

Apache Pig

- *Overview of apps, high level languages, services*
- *Databases/Stores*
- *Querying*
- *Machine Learning*
- *Graph Processing*

Databases/Stores

- ***Avro***: data structures within context of Hadoop MapReduce jobs.
- ***Hbase***: distributed non-relational database
- ***Cassandra***: distributed data management system

Querying

- **Pig** : Platform for analyzing large data sets in HDFS
- **Hive** : Query and manage large datasets
- **Impala** : High-performance, low-latency SQL querying of data in Hadoop file formats
- **Spark** : General processing engine for streaming, SQL, machine learning and graph processing.

Machine Learning, Graph Processing

- ***Giraph***: Iterative graph processing using Hadoop framework
- ***Mahout***: Framework for machine learning applications using Hadoop, Spark
- ***Spark***: General processing engine for streaming, SQL, machine learning and graph processing.

Apache Pig

- *Pig components – PigLatin, and infrastructure layer*
- *Typical Pig use cases*
- *Run Pig with Hadoop integration.*

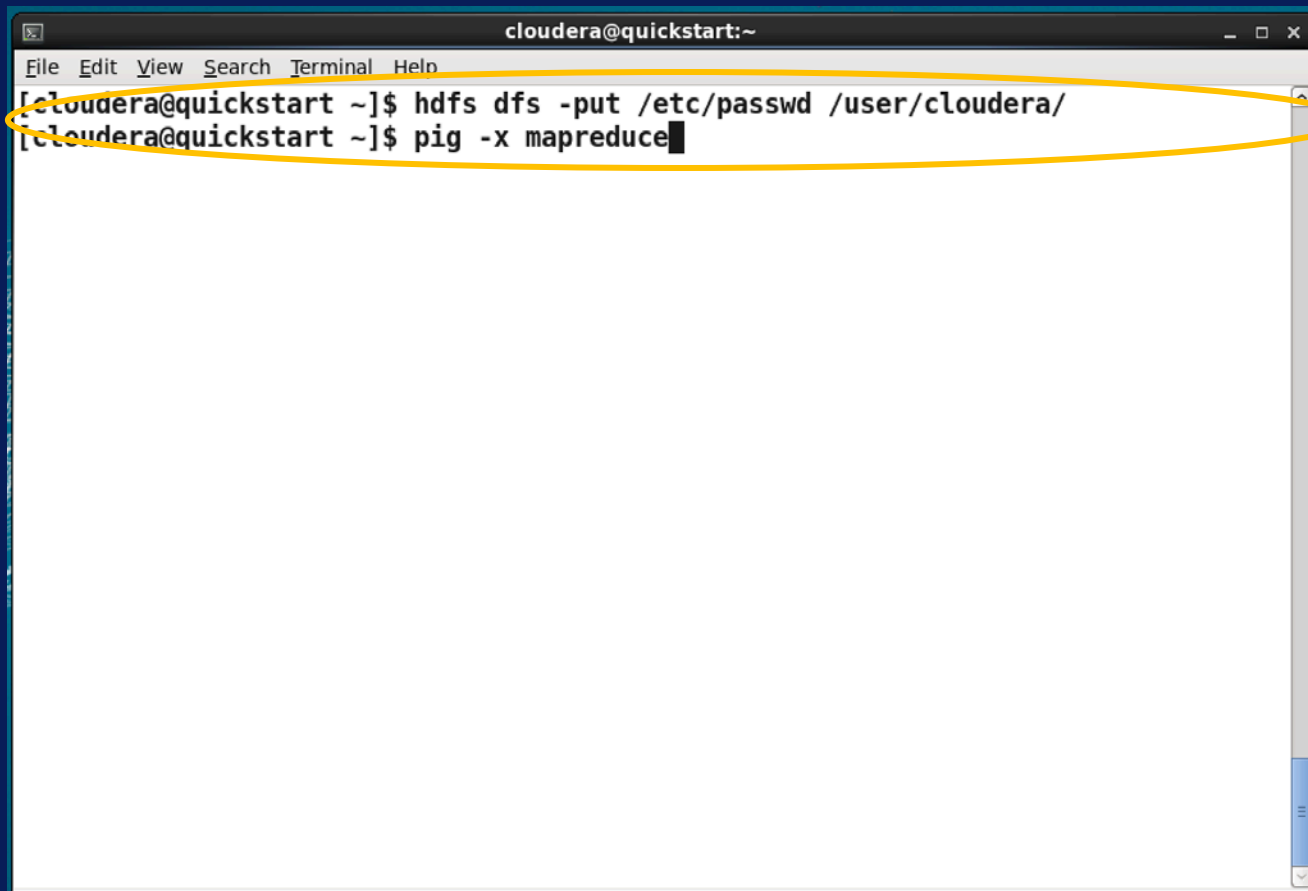
Apache Pig

- *Platform for data processing*
- *Pig Latin: High level language*
- *Pig execution environment: Local, MapReduce, Tez*
- *In built operators and functions*
- *Extensible*

Pig Usage Areas

- *Extract, Transform, Load (ETL) operations*
- *Manipulating, analyzing “raw” data*
- *Widely used, extensive list at:*
<https://cwiki.apache.org/confluence/display/PIG/PoweredBy>

