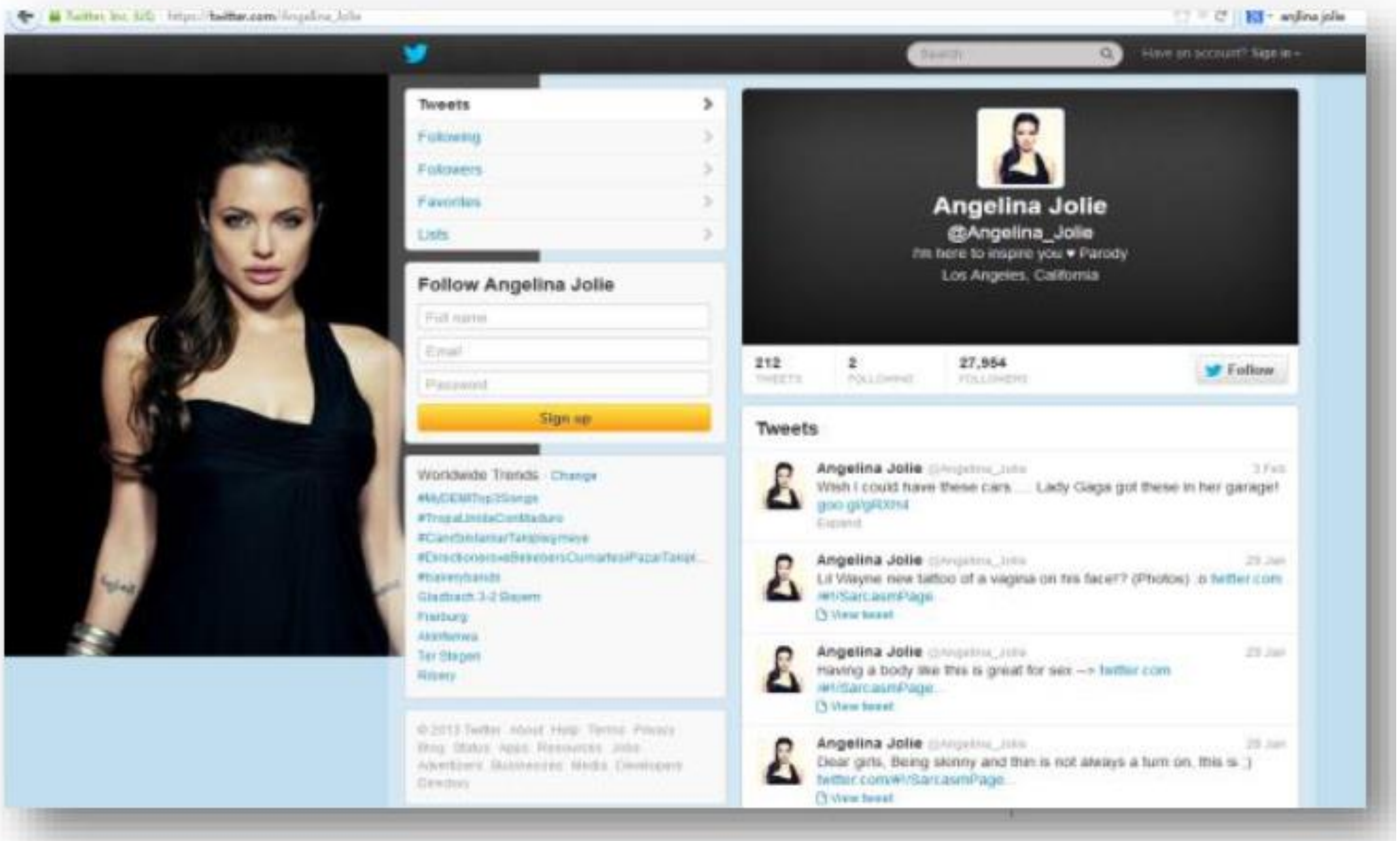
HBase

Agenda

- ✓ Motivation for HBase
  - ➢ What and Why
- ✓ Hbase
  - ➢ Overview
  - ➢ Architecture
  - ➢ Features
  - ➢ HBase Commands
  - ➢ Data Loading Techniques
- ✓ Zookeeper

Problems in Real World



Angelina Jolie
@Angelina_Jolie
I'm here to inspire you ♥ Parody
Los Angeles, California

212 TWEETS · 2 FOLLOWING · 27,954 FOLLOWERS

Tweets

Angelina Jolie @Angelina_Jolie · 3 Feb
Wish I could have these cars .... Lady Gaga got these in her garage! goo.gl/gRXm4

Angelina Jolie @Angelina_Jolie · 29 Jan
Lil Wayne new tattoo of a vagina on his face!? (Photos) :o twitter.com/#!/SarcasmPage...

Angelina Jolie @Angelina_Jolie · 29 Jan
Having a body like this is great for sex --> twitter.com/#!/SarcasmPage...

Angelina Jolie @Angelina_Jolie · 29 Jan
Dear girls, Being skinny and thin is not always a turn on, this is ;) twitter.com/#!/SarcasmPage...

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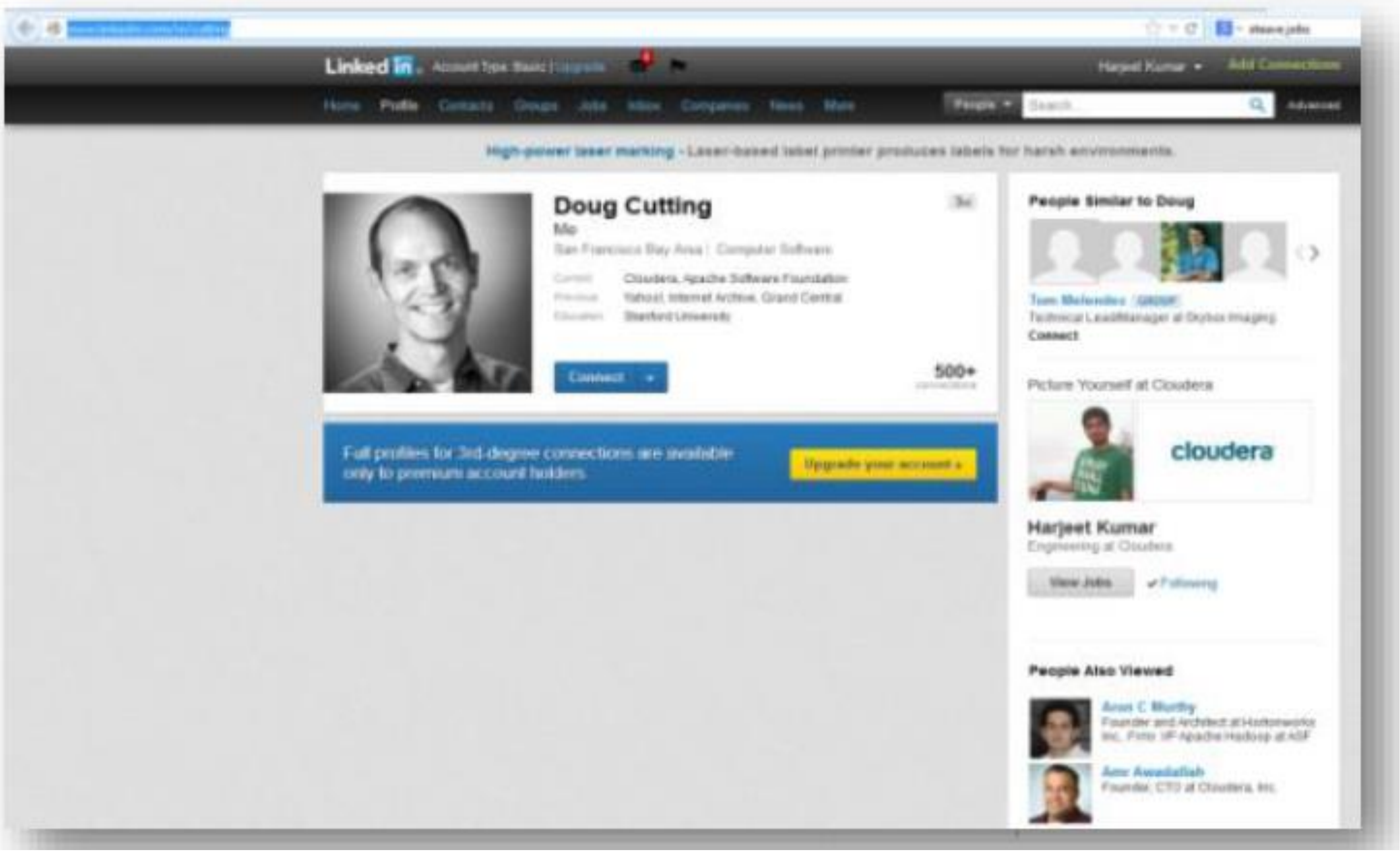
Problems in Real World



High-power laser marking - Laser-based label printer produces labels for harsh environments.

