

Hadoop HDFS

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Topics

- What is and Why HDFS?
- HDFS Architecture
- HDFS Features
- HDFS Commands
- HDFS Web UI
- Hue web UI

What is and Why HDFS?

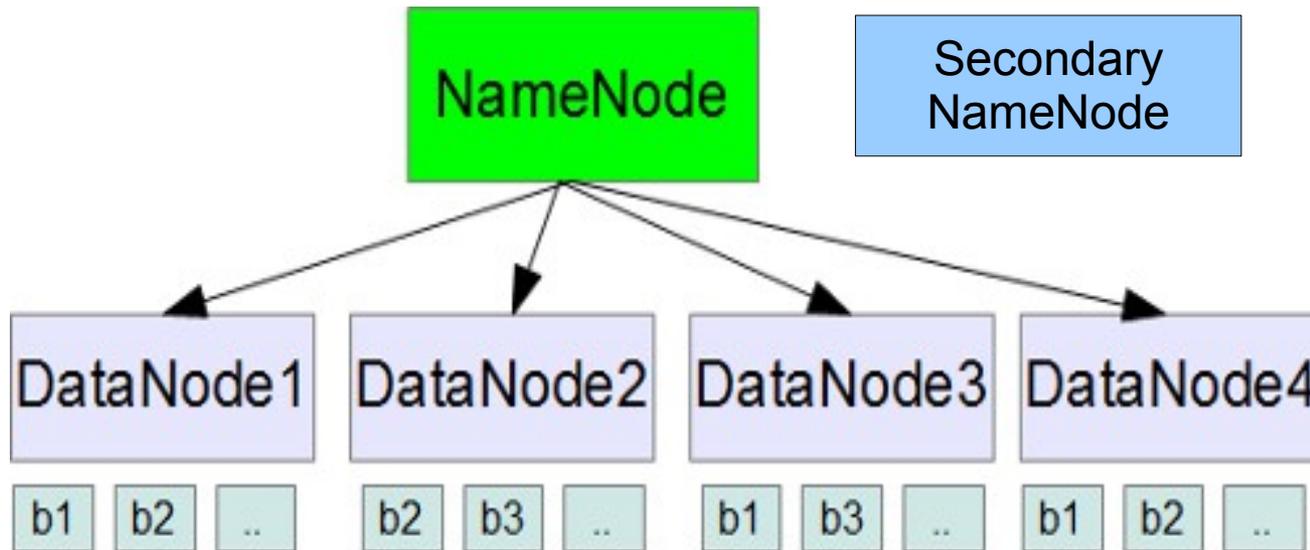
What is HDFS?

- HDFS is a **virtual FS (File System)** built on top of local FS
 - > When you start writing data into HDFS, it eventually gets written onto the local FS (of distributed machines)
- You can't browse HDFS like you do with the local FS
 - > You need to use the HDFS commands (similar to local FS commands, however) or
 - > Or you can use the HDFS Web UI
 - > Or the available APIs
- HDFS stores data as **blocks in a replicated fashion**
 - > Management and replication of blocks are handled by HDFS
- HDFS is the primary distributed storage used by Hadoop applications
 - > Scalability, Reliability, Automatic distribution of data

HDFS Architecture

HDFS Architecture

- For each Hadoop cluster, there is a single Name node, a single Secondary name node, and multiple data nodes
- Each block is replicated among data nodes



