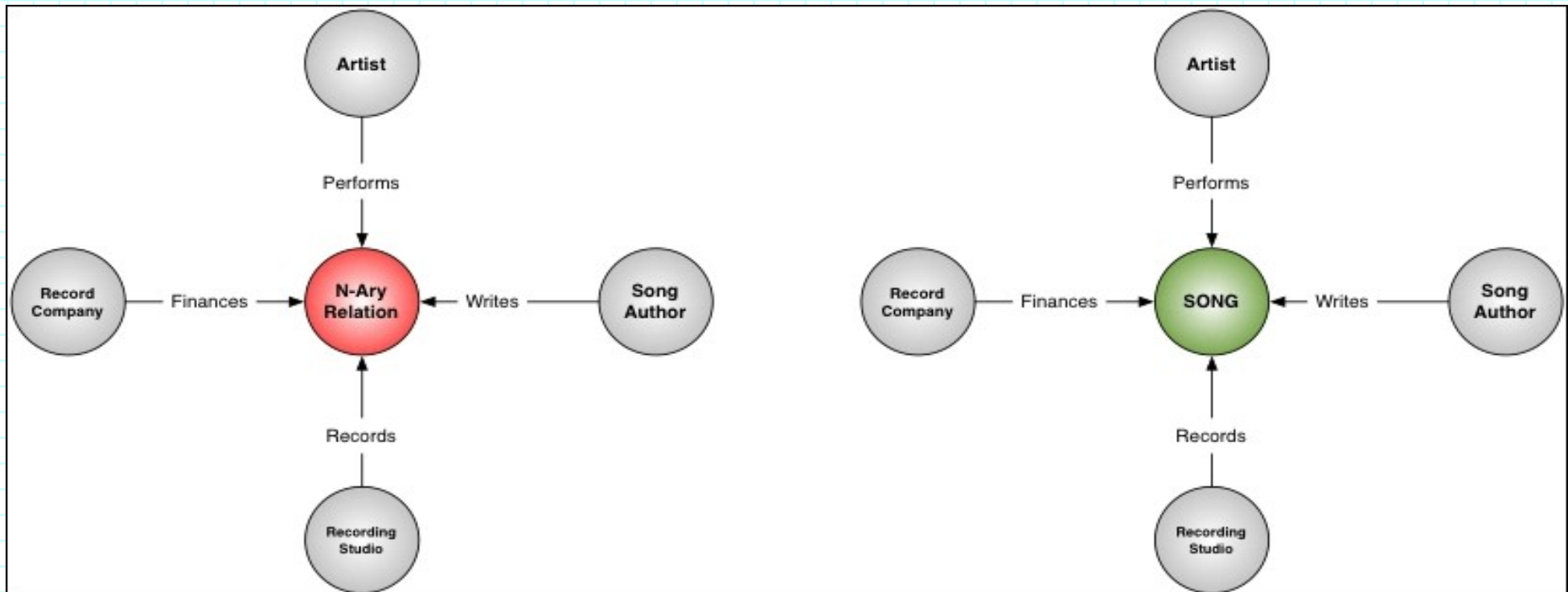
“Learning Neo4J”, Rik Van Bruggen, 2014

# Neo4J Data Model



