HBase

	RDBMS	HBASE
-	Requires SQL	NoSQL
-	Fixed schema	No fixed schema
-	Row oriented	Column oriented
-	Not Scalable	Scalable
-	Static	Dynamic
-	Slower retrival of data	Faster retrival
-	It follows ACID prop.	It follows CAP (consistency, Availability, Partition - tolerance) theorem
-	Handles structured data	Handles structured, semi-str. & unstruc. data
-	Cannot handle sparse data	Can handle sparse data.
-	Latency is present	Low latency

* Limitations of hadoop
- Performs batch processing, sequential manner
- Needed to search entire dataset.
- Processing a huge dataset results into huge data set, which is also processed sequentially

HBase.

→ Open-source, horizontally scalable.
→ Distributed column-oriented db build on top of hadoop fs.
→ Provides random real-time read/write access to data in hadoop fs.

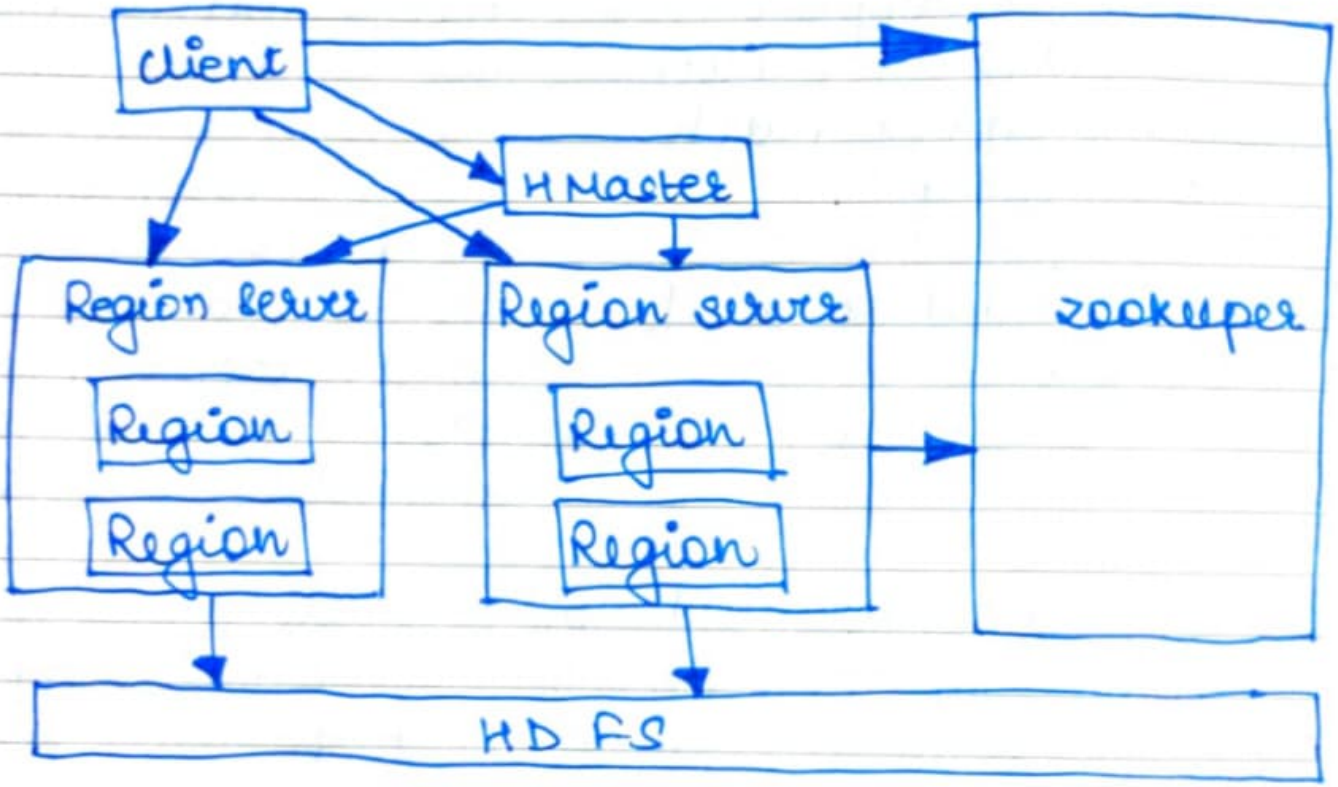
HDFS	HBase
- For storing files	Storing in HDFS & processing.
- does not support fast individual record lookups	Provides fast lookup for larger tables.
- High latency batch processing	Low latency access to single rows (Random access)
Sequential access of data	Uses hash tables & provides random access, & stores data in indexed HDFS for faster lookups.

