

ASSIGNMENT- ADVANCE HBASE

Task 1: Questions and Answers

1) NO SQL DATABASE:

--> Also called as "not only sql database", it is required to process bigdata and at the same time it supports the low latency queries.

Ex: Oracle, PostgreSQL, and Microsoft SQL Server.

2) Types of NO SQL DATABASE

--> The data is stored as :

There are 3 types of no sql database:

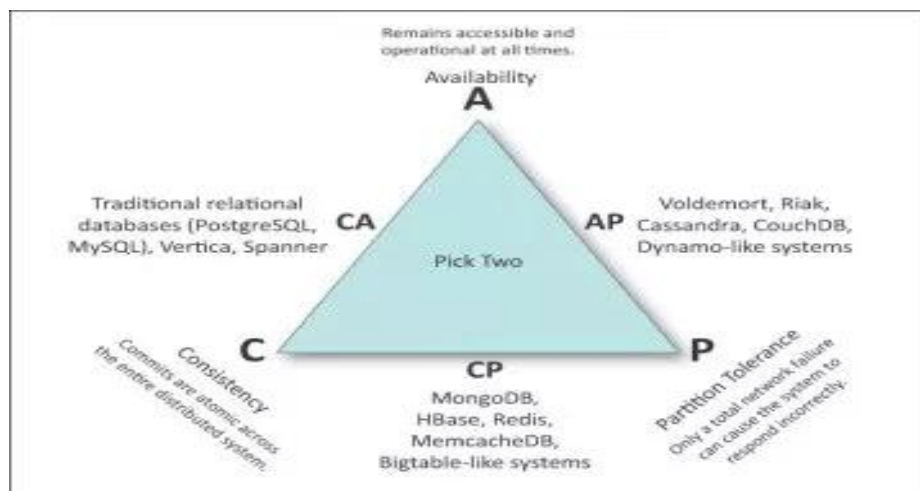
a) Columnar no sql database: Here the structured data are stored (like testfiles) in rows and columns. Ex HBASE and CASSENDRA

b) Documental no sql database: Here the semi structured data is stored (like json,xml etc). Ex MongoDB and Mark logic

c) Memory no sql database: The data is stored in memory (Structured data). Ex MEMCACHE, COUCHDB AND REDIS DB.

d) Graph no sql database: The data is stored using graph structures with nodes and edges. Ex NEO4J.

3) CAP THEOREM



Consistency: Whenever you read a record (or data), consistency guaranties that it will give same data how many times you read. Simply we can say that each server returns the right response to each request, thus the system will be always consistent whenever you read or write data into that.

Availability: Availability simply means that each request eventually receives a response (even if it's not the latest data or consistent across the system or just a message saying the system isn't working).

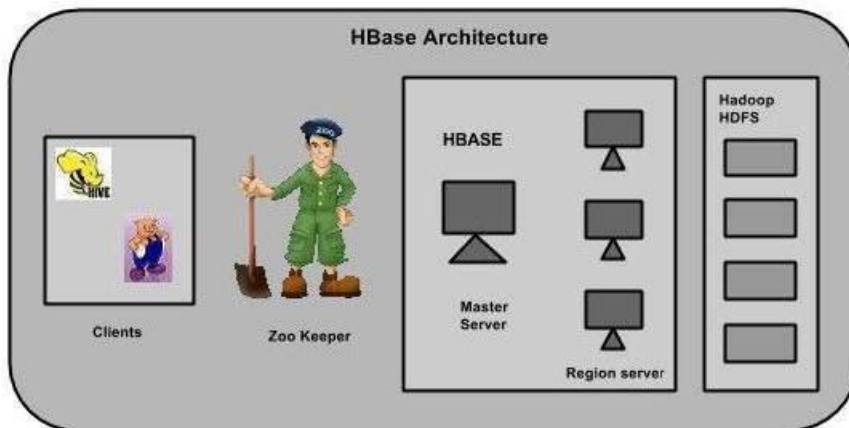
Partition Tolerance: Partition Tolerance means that the cluster continues to function even if there is a "partition" (communications break) between two nodes (both nodes are up, but can't communicate).