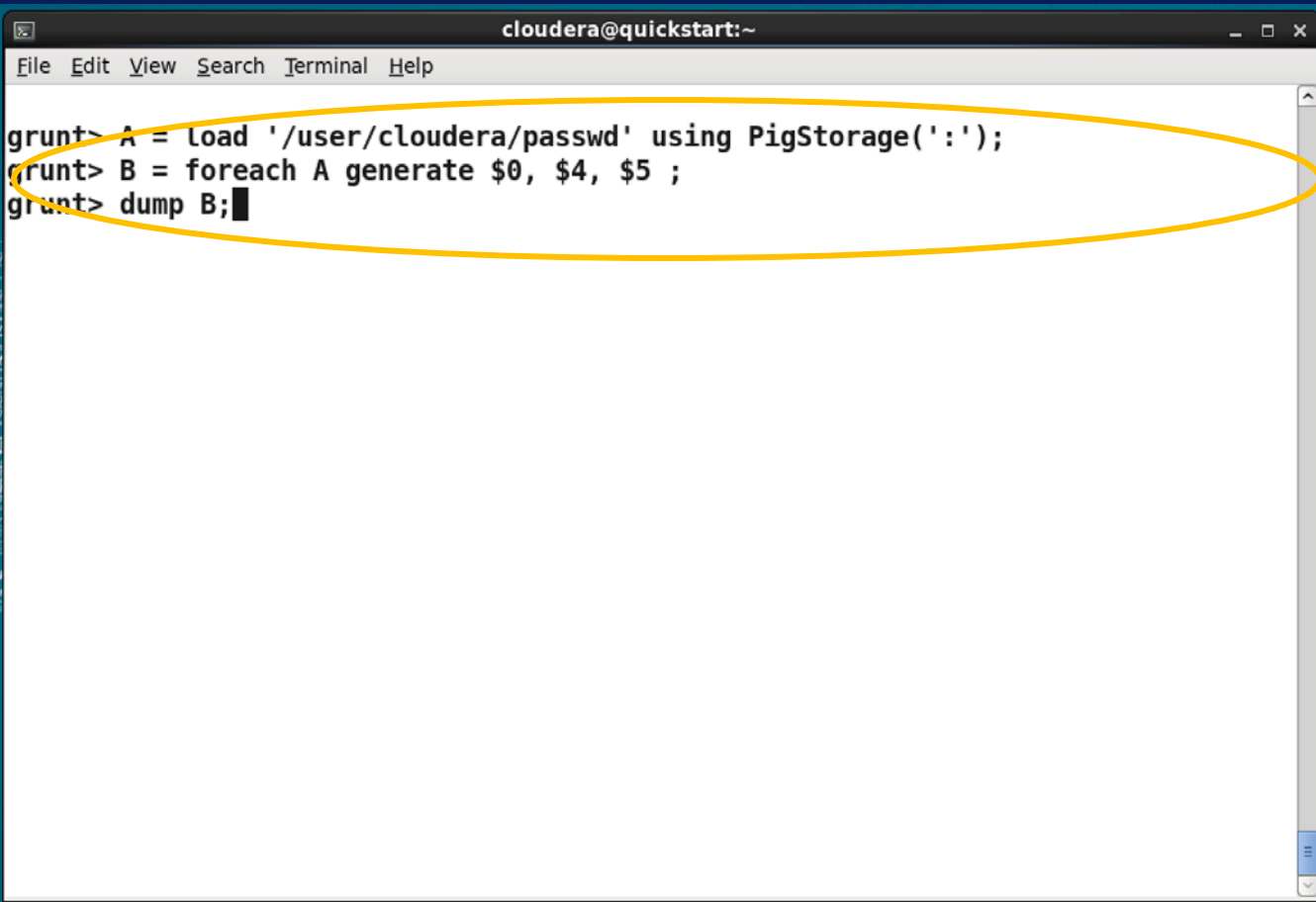
Pig Example

A terminal window titled 'cloudera@quickstart:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows two commands: 'hdfs dfs -put /etc/passwd /user/cloudera/' and 'pig -x mapreduce'. A yellow oval highlights the first command.

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ hdfs dfs -put /etc/passwd /user/cloudera/  
[cloudera@quickstart ~]$ pig -x mapreduce
```

- *Load passwd file and work with data.*
- *Step 1:*
hdfs dfs -put
/etc/passwd
/user/cloudera
(Note: this is a single line)
- *Step 2:*
pig -x mapreduce

Pig Example



```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
grunt> A = load '/user/cloudera/passwd' using PigStorage(':');  
grunt> B = foreach A generate $0, $4, $5 ;  
grunt> dump B;
```

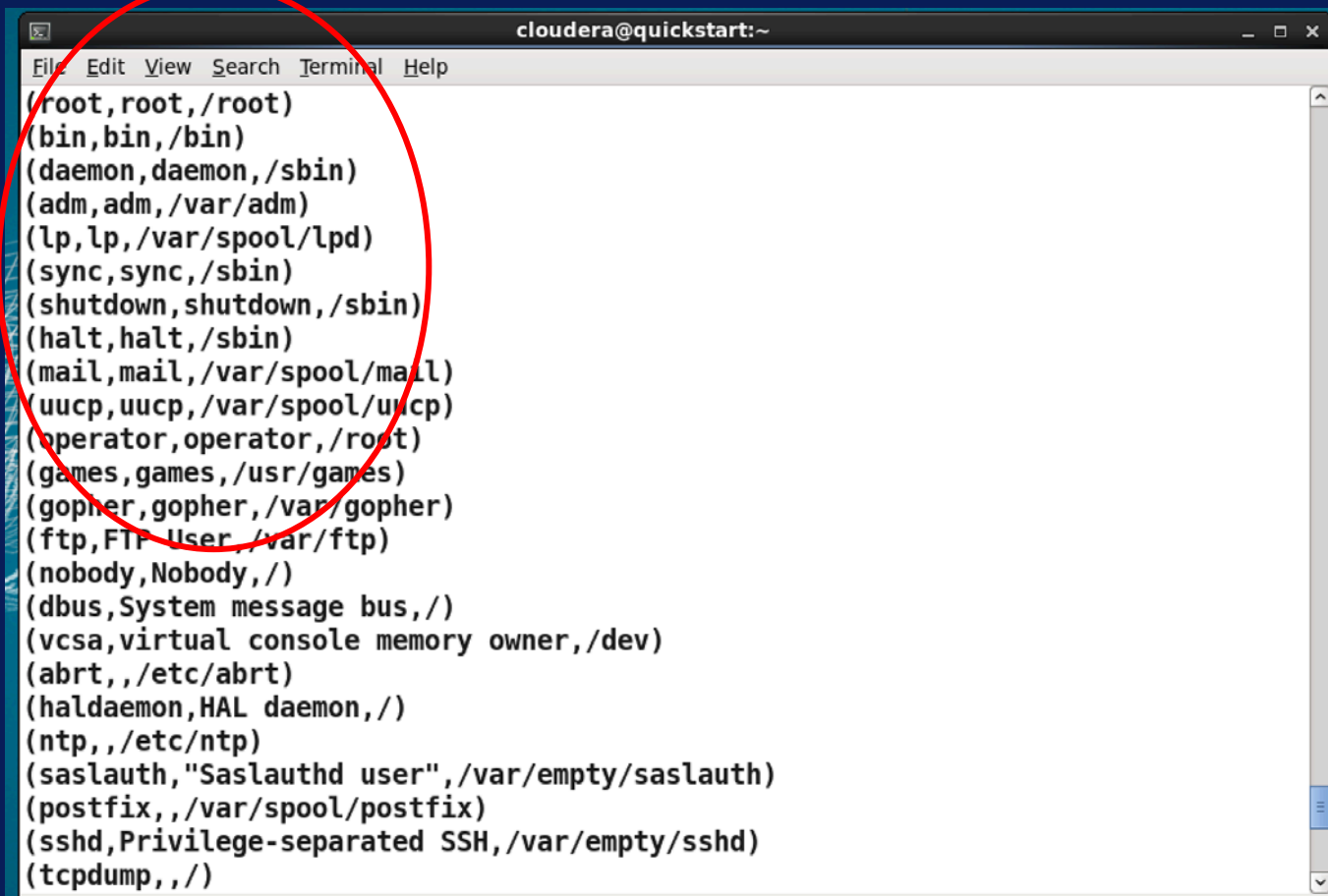
- *Puts you in “grunt” shell.*
- *clear*
- *Load the file:*
load
'/user/cloudera/passwd'
using PigStorage(':');
- *Pick subset of values:*
B = foreach A generate \$0,
\$4, \$5;
dump B;

Pig Example

*Backend
Hadoop job info.*

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
ne.mapReduceLayer.MapReduceLauncher - HadoopJobId: job_1443986695067_0002  
2015-10-04 13:36:58,424 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - Processing aliases A,B  
2015-10-04 13:36:58,424 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - detailed locations: M: A[1,4],B[2,4] C: R  
:  
2015-10-04 13:36:58,424 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - More information at: http://localhost:5003  
/jobdetails.jsp?jobid=job_1443986695067_0002  
2015-10-04 13:36:58,480 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - 0% complete  
2015-10-04 13:37:12,355 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - 50% complete  
2015-10-04 13:37:14,056 [main] INFO org.apache.hadoop.conf.Configuration.deprec  
ation - mapred.reduce.tasks is deprecated. Instead, use mapreduce.job.reduces  
2015-10-04 13:37:14,126 [main] INFO org.apache.pig.backend.hadoop.executionengi  
ne.mapReduceLayer.MapReduceLauncher - 100% complete  
2015-10-04 13:37:14,128 [main] INFO org.apache.pig.tools.pigstats.SimplePigStat  
s - Script Statistics:  
  
HadoopVersion  PigVersion      UserId  StartedAt      FinishedAt      Features  
2.6.0-cdh5.4.2  0.12.0-cdh5.4.2 cloudera 2015-10-04 13:36:53 2015-10-  
04 13:37:14 UNKNOWN
```

