

# DATABASE SYSTEMS

**Presented by Prof. Elisha T. O. Omulo**

## WEEK 13 AGENDA

- NoSQL Databases
- NewSQL Databases

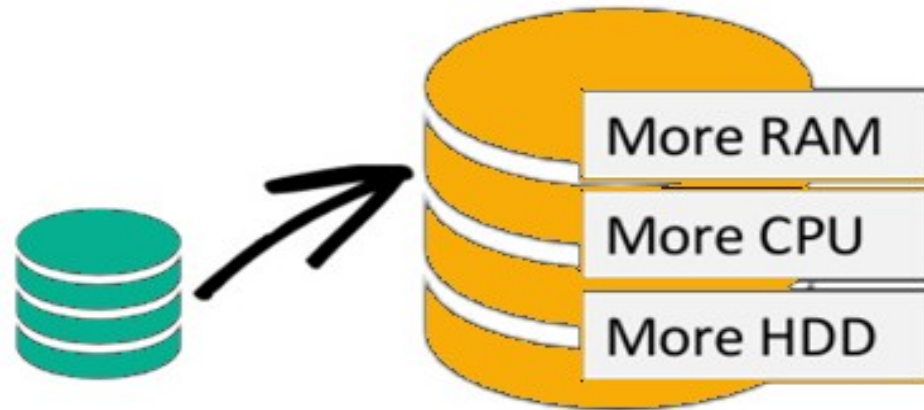
**Course Textbook:** Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles Fundamentals of Design, Implementation, and Management, 14<sup>th</sup> Edition, 2022, ISBN-13978-0357673034.

## **NoSQL Databases** (Source:<https://www.oracle.com/ke/database/nosql/what-is-nosql/> )

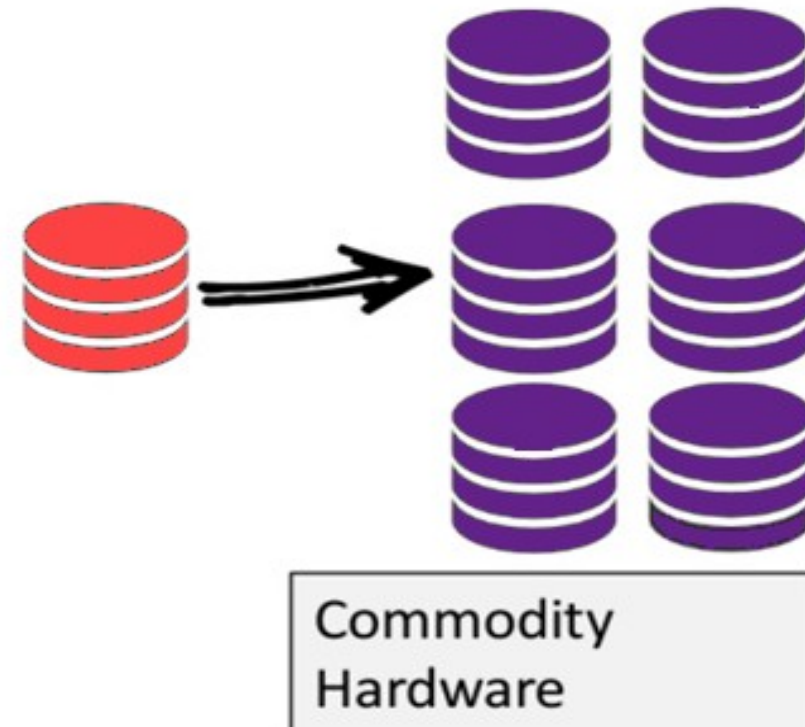
- NoSQL (“Not Only SQL” or “Not SQL.” ) databases are a new generation of databases that do not use the relational model and support the specific needs of Big Data organizations.
- NoSQL databases offer distributed data stores that provide high scalability, availability, and fault tolerance by sacrificing data consistency and shifting the burden of maintaining relationships and data integrity to the program code.
- In NoSQL databases, data can be stored without defining the schema upfront; it is possible to get build and review quickly, defining the data model in the process. This is suitable for specific business requirements, whether it’s graph-based, column-oriented, document-oriented, or as a key-value store.

# NoSQL Databases (Source: <https://www.guru99.com/nosql-tutorial.html#4> )

**Scale-Up** (*vertical* scaling):



**Scale-Out** (*horizontal* scaling):



## **NoSQL Databases** (Source:<https://www.oracle.com/ke/database/nosql/what-is-nosql/> )

- **Good for businesses and organizations innovating rapidly, being able to stay agile and continue operating at any scale.**
- **Offer flexible schemas and also support a variety of data models that are ideal for building applications that require large data volumes and low latency or response times—for example, online gaming and ecommerce web applications.**
- **Use unstructured storage; designed for fast, simple queries, vast data, and frequent application changes; they make programming much simpler for developers.**
- **Rely on a process called “sharding or partitioning” to scale out horizontally, which means that more machines can be added to handle data across multiple servers.**
- **Can handle extremely large amounts of data.**