Doug Cutting

Me

San Francisco Bay Area | Computer Software

Current: Cloudera, Apache Software Foundation

Previous: Yahoo!, Internet Archive, Grand Central

Education: Stanford University

Full profiles for 3rd-degree connections are available only to premium account holders.

People Similar to Doug

Tom Melendez GROUP

Technical Lead/Manager at Orbit Imaging

Connect

Picture Yourself at Cloudera

Harjeet Kumar

Engineering at Cloudera

People Also Viewed

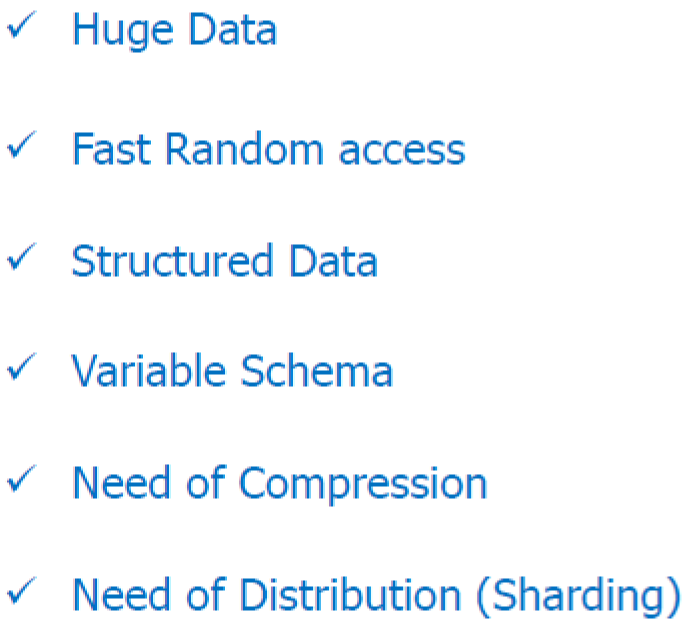
Arun C Murthy

Founder and Architect at Hortonworks Inc., Formerly VP Apache Hadoop at ASF

Amr Awadallah

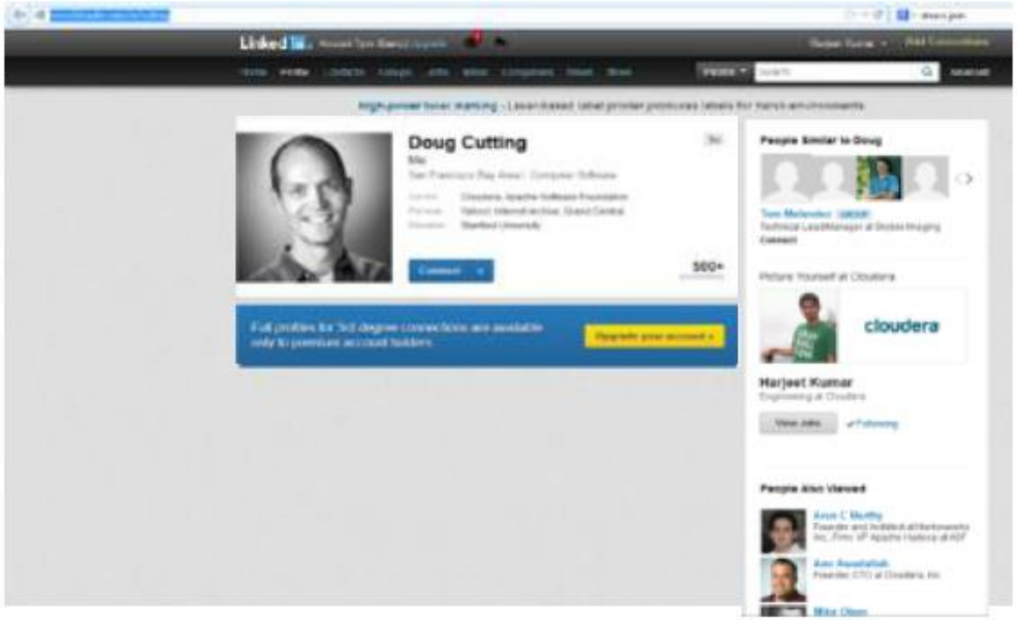
Founder, CTO at Cloudera, Inc.

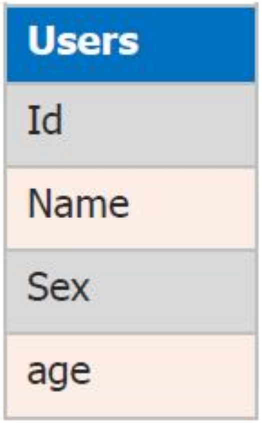
So, What Is Common?



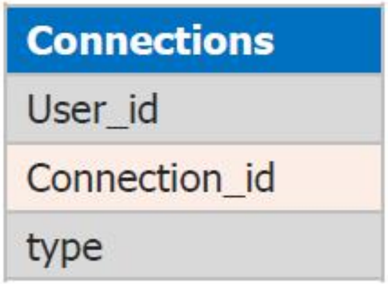
- ✓ Huge Data
- ✓ Fast Random access
- ✓ Structured Data
- ✓ Variable Schema
- ✓ Need of Compression
- ✓ Need of Distribution (Sharding)

How RDBMS will solve this?



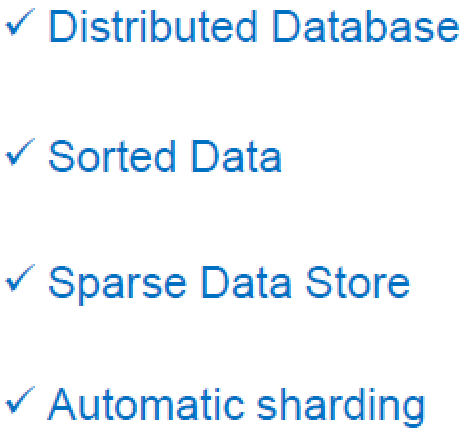


Users
Id
Name
Sex
age



Connections
User_id
Connection_id
type

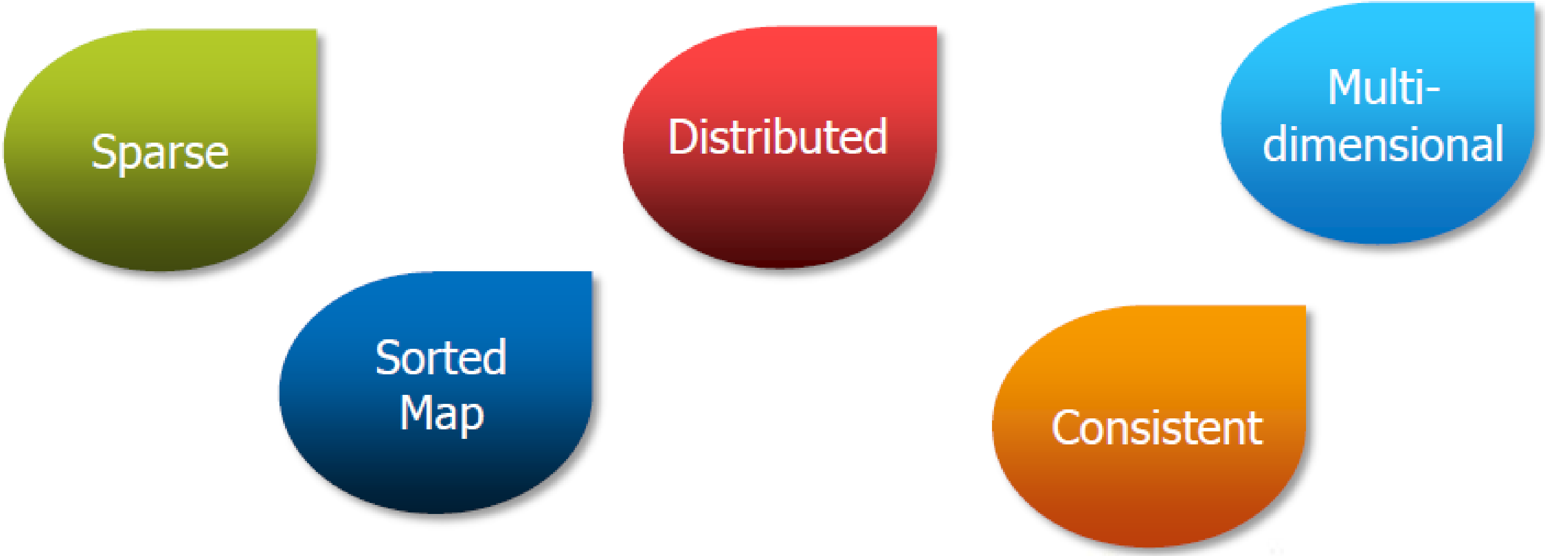
Characteristics Of Probable Solution



- ✓ Distributed Database
- ✓ Sorted Data
- ✓ Sparse Data Store
- ✓ Automatic sharding