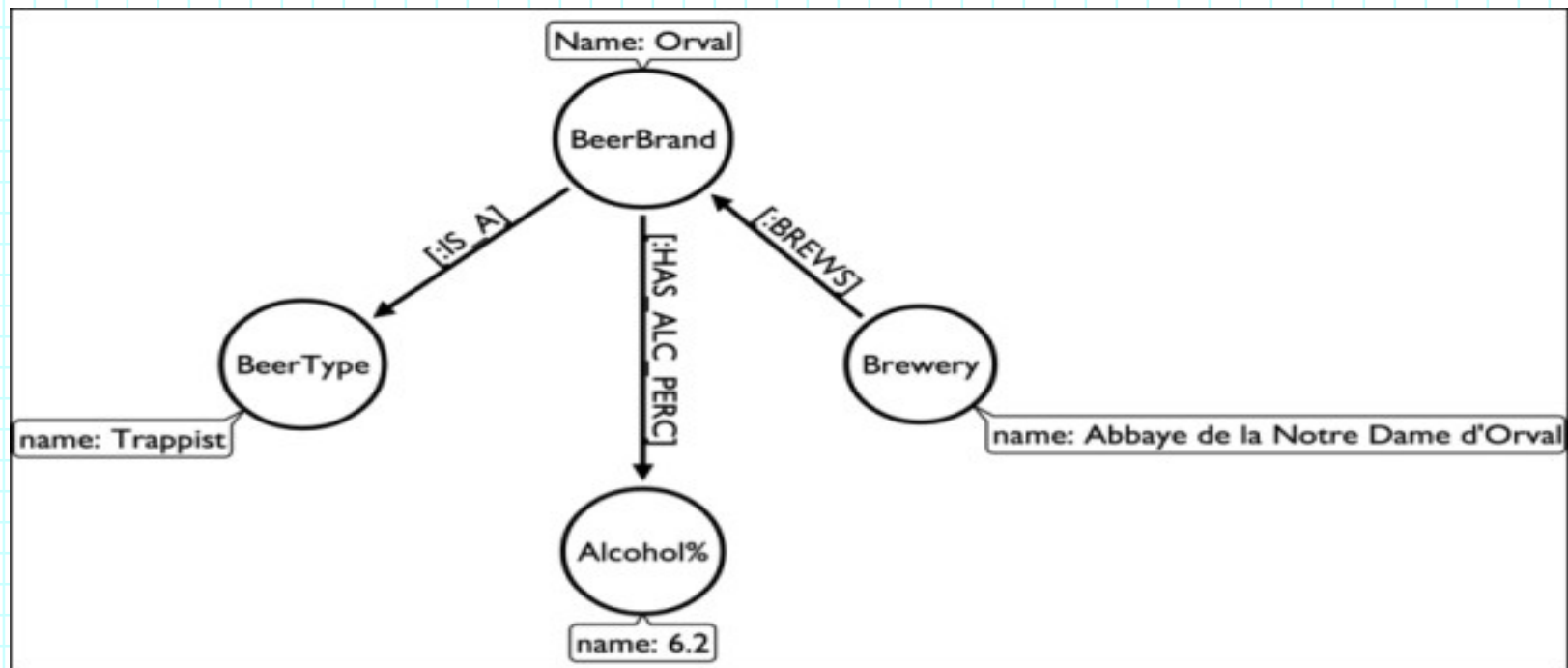
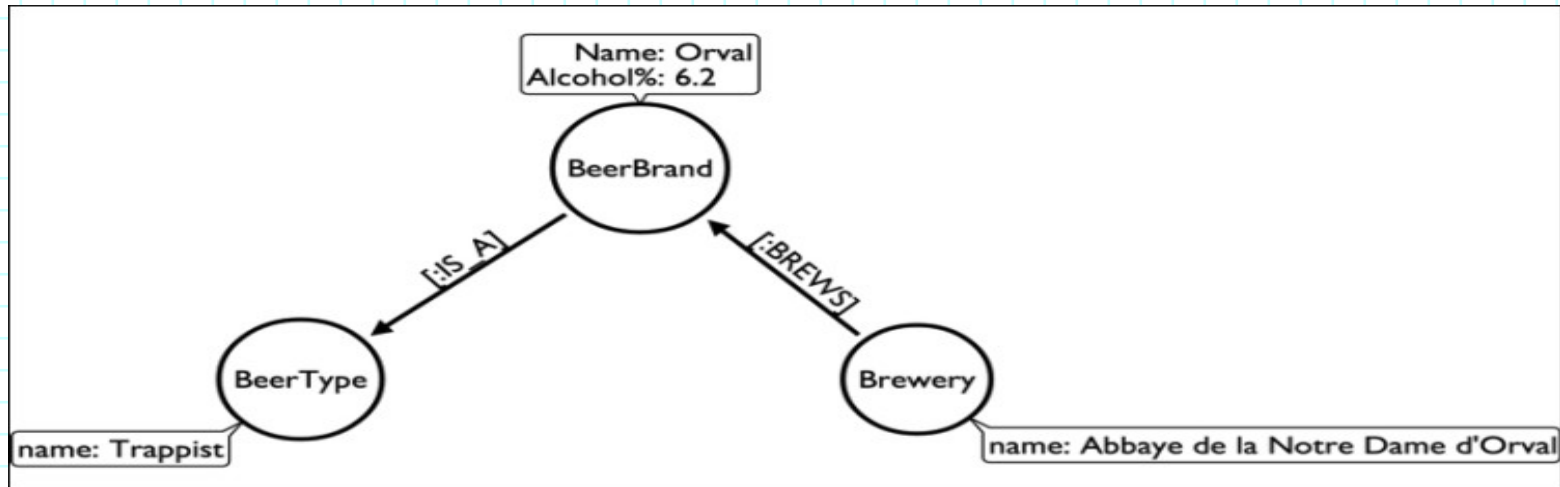
# Neo4J Data Model – Best Practices