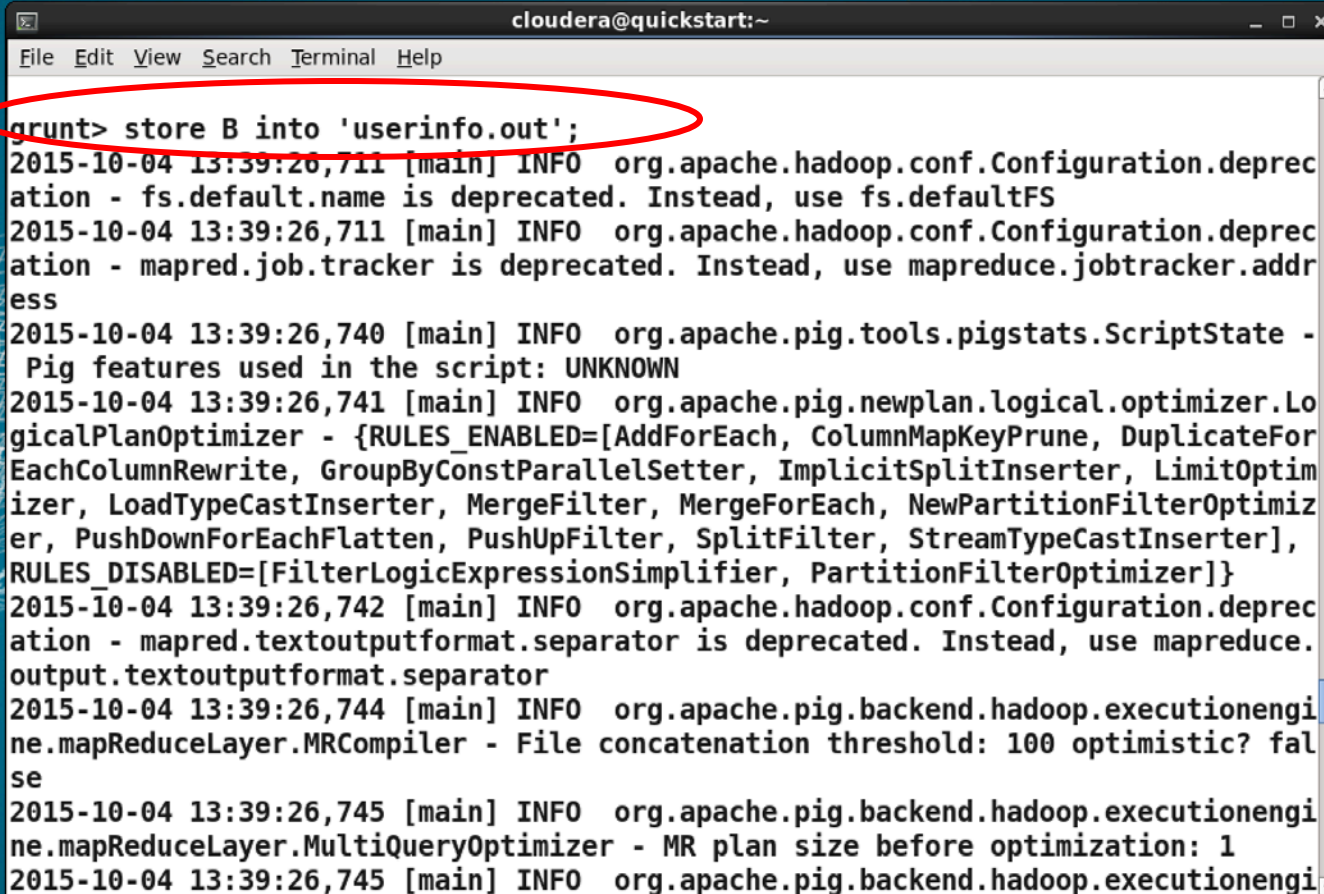
Pig Example



```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
(root,root,/root)  
(bin,bin,/bin)  
(daemon,daemon,/sbin)  
(adm,adm,/var/adm)  
(lp,lp,/var/spool/lpd)  
(sync,sync,/sbin)  
(shutdown,shutdown,/sbin)  
(halt,halt,/sbin)  
(mail,mail,/var/spool/mail)  
(uucp,uucp,/var/spool/uucp)  
(operator,operator,/root)  
(games,games,/usr/games)  
(gopher,gopher,/var/gopher)  
(ftp,FTP User,/var/ftp)  
(nobody,Nobody,/)   
(dbus,System message bus,/)   
(vcsa,virtual console memory owner,/dev)   
(abrt,,/etc/abrt)   
(haldaemon,HAL daemon,/)   
(ntp,,/etc/ntp)   
(sasauth,"Saslauthd user",/var/empty/sasauth)   
(postfix,,/var/spool/postfix)   
(sshd,Privilege-separated SSH,/var/empty/sshd)   
(tcpdump,,/)
```