HBase Definition

- ✓ **HBase is a key/value store. Specifically it is:**



Sparse

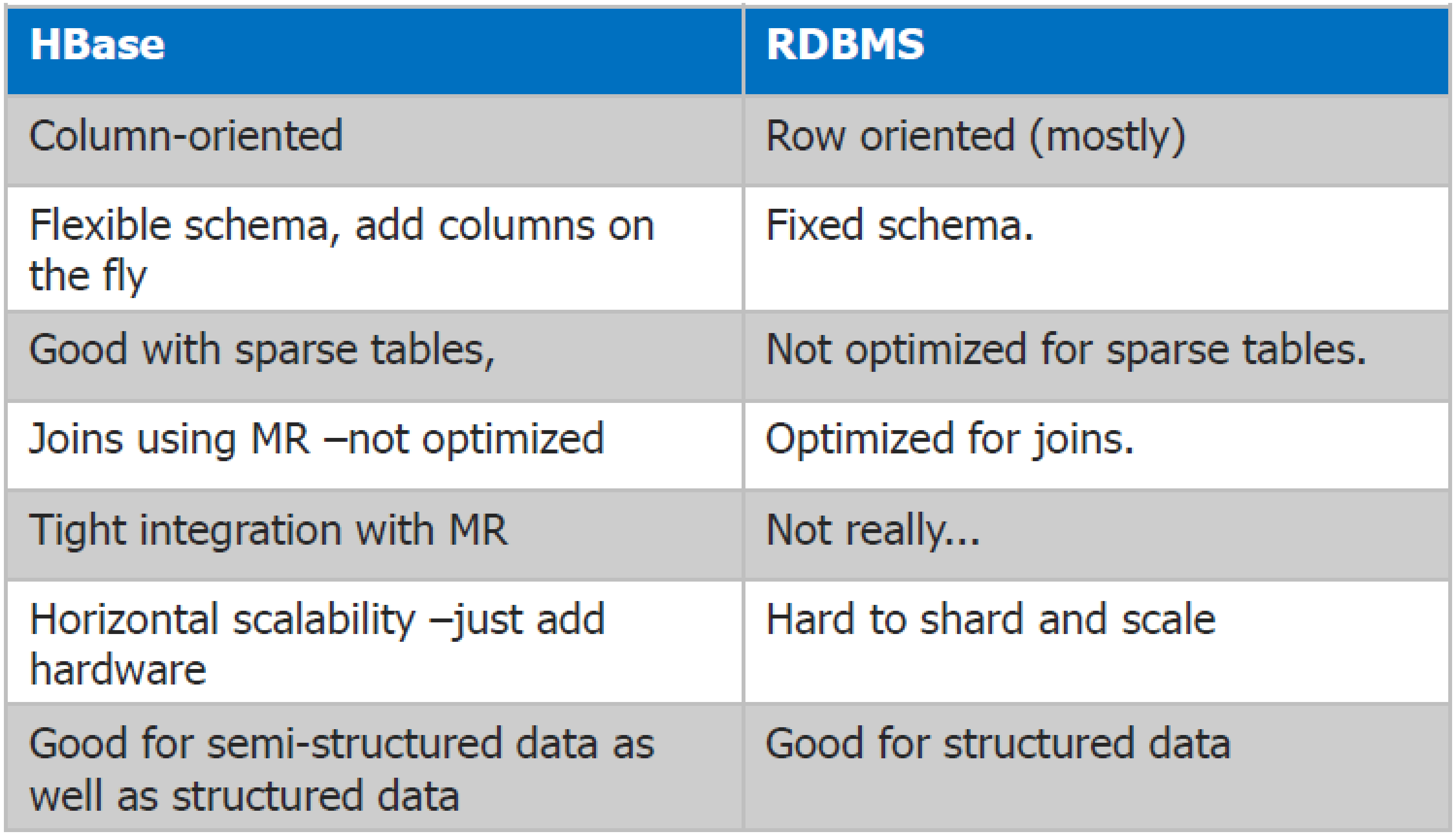
Distributed

Multi-dimensional

Sorted Map

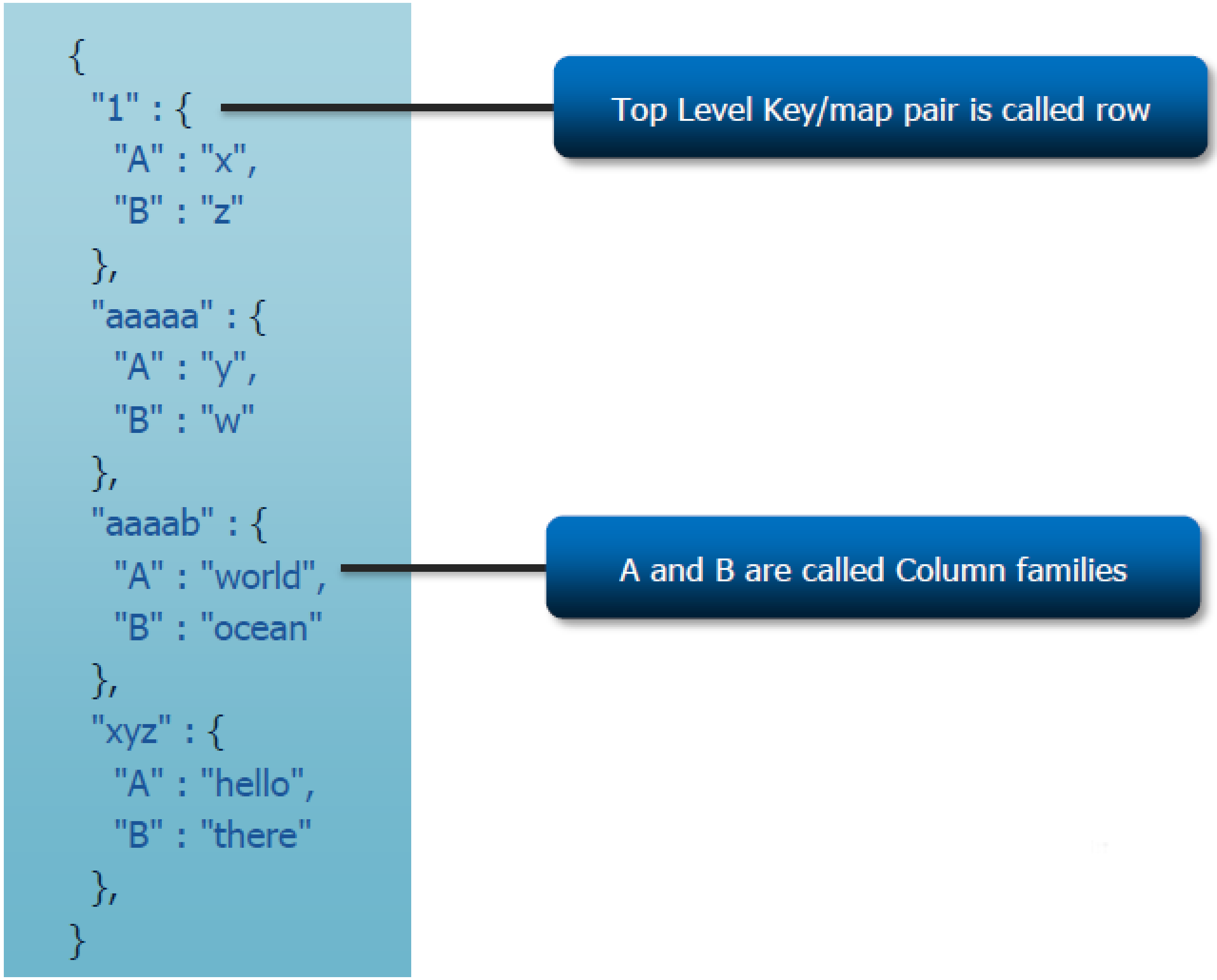
Consistent

Hbase v/s RDBMS



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 structured data	Good for structured data