- Design for query-ability
- Align relationships with use cases
- Look for n-ary relationships

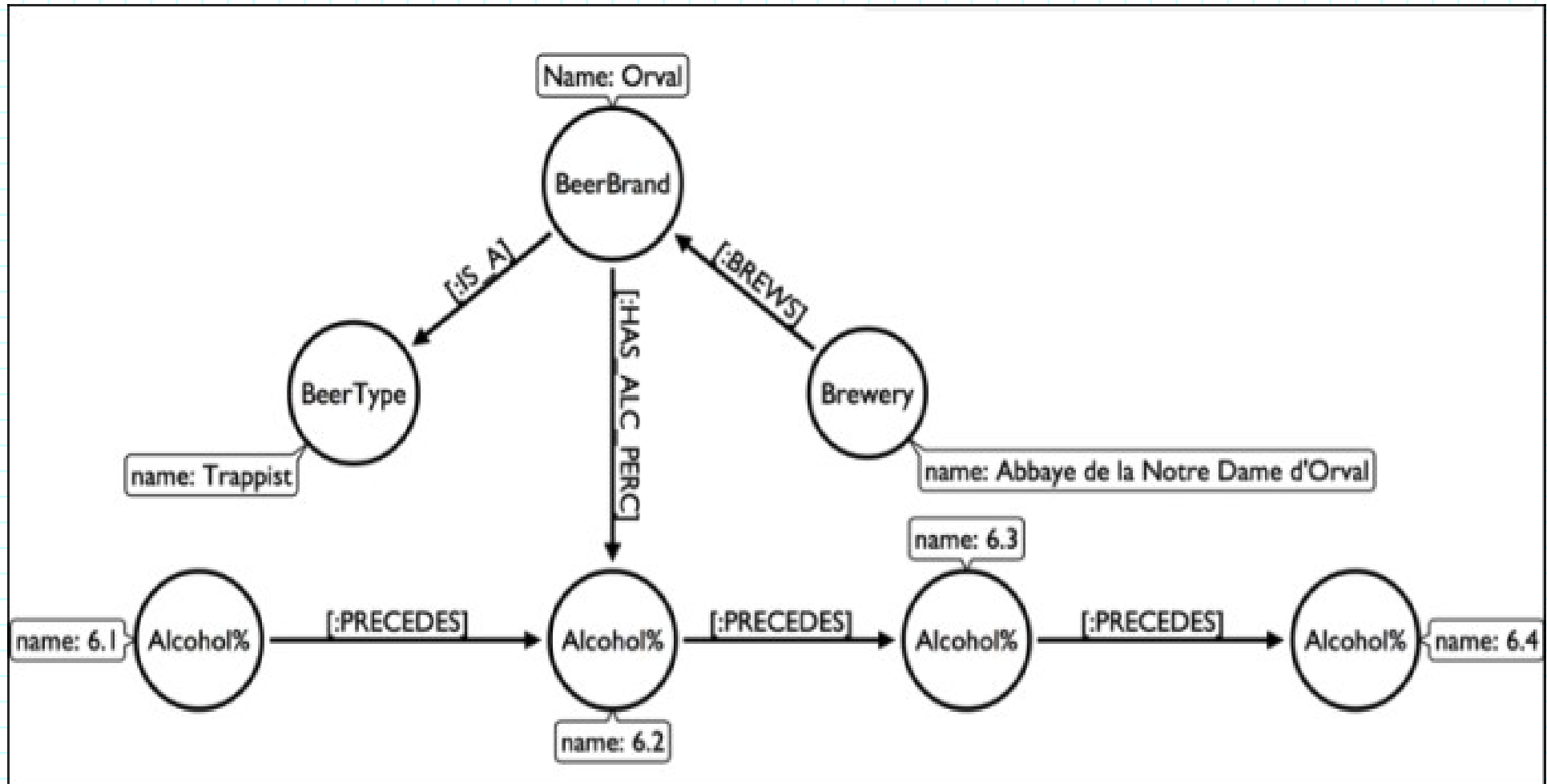


