Data Modelling Using Graphs and Comparison of Graph Model and Relational Model

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Abstract—**This paper details the Data modelling using graphs. It goes through the details of different data models with representations, working of graph data model, different examples of graph data model like Noe4j, Dgraph etc. Also different applications of graph model is also listed, comparison of graph model and relational model is find out. And finally, we'll look into the challenges of this in real world.**

I. INTRODUCTION

Data modeling is the process of creating a visual representation of either a whole information system or parts of it to communicate connections between data points and structures. The main goal is to illustrate the types of data used and stored within the system, the relationships among these data types, the ways the data can be grouped and organized and its formats and attributes.[1]

In graph data modeling as the name suggests graph- based data model where each element is stored here as nodes and nodes are connected with edges. There are different types of graph data models like Noe4j, JanusGraph, Dgraph etc. There are some difference between graph model and relational model and there are some challenges faces by the system.[1]

II. TYPES OF DATA MODELS

There are mainly three data models.

1) *Conceptual data models:* They are also referred to as domain models and offer a big-picture view of what the system will contain, how it will be organized, and which business rules are involved.
2) *Logical data models:* They are less abstract and provide greater detail about the concepts and relationships in the domain under consideration.
3) *Physical data models.:* They provide a schema for how the data will be physically stored within a database As such, they're the least abstract of all. They offer finalized design that can be implemented as a relation database.

III. GRAPH BASED DATA MODELLING

Graph Based Data Model in NoSQL is a type of Data Model which tries to focus on building the relationship between data elements. As the name suggests Graph-Based Data Model, each element here is stored as a node, and the association between these elements is often known as Links. Association is stored directly as these are the first-class elements of the data model. These data models give us a conceptual view of the data.[2]

There are mainly three elements in graph based data model.

- Nodes : These are the instances of data that represent objects which is to be tracked.
- Edges: As we already know edges represent relationships between nodes.
- Properties: It represents information associated with nodes.[2]

Below figure represents the the three components in a graph based model.

IV. WHY GRAPH BASED MODELLING ?

Relational databases store highly structured data which have several records storing the same type of data so they can be used to store structured data and, they do not store the relationships between the data.Unlike other databases, graph databases store relationships and connections.Also the data model for graph databases is simpler compared to other databases.
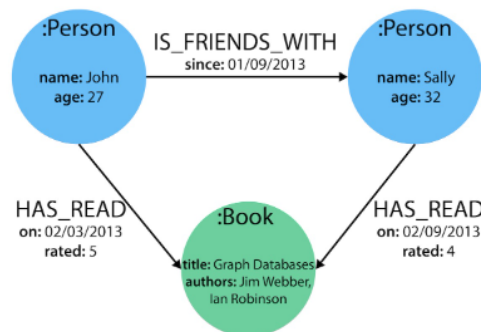

Fig. 1. Example of Graph Data Model - Neo4j

V. WORKING OF GRAPH DATA MODEL

In these data models, the nodes which are connected together are connected physically and the physical connection among them is also taken as a piece of data. Connecting data in this way becomes easy to query a relationship. This data model reads the relationship from storage directly instead of calculating and querying the connection steps. Like many different NoSQL databases these data models don't have any schema as it is important because schema makes the model well and good and easy to edit.[2]

VI. EXAMPLES OF GRAPH DATA MODELS

Here are some examples of graphs data models,

- Neo4j : It stands for Network Exploration and Optimization 4 Java. As the name suggests this graph database is written in Java with native graph storage and processing.[2]

- JanusGraph: These are very helpful in big data analytics. It is a scalable graph database system open source too.[2]

- DGraph: It is an open-source distributed graph database system designed with scalability.[2]
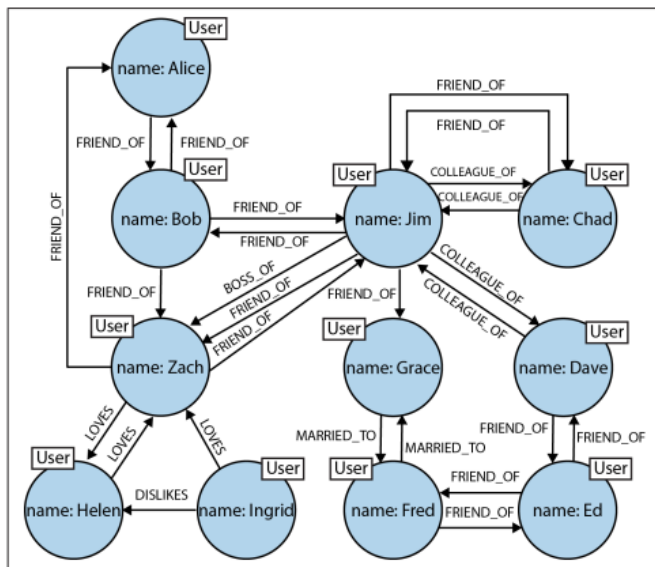

Figure 2-5. Easily modeling friends, colleagues, workers, and (unrequited) lovers in a graph

Fig. 2. Social Network Graph

VII. APPLICATIONS OF GRAPH DATA MODEL

Graph Data model has a wide variety of applications. Graph data models are very much used in fraud detection which itself is very much useful and important. Also Graph model is used in Digital asset management which provides a scalable database model to keep track of digital assets. Also it is used in Network management which alerts a network administrator about problems in a network. Graph Data model is used in Context-aware services by giving traffic updates and many more. In some cases it is used in Real-Time Recommendation Engines which provide a better user experience.[2]

VIII. GRAPH DATABASE MODEL VS. RELATIONAL DATABASE MODEL

Here some of the difference between Graph Database model and relational database model is listed.[3]

1) In graph database, data is stored in graphs whereas in Relational database, data is stored in tables.
2) In graph database there are nodes but in Relational database, there are rows.
3) In graph database there are properties and their values, in Relational database, there are columns and data.
4) In graph database the connected nodes are defined by relationships, in Relational database, constraints are used instead of that.
5) In graph database traversal is used instead of join whereas In Relational model, join is used instead of traversal.[4]

IX. CHALLENGES OF GRAPH DATA MODEL

- Unprofessional Graphs: It seems to be noted that, graphs are very unprofessional in different system especially when we consider the transnational based systems, it is noted that graph data model is very unprofessional.[2]
- Small User Base: The user base is small which makes it very difficult to get support when running into a system.[2]
- Representation of data for large complex systems is very difficult using graph database.

X. CONCLUSION

In this paper, we discussed the Graph data modelling which describes the basis introduction of how the data is stored in the database.In graph based modelling mainly three components are there which are nodes, edges, properties. Then working of graph model is also mentioned there. Different examples of graph data models are there like Noe4j, JanusGraph, Dgraph etc. Graph model has wide variety of applications in networking and other related systems. Then discussed the difference between graph model and relational model and the different challenges faced by the graph data model.

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