HBase–The Map Is Multi-Dimensional

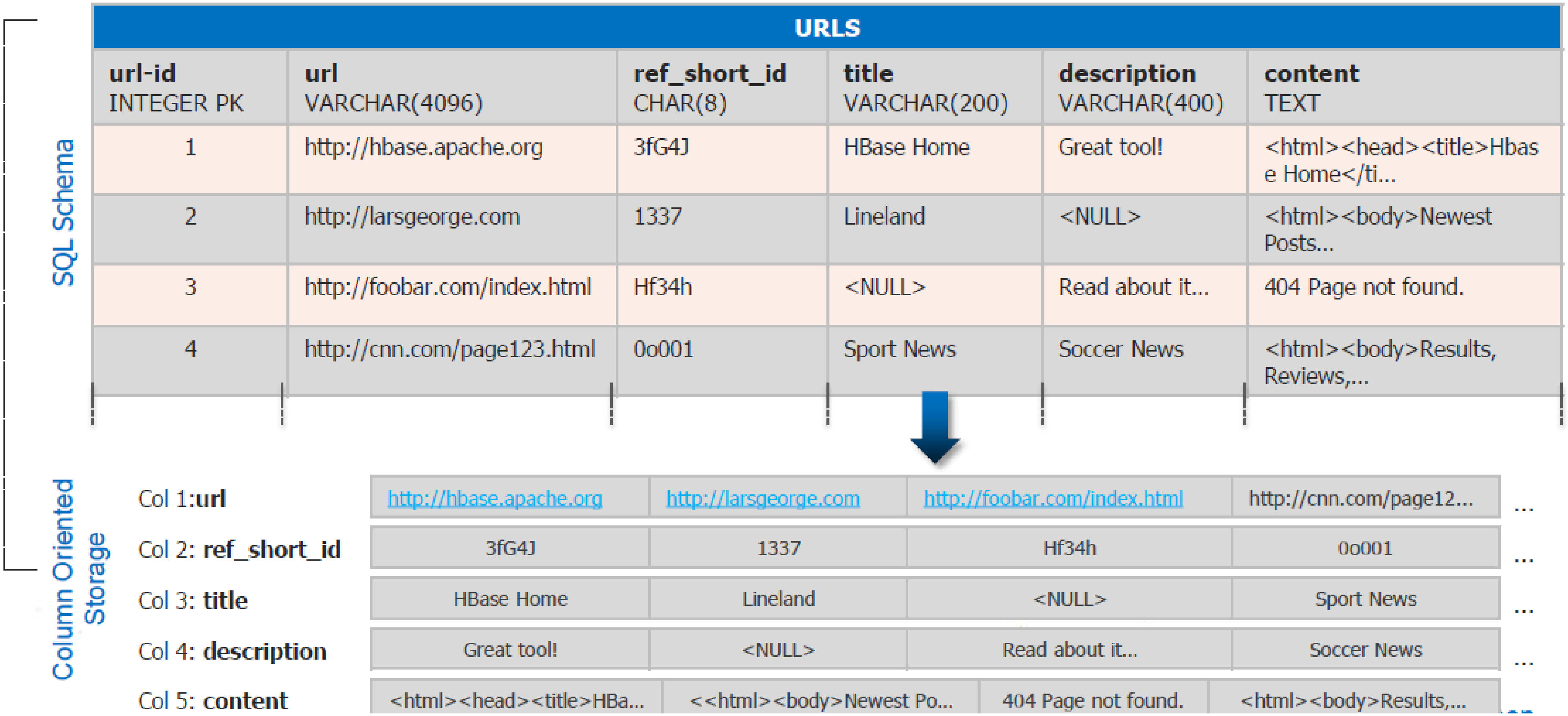


```
{
  "1" : {
    "A" : "x",
    "B" : "z"
  },
  "aaaaa" : {
    "A" : "y",
    "B" : "w"
  },
  "aaaab" : {
    "A" : "world",
    "B" : "ocean"
  },
  "xyz" : {
    "A" : "hello",
    "B" : "there"
  },
}
```

Top Level Key/map pair is called row

A and B are called Column families

Row vs Column Oriented DBs

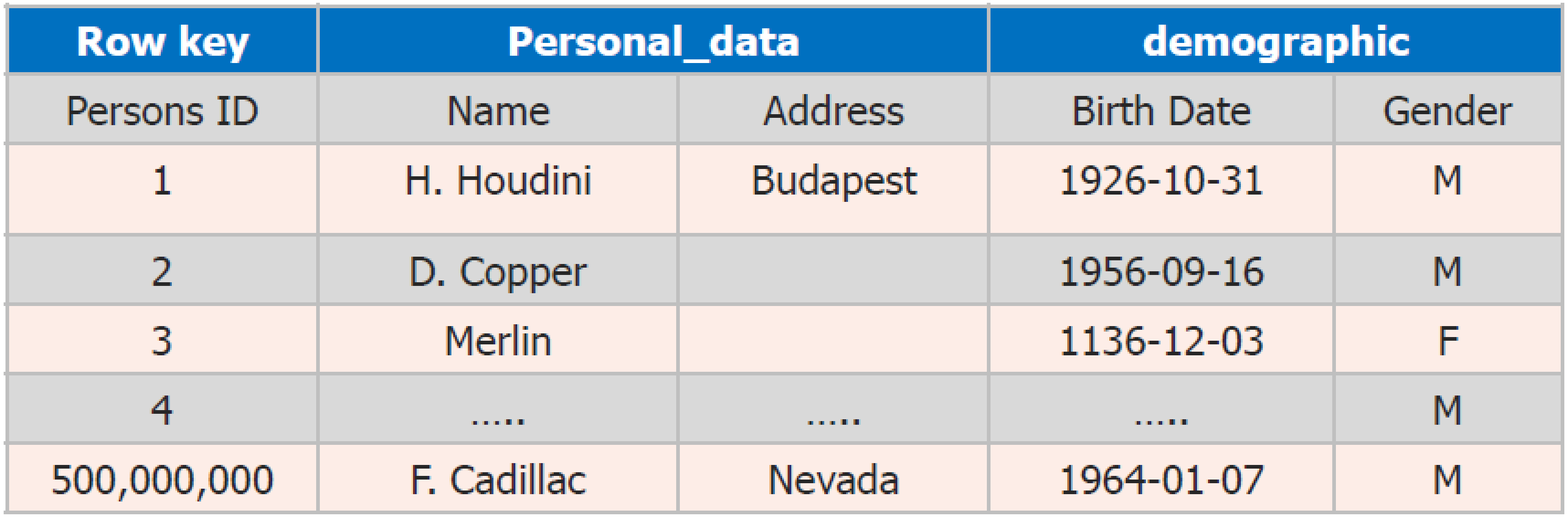


SQL Schema
Column Oriented Storage

URLS					
url-id INTEGER PK	**url** VARCHAR(4096)	**ref_short_id** CHAR(8)	**title** VARCHAR(200)	**description** VARCHAR(400)	**content** TEXT
1	http://hbase.apache.org	3fG4J	HBase Home	Great tool!	<html><head><title>Hbase Home</ti...
2	http://larsgeorge.com	1337	Lineland	<NULL>	<html><body>Newest Posts...
3	http://foobar.com/index.html	Hf34h	<NULL>	Read about it...	404 Page not found.
4	http://cnn.com/page123.html	0o001	Sport News	Soccer News	<html><body>Results, Reviews,...