- ***Outputs username, full name, and home directory path.***

Pig Example



```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
grunt> store B into 'userinfo.out';  
2015-10-04 13:39:26,711 [main] INFO org.apache.hadoop.conf.Configuration.deprecation - fs.default.name is deprecated. Instead, use fs.defaultFS  
2015-10-04 13:39:26,711 [main] INFO org.apache.hadoop.conf.Configuration.deprecation - mapred.job.tracker is deprecated. Instead, use mapreduce.jobtracker.address  
2015-10-04 13:39:26,740 [main] INFO org.apache.pig.tools.pigstats.ScriptState - Pig features used in the script: UNKNOWN  
2015-10-04 13:39:26,741 [main] INFO org.apache.pig.newplan.logical.optimizer.LogicalPlanOptimizer - {RULES_ENABLED=[AddForEach, ColumnMapKeyPrune, DuplicateForEachColumnRewrite, GroupByConstParallelSetter, ImplicitSplitInserter, LimitOptimizer, LoadTypeCastInserter, MergeFilter, MergeForEach, NewPartitionFilterOptimizer, PushDownForEachFlatten, PushUpFilter, SplitFilter, StreamTypeCastInserter], RULES_DISABLED=[FilterLogicExpressionSimplifier, PartitionFilterOptimizer]}  
2015-10-04 13:39:26,742 [main] INFO org.apache.hadoop.conf.Configuration.deprecation - mapred.textoutputformat.separator is deprecated. Instead, use mapreduce.output.textoutputformat.separator  
2015-10-04 13:39:26,744 [main] INFO org.apache.pig.backend.hadoop.executionengine.mapReduceLayer.MRCompiler - File concatenation threshold: 100 optimistic? false  
2015-10-04 13:39:26,745 [main] INFO org.apache.pig.backend.hadoop.executionengine.mapReduceLayer.MultiQueryOptimizer - MR plan size before optimization: 1  
2015-10-04 13:39:26,745 [main] INFO org.apache.pig.backend.hadoop.executionengine
```

- ***Can store this processed data in HDFS***

- ***Command:***
store B into 'userinfo.out';

Pig Example

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
grunt> quit  
[cloudera@quickstart ~]$ clear  
  
[cloudera@quickstart ~]$ hdfs dfs -ls /user/cloudera  
Found 2 items  
-rw-r--r--  1 cloudera cloudera      2561 2015-10-04 12:41 /user/cloudera/passwd  
drwxr-xr-x  - cloudera cloudera      0 2015-10-04 13:39 /user/cloudera/userinfo.out  
[cloudera@quickstart ~]$ hdfs dfs -ls /user/cloudera/userinfo.out  
Found 2 items  
-rw-r--r--  1 cloudera cloudera      0 2015-10-04 13:39 /user/cloudera/userinfo.out/_SUCCESS  
-rw-r--r--  1 cloudera cloudera    1459 2015-10-04 13:39 /user/cloudera/userinfo.out/part-m-000000  
[cloudera@quickstart ~]$
```

• *Verify the new data is in HDFS.*

Summary

- *Used interactive shell for Pig example*
- *Can also run using scripts*
- *Also as embedded programs in a host language (Java for example).*

Apache Hive

- *Query and manage data using HiveQL*
- *Run interactively using beeline.*
- *Other run mechanisms*

Apache Hive

- *Data warehouse software*
- *HiveQL: SQL like language to structure, and query data*
- *Execution environment: MapReduce, Tez, Spark*
- *Data in HDFS, HBase*
- *Custom mappers/reducers*

Hive Usage Areas

- *Data mining, analytics*
- *Machine learning*
- *Ad hoc analysis*
- ***Widely used, extensive list at:***
<https://cwiki.apache.org/confluence/display/Hive/PoweredBy>

Hive Example

- *Revisit /etc/passwd file example from Pig lesson video.*
- *Start by loading file into HDFS:*
hdfs dfs -put /etc/passwd /tmp/
- *Run beeline to access interactively:*
beeline -u jdbc:hive2://

Hive Example

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ hdfs dfs -put /etc/passwd /tmp/  
[cloudera@quickstart ~]$ hdfs dfs -ls /tmp/  
Found 3 items  
drwxr-xr-x  - hdfs      supergroup          0 2015-06-09 03:36 /tmp/hadoop-yarn  
drwx-wx-wx  - hive      supergroup          0 2015-10-04 15:25 /tmp/hive  
-rw-r--r--  1 cloudera supergroup      2561 2015-10-04 15:27 /tmp/passwd  
[cloudera@quickstart ~]$ beeline -u jdbc:hive2://  
scan complete in 4ms  
Connecting to jdbc:hive2://  
Added [/usr/lib/hive/lib/hive-contrib.jar] to class path  
Added resources: [/usr/lib/hive/lib/hive-contrib.jar]  
Connected to: Apache Hive (version 1.1.0-cdh5.4.2)  
Driver: Hive JDBC (version 1.1.0-cdh5.4.2)  
Transaction isolation: TRANSACTION_REPEATABLE_READ  
Beeline version 1.1.0-cdh5.4.2 by Apache Hive  
0: jdbc:hive2://>  
0: jdbc:hive2://> █
```

- *Copy passwd file to HDFS*
- *Running interactively using beeline.*

Hive Example: Command list

```
CREATE TABLE userinfo ( uname STRING, pswd STRING, uid INT, gid  
INT, fullname STRING, hdir STRING, shell STRING ) ROW FORMAT  
DELIMITED FIELDS TERMINATED BY ':' STORED AS TEXTFILE;
```

```
LOAD DATA INPATH '/tmp/passwd' OVERWRITE INTO TABLE userinfo;
```

```
SELECT uname, fullname, hdir FROM userinfo ORDER BY uname ;
```