4) ARCHITECTURE OF HBASE

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. The term 'store' is used for regions to explain the storage structure.

HBase Architecture

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



MasterServer:

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.

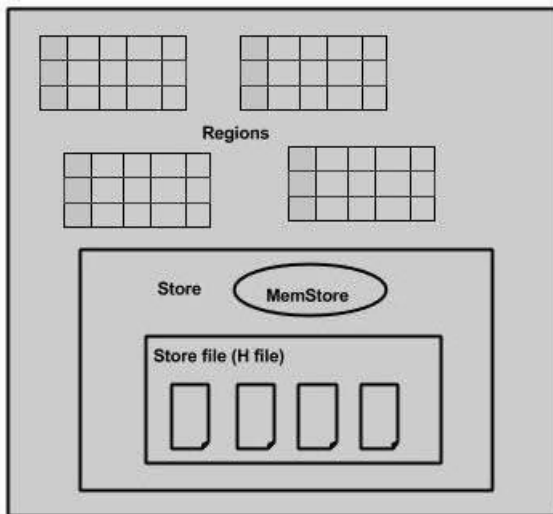
RegionServer:

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

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.

It contains 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.

5) HBASE VS RDBMS

HBase:

An open source and sorted map data built on Hadoop is what we call HBase. Basically, it is column-oriented and horizontally scalable. Moreover, it offers APIs enabling development in practically any programming language. Also, it offers random real-time read/write access to data in the Hadoop File System, as it is a part of the Hadoop ecosystem that.

RDBMS:

RDBMS refers to Relational Database Management Systems. Basically, systems like SQL, MS SQL Server, IBM DB2, Oracle, MySQL, and Microsoft Access are based on RDBMS. Since it is based on the relational model introduced by E.F. Codd so it is called Relational Database Management System (RDBMS).

A) Database Type

- **HBase**

HBase is the column-oriented database. On defining Column oriented, each column is a contiguous unit of page. HBase supports both structured and nonstructural data.

- **RDBMS**

Whereas, RDBMS is row-oriented that means here each row is a contiguous unit of page. RDBMS is suited for structured data.

B) Schema-type

- **HBase**

Schema of HBase is less restrictive, adding columns on the fly is possible.

- **RDBMS**

However, Schema of RDBMS is more restrictive.

C) JOINS

- **HBase**

HBase supports JOINS.

- **RDBMS**

RDBMS does not support JOINS

D) Features of HBase and RDBMS

HBase

- HBase is horizontally scalable.
- Integrations with Map/Reduce framework.
- Moreover, it is possible to refer HBase as a key-value store or column family-oriented database.
- Follow the link to learn more about HBase Features

RDBMS

- Here, in form of rows and columns, data stores.
- By using SQL queries, it also supports virtual tables from where we can retrieve data.
- For the purpose of data uniqueness, RDBMS provides a primary key.
- Also, it offers referential integrity.

TASK2:

EXPLANATION: HERE IN THIS TASK WE HAVE TO IMPORT TSV (TAB SEPERATED VALUES) FROM HDFS TO HBASE. SO FOR DOING THAT FIRST WE NEED TO LOGIN INTO HBASE SHELL.

STEP 1: AFTER LOGGING INTO HBASE WE NEED TO CREATE A TABLE. THE TABLE NAME IS 'bulkth' HAVING COLUMN FAMILIES AS 'cf1' AND 'cf2'.

COMMAND: `create 'bulkth','cf1','cf2'`

SOLUTION:

```
hbase(main):001:0> create 'bulkth','cf1','cf2'
0 row(s) in 2.2330 seconds
```

=> `Hbase::Table - bulkth`

EXPLANATION: AFTER CREATING THE TABLE EXIT THE HBASE SHELL AND GO BACK TO HDFS SHELL. FOR THAT WE NEED TO TYPE 'exit'.