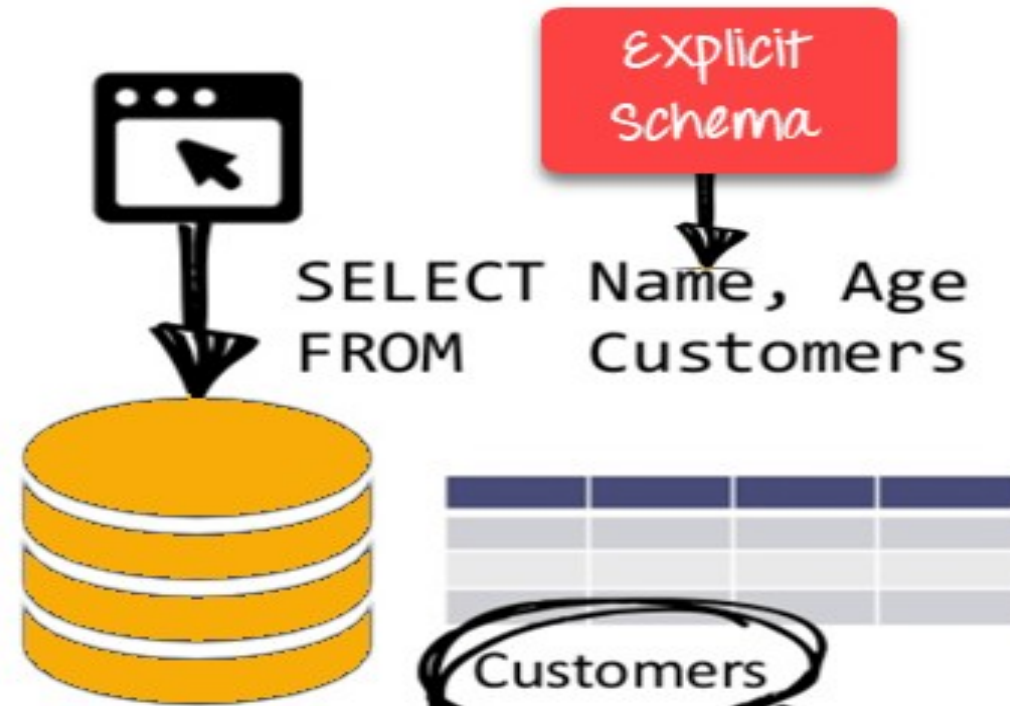
## **NoSQL Databases** (Source:<https://www.oracle.com/ke/database/nosql/what-is-nosql/> )

### **Benefits include:**

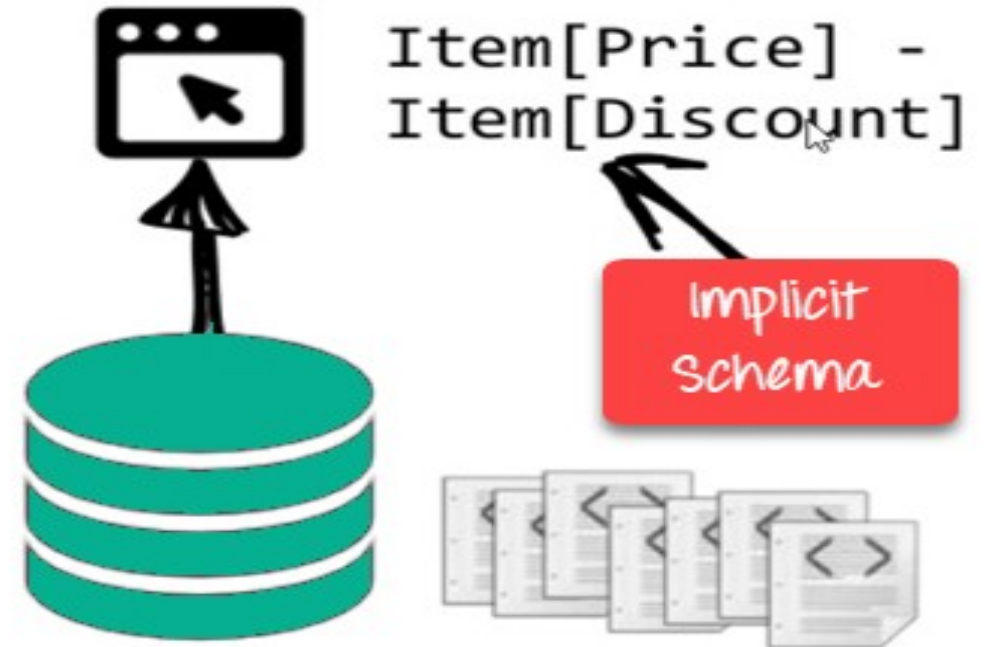
- **Flexibility-** data can be stored in a more free-form.
- **Scalability-** scale out by using commodity hardware.
- **High performance-** can handle data volume or traffic increases.
- **Availability** - automatically replicate data across multiple servers, data centers, or cloud resources.
- **Highly Functional-** designed for distributed data stores that have extremely large data storage needs. So they can handle big data, real-time web apps, customer 360, online shopping, online gaming, Internet of things, social networks, and online advertising applications.