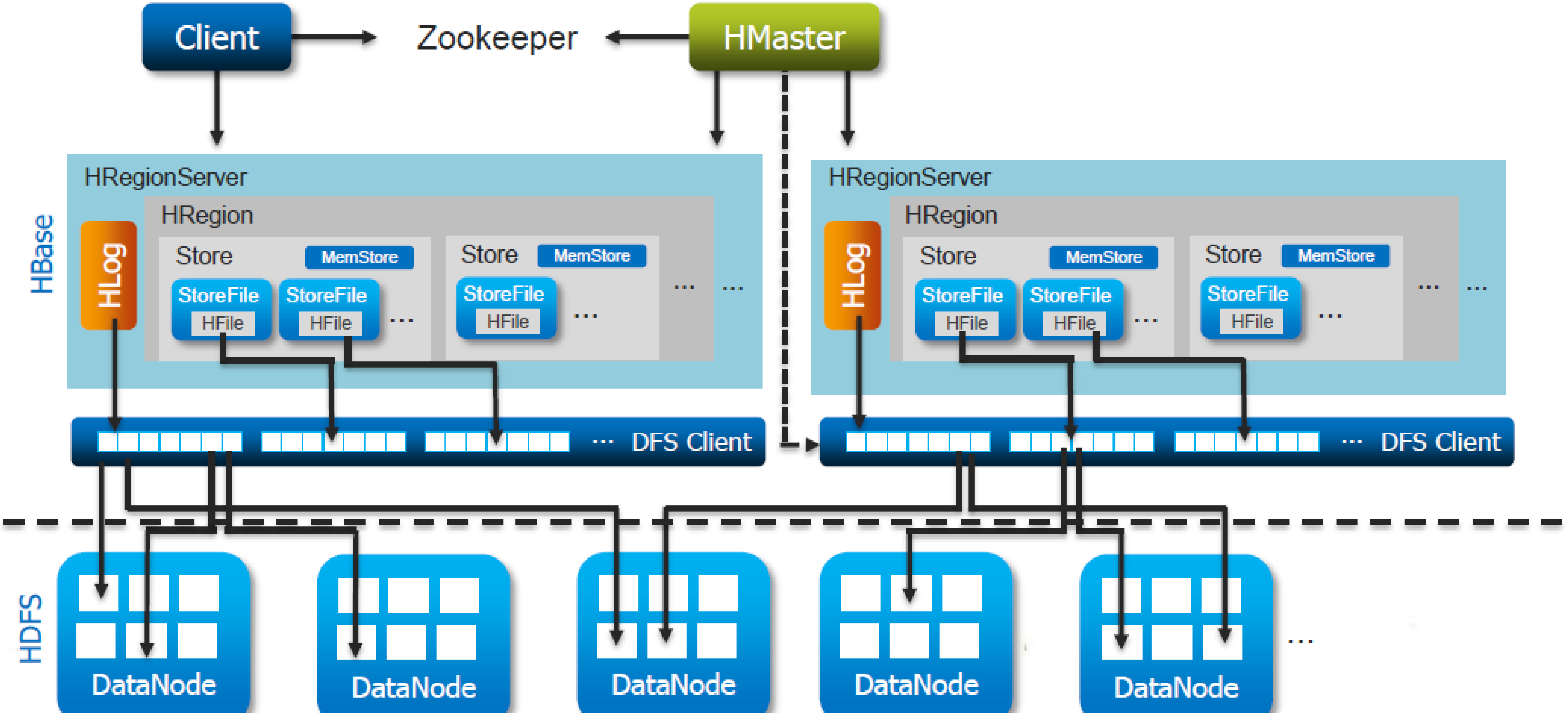
Col 1:**url**	http://hbase.apache.org	http://larsgeorge.com	http://foobar.com/index.html	http://cnn.com/page12...	...
Col 2: **ref_short_id**	3fG4J	1337	Hf34h	0o001	...
Col 3: **title**	HBase Home	Lineland	<NULL>	Sport News	...
Col 4: **description**	Great tool!	<NULL>	Read about it...	Soccer News	...
Col 5: **content**	<html><head><title>HBa...	<<html><body>Newest Po...	404 Page not found.	<html><body>Results,...	

Data Model

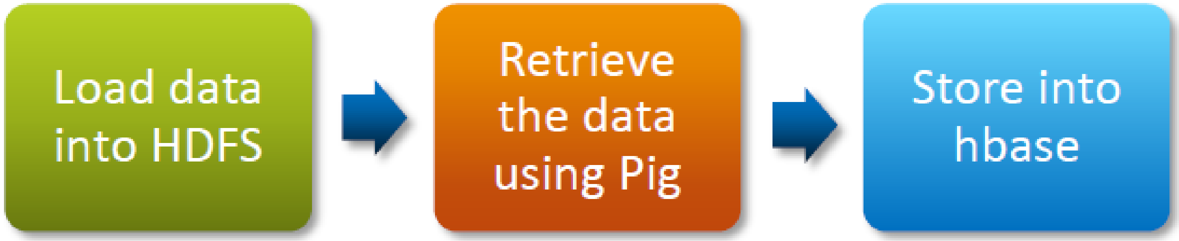


Row key	Personal_data		demographic	
Persons ID	Name	Address	Birth Date	Gender
1	H. Houdini	Budapest	1926-10-31	M
2	D. Copper		1956-09-16	M
3	Merlin		1136-12-03	F
4	.....	.....	.....	M
500,000,000	F. Cadillac	Nevada	1964-01-07	M

HBase Storage Architecture



Loading Data Into HBASE Using Pig



Load data into HDFS

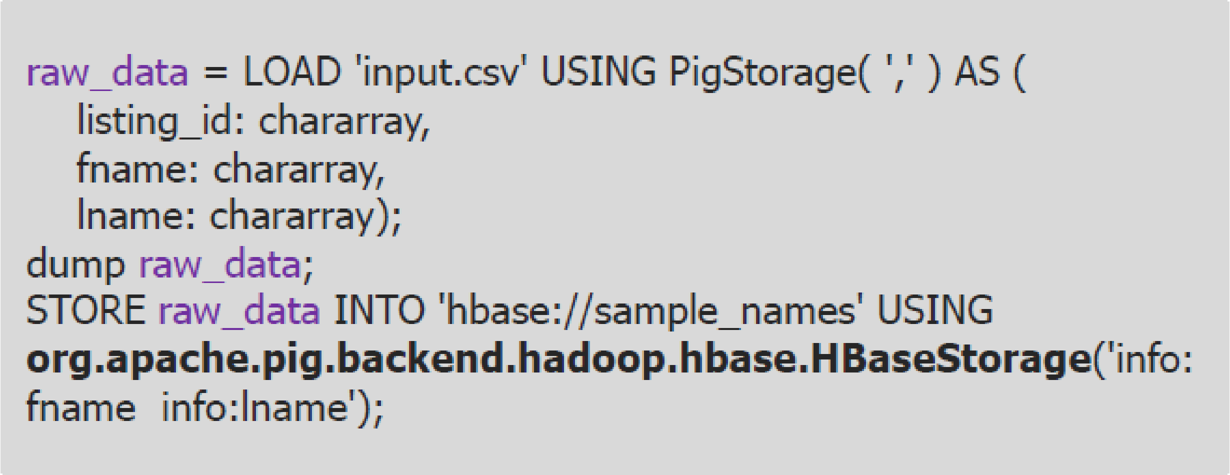
Retrieve the data using Pig

Store into hbase

Example:

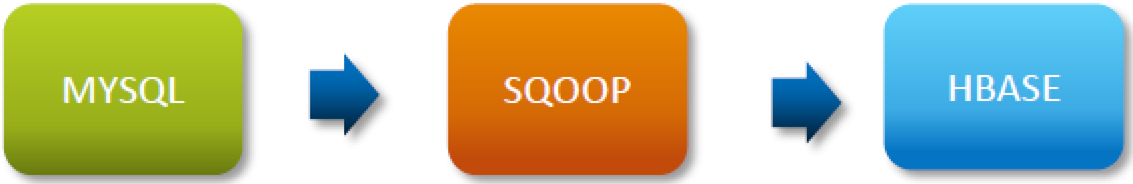
input.csv

```
1, fname1, lname1
2, fname2, lname2
3, fname3, lname3
```