# Neo4J Data Model – Best Practices

## ■ Granulate Nodes

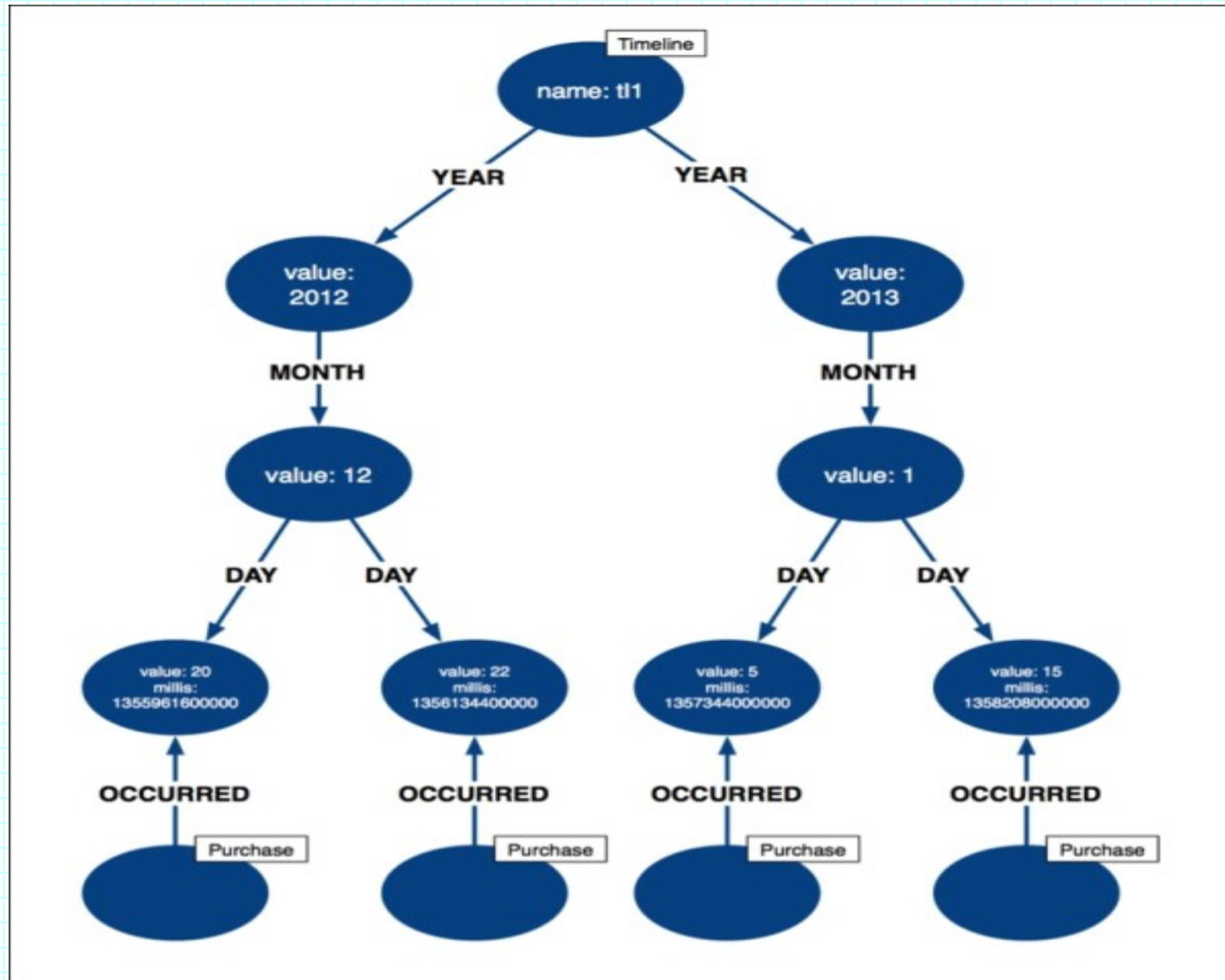


# Neo4J Data Model – Indexes