COMMAND: `exit`

SOLUTION:

```
hbase(main):002:0> exit
You have new mail in /var/spool/mail/acadgild
```

STEP 2: AFTER EXITING THE HBASE SHELL HERE WE NEED TO CREATE A DIRECTORY AS HBASE AND THEN CHANGE THE DIRECTORY TO HBASE

COMMAND: `mkdir hbase`

COMMAND: `cd hbase`

SOLUTION:

```
[acadgild@localhost ~]$ mkdir hbase  
[acadgild@localhost ~]$ cd hbase
```

STEP 3: NOW WE NEED TO CREATE A TSV FILE AND ENTER SOME VALUES AND THEN STORE IT IN HDFS USING 'put' COMMAND.

COMMAND: vi bulk_data.tsv

EXPLANATION: AS SOON AS WE TYPE THE ABOVE COMMAND A FILE OPENS IN WHICH WE HAVE TO ENTER SOME VALUE. AFTER ENTERING THE VALUES WE NEED TO SAVE AND EXIT THE FILE. TO EXIT THE FILE USE "esc + :wq + enter" (as soon as we press esc button, type ':wq' and then press enter button). NOW WE NEED TO STORE THE FILE IN HDFS. THIS FILE WILL BE SAVED IN THE CREATED DIRECTORY "hbase". REFER THE BELOW COMMAND.

COMMAND: `hadoop fs -put bulk_data.tsv /hbase/`



SOLUTION:

```
[acadgild@localhost hbase]$ hadoop fs -put bulk_data.tsv /hbase/19/01/08  
15:30:29 WARN util.NativeCodeLoader: Unable to load native-hadoop library  
for your platform... using builtin-java classes where applicable  
You have new mail in /var/spool/mail/acadgild
```

STEP 4: NOW WE NEED TO IMPORT THIS FILE FROM HDFS INTO THE HBASE. BY USING THE BELOW COMMAND WE IMPORT THE FILE INTO HBASE FROM HDFS WITH THE FOLLOWING ARGUMENTS <CREATED TABLE NAME> <PATH OF THE SAVED FILE IN HDFS>

```
COMMAND: hbase org.apache.hadoop.hbase.mapreduce.ImportTsv -
Dimportttsv.columns=HBASE_ROW_KEY,cf1:name,cf2:exp bulktb
/hbase/bulk_data.tsv
```