Hive Example

- *Run the Create table command*

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ beeline -u jdbc:hive2://  
scan complete in 2ms  
Connecting to jdbc:hive2://  
Added [/usr/lib/hive/lib/hive-contrib.jar] to class path  
Added resources: [/usr/lib/hive/lib/hive-contrib.jar]  
Connected to: Apache Hive (version 1.1.0-cdh5.4.2)  
Driver: Hive JDBC (version 1.1.0-cdh5.4.2)  
Transaction isolation: TRANSACTION_REPEATABLE_READ  
Beeline version 1.1.0-cdh5.4.2 by Apache Hive  
0: jdbc:hive2://> CREATE TABLE userinfo ( uname STRING, pswd STRING, uid INT, gi  
d INT, fullname STRING, hdir STRING, shell STRING ) ROW FORMAT DELIMITED FIELDS  
TERMINATED BY ':' STORED AS TEXTFILE;  
OK  
No rows affected (1.077 seconds)  
0: jdbc:hive2://>  
0: jdbc:hive2://> █
```

Hive Example

- *Load passwd file from HDFS*

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
Connected to: Apache Hive (version 1.1.0-cdh5.4.2)  
Driver: Hive JDBC (version 1.1.0-cdh5.4.2)  
Transaction isolation: TRANSACTION_REPEATABLE_READ  
Beeline version 1.1.0-cdh5.4.2 by Apache Hive  
0: jdbc:hive2://> CREATE TABLE userinfo ( uname STRING, pswd STRING, uid INT, gi  
d INT, fullname STRING, hdir STRING, shell STRING ) ROW FORMAT DELIMITED FIELDS  
TERMINATED BY ':' STORED AS TEXTFILE;  
OK  
No rows affected (1.077 seconds)  
0: jdbc:hive2://>  
0: jdbc:hive2://> LOAD DATA INPATH '/tmp/passwd' OVERWRITE INTO TABLE userinfo;  
Loading data to table default.userinfo  
15/10/04 15:41:23 [HiveServer2-Background-Pool: Thread-26]: ERROR hdfs.KeyProvid  
erCache: Could not find uri with key [dfs.encryption.key.provider.uri] to create  
a keyProvider !!  
chgrp: changing ownership of 'hdfs://quickstart.cloudera:8020/user/hive/warehous  
e/userinfo/passwd': User does not belong to hive  
Table default.userinfo stats: [numFiles=1, numRows=0, totalSize=2561, rawDataSiz  
e=0]  
OK  
No rows affected (0.491 seconds)  
0: jdbc:hive2://>  
0: jdbc:hive2://>
```

Hive Example

- *Select info - this launches the Hadoop job and outputs once its complete.*

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
cloudera@quickstart:~$ jdbc:hive2://> SELECT uname, fullname, hdir FROM userinfo ORDER BY uname ;  
Query ID = cloudera_20151004154141_aa932488_439e_4378_8a93_3adcc30076ef  
Total jobs = 1  
Launching Job 1 out of 1  
Number of reduce tasks determined at compile time: 1  
In order to change the average load for a reducer (in bytes):  
  set hive.exec.reducers.bytes.per.reducer=<number>  
In order to limit the maximum number of reducers:  
  set hive.exec.reducers.max=<number>  
In order to set a constant number of reducers:  
  set mapreduce.job.reduces=<number>  
15/10/04 15:41:57 [HiveServer2-Background-Pool: Thread-34]: WARN mapreduce.JobSubmitter: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.  
Starting Job = job_1443997416755_0001, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1443997416755_0001/  
Kill Command = /usr/lib/hadoop/bin/hadoop job -kill job_1443997416755_0001  
WARN : Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.  
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1  
15/10/04 15:42:09 [HiveServer2-Background-Pool: Thread-34]: WARN mapreduce.Counters: Group org.apache.hadoop.mapred.Task$Counter is deprecated. Use org.apache.hadoop.mapreduce.TaskCounter instead  
2015-10-04 15:42:09,249 Stage-1 map = 0%,  reduce = 0%
```

Hive Example

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
MapReduce Jobs Launched:  
Stage-Stage-1: Map: 1 Reduce: 1 Cumulative CPU: 1.97 sec HDFS Read: 8828 HD  
FS Write: 1459 SUCCESS  
Total MapReduce CPU Time Spent: 1 seconds 970 msec  
OK  
+-----+-----+  
+---+  
|      uname      |      fullname      |      hdir      |  
+-----+-----+  
+---+  
| abrt             |                     | /etc/abrt      |  
| adm              | adm                 | /var/adm       |  
| avahi-autoipd    | Avahi IPv4LL Stack | /var/lib/avahi-autoipd |  
| bin              | bin                 | /bin            |  
| cloudera         |                     | /home/cloudera |  
| cloudera-scm     | Cloudera Manager   | /var/lib/cloudera-scm-server |  
| daemon          | daemon              | /sbin           |
```

- **Completed MapReduce jobs; output shows username, fullname, and home directory.**

Summary

- *Used beeline for interactive Hive example*
- *Can also use*
 - *Hive command line interface (CLI)*
 - *Hcatalog*
 - *WebHcat.*

Apache HBase

- *Hbase features*
- *Run interactively using HBase shell.*
- *List other access mechanisms*

Apache HBase

- *Scalable data store*
- *Non-relational distributed database*
- *Runs on top of HDFS*
- *Compression*
- *In-memory operations: MemStore, BlockCache*