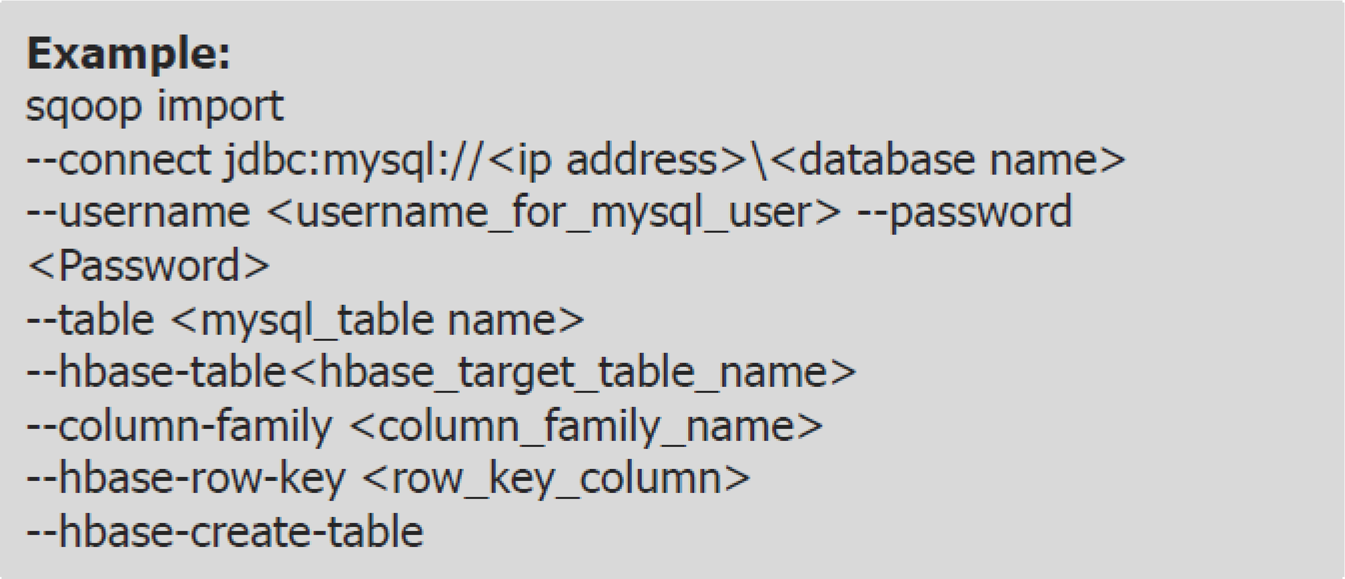


```
raw_data = LOAD 'input.csv' USING PigStorage( ',' ) AS (
    listing_id: chararray,
    fname: chararray,
    lname: chararray);
dump raw_data;
STORE raw_data INTO 'hbase://sample_names' USING
org.apache.pig.backend.hadoop.hbase.HBaseStorage('info:
fname  info:lname');
```

Loading Data Into HBASE Using Sqoop



Sqoop can be used to directly import data from RDBMS to Hbase:



Example:

```
sqoop import
--connect jdbc:mysql://<ip address>\<database name>
--username <username_for_mysql_user> --password
<Password>
--table <mysql_table name>
--hbase-table<hbase_target_table_name>
--column-family <column_family_name>
--hbase-row-key <row_key_column>
--hbase-create-table
```

Problem

Problem:

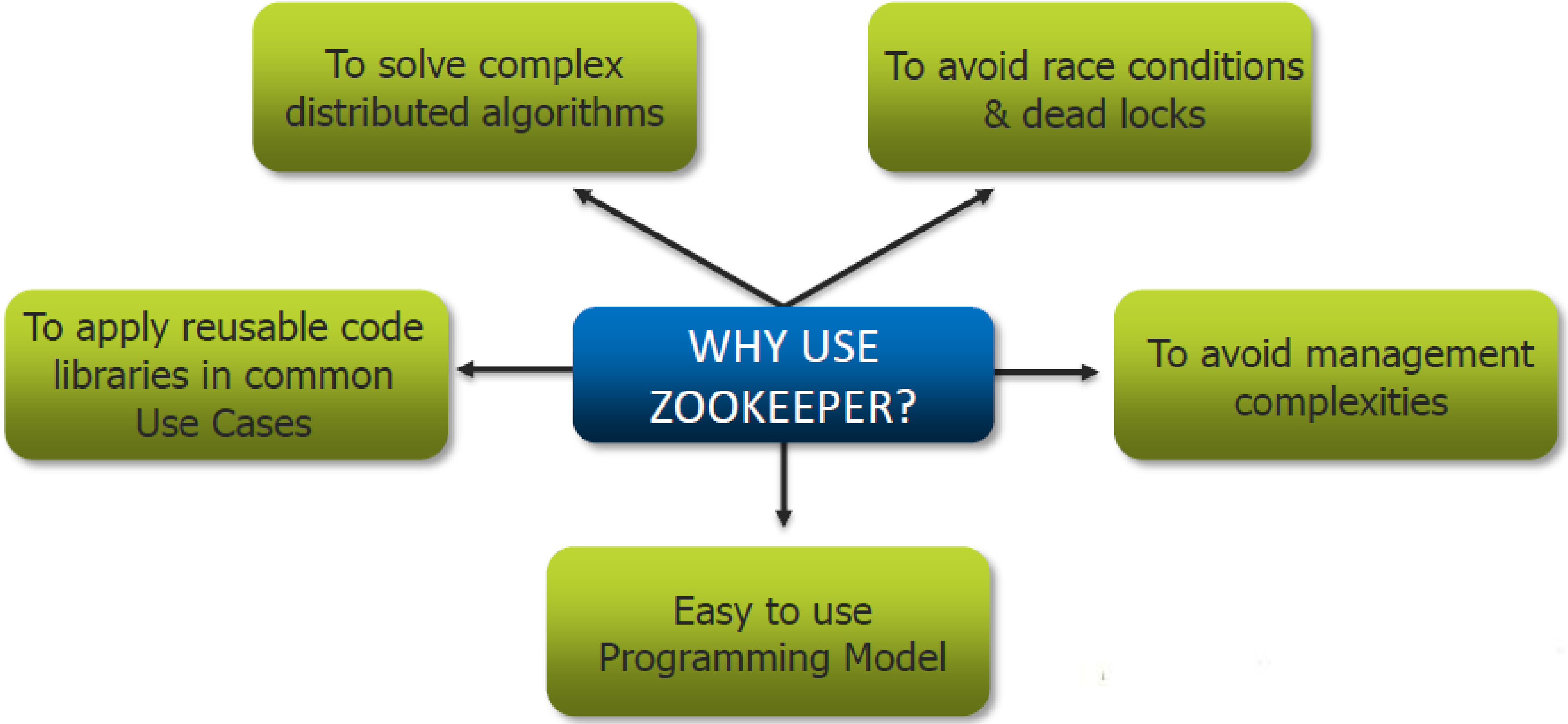
In a distributed environment, getting processes to act in any kind of synchrony is an extremely hard problem.

For example, simply having a set of processes wait until they've all reached the same point in their execution – a kind of distributed barrier– is surprisingly difficult to do correctly.

Solution:

ZooKeeper offers an API to facilitate this sort of distributed coordination.
For example, it is often used to serve locks to client processes – locks are just another kind of coordination primitive.

Why Use Zookeeper?



WHY USE ZOOKEEPER?

To solve complex distributed algorithms

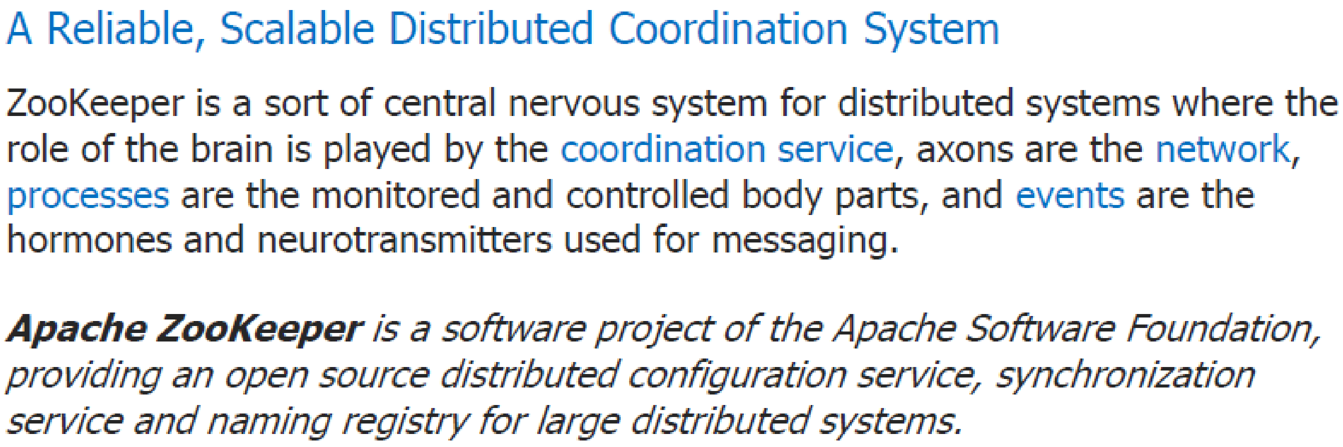
To avoid race conditions & dead locks

To apply reusable code libraries in common Use Cases

To avoid management complexities

Easy to use Programming Model

What Is A ZooKeeper?