SOLUTION:

```
[acadgild@localhost hbase]$ hbase
org.apache.hadoop.hbase.mapreduce.ImportTsv -
Dimportttsv.columns=HBASE_ROW_KEY,cf1:name,cf2:exp bulktb
/hbase/bulk_data.tsv
2019-01-08 15:31:14,970 WARN [main] util.NativeCodeLoader: Unable to
load native-hadoop library for your platform... using builtin-java
classes where applicable
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/home/acadgild/install/hbase/hbase-
1.2.6/lib/slf4j-log4j12-
1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/home/acadgild/install/hadoop/hadoop-
2.6.5/share/hadoop/common/lib/slf4j-log4j12-
1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple\_bindings for an
explanation.
SLF4J: Actual binding is of type [org.slf4j.impl.Log4jLoggerFactory]
2019-01-08 15:31:16,742 INFO [main] zookeeper.RecoverableZooKeeper:
Process identifier=hconnection-0x6025e1b6 connecting to ZooKeeper
ensemble=localhost:2181
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:zookeeper.version=3.4.6-1569965, built on 02/20/2014 09:09
GMT
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:host.name=localhost
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:java.version=1.8.0_151
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:java.vendor=Oracle Corporation
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:java.home=/usr/java/jdk1.8.0_151/jre
2019-01-08 15:31:16,780 INFO [main] zookeeper.ZooKeeper: Client
environment:java.class.path=/home/acadgild/install/hbase/hbase-
1.2.6/conf:/usr/java/jdk1.8.0_151/lib/tools.jar:/home/acadgild/install/hb
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1.2.6/lib/disruptor-3.3.0.jar:/home/acadgild/install/hbase/hbase-
1.2.6/lib/findbugs-annotations-1.3.9-
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2.5.1.jar:/home/acadgild/install/hbase/hbase-1.2.6/lib/hadoop-hdfs-
2.5.1.jar:/home/acadgild/install/hbase/hbase-1.2.6/lib/hadoop-mapreduce-
client-app-2.5.1.jar:/home/acadgild/install/hbase/hbase-1.2.6/lib/hadoop-
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2.6.5/share/hadoop/common/lib/jetty-
6.1.26.jar:/home/acadgild/install/hadoop/hadoop-
2.6.5/share/hadoop/common/lib/avro-
1.7.4.jar:/home/acadgild/install/hadoop/hadoop-
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2.6.5.jar:/home/acadgild/install/hadoop/hadoop-2.6.5/contrib/capacity-
scheduler/*.jar
2019-01-08 15:31:16,793 INFO [main] zookeeper.ZooKeeper: Client
environment:java.library.path=/usr/java/packages/lib/amd64:/usr/lib64:/li
b64:/lib:/usr/lib
2019-01-08 15:31:16,793 INFO [main] zookeeper.ZooKeeper: Client
environment:java.io.tmpdir=/tmp
2019-01-08 15:31:16,793 INFO [main] zookeeper.ZooKeeper: Client
environment:java.compiler=<NA>
2019-01-08 15:31:16,796 INFO [main] zookeeper.ZooKeeper: Client
environment:os.name=Linux
2019-01-08 15:31:16,797 INFO [main] zookeeper.ZooKeeper: Client
environment:os.arch=amd64
2019-01-08 15:31:16,797 INFO [main] zookeeper.ZooKeeper: Client
environment:os.version=2.6.32-696.18.7.el6.x86_64
2019-01-08 15:31:16,797 INFO [main] zookeeper.ZooKeeper: Client
environment:user.name=acadgild
2019-01-08 15:31:16,797 INFO [main] zookeeper.ZooKeeper: Client
environment:user.home=/home/acadgild

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2019-01-08 15:31:16,797 INFO [main] zookeeper.ZooKeeper: Client environment:user.dir=/home/acadgild/hbase
2019-01-08 15:31:16,799 INFO [main] zookeeper.ZooKeeper: Initiating client connection, connectString=localhost:2181 sessionTimeout=90000 watcher=hconnection-0x6025e1b60x0, quorum=localhost:2181, baseZNode=/hbase
2019-01-08 15:31:16,897 INFO [main-SendThread=localhost:2181] zookeeper.ClientCnxn: Opening socket connection to server localhost/127.0.0.1:2181. Will not attempt to authenticate using SASL (unknown error)
2019-01-08 15:31:16,938 INFO [main-SendThread=localhost:2181] zookeeper.ClientCnxn: Socket connection established to localhost/127.0.0.1:2181, initiating session
2019-01-08 15:31:16,978 INFO [main-SendThread=localhost:2181] zookeeper.ClientCnxn: Session establishment complete on server localhost/127.0.0.1:2181, sessionId = 0x1682c909d7a0012, negotiated timeout = 90000
2019-01-08 15:31:20,345 INFO [main] Configuration.deprecation: io.bytes.per.checksum is deprecated. Instead, use dfs.bytes-per-checksum
2019-01-08 15:31:20,614 INFO [main] client.ConnectionManager\$HConnectionImplementation: Closing zookeeper sessionId=0x1682c909d7a0012
2019-01-08 15:31:20,620 INFO [main-EventThread] zookeeper.ClientCnxn: EventThread shut down
2019-01-08 15:31:20,620 INFO [main] zookeeper.ZooKeeper: Session: 0x1682c909d7a0012 closed
2019-01-08 15:31:21,032 INFO [main] client.RMPProxy: Connecting to ResourceManager at localhost/127.0.0.1:8032
2019-01-08 15:31:21,747 INFO [main] Configuration.deprecation: io.bytes.per.checksum is deprecated. Instead, use dfs.bytes-per-checksum
2019-01-08 15:31:26,460 INFO [main] input.FileInputFormat: Total input paths to process : 1
2019-01-08 15:31:26,591 INFO [main] mapreduce.JobSubmitter: number of splits:1
2019-01-08 15:31:26,648 INFO [main] Configuration.deprecation: io.bytes.per.checksum is deprecated. Instead, use dfs.bytes-per-checksum
2019-01-08 15:31:27,125 INFO [main] mapreduce.JobSubmitter: Submitting tokens for job: job_1546936746916_0002
2019-01-08 15:31:27,852 INFO [main] impl.YarnClientImpl: Submitted application application_1546936746916_0002
2019-01-08 15:31:27,928 INFO [main] mapreduce.Job: The url to track the job: http://localhost:8088/proxy/application_1546936746916_0002/
2019-01-08 15:31:27,929 INFO [main] mapreduce.Job: Running job: job_1546936746916_0002
2019-01-08 15:31:49,498 INFO [main] mapreduce.Job: Job job_1546936746916_0002 running in uber mode : false
2019-01-08 15:31:49,503 INFO [main] mapreduce.Job: map 0% reduce 0%
2019-01-08 15:32:04,860 INFO [main] mapreduce.Job: map 100% reduce 0%
2019-01-08 15:32:04,944 INFO [main] mapreduce.Job: Job job_1546936746916_0002 completed successfully
2019-01-08 15:32:05,403 INFO [main] mapreduce.Job: Counters: 31

File System Counters

FILE: Number of bytes read=0

FILE: Number of bytes written=139457

