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"OPTIMIZNG COMPLEX QUERIES: A COMPREHENSIVE REVIEW OF EVALUATION STRATEGIES IN RELATIONAL AND NON-RELATIONAL DATABASES"

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Abstract: The growth in data and the emergent cloud environment resulted in the production of new databases. Applications have to interact with many heterogeneous data stores that depend on the type of data they have to manage. Interacting with several heterogeneous data models through different APIs, query languages, and different data stores becomes challenging for developers. Complex queries are not able to execute in a declarative way as they used to with mono-data store applications, and they need extra effort for implementation. There are two types of databases: relational and NOSQL databases. Relational databases are table-based, where there is no scalability, duplication, or joining of tables, which is expensive and difficult to handle when the data is complex. Due to the limitations of relational databases, the NOSQL approach has emerged to achieve scalability and is also able to manage huge amounts of data. This paper is a review of the new data management required by many new applications so as to interact with several heterogeneous data stores.

Keywords: NOSQL, SQL, ACID, BASE, NEO4J, HBASE, RDBMS, COUCHDB, SIMPLEDB.

I. INTRODUCTION

Databases are the most important part of the information system. Databases are used to store and retrieve data; the two types of databases are relational and non-relational databases. The most commonly used relational data is SQL, and non-relational data is NOSQL. SQL is a structured query language and is widely used mostly because of its consistency and functionality, but it also has certain limitations, such as scalability and handling huge amounts of data. Google, Facebook, Amazon, and LinkedIn were the first companies to address the inability of relational databases to handle big data. Relational databases follow ACID properties, whereas NOSQL follows BASE properties. SQL is a database that stores data in tabular form. Relational databases are divided into rows and columns. A row represents a record, while a column represents a field. Tables are joined using keys. The limitations of relational databases resulted in NOSQL, where there is no schematic structure. Each record can have multiple fields, called a dynamic schema. NOSQL provides a feature called sharding used for database partitioning. The main motive of NOSQL is to provide efficient storage and data retrieval. Some of the NOSQL databases that have been introduced over the years are Neo4j, Hbase, etc. Cloud vendors use these databases as per their needs. NOSQL was first introduced in 1988 for naming relational databases without using SQL. Many NOSQL databases are available, each with a different usage. They are mostly divided into four categories: key-value data stores, document stores, column stores, and graph databases.

II. LITERATURE REVIEW

- **BHAT AND JADHAV (2010),** in their research paper entitled "Moving towards Non-Relational Databases", describe that RDBMS has been widely used over the years and provides users with simplicity, robustness, compatibility, etc. Which formed the foundation for application stacks, but with the introduction of the cloud, RDBMS underwent many challenges, which led to the emergence of new document-centric or resource-centric databases that are non-relational in nature, such as CouchDB, SimpleDB, etc. Many experiments were performed on these databases that highlighted their silent features and how they differed from the previous databases.
- **CATTELL (2010),** in his research paper entitled "Scalable SQL and NOSQL Data Stores", describes the different SQL and NOSQL data stores that were designed to scale simple OLTP-style application loads. These systems allow multiple users to update and read at the same time, which was not the case in earlier databases.
- **OKMANENTAL (2011), in** the research paper entitled "Security Issues in NOSQL Databases" describes, due to the development of cloud computing and web applications, the need for databases that could store huge amounts of data where there is more

scalability and availability. This led many companies to come up with non-relational databases, i.e., NOSQL databases. These databases are neither relational nor do they support SQL. These databases need high security and consistency since very sensitive data is stored here. The focus here is on two databases, i.e., Cassandra and MongoDB.