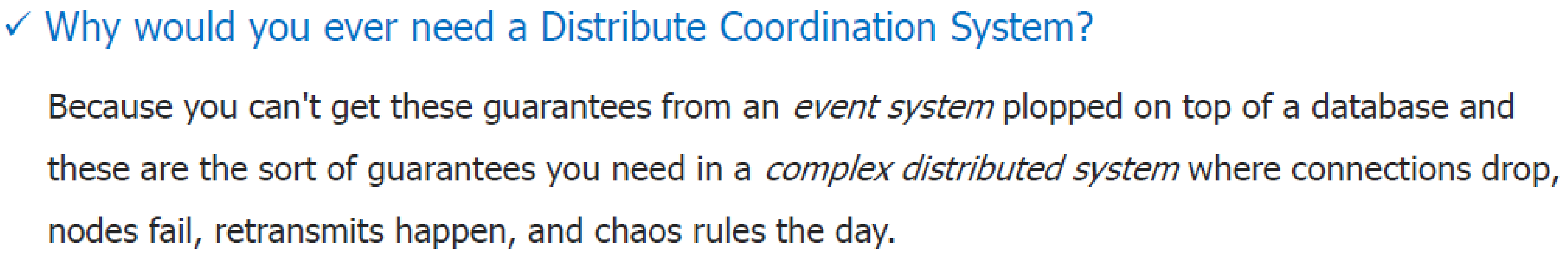
A Reliable, Scalable Distributed Coordination System

ZooKeeper is a sort of central nervous system for distributed systems where the role of the brain is played by the coordination service, axons are the network, processes are the monitored and controlled body parts, and events are the hormones and neurotransmitters used for messaging.

Apache ZooKeeper *is a software project of the Apache Software Foundation, providing an open source distributed configuration service, synchronization service and naming registry for large distributed systems.*

Every complex distributed application needs a coordination and orchestration system of some sort, so the ZooKeeper folks at Yahoo decide to build a good one and open source it for everyone to use!

Distribute Coordination System

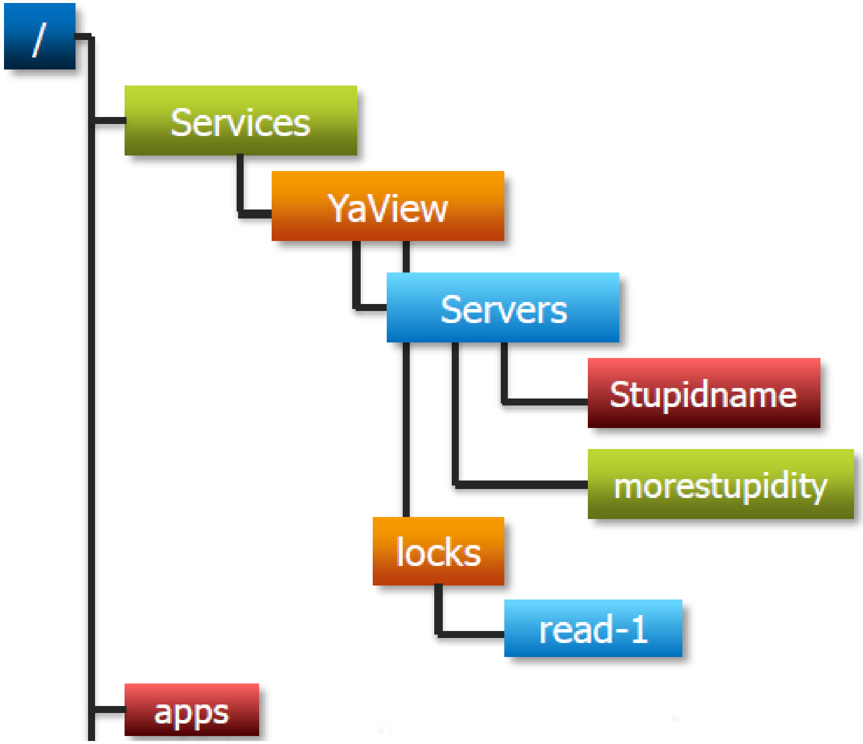


✓ Why would you ever need a Distribute Coordination System?

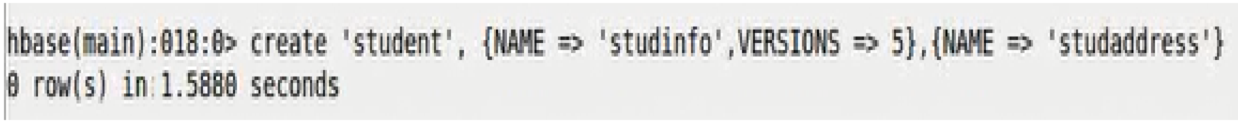
Because you can't get these guarantees from an *event system* plopped on top of a database and these are the sort of guarantees you need in a *complex distributed system* where connections drop, nodes fail, retransmits happen, and chaos rules the day.

ZooKeeperData Model

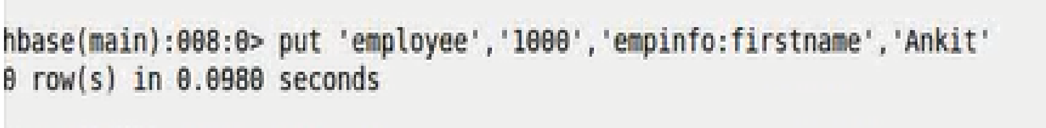
- ✓ Hierarchal namespace (like a File System)
- ✓ Each znode has data and children
- ✓ Data is read and written in its entity



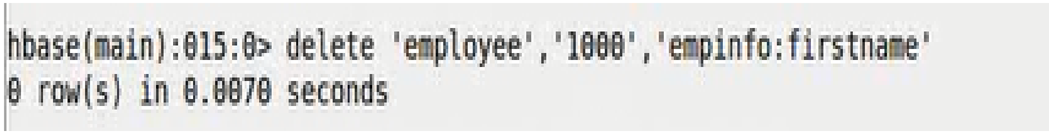
Hbase Commands



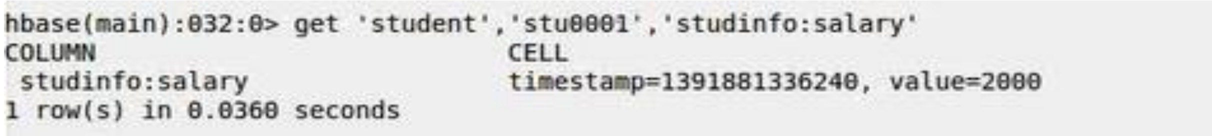
```
hbase(main):018:0> create 'student', {NAME => 'studinfo',VERSIONS => 5},{NAME => 'studaddress'}
0 row(s) in 1.5880 seconds
```



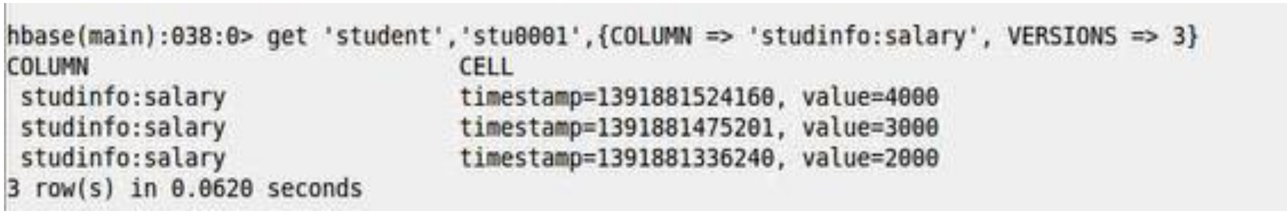
```
hbase(main):008:0> put 'employee','1000','empinfo:firstname','Ankit'
0 row(s) in 0.0980 seconds
```



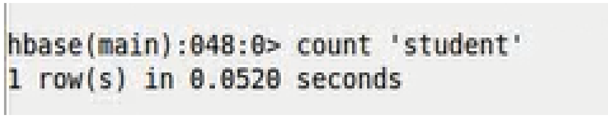
```
hbase(main):015:0> delete 'employee','1000','empinfo:firstname'
0 row(s) in 0.0070 seconds
```



```
hbase(main):032:0> get 'student','stu0001','studinfo:salary'
COLUMN                          CELL
 studinfo:salary                timestamp=1391881336240, value=2000
1 row(s) in 0.0360 seconds
```

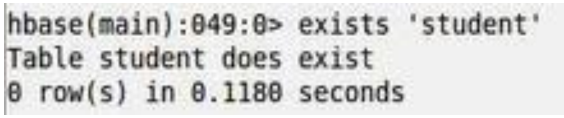


```
hbase(main):038:0> get 'student','stu0001',{COLUMN => 'studinfo:salary', VERSIONS => 3}
COLUMN                          CELL
 studinfo:salary                timestamp=1391881524160, value=4000
 studinfo:salary                timestamp=1391881475201, value=3000
 studinfo:salary                timestamp=1391881336240, value=2000
3 row(s) in 0.0620 seconds
```

