NATIONAL UNIVERSITY OF MODERN LANGUAGES

DATABASE MANAGEMENT SYSTEM ASSIGNMENT - 1

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Assignment 1: Comparative Study of Modern Database Systems

Part A: Overview of Database Types

In today's data-driven world, choosing the right type of database is crucial for system performance, flexibility, and scalability. Databases are broadly categorized into two main types: relational (SQL) and non-relational (NoSQL). Below is a comparative discussion between them.

Aspect	SQL Databases	NoSQL Databases
Data Model	Structured, table-based with defined schema.	Flexible model - document, key-value, graph, etc.
Schema	Fixed and predefined schema.	Schema-less or dynamic schemas.
Transaction Model	Follows ACID principles.	Typically follows BASE properties.
Scalability	Scales vertically by upgrading hardware.	Scales horizontally by adding more machines.
Flexibility	Best for structured data with complex relationships.	Good for unstructured and semi-structured data.
Use Cases	Banking systems, ERP, legacy applications.	IoT, social media, real-time analytics.

Part B: Comparative Analysis of Selected Databases

This section compares three different types of databases—PostgreSQL (Relational), MongoDB (Document-oriented NoSQL), and Cassandra (Wide-column NoSQL). The comparison is based on several key features.

1. PostgreSQL (Relational Database)

PostgreSQL is an open-source object-relational database system that uses SQL. It supports advanced data types and performance optimization features. It is ideal for applications where complex querying and data integrity are priorities.

2. MongoDB (Document-Oriented NoSQL)

MongoDB is a NoSQL database that stores data in JSON-like documents. It is designed for high availability and scalability, and is well-suited for agile development and systems requiring flexible schemas.

3. Cassandra (Wide-Column NoSQL)

Apache Cassandra is a distributed NoSQL database designed for handling large volumes of data across many servers without a single point of failure. It provides high availability and excellent performance for write-heavy workloads.

Comparison Table

Feature	PostgreSQL	MongoDB	Cassandra
Data Model	Relational - tables and rows.	Document-oriented - BSON.	Wide-column store.
Query Language	SQL	Mongo Query Language (MQL)	CQL (Cassandra Query Language)
Schema Flexibility	Rigid and structured.	Highly flexible and dynamic.	Semi-structured.
Consistency Model	ACID-compliant.	Tunable (Eventual or Strong).	Eventual consistency (BASE).
Indexing Support	Advanced indexing support.	Built-in indexes for fast queries.	Supports secondary indexes via plugins.

Performance	Great for complex read/write.	Efficient for real-time reads.	Highly efficient for large-scale writes.
Best Use Cases	Finance, enterprise systems.	Content management, IoT apps.	Sensor data, time-series logs.

Conclusion

Each of the discussed databases has its strengths and ideal scenarios. PostgreSQL works best where data consistency and advanced querying are required. MongoDB suits use cases that need flexible schemas and fast prototyping. Cassandra excels in distributed environments needing high availability and fault tolerance. The choice depends on the specific needs of the application and the nature of the data being managed.