# NoSQL Databases (Source: <https://www.oracle.com/ke/database/nosql/what-is-nosql/> )

RDBMS:



NoSQL DB:





# NoSQL Databases (Source:<https://www.oracle.com/ke/database/nosql/what-is-nosql/> )

## Types of NoSQL databases

- **Key value-** most flexible; the application has complete control over what is stored in the value field without any restrictions.
- **Document** - aka document store or document-oriented databases; used for storing, retrieving, and managing semi-structured data.
- **Graph** - organizes data as nodes and relationships; shows the connections between nodes; supports richer and fuller representation of data; applied in social networks, reservation systems, and fraud detection.
- **Wide column** - databases store and manage data in the form of tables, rows, and columns; used in applications that require a column format to capture schema-free data.
- **Examples:** Oracle NoSQL Database; MongoDB;



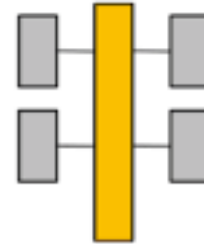
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## SQL Database

### Relational

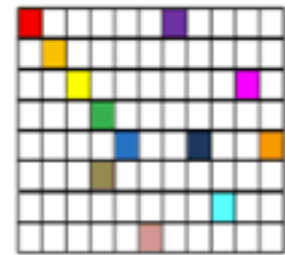


### Analytical (OLAP)



## NoSQL Database

### Column-Family



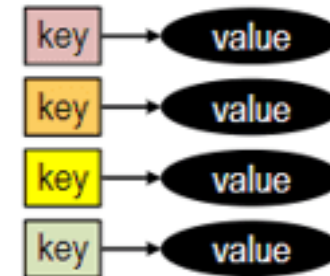
### Graph



### Document



### Key-Value



# NoSQL Databases (Source:<https://www.guru99.com/nosql-tutorial.html#4> )

## Features of NoSQL

**Non-relational:** never follow the relational model; no tables with flat fixed-column records; use self-contained aggregates or BLOBs; does not need many relational DB constructs eg. ACID;

**Schema-free:** either schema-free or have relaxed schemas; allow heterogeneous structures of data in the same domain;

**Simple API:** easy to use interfaces for storage and querying data provided; APIs allow low-level data manipulation & selection methods; Text-based protocols mostly used with HTTP REST with JSON; no standard based NoSQL query language; Web-enabled databases running as internet-facing services;

**Distributed:** Multiple NoSQL databases can be executed in a distributed fashion; Offers auto-scaling and fail-over capabilities; ACID concept can be sacrificed for scalability and throughput; no synchronous replication between distributed nodes  
Asynchronous.

## NewSQL Databases (Source: <https://www.geeksforgeeks.org/difference-between-nosql-and-newsql/>)

### NewSQL :

- Is a database that is a combination of relational model with the advancement in scalability, flexibility with types of data. Such databases focus on the features which are not present in NoSQL, that offer a strong consistency guarantee. This covers two layers of data one relational one and a key-value store.
- **Advantages of NewSQL** : introduces new implementation to traditional relational databases; brings together the advantages of SQL and NoSQL; easy to migrate between the type and needs of the user.
- **Disadvantages of NewSQL** : offer partial access to rich traditional systems; may cause a problem in-memory architecture for exceeding volumes of data.

# NewSQL Databases (Source: <https://www.geeksforgeeks.org/difference-between-nosql-and-newsql/>)

## NoSQL compared with NewSQL :

| NoSQL   | NewSQL  |
|---|---|
| • schema-free database.                       | schema-fixed as well as a schema-free database.     |
| • It is horizontally scalable.                | It is horizontally scalable.                        |
| • Has automatic high-availability             | Has built in high-availability                      |
| • Supports cloud, on-disk, and cache storage. | Supports cloud, on-disk, and cache storage          |
| • It promotes CAP properties.                 | It promotes ACID properties.                        |
| • Online Transactional P. not supported.      | Online Transactional Processing is fully supported. |
| • There are low-security concerns.            | There are moderate security concerns.               |
| • Use:Big Data, Social Net. Ap.and IOT.       | Use: E-Commerce, Telecom industry, and Gaming.      |
| • Eg.DynamoDB, MongoDB, RaveenDB              | Eg. VoltDB, CockroachDB, NuoDB                      |

## Week 13 exercises

- 1) Investigate and describe NoSQL Databases
- 2) Investigate and describe the nature of the NewSQL Databases

## Week 13 Session References

- [Course Text] Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles: Fundamentals of Design, Implementation, and Management, 14<sup>th</sup> Edition, 2022, ISBN-13978-0357673034.
- Thomas M. Connolly, Carolyn E. Begg (2021). Database Systems: A Practical Approach to Design, Implementation, and Management. Published by Pearson (July 14th 2021). ISBN-13: 9780137517053

# Thank You