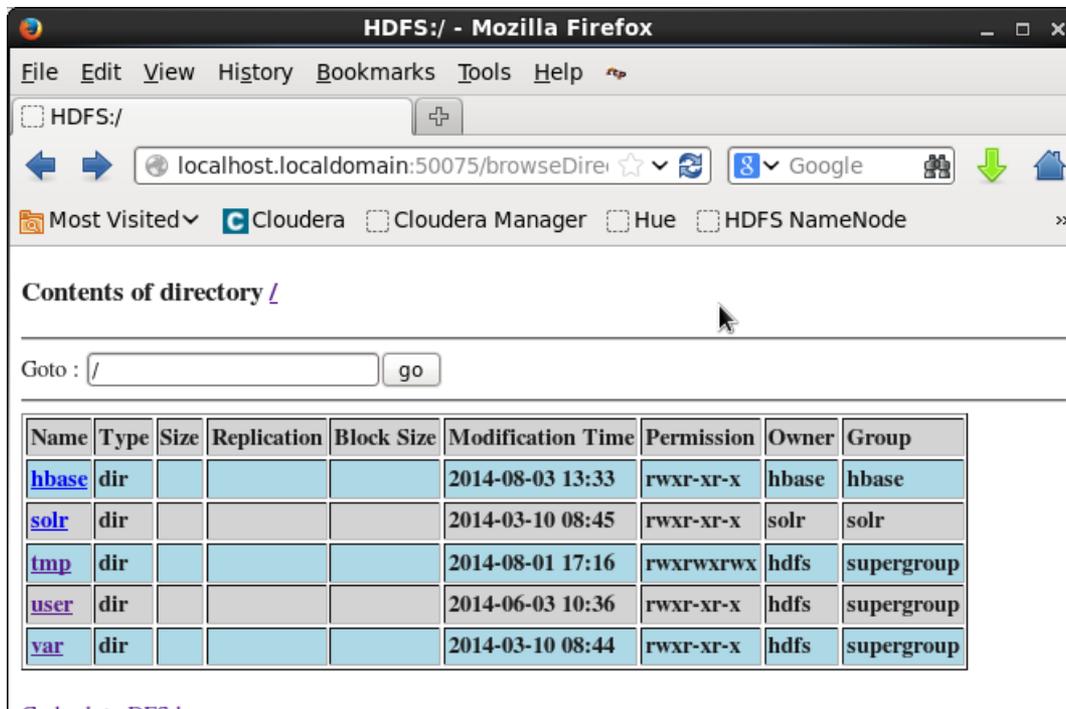
In the example above, block b1 is replicated in DataNode1, DataNode3, DataNode4

Nodes in HDFS Architecture

- Name node
 - > Contains file system metadata
 - > Monitors health of the data nodes
 - > Clients communicate with Name node
- Data node
 - > Handles client requests
 - > Sends heartbeats to namenode (default is 3 seconds)
 - > Rack aware – A set of data nodes can be located in a rack, blocks will be replicated across the racks
- Secondary name node
 - > Not for high availability of Name node (as its name may sound like it)
 - > Performs periodic checkpoints - Reads periodically the filesystem changes log of Name node and apply them into the Name node's metadata file