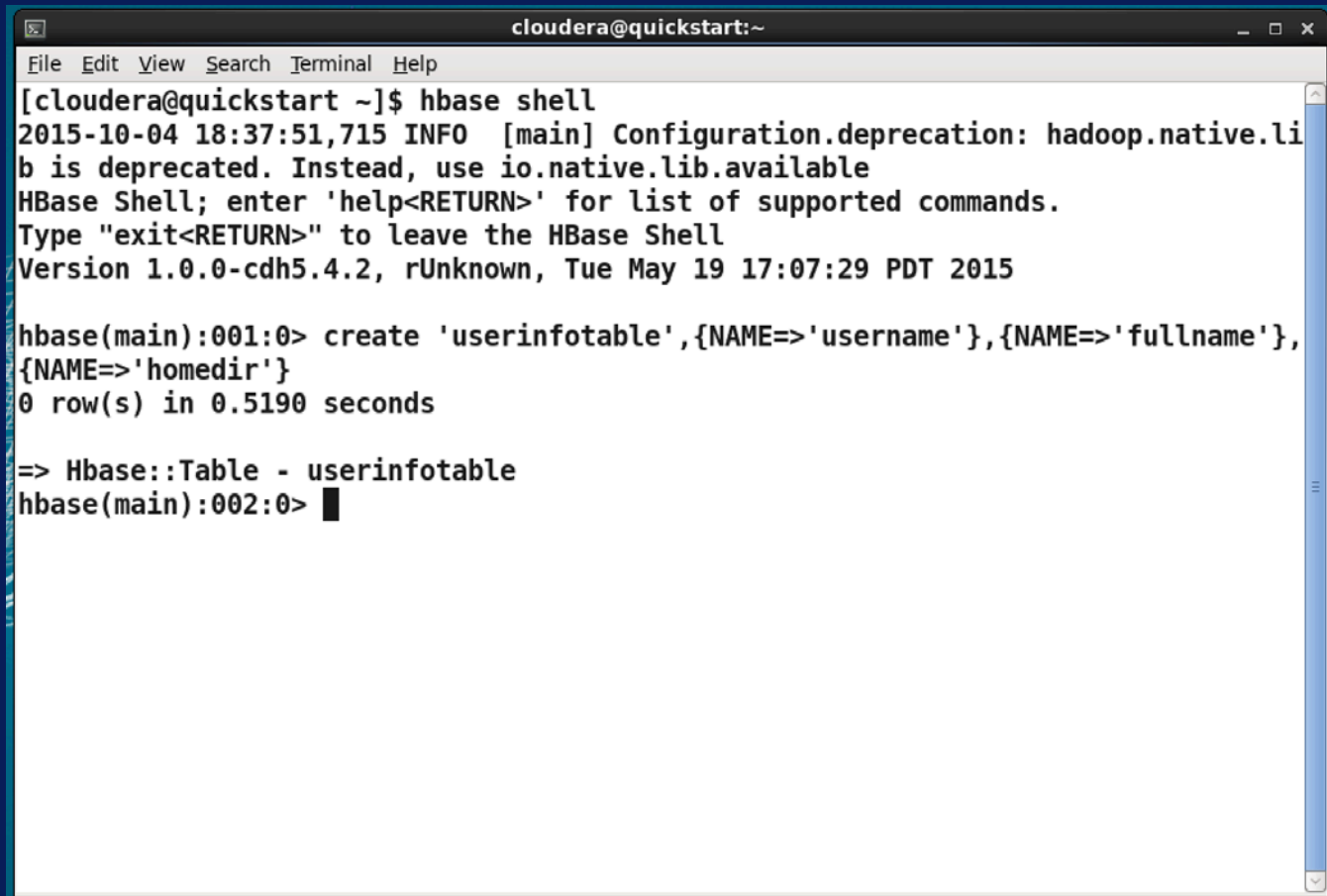
HBase Features

- *Consistency*
- *High Availability*
- *Automatic Sharding*

Hbase Features

- *Replication*
- *Security*
- *SQL like access (Hive, Spark, Impala)*

HBase Example

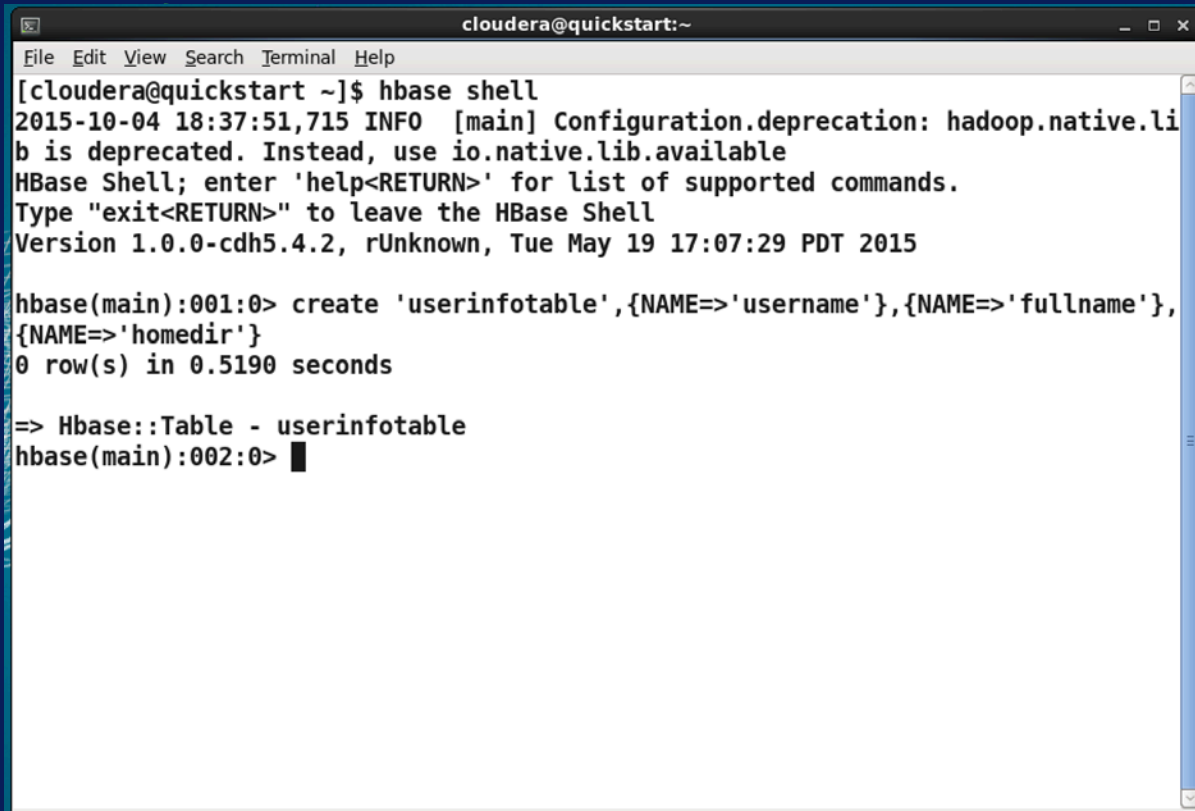
A terminal window titled 'cloudera@quickstart:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the execution of 'hbase shell', which outputs a deprecation warning, a help message, and the version '1.0.0-cdh5.4.2'. Then, the command 'create 'userinfotable',{NAME=>'username'},{NAME=>'fullname'},{NAME=>'homedir'}' is executed, resulting in '0 row(s) in 0.5190 seconds'. Finally, the prompt changes to 'Hbase::Table - userinfotable' and the user enters 'hbase(main):002:0>' followed by a cursor.