- It is column-oriented db. and table are sorted by row. The table schema only ~~provides~~ defines column families, which are key-value pairs.

- Table is a collection of rows
- Row is a collection of column families
- Column family is a collection of columns
- Column is a collection of key-value pairs.

- Features of HBase
- Linearly scalable.
- Automatic failure support.
- Provides consistent reads & writes.
- Integrates with Hadoop, both as source & destin.
- Has easy JAVA API for client.
- Provides data replication across clusters.

★ Architecture



1. HMaster :-
→ Master server of HBase
→ Process in which regions are assigned to region server as well as DDL operations.
- Table (create Table, remove, enable disable)
- Column family (add column, modify column)
- Region (move, assign)

→ Manages region server instances present in cluster.
→ Controlling load balancing, failover etc.
→ Acts as an interface for DDL operations.

8. Zookeeper :-
→ Maintains server state, coordination service.
→ Provides services like maintaining configuration information, naming, providing distributed synchronization, server failure notification etc
→ Clients communicate with region servers via zookeeper

3. Region Server
→ HBase Tables are divided horizontally by row key range into Regions.
→ Regions are the basic building elements of HBase cluster that consists of distribution of tables & are comprised of column families.
→ Runs on HDFS DN.
→ Regions are responsible for handling, managing executing as well as reads & writes HBase operations on that set of region.
→ Default size of region → 256MB.

→ HMaster → Region server
- Hosting & managing regions
- Splitting regions automatically
- Handling read & Writes requests.
- communication with client directly

• Region → building element of HBase consist of distributed of tables & comprised of column families. contains multiple store, one for each column family. Has memstore, n file.

★ MetaTable. (stored on Region Servers)
→ It holds the location of the regions in HBase cluster.
→ It keeps list of all Regions in the system
→ Structure of Mita table:
1. key: region start key, region id.
2. Values: Region Server.
→ Handled by zookeeper.
- It is like a binary tree.

★ HBase Write Steps
① First step: is to write the data to the write-ahead log, while the client issues a put request:
→ To the end of WAL file, all the edits are appended which is stored on disk.
→ In case a server crashes, WAL is used to recover not-yet-persisted data

② As soon as data is written to WAL, it is stored in MemStore. (256 mb written stored in → H files in chunks 100mb)

★ Region Server Components

1. WAL (Write-ahead log)
→ Stores new data to permanent storage.
→ Also used for recovery.

2. Block Cache
→ It is the read cache.

read

→ stores frequent data in memory & removes least read data when full.

3. MemStore
→ Write Cache, stores new data which has not been written to disk.
→ sorts before writting.
→ One MemStore per column family

4. HFiles
→ These files stores the rows as sorted KeyValue on disk.

* Compaction
→ Combining of HFiles to reduce the storage & reduce the no. of disk seeks needed for read.

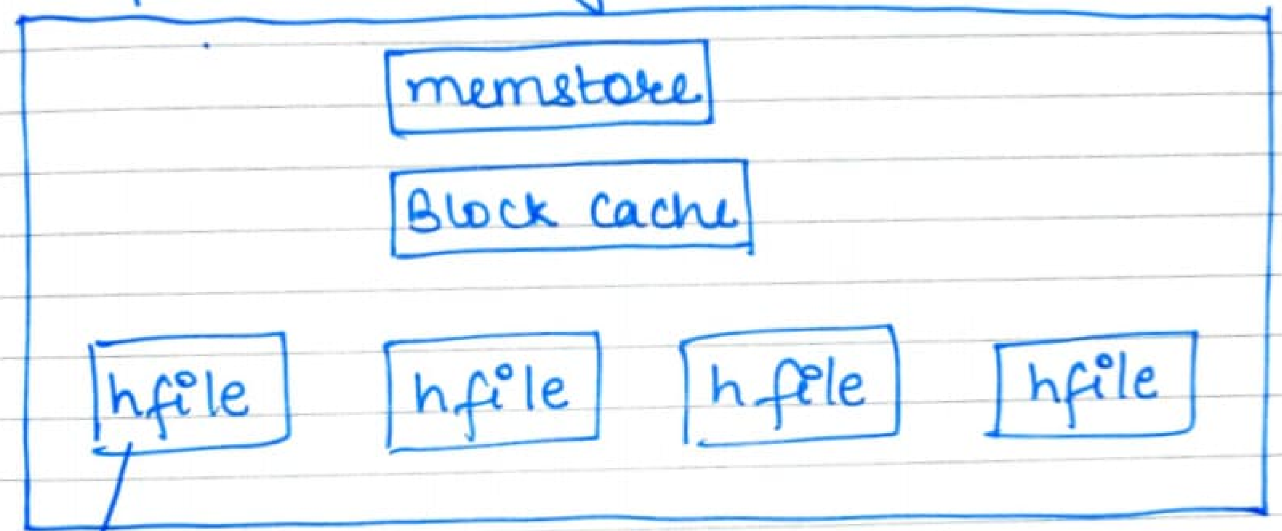
1. Minor : Picks smaller HFiles & combines them to bigger HFile. It performs merge sort.