How Client Reads Data in HDFS

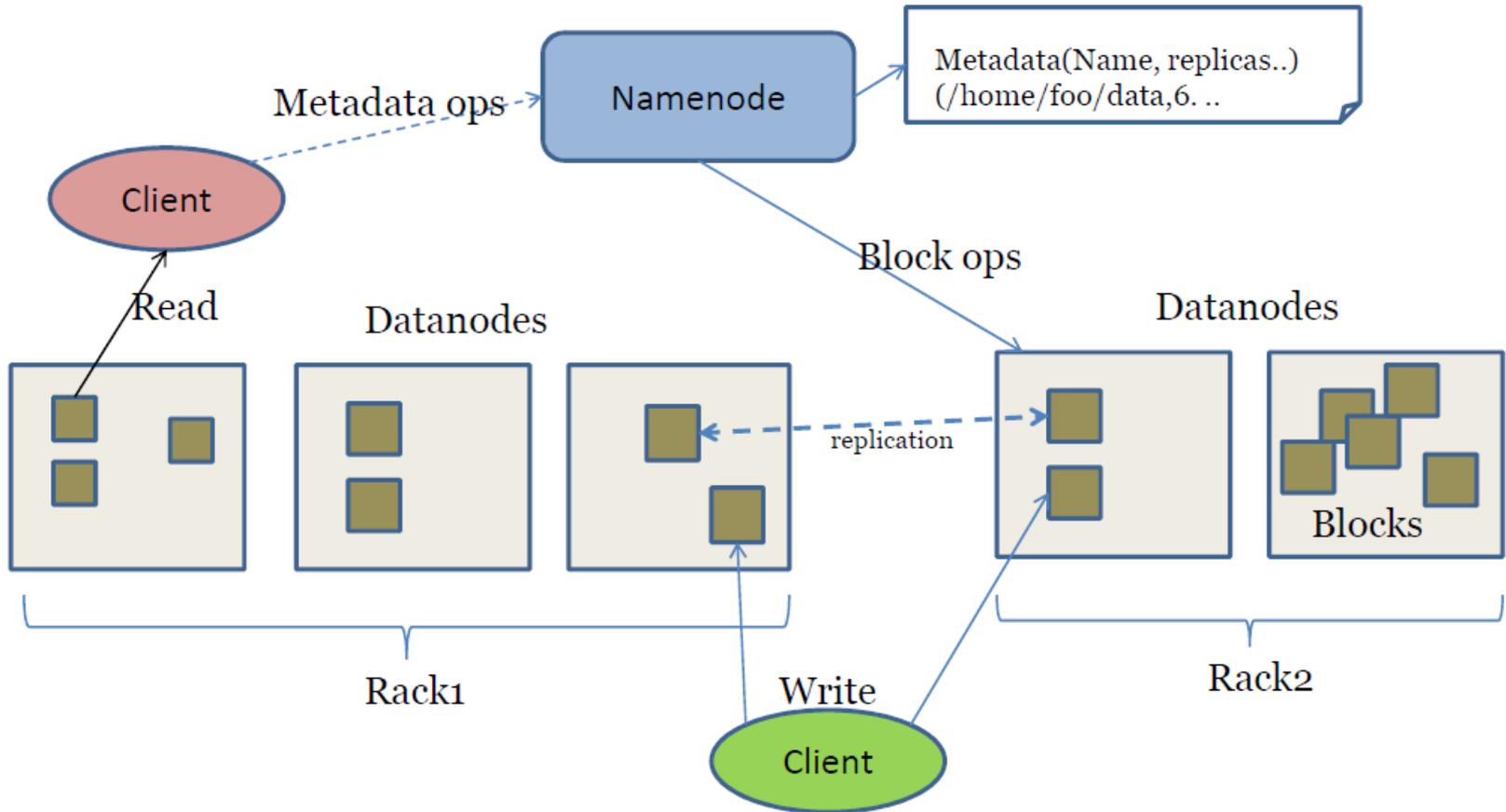
- When access to a particular block of data is required, the following occurs
 - > Metadata stored in the Name node is searched
 - > The location of that block on a particular datanode is returned to the client
 - > The client then reads data directly from there



The screenshot shows a web browser window titled 'HDFS:/' with the address bar containing 'localhost.localdomain:50075/browseDire'. The page displays the 'Contents of directory /' and a table of files and directories. The table has columns for Name, Type, Size, Replication, Block Size, Modification Time, Permission, Owner, and Group. The entries are as follows:

Name	Type	Size	Replication	Block Size	Modification Time	Permission	Owner	Group
hbase	dir				2014-08-03 13:33	rw-r-xr-x	hbase	hbase
solr	dir				2014-03-10 08:45	rw-r-xr-x	solr	solr
tmp	dir				2014-08-01 17:16	rw-rw-rw-	hdfs	supergroup
user	dir				2014-06-03 10:36	rw-r-xr-x	hdfs	supergroup
var	dir				2014-03-10 08:44	rw-r-xr-x	hdfs	supergroup