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ hbase shell  
2015-10-04 18:37:51,715 INFO [main] Configuration.deprecation: hadoop.native.lib  
is deprecated. Instead, use io.native.lib.available  
HBase Shell; enter 'help<RETURN>' for list of supported commands.  
Type "exit<RETURN>" to leave the HBase Shell  
Version 1.0.0-cdh5.4.2, rUnknown, Tue May 19 17:07:29 PDT 2015  
  
hbase(main):001:0> create 'userinfotable',{NAME=>'username'},{NAME=>'fullname'},  
{NAME=>'homedir'}  
0 row(s) in 0.5190 seconds  
  
=> Hbase::Table - userinfotable  
hbase(main):002:0> █
```

- Start HBase shell:
hbase shell

HBase Example

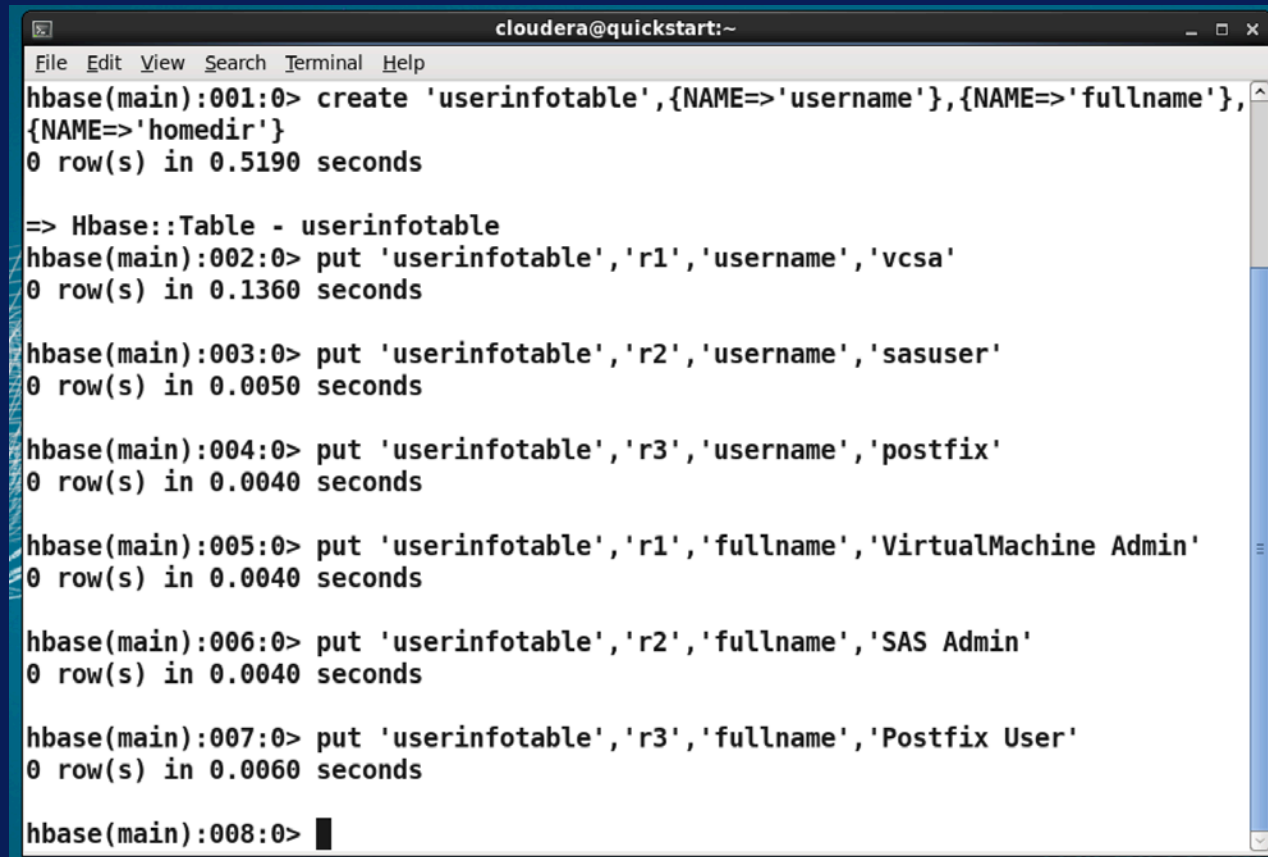
- *Create Table: **create***
'usertableinfo',{NAME=>'username'},{NAME=>'fullname'},{NAME=>'hom

A terminal window titled 'cloudera@quickstart:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the execution of 'hbase shell', which outputs version and deprecation information. Then, the 'create' command is used to create a table named 'userinfotable' with columns 'username', 'fullname', and 'homedir'. The output shows the table was created successfully in 0.5190 seconds. Finally, the prompt returns to the HBase shell.

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ hbase shell  
2015-10-04 18:37:51,715 INFO [main] Configuration.deprecation: hadoop.native.lib  
is deprecated. Instead, use io.native.lib.available  
HBase Shell; enter 'help<RETURN>' for list of supported commands.  
Type "exit<RETURN>" to leave the HBase Shell  
Version 1.0.0-cdh5.4.2, rUnknown, Tue May 19 17:07:29 PDT 2015  
  
hbase(main):001:0> create 'userinfotable',{NAME=>'username'},{NAME=>'fullname'},  
{NAME=>'homedir'}  
0 row(s) in 0.5190 seconds  
  
=> Hbase::Table - userinfotable  
hbase(main):002:0> █
```

HBase Example

- *Add data: put 'userinfotable','r1','username','vcsa'*

A screenshot of a terminal window titled 'cloudera@quickstart:~'. The terminal shows a series of HBase commands and their outputs. The commands are: 1. 'create 'userinfotable',{NAME=>'username'},{NAME=>'fullname'},{NAME=>'homedir'}' which creates a table and returns '0 row(s) in 0.5190 seconds'. 2. An equals sign followed by 'Hbase::Table - userinfotable'. 3. 'put 'userinfotable','r1','username','vcsa'' which returns '0 row(s) in 0.1360 seconds'. 4. 'put 'userinfotable','r2','username','sasuser'' which returns '0 row(s) in 0.0050 seconds'. 5. 'put 'userinfotable','r3','username','postfix'' which returns '0 row(s) in 0.0040 seconds'. 6. 'put 'userinfotable','r1','fullname','VirtualMachine Admin'' which returns '0 row(s) in 0.0040 seconds'. 7. 'put 'userinfotable','r2','fullname','SAS Admin'' which returns '0 row(s) in 0.0040 seconds'. 8. 'put 'userinfotable','r3','fullname','Postfix User'' which returns '0 row(s) in 0.0060 seconds'. The prompt 'hbase(main):008:0>' is visible at the bottom with a cursor.