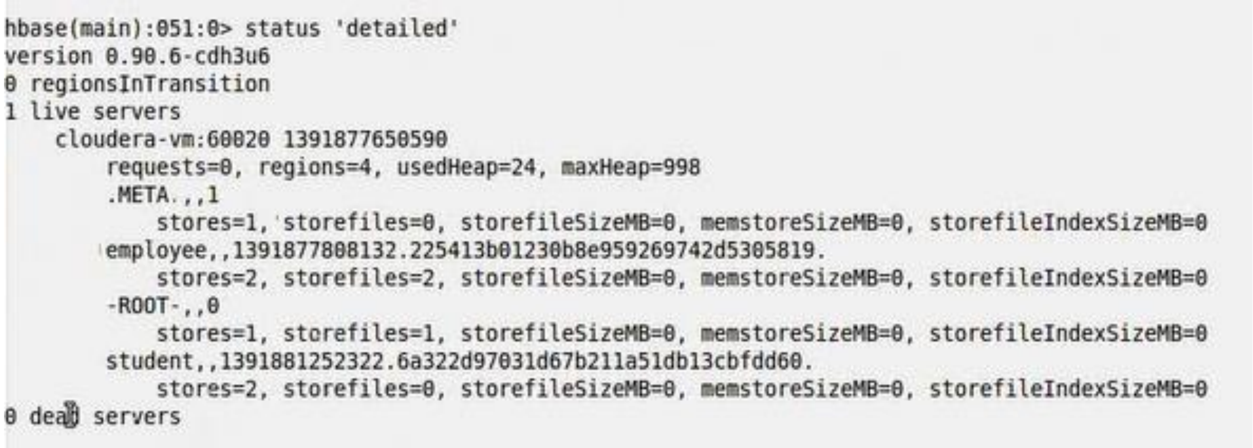


```
hbase(main):048:0> count 'student'
1 row(s) in 0.0520 seconds
```

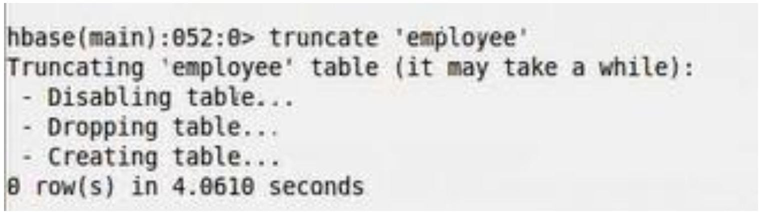
Hbase Commands



```
hbase(main):049:0> exists 'student'
Table student does exist
0 row(s) in 0.1180 seconds
```

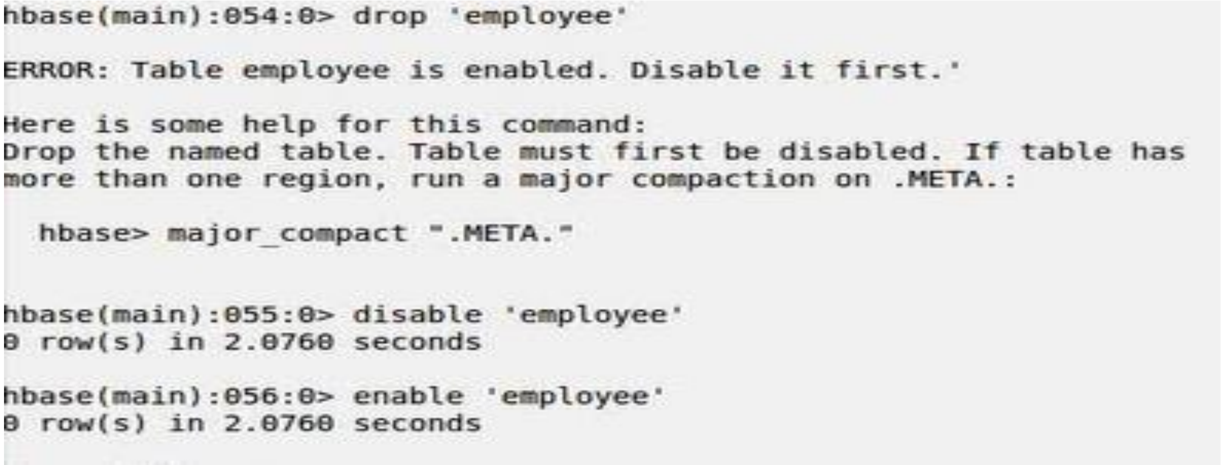


```
hbase(main):051:0> status 'detailed'
version 0.90.6-cdh3u6
0 regionsInTransition
1 live servers
    cloudera-vm:60020 1391877650590
        requests=0, regions=4, usedHeap=24, maxHeap=998
        .META.,,1
            stores=1, storefiles=0, storefileSizeMB=0, memstoreSizeMB=0, storefileIndexSizeMB=0
        employee,,1391877808132.225413b01230b8e959269742d5305819.
            stores=2, storefiles=2, storefileSizeMB=0, memstoreSizeMB=0, storefileIndexSizeMB=0
        -ROOT-,,0
            stores=1, storefiles=1, storefileSizeMB=0, memstoreSizeMB=0, storefileIndexSizeMB=0
        student,,1391881252322.6a322d97031d67b211a51db13cbfdd60.
            stores=2, storefiles=0, storefileSizeMB=0, memstoreSizeMB=0, storefileIndexSizeMB=0
0 dead servers
```

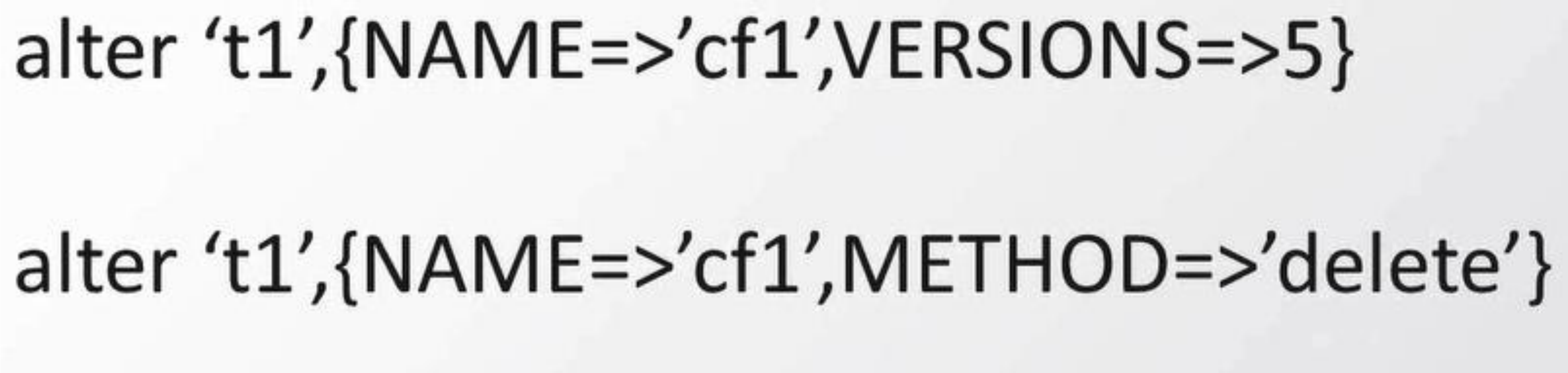


```
hbase(main):052:0> truncate 'employee'
Truncating 'employee' table (it may take a while):
 - Disabling table...
 - Dropping table...
 - Creating table...
0 row(s) in 4.0610 seconds
```

Hbase Commands



```
hbase(main):054:0> drop 'employee'

ERROR: Table employee is enabled. Disable it first.'

Here is some help for this command:
Drop the named table. Table must first be disabled. If table has
more than one region, run a major compaction on .META.:

  hbase> major_compact ".META."


hbase(main):055:0> disable 'employee'
0 row(s) in 2.0760 seconds

hbase(main):056:0> enable 'employee'
0 row(s) in 2.0760 seconds
```



```
alter ‘t1’,{NAME=>’cf1’,VERSIONS=>5}

alter ‘t1’,{NAME=>’cf1’,METHOD=>’delete’}
```

Zookeeper

- Hbase zkcli
- Ls /
- Node creation : Create /jaymin <value> and then get /jaymin
- Get /hbase/root-region-server
- Ls /hbase/rs – to get all region servers
- Types of znodes – ephemeral (when rs dies, this node gets deleted from zookeeper)and persistent