HDFS Architecture



HDFS Internal Directories

- Directory where namenode stores its metadata
 - > Set with default value `${hadoop.tmp.dir}/dfs/name`
 - > Can be specified explicitly by `dfs.name.dir`
- Directory where HDFS data blocks are stored
 - > Set with default value `${hadoop.tmp.dir}/dfs/data`
 - > Can be specified explicitly by `dfs.data.dir`
- Directory where secondary namenode store its checkpoints
 - > Set with default value is `${hadoop.tmp.dir}/dfs/namesecondary`
 - > Can be specified explicitly by `fs.checkpoint.dir`

HD FS Features

Blocks in Data nodes

- Blocks are 64M bytes (default)
 - > In Cloudera QuickStart VM, it is set to 128M bytes
- HDFS handles
 - > Block placement
 - > Rebalancing
 - > Replication management

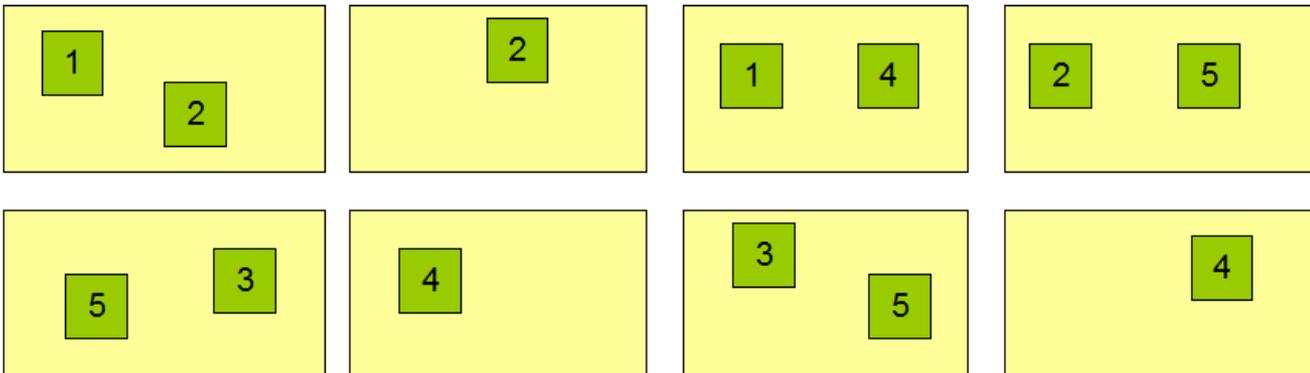
Block Replication

- Blocks are replicated for reliability

Block Replication

Namenode (Filename, numReplicas, block-ids, ...)
/users/sameerp/data/part-0, r:2, {1,3}, ...
/users/sameerp/data/part-1, r:3, {2,4,5}, ...