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
hbase(main):001:0> create 'userinfotable',{NAME=>'username'},{NAME=>'fullname'},  
{NAME=>'homedir'}  
0 row(s) in 0.5190 seconds  
  
=> Hbase::Table - userinfotable  
hbase(main):002:0> put 'userinfotable','r1','username','vcsa'  
0 row(s) in 0.1360 seconds  
  
hbase(main):003:0> put 'userinfotable','r2','username','sasuser'  
0 row(s) in 0.0050 seconds  
  
hbase(main):004:0> put 'userinfotable','r3','username','postfix'  
0 row(s) in 0.0040 seconds  
  
hbase(main):005:0> put 'userinfotable','r1','fullname','VirtualMachine Admin'  
0 row(s) in 0.0040 seconds  
  
hbase(main):006:0> put 'userinfotable','r2','fullname','SAS Admin'  
0 row(s) in 0.0040 seconds  
  
hbase(main):007:0> put 'userinfotable','r3','fullname','Postfix User'  
0 row(s) in 0.0060 seconds  
  
hbase(main):008:0> █
```

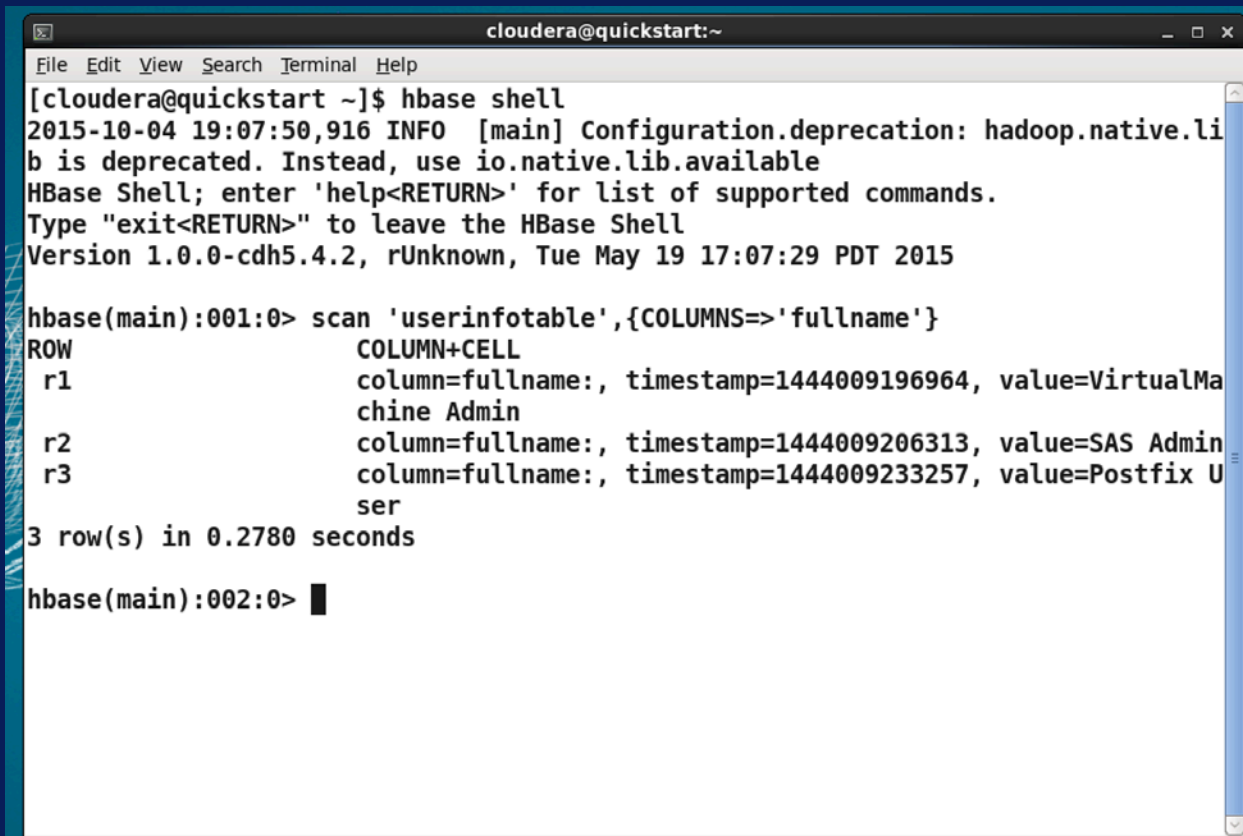

HBase Example

- *Scan table after data entry: **scan 'userinfotable'***

```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
hbase(main):026:0> scan 'userinfotable'  
ROW COLUMN+CELL  
r1 column=fullname:, timestamp=1444009196964, value=VirtualMa  
chine Admin  
r1 column=homedir:, timestamp=1444009268956, value=/home/vcsa  
r1 column=username:, timestamp=1444009138897, value=vcsa  
r2 column=fullname:, timestamp=1444009206313, value=SAS Admin  
r2 column=homedir:, timestamp=1444009278709, value=/var/sasus  
er  
r2 column=username:, timestamp=1444009151766, value=sasuser  
r3 column=fullname:, timestamp=1444009233257, value=Postfix U  
ser  
r3 column=homedir:, timestamp=1444009289281, value=/user/post  
fix  
r3 column=username:, timestamp=1444009162921, value=postfix  
3 row(s) in 0.0290 seconds  
  
hbase(main):027:0>  
hbase(main):028:0*  
hbase(main):029:0*  
hbase(main):030:0*  
hbase(main):031:0*  
hbase(main):032:0*  
hbase(main):033:0*
```

HBase Example

- *Select info from all rows corresponding to column 'fullname'.*



```
cloudera@quickstart:~  
File Edit View Search Terminal Help  
[cloudera@quickstart ~]$ hbase shell  
2015-10-04 19:07:50,916 INFO [main] Configuration.deprecation: hadoop.native.lib  
is deprecated. Instead, use io.native.lib.available  
HBase Shell; enter 'help<RETURN>' for list of supported commands.  
Type "exit<RETURN>" to leave the HBase Shell  
Version 1.0.0-cdh5.4.2, rUnknown, Tue May 19 17:07:29 PDT 2015  
  
hbase(main):001:0> scan 'userinfotable',{COLUMNS=>'fullname'}  
ROW COLUMN+CELL  
r1 column=fullname:, timestamp=1444009196964, value=VirtualMa  
chine Admin  
r2 column=fullname:, timestamp=1444009206313, value=SAS Admin  
r3 column=fullname:, timestamp=1444009233257, value=Postfix U  
ser  
3 row(s) in 0.2780 seconds  
  
hbase(main):002:0> █
```

Summary

- *We used: **Apache HBase Shell***
- *Other options:*
 - *HBase, MapReduce*
 - *HBase API*
 - *HBase External API*