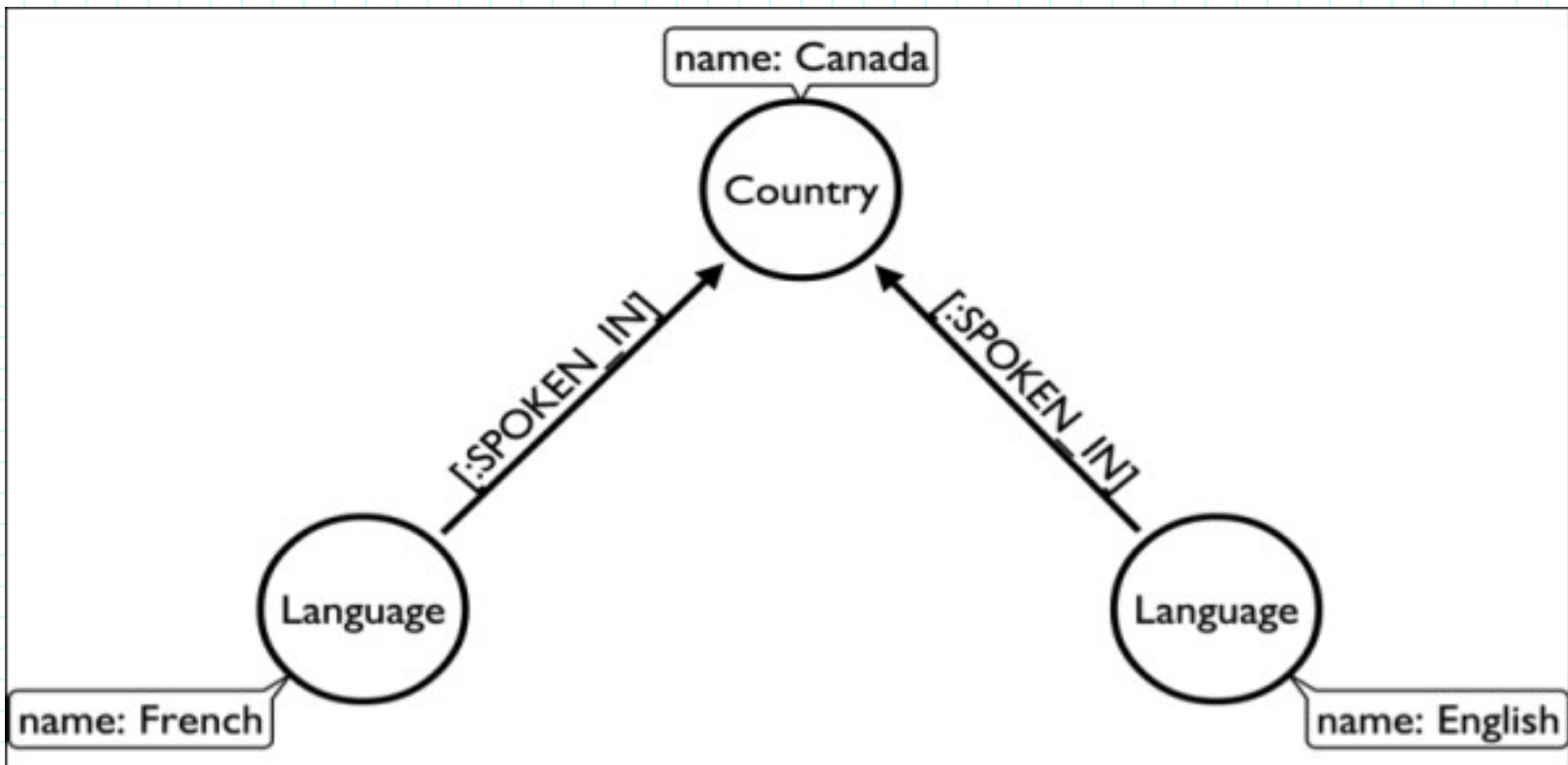


# Neo4J Data Model – Indexes

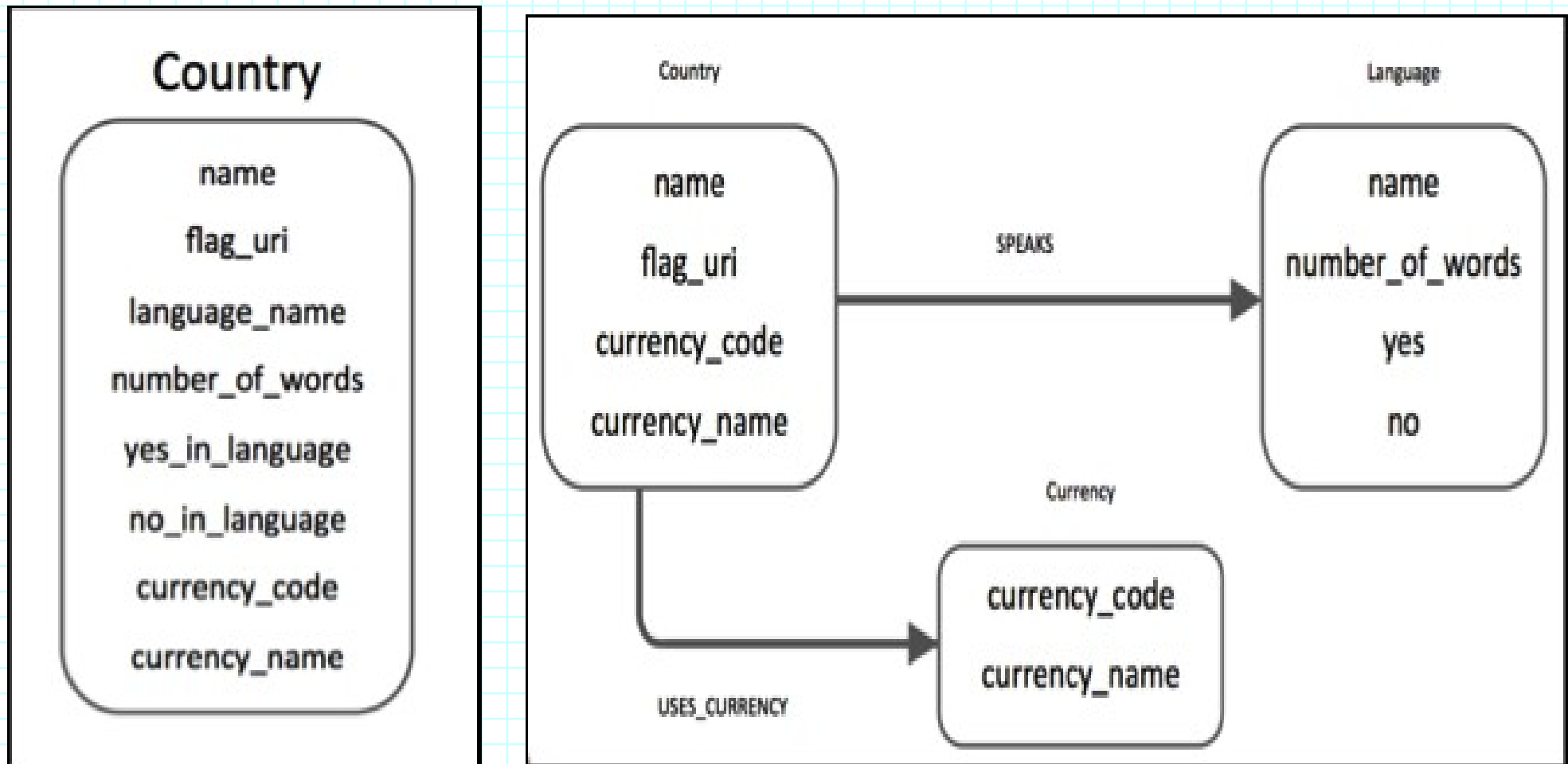