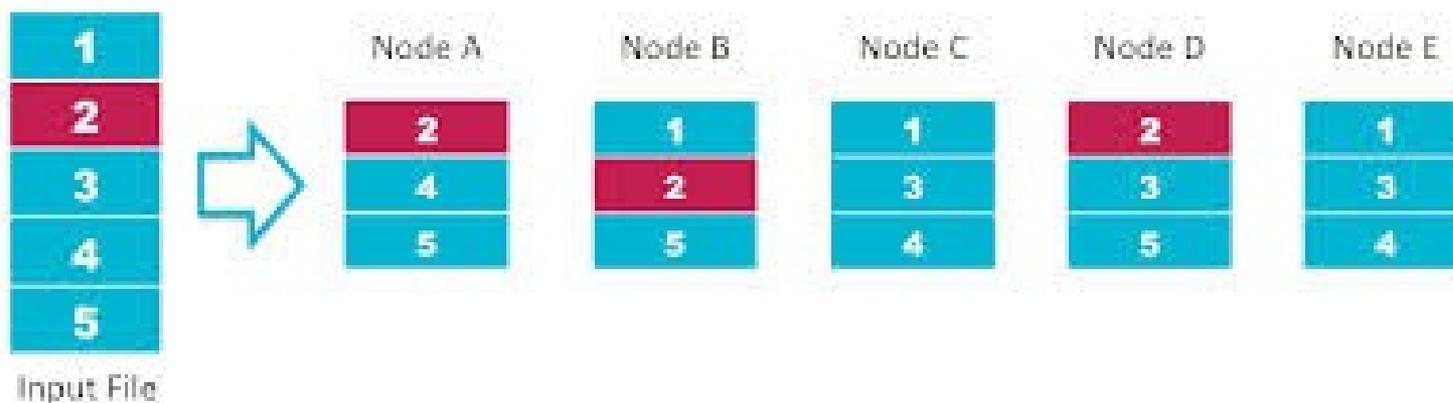
Datanodes



HDFS Data Distribution

- Number of data nodes a block is placed on is controlled by replication factor - If your replication is set to 3, it will be put on 3 separate data nodes

HDFS Data Distribution



- Block is also placed across different racks
 - > If you set replication of 3 and have 2 racks, two blocks will be in one rack and the third block will be placed in the other rack

Lab:

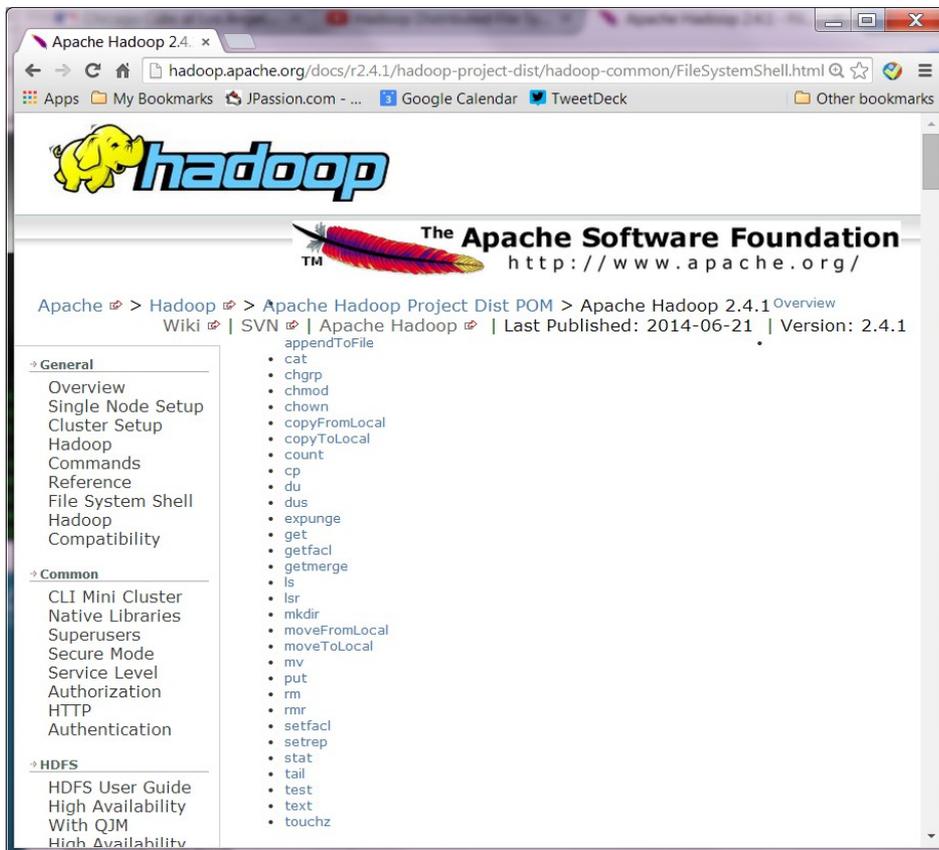
Exercise 1: Study the HDFS Architecture
5906_hadoop_hdfs.zip