2. Major : In a bigger HFile the same column families are placed together.

→ Scheduled during low peak load timings to avoid congestion.

* HBASE Architecture
- Zookeeper → Hmaster → Region Server → Regions → Column Family store.
- Region
- Actual data is splitted in regions
- → size (default) of region → 256 mb. (for optimal performance).

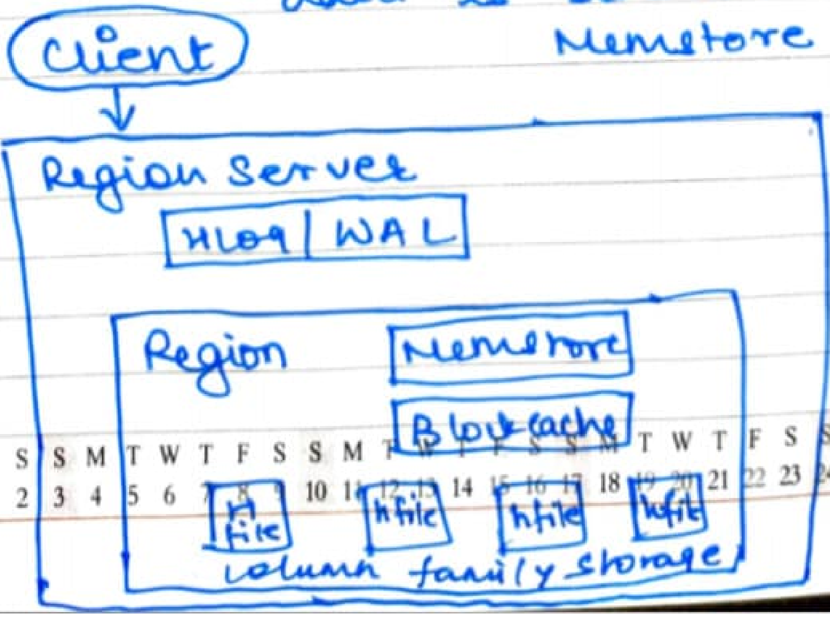
→ components in Region



size is in kbs — storing column families

Write operation

→ data is sent to WAL & then to Memstore → after memory is full of memstore it flushes data into Hfiles.



Before writing data on disk, it is written in buffer which is memstore (assume 100 mb)

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→ Read Operation

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Client → Metatable on Region Servers &
9 → It gives location of region where
table is stored → memstore, Block
10 cache, hfiles are scanned for data. →
given to client.

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* Commands

→ status - Provides the status of HBase, no. of servers
→ version - Provides the version of HBase
→ table_help - Provides help for table-reference cmds.
→ whoami - Provides information abt the user.

* Data definition language
→ create, list, disable, is_disabled, enable, is_enabled, describe, alter, exists, drop, drop_all,

* DML
→ put - puts a cell value at a specified column in a specified row in a particular table.
→ get - fetch contents of row or a cell.
→ delete - delete a cell value in a table
→ deleteall - delete all the cells in a given row.
→ scan, count, truncate,

eg.

Row key	Data
cutting	info : {'height' : '9ft', 'state' : 'CA'} roles : {'ASF' : 'Director', 'Hadoop' : 'Founder'}
tlipcon	info : {'height' : '5ft7', 'state' : 'CA'} roles : {'Hadoop' : 'committer'@ts=2010, 'Hadoop' : 'PMC'@ts=2011, 'Hive' : 'contributor'}

Creates sp. HBase tables of column families.

info Column family

Row key	Column key	Timestamp	Cell value
cutting	info : height	1273516197868	9ft
cutting	info : state	1043871824184	CA
tlipcon	info : height	12738784447049	5ft 7
tlipcon	info : state	1273616297446	CA

Roles Column family

Row key	Column key	Timestamp	Cell value
cutting	roles : ASF	1273871823022	Director
cutting	roles : Hadoop	1183746289103	Founder
tlipcon	roles : Hadoop	...	PMC
tlipcon	roles : Hadoop	....	committer
tlipcon	roles : Hive	....	contributor

Sorted on disk by Row key, column key, desc. timestamp.