Nosql Databases

A NoSQL (originally referring to "non SQL" or "non relational") database provides a mechanism for storage and retrieval of data that is modeled in means other than the tabular relations used in relational databases. Such databases have existed since the late 1960s, but did not obtain the "NoSQL" moniker until a surge of popularity in the early twenty-first century,[2] triggered by the needs of Web 2.0 companies such as Facebook, Google, and Amazon.[3][4][5] NoSQL databases are increasingly used in big data and real-time web applications.[6] NoSQL systems are also sometimes called "Not only SQL" to emphasize that they may support SQL-like query languages.

Types of Nosql Databases

Key-value store

Key-value (KV) stores use the associative array (also known as a map or dictionary) as their fundamental data model. In this model, data is represented as a collection of key-value pairs, such that each possible key appears at most once in the collection.[22][23]

The key-value model is one of the simplest non-trivial data models, and richer data models are often implemented as an extension of it. The key-value model can be extended to a discretely ordered model that maintains keys in lexicographic order. This extension is computationally powerful, in that it can efficiently retrieve selective key ranges.[24]

Key-value stores can use consistency models ranging from eventual consistency to serializability. Some databases support ordering of keys. There are various hardware implementations, and some users maintain data in memory (RAM), while others employ solid-state drives (SSD) or rotating disks (aka Hard Disk Drive (HDD)).

Document store

The central concept of a document store is the notion of a "document". While each document-oriented database implementation differs on the details of this definition, in general, they all assume that documents encapsulate and encode data (or information) in some standard formats or encodings. Encodings in use include XML, YAML, and JSON as well as binary forms like BSON. Documents are addressed in the database via a unique key that represents that document. One of the other defining characteristics of a document-oriented database is that in addition to the key lookup performed by a key-value store, the database also offers an API or query language that retrieves documents based on their contents.

Different implementations offer different ways of organizing and/or grouping documents:

- Collections
- Tags

- Non-visible metadata
- Directory hierarchies

Compared to relational databases, for example, collections could be considered analogous to tables and documents analogous to records. But they are different: every record in a table has the same sequence of fields, while documents in a collection may have fields that are completely different.

Graph

This kind of database is designed for data whose relations are well represented as a graph consisting of elements interconnected with a finite number of relations between them. The type of data could be social relations, public transport links, road maps, network topologies, etc.

Object database

- db4o
- GemStone/S
- InterSystems Caché
- JADE
- ObjectDatabase++
- ObjectDB
- Objectivity/DB
- ObjectStore
- ODABA
- Perst
- OpenLink Virtuoso
- Versant Object Database
- ZODB

Tabular

- Apache Accumulo

- Bigtable
- Apache Hbase
- Hypertable
- Mnesia
- OpenLink Virtuoso

Tuple store

- Apache River
- GigaSpaces
- Tarantool
- TIBCO ActiveSpaces
- OpenLink Virtuoso

Triple/quad store (RDF) database

- AllegroGraph
- Apache JENA (It is a framework, not a database)
- MarkLogic
- Ontotext-OWLIM
- Oracle NoSQL database
- Profium Sense
- Virtuoso Universal Server

Hosted

- Amazon DynamoDB
- Amazon SimpleDB
- Datastore on Google Appengine

- Clusterpoint database
- Cloudant Data Layer (CouchDB)
- Freebase
- Microsoft Azure Tables
- Microsoft Azure DocumentDB
- OpenLink Virtuoso

Multivalue databases

- D3 Pick database
- Extensible Storage Engine (ESE/NT)
- InfinityDB
- InterSystems Caché
- jBASE Pick database
- mvBase Rocket Software
- mvEnterprise Rocket Software
- Northgate Information Solutions Reality, the original Pick/MV Database
- OpenQM
- Revelation Software's OpenInsight
- UniData Rocket U2
- UniVerse Rocket U2

Multimodel database

- Apache Ignite[25][26]
- ArangoDB
- Couchbase

- FoundationDB
- MarkLogic
- OrientDB
- Cosmos DB

CAP Theorem

In theoretical computer science, the CAP theorem, also named Brewer's theorem after computer scientist Eric Brewer, states that it is impossible for a distributed data store to simultaneously provide more than two out of the following three guarantees: Consistency: Every read receives the most recent write or an error.

HBase Architecture

In HBase, tables are split into regions and are served by the region servers. Regions are vertically divided by column families into “Stores”. Stores are saved as files in HDFS. Shown below is the architecture of HBase.

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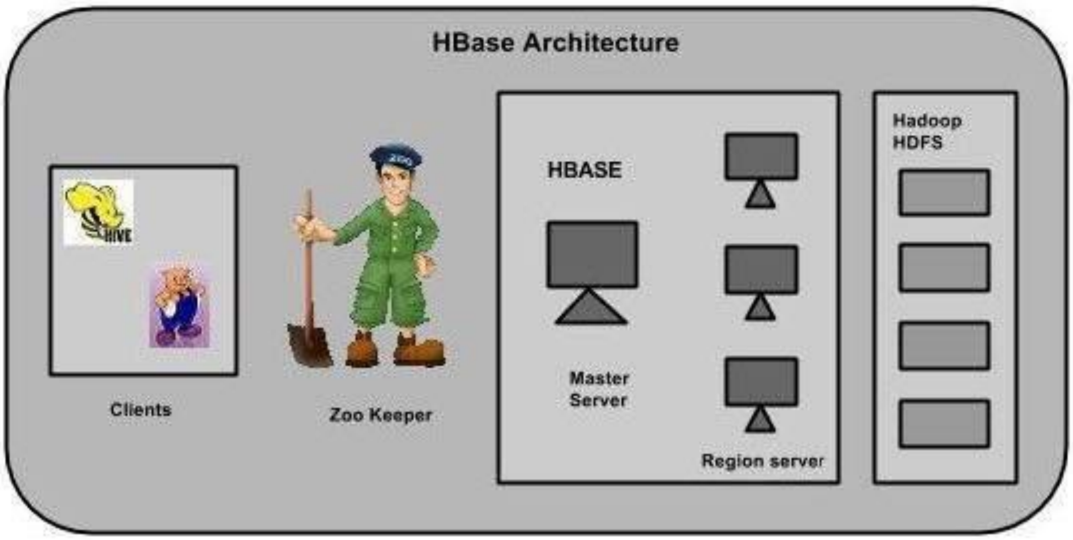


HBase has three major components: the client library, a master server, and region servers. Region servers can be added or removed as per requirement.