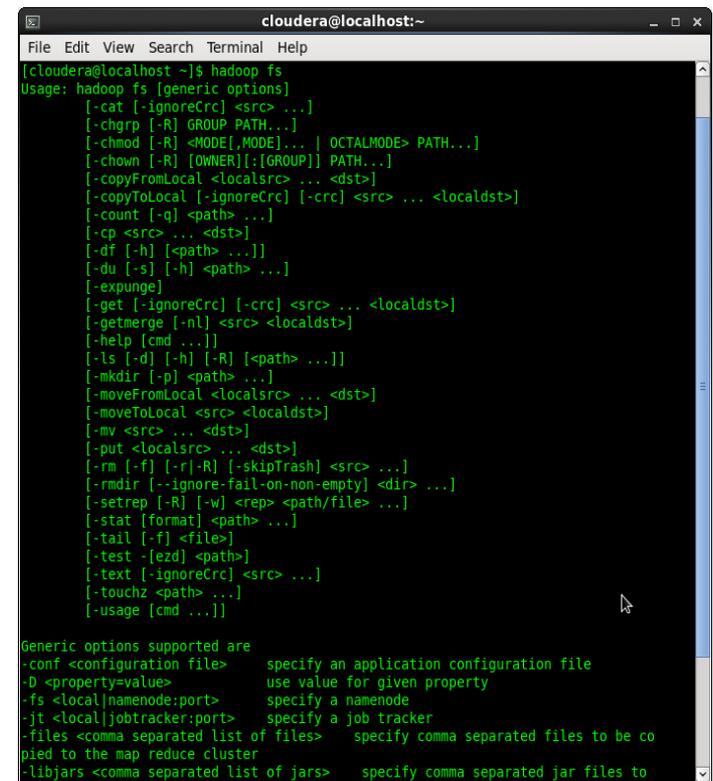
HDFS Commands

HDFS Commands

- <http://hadoop.apache.org/docs/r2.4.1/hadoop-project-dist/hadoop-common/FileSystemShell.html>



The screenshot shows the Apache Hadoop 2.4.1 website. The main navigation menu includes: General, Common, and HDFS. Under the HDFS section, the following links are listed: HDFS User Guide, High Availability With QJM, and High Availability. The page also features the Hadoop logo and the Apache Software Foundation logo.



```
cloudera@localhost:~  
File Edit View Search Terminal Help  
[cloudera@localhost ~]$ hadoop fs  
Usage: hadoop fs [generic options]  
[-cat [-ignoreCrc] <src> ...]  
[-chgrp [-R] GROUP PATH...]  
[-chmod [-R] <MODE[,MODE]... | OCTALMODE> PATH...]  
[-chown [-R] [OWNER][:[GROUP]] PATH...]  
[-copyFromLocal <localsrc> ... <dst>]  
[-copyToLocal [-ignoreCrc] [-crc] <src> ... <localdst>]  
[-count [-q] <path> ...]  
[-cp <src> ... <dst>]  
[-df [-h] <path> ...]  
[-du [-s] [-h] <path> ...]  
[-expunge]  
[-get [-ignoreCrc] [-crc] <src> ... <localdst>]  
[-getmerge [-nl] <src> <localdst>]  
[-help [cmd ...]]  
[-ls [-d] [-h] [-R] <path> ...]  
[-mkdir [-p] <path> ...]  
[-moveFromLocal <localsrc> ... <dst>]  
[-moveToLocal <src> <localdst>]  
[-mv <src> ... <dst>]  
[-put <localsrc> ... <dst>]  
[-rm [-f] [-r] [-R] [-skipTrash] <src> ...]  
[-rmdir [-ignore-fail-on-non-empty] <dir> ...]  
[-setrep [-R] [-w] <rep> <path/file> ...]  
[-stat [format] <path> ...]  
[-tail [-f] <file>]  
[-test [-ezd] <path>]  
[-text [-ignoreCrc] <src> ...]  
[-touchz <path> ...]  
[-usage [cmd ...]]  
  
Generic options supported are  
-conf <configuration file> specify an application configuration file  
-D <property=value> use value for given property  
-fs <local|namenode:port> specify a namenode  
-jt <local|jobtracker:port> specify a job tracker  
-files <comma separated list of files> specify comma separated files to be copied to the map reduce cluster  
-libjars <comma separated list of jars> specify comma separated jar files to
```

