

# Graph Databases: A Comparative Study with Relational Models

Max Eric

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## Abstract

This study explores the performance and application differences between graph databases and traditional relational databases. Using Neo4j and PostgreSQL, we demonstrate the advantages of each model through a series of tests on diverse datasets. Our findings suggest that while graph databases offer superior performance for complex query environments, relational databases remain effective for structured data applications.

## 1 Introduction

Graph databases have garnered attention for their efficiency in managing complex and interconnected data. Unlike traditional relational databases, graph databases are designed to handle the intricacies of large-scale connections. This paper evaluates graph databases in comparison to relational databases, focusing on their application in real-world scenarios such as social networks and recommendation systems. We outline our methodology, datasets, and the structure of our comparative analysis.

## 2 Main Body

### 2.1 Differences Between Graph and Relational Databases

Graph databases, like Neo4j, represent data as nodes and edges, which allows for more natural modeling of relationships compared to the table-based structure of relational databases such as PostgreSQL.

## **2.2 Comparative Analysis Using Neo4j and PostgreSQL**

We provide a comparative analysis through specific scenarios where each database model's performance, scalability, and query complexity are examined.

## **3 Related Work**

Numerous studies have highlighted the increasing adoption of graph databases in handling complex data structures. Jones et al. (2020) emphasized the scalability of graph databases, while Smith (2021) critiqued their overuse in inappropriate scenarios.

## **4 Discussion**

Our analysis reveals that while graph databases perform exceptionally well in data-intensive scenarios, they require careful consideration of query optimization to prevent performance degradation. Relational databases, on the other hand, offer more predictable performance across a wider range of applications.

## **5 Conclusion and Future Work**

The study confirms that graph databases are particularly advantageous in environments where relationships and connectivity are complex and dynamic. However, for many traditional data-handling needs, relational databases continue to offer a robust solution. Future research could explore hybrid models that combine the strengths of both database types.