# Modelling Pitfalls: Rich Properties

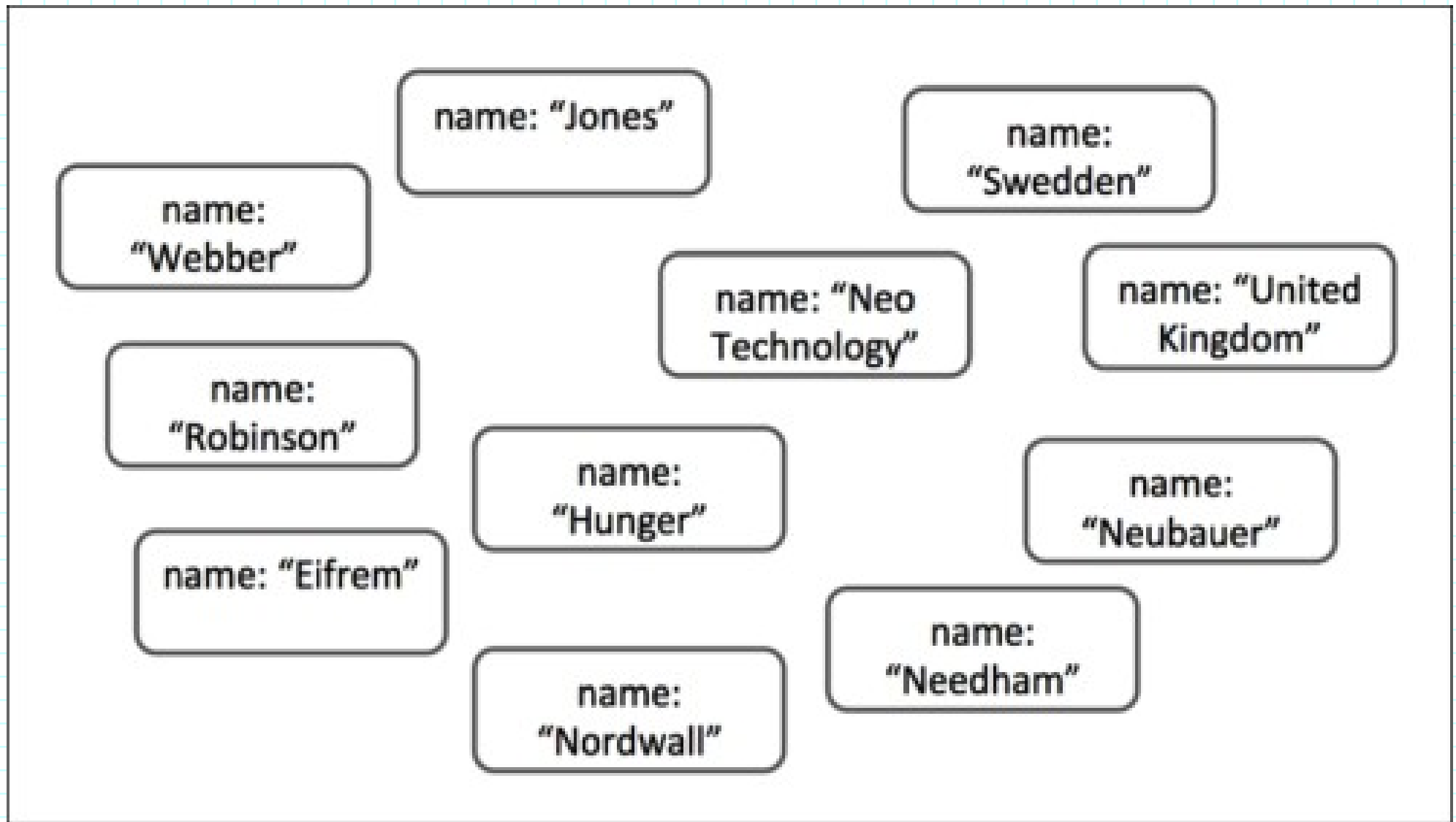
```
name: "Canada"  
languages_spoken:  
  "[ 'English', 'French' ]"
```