HDFS Commands

- Start with “`hadoop fs -<command>`”
 - > `hadoop fs -ls`
 - > `hadoop fs -cat`
 - > `hadoop fs -mkdir test_dir1`
 - > `hadoop fs -rm -r test_dir1`
- Copying local directory/files to HDFS
 - > `hadoop fs -copyFromLocal <local-directory/files> <HDFS-directory/files>`
- Copying HDFS directory/files to local file system
 - > `hadoop fs -copyToLocal <HDFS-directory/files> <local-directory/files>`

Lab:

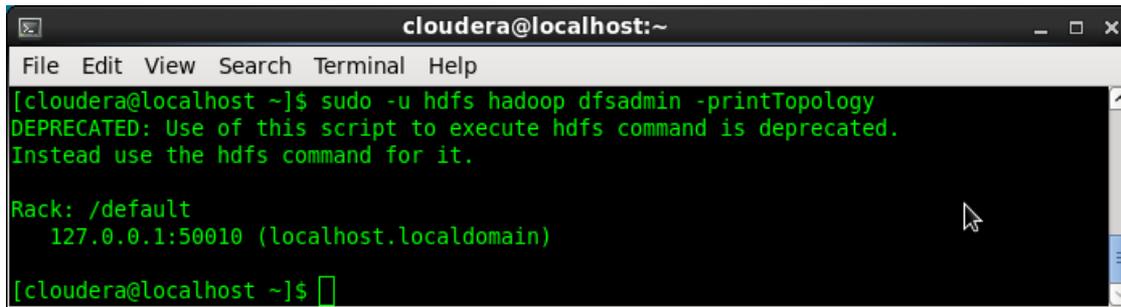
Exercise 2: Command-line HDFS Operations 5906_hadoop_hdfs.zip



HDFS Admin Commands

HDFS Admin Commands

- http://hadoop.apache.org/docs/r1.0.4/commands_manual.html#Administration+Commands

A terminal window titled 'cloudera@localhost:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the execution of the command 'sudo -u hdfs hadoop dfsadmin -printTopology'. The output is green text: 'DEPRECATED: Use of this script to execute hdfs command is deprecated. Instead use the hdfs command for it.' followed by 'Rack: /default' and '127.0.0.1:50010 (localhost.localdomain)'. The prompt returns to '[cloudera@localhost ~]\$'.

```
cloudera@localhost:~  
File Edit View Search Terminal Help  
[cloudera@localhost ~]$ sudo -u hdfs hadoop dfsadmin -printTopology  
DEPRECATED: Use of this script to execute hdfs command is deprecated.  
Instead use the hdfs command for it.  
  
Rack: /default  
127.0.0.1:50010 (localhost.localdomain)  
[cloudera@localhost ~]$
```

Lab:

**Exercise 3: Command-line HDFS
Admin Operations
5906_hadoop_hdfs.zip**



HDFS Web UI

HDFS Web UI

- NameNode and DataNode each run an internal web server in order to display basic information about the current status of the cluster.
 - > With the default configuration, the NameNode front page is at <http://namenode-name:50070/>
 - > It lists the DataNodes in the cluster and basic statistics of the cluster
- The web interface can also be used to browse the file system (using "Browse the file system" link on the NameNode front page).