Master Server

The master server -

- Assigns regions to the region servers and takes the help of Apache ZooKeeper for this task.
- Handles load balancing of the regions across region servers. It unloads the busy servers and shifts the regions to less occupied servers.
- Maintains the state of the cluster by negotiating the load balancing.
- Is responsible for schema changes and other metadata operations such as creation of tables and column families.

Regions

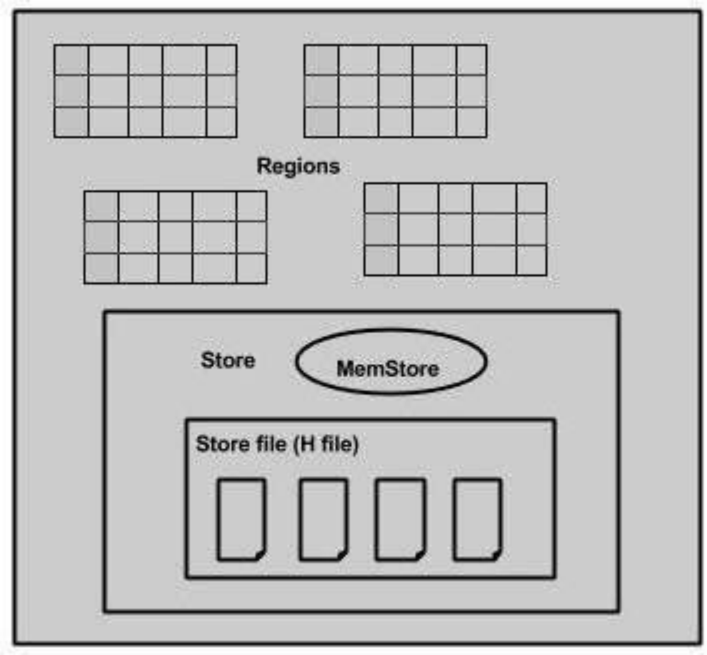
Regions are nothing but tables that are split up and spread across the region servers.

Region server

The region servers have regions that -

- Communicate with the client and handle data-related operations.
- Handle read and write requests for all the regions under it.
- Decide the size of the region by following the region size thresholds.

When we take a deeper look into the region server, it contain regions and stores as shown below:



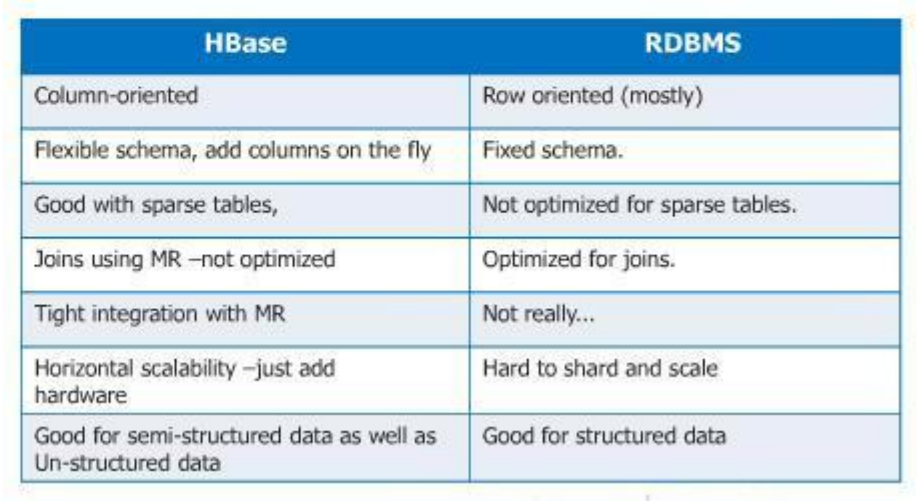
The store contains memory store and HFiles. Memstore is just like a cache memory. Anything that is entered into the HBase is stored here initially. Later, the data is transferred and saved in Hfiles as blocks and the memstore is flushed.

Zookeeper

- Zookeeper is an open-source project that provides services like maintaining configuration information, naming, providing distributed synchronization, etc.
- Zookeeper has ephemeral nodes representing different region servers. Master servers use these nodes to discover available servers.
- In addition to availability, the nodes are also used to track server failures or network partitions.
- Clients communicate with region servers via zookeeper.
- In pseudo and standalone modes, HBase itself will take care of zookeeper.

HBase vs RDBMS

Difference between RDBMS and HBase. Hadoop and RDBMS are varying concepts of processing, retrieving and storing the data or information. While Hadoop is an open-source Apache project, RDBMS stands for Relational Database Management System. ... SQL is utilized to retrieve needed data which is stored in such tables.



HBase	RDBMS
Column-oriented	Row oriented (mostly)
Flexible schema, add columns on the fly	Fixed schema.
Good with sparse tables,	Not optimized for sparse tables.
Joins using MR –not optimized	Optimized for joins.
Tight integration with MR	Not really...
Horizontal scalability –just add hardware	Hard to shard and scale
Good for semi-structured data as well as Un-structured data	Good for structured data