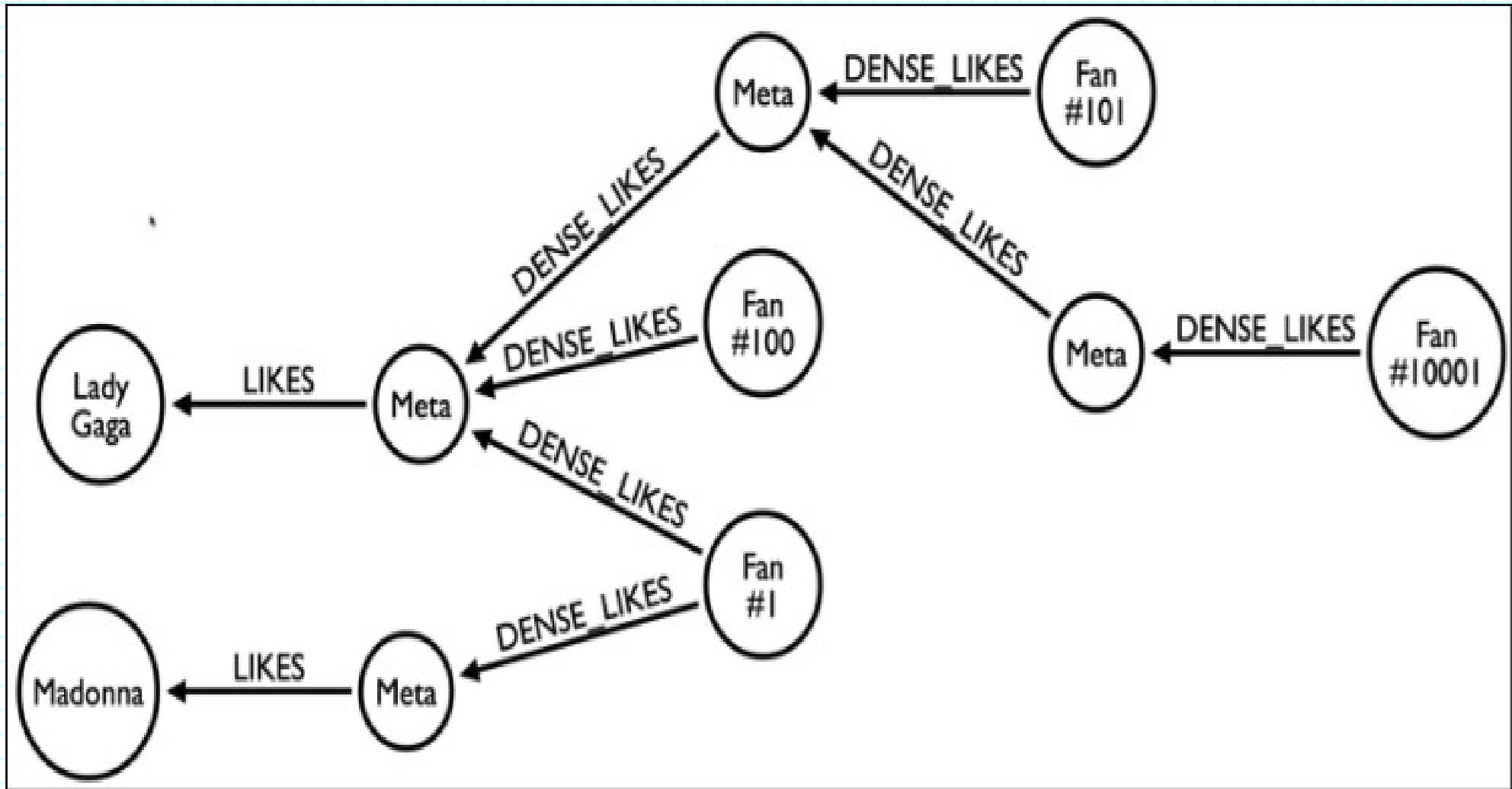
# Modelling Pitfalls: Multiple Concepts



# Modelling Pitfalls: Unconnected Graphs



# Modelling Pitfalls: Dense Nodes



# Cypher

```
CREATE (TheMatrix:Movie {title:'The Matrix', released:1999, tagline:'Welcome to the Real World'})
CREATE (Keanu:Person {name:'Keanu Reeves', born:1964})
CREATE (Carrie:Person {name:'Carrie-Anne Moss', born:1967})
CREATE (Laurence:Person {name:'Laurence Fishburne', born:1961})
CREATE (Hugo:Person {name:'Hugo Weaving', born:1960})
CREATE (LillyW:Person {name:'Lilly Wachowski', born:1967})
CREATE (LanaW:Person {name:'Lana Wachowski', born:1965})
CREATE (JoelS:Person {name:'Joel Silver', born:1952})
CREATE
  (Keanu)-[:ACTED_IN {roles:['Neo']}]->(TheMatrix),
  (Carrie)-[:ACTED_IN {roles:['Trinity']}]->(TheMatrix),
  (Laurence)-[:ACTED_IN {roles:['Morpheus']}]->(TheMatrix),
  (Hugo)-[:ACTED_IN {roles:['Agent Smith']}]->(TheMatrix),
  (LillyW)-[:DIRECTED]->(TheMatrix),
  (LanaW)-[:DIRECTED]->(TheMatrix),
  (JoelS)-[:PRODUCED]->(TheMatrix)