HDFS Web UI

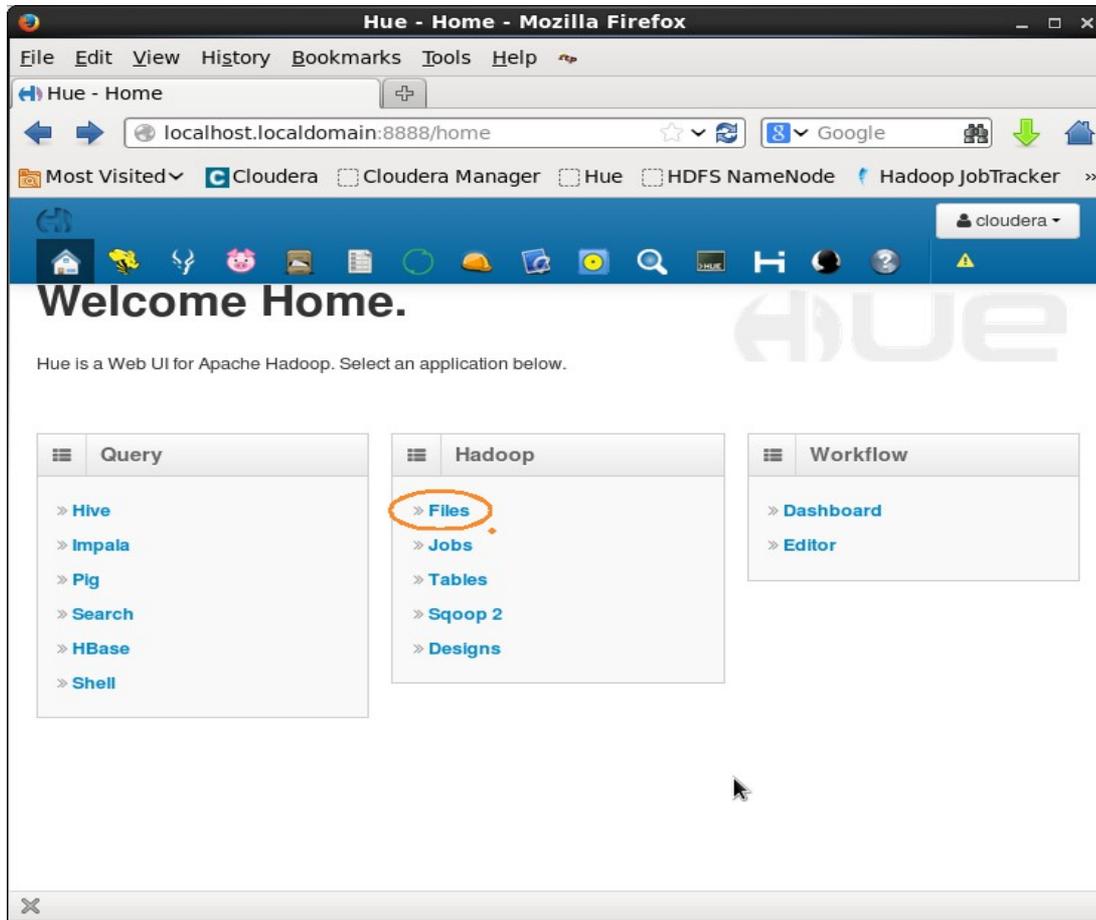
The screenshot shows the HDFS Web UI in a Mozilla Firefox browser window. The address bar displays the URL `localhost.localdomain:50075/browseDirectory.jsp?i`. The page title is "HDFS:/" and the content area shows "Contents of directory /". Below this is a "Goto:" field with a "go" button. A table lists the contents of the directory, with the "user" entry circled in red. Below the table is a link "Go back to DFS home" and a section for "Local logs" with a "Log directory" link and the text "Hadoop, 2014.".

Name	Type	Size	Replication	Block Size	Modification Time	Permission	Owner	Group
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tmp	dir				2014-08-01 17:16	rwXrwxrwx	hdfs	supergroup
user	dir				2014-06-03 10:36	rwXR-Xr-X	hdfs	supergroup
var	dir				2014-03-10 08:44	rwXR-Xr-X	hdfs	supergroup

Hue Web UI

What is Hue?

- Hue is a Web interface for all Hadoop related operations



Lab:

Exercise 4: Hue Web UI Interface 5906_hadoop_hdfs.zip



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