```

FILE: Number of read operations=0
FILE: Number of large read operations=0
FILE: Number of write operations=0
HDFS: Number of bytes read=150
HDFS: Number of bytes written=0
HDFS: Number of read operations=2
HDFS: Number of large read operations=0
HDFS: Number of write operations=0
Job Counters
  Launched map tasks=1
  Data-local map tasks=1
  Total time spent by all maps in occupied slots (ms)=13130
  Total time spent by all reduces in occupied slots (ms)=0
  Total time spent by all map tasks (ms)=13130
  Total vcore-seconds taken by all map tasks=13130
  Total megabyte-seconds taken by all map tasks=13445120
Map-Reduce Framework
  Map input records=4
  Map output records=4
  Input split bytes=106
  Spilled Records=0
  Failed Shuffles=0
  Merged Map outputs=0
  GC time elapsed (ms)=230
  CPU time spent (ms)=2650
  Physical memory (bytes) snapshot=104460288
  Virtual memory (bytes) snapshot=2067746816
  Total committed heap usage (bytes)=32571392
ImportTsv
  Bad Lines=0
File Input Format Counters
  Bytes Read=44
File Output Format Counters
  Bytes Written=0
You have new mail in /var/spool/mail/acadgild

```

STEP 5: AFTER THE FILE IS IMPORTED. CHECK THE IMPORTED FILE IN HBASE

EXPLANATION: WE CAN CHECK THE WHETHER THE IMPORTED FILE FROM HDFS TO HBASE IS DONE OR NOT BY GOING INTO HBASE SHELL AND THEN BY USING THE COMMAND 'scan' . WE CAN SEE THE OUTPUT IN THE HBASE SHELL.

COMMAND: scan 'bulkth'

SOLUTION:

```

hbase(main):001:0> scan 'bulkth'
ROW COLUMN+CELL
  1) column=cf1:name, timestamp=1546940553658,
value=Amit
  1) column=cf2:exp, timestamp=1546940553658, value=4
  2) column=cf1:name, timestamp=1546940553658,
value=girija
  2) column=cf2:exp, timestamp=1546940553658, value=3

```

```

3)          column=cf1:name, timestamp=1546940553658,
value=jatin
3)          column=cf2:exp, timestamp=1546940553658, value=5
4)          column=cf1:name, timestamp=1546940553658,
value=swati
4)          column=cf2:exp, timestamp=1546940553658, value=s
4 row(s) in 0.9770 seconds

```

hbase(main):001:0> scan 'bulk1b'

```

ROW          COLUMN+CELL
1)          column=cf1:name, timestamp=1546943570062, value=Amit
1)          column=cf2:exp, timestamp=1546943570062, value=4
2)          column=cf1:name, timestamp=1546943570062, value=girija
2)          column=cf2:exp, timestamp=1546943570062, value=3
3)          column=cf1:name, timestamp=1546943570062, value=jatin
3)          column=cf2:exp, timestamp=1546943570062, value=5
4)          column=cf1:name, timestamp=1546943570062, value=swati
4)          column=cf2:exp, timestamp=1546943570062, value=s
4 row(s) in 0.7790 seconds

```