```

# Cypher

```
MATCH (tom {name: "Tom Hanks"}) RETURN tom
```

```
MATCH (cloudAtlas {title: "Cloud Atlas"}) RETURN  
cloudAtlas
```

```
MATCH (people:Person) RETURN people.name LIMIT  
10
```

```
MATCH (nineties:Movie) WHERE nineties.released >=  
1990 AND nineties.released < 2000 RETURN  
nineties.title
```

# Cypher

```
MATCH (tom:Person {name: "Tom Hanks"})-[:ACTED_IN]->(tomHanksMovies)
RETURN tom,tomHanksMovies
```

```
MATCH (cloudAtlas {title: "Cloud Atlas"})<-[:DIRECTED]-(directors) RETURN
directors.name
```

```
MATCH (tom:Person {name:"Tom Hanks"})-[:ACTED_IN]->(m)<-[:ACTED_IN]-
(coActors) RETURN coActors.name
```

```
MATCH (bacon:Person {name:"Kevin Bacon"})-[*1..4]-(hollywood)
RETURN DISTINCT hollywood
```

```
MATCH p=shortestPath(
  (bacon:Person {name:"Kevin Bacon"})-[*]-(meg:Person {name:"Meg Ryan"})
)
RETURN p
```



# Other Features

- Consistency
- Transactions
- Availability
- Scaling

# Use Cases

- Connected Data
- Routing, Dispatch, Location-based services
- Recommendation Engines