- **JATANA et al. (2012),** in their research paper entitled "A Survey and Comparison of Relational and Non-Relational Databases,", describe the comparison between relational and non-relational databases. The database is more concerned with the way they handle huge amounts of data in a consistent, stable, repeatable, and quick manner. These prominent features of relational and non-relational databases form the basis for the comparison of relational and non-relational databases. While relational models are based on mathematical theory, non-relational models may or may not be based on mathematical theory. When we talk about robustness, flexibility, reliability, robustness, and scalability, a relational model is beneficial, but when data is huge, we go for non-relational since it shows signs of usability.
- **SHARMA et al. (2012),** in their research paper entitled "SQL and NOSQL Databases", describe that when the data is huge, we go for NOSQL. In NOSQL, databases are distributed, non-relational, open source, and horizontally scalable. The ACID properties followed here are different from those used in SQL. This paper describes the background of NOSQL and discusses the characteristics, pros, and cons of NOSQL.
- **ARORA and GUPTA (2012), in their** research paper entitled "Cloud Databases: A Paradigm Shift in Databases", describe that for many years' relational databases have ruled the IT industry, but from the last few years, the IT industry has seen many changes, like standalone applications being replaced by web-based applications, similarly dedicated servers with multiple distributed servers, and many more. In today's time, cloud computing has become the biggest change that has ever taken place in the IT industry because of its lower cost, scalability, and pay-per-use. There are many cloud-based applications, like Big Table, Sherpa, etc. They address the problems in relational databases. Cloud-based applications are mainly data-intensive, while transactional data management applications are write-intensive. Such types of applications need ACID properties, but these can't be deployed on the cloud. The main aim of this paper is to review the state of the art in cloud databases and their architectures, discuss the challenges faced while developing cloud databases, and discuss properly used cloud databases.
- **TAURO et al. (2012),** in their research paper entitled "Comparative Study of the New Generation of Agile, Scalable, and High Performance NOSQL Databases", describe that relational databases have been widely used over the years, but when it came to handling huge volumes of data like the internet, relational databases failed. So the NOSQL database came into existence. This paper talks about the problems faced by relational databases and the different types of NOSQL databases that are used to handle real-world problems.
- **BHATEWARA AND WAGHMARE (2012),** in their research paper entitled "Improving Network Scalability Using NOSQL Database", describe that traditional databases were designed for complex queries and structured data, but in the cloud, the data is huge, dynamic, and non-structured, so that's why we go for NOSQL. It also discusses the various non-structured databases and talks about the advantages and disadvantages of Cassandra and how it improves scalability.
- **NAYAK et al. (2013),** in their research paper entitled "Type of NOSQL Databases and Their Comparison with Relational Databases", describe NOSQL, how it has emerged and came as an alternative to relational databases. This paper also discusses the NOSQL data model, types of NOSQL data stores, what are its advantages and disadvantages, what are its characteristics and features, future prospects, and query language.
- **GAJENDRA's** research paper, entitled "A Survey on NOSQL Databases", describes how, over the years, NOSQL data stores have emerged and why RDBMS could not achieve these requirements. Also, it describes the concepts of data stores and how ACID properties can be composed to achieve reliability and scalability.

III. EXISTING SYSTEM

The elasticity property of cloud computing provides an executing environment for managing applications like big data management. Big data involves 3V's model volume, velocity, and variety. Volume refers to the amount of information, velocity refers to the rate at which data flows, and variety refers to data availability. These days, data stores consist of various heterogeneous APIs. Developers need to know about all these APIs while coding their applications. Due to heterogeneity, there is no declarative way of defining and executing complex queries. When applications migrate from one cloud to another, developers need to readopt the application source code so as to interact with the new data store.

IV. DRAWBACKS OF EXISTING METHOD

i. Developers need to get the knowledge of all the APIs while coding.
ii. Defining and executing complex queries is difficult.
iii. Readopting of application source code while migrating from one cloud to other.

V.PROPOSED SYSTEM

This is the major element in our model, representing various data stores where an application can choose among them. An example of this is a cloud environment where the data stores are deployed in a cloud consisting of one or multiple concepts of type entity. This concept includes a table in a relational database, a collection of documents in a data store, and a data base in a key value data store.

VI. ADVANTAGES OF PROPOSED METHOD

- Variety of data stores is available for applications.
- Data stores are available in the cloud.

VII. CONCLUSION

This document provides an overview of different types of data stores such as NOSQL and relational data stores. This article discusses relational database issues and the benefits of NOSQL data stores. This paper focuses on new data management requirements for modern interactive applications to address the heterogeneity of data stores.

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