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HADOOP SET UP A SINGLE HADOOP CLUSTER AND SHOW THE PROCESS USING WEB UI

AIM:

To set-up one node Hadoop cluster.

PROCEDURE:

1. System Update
2. Install Java
3. Add a dedicated Hadoop user
4. Install SSH and setup SSH certificates
5. Check if SSH works
6. Install Hadoop
7. Modify Hadoop config files
8. Format Hadoop filesystem
9. Start Hadoop
10. Check Hadoop through web UI
11. Stop Hadoop

THEORY

Hadoop is an Apache open source framework written in java that allows distributed processing of large datasets across clusters of computers using simple programming models. A Hadoop frameworked application works in an environment that provides distributed storage and computation across clusters of computers. Hadoop is designed to scale up from a single server to thousands of machines, each offering local computation and storage.

HADOOP ARCHITECTURE

Hadoop framework includes following four modules:

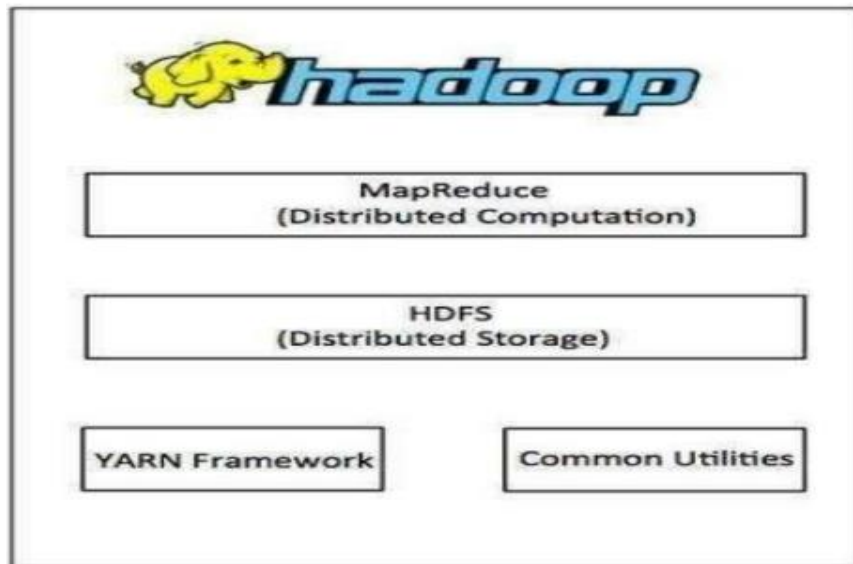
Hadoop Common: These are Java libraries and utilities required by other Hadoop modules. These libraries provide filesystem and OS level abstractions and contain the necessary Java files and scripts required to start Hadoop.

Hadoop YARN: This is a framework for job scheduling and cluster resource management

Hadoop Distributed File System (HDFS): A distributed file system that provides highthroughput access to application data.

Hadoop MapReduce: This is a YARN-based system for parallel processing of large data sets.

We can use following diagram to depict these four components available in Hadoop Framework.



PROCEDURE

Step 1 – System Update

\$ sudo apt-get update

```
ubuntu@ubuntu-VirtualBox: ~  
ubuntu@ubuntu-VirtualBox:~$ sudo apt-get update  
[sudo] password for ubuntu:  
Hit http://in.archive.ubuntu.com wily InRelease  
Get:1 http://security.ubuntu.com wily-security InRelease [65.9 kB]  
Get:2 http://in.archive.ubuntu.com wily-updates InRelease [65.9 kB]  
Get:3 http://security.ubuntu.com wily-security/main Sources [53.8 kB]  
Hit http://in.archive.ubuntu.com wily-backports InRelease  
Get:4 http://security.ubuntu.com wily-security/restricted Sources [2,854 B]  
Get:5 http://security.ubuntu.com wily-security/universe Sources [13.9 kB]  
Get:6 http://security.ubuntu.com wily-security/multiverse Sources [2,784 B]  
Get:7 http://security.ubuntu.com wily-security/main amd64 Packages [172 kB]  
Get:8 http://security.ubuntu.com wily-security/restricted amd64 Packages [10.9 k  
B]  
Get:9 http://security.ubuntu.com wily-security/universe amd64 Packages [56.2 kB]  
Get:10 http://security.ubuntu.com wily-security/multiverse amd64 Packages [6,248  
B]  
Get:11 http://security.ubuntu.com wily-security/main i386 Packages [169 kB]  
Get:12 http://security.ubuntu.com wily-security/restricted i386 Packages [10.8 k  
B]  
100% [Waiting for headers] [Waiting for headers] 73.8 kB/s 0s
```

Step 2 – Install Java and Set JAVA_HOME

//This first thing to do is to setup the webupd8 ppa on your system. Run the following command and proceed.

```
$ sudo apt-add-repository ppa:webupd8team/java
```

```
$ sudo apt-get update
```

//After setting up the ppa repository, update the package cache as well.

//Install the Java 8 installer

```
$ sudo apt-get install oracle-java8-installer
```

// After the installation is finished, Oracle Java is setup. Run the java command again to check the version and vendor.

```
ubuntu@ubuntu-VirtualBox:~$ sudo apt-get install oracle-java8-installer
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libntdb1 python-ntdb
Use 'apt-get autoremove' to remove them.
The following extra packages will be installed:
  gsfonnts-x11 java-common
Suggested packages:
  default-jre equivs binfmt-support visualvm ttf-baeknuk ttf-unfonts
  ttf-unfonts-core ttf-kochi-gothic ttf-sazanami-gothic ttf-kochi-mincho
  ttf-sazanami-mincho ttf-arphic-uming
The following NEW packages will be installed:
  gsfonnts-x11 java-common oracle-java8-installer
0 upgraded, 3 newly installed, 0 to remove and 0 not upgraded.
Need to get 163 kB of archives.
After this operation, 511 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://ppa.launchpad.net/webupd8team/java/ubuntu/ wily/main oracle-java8-i
nstaller all 8u101+8u101arm-1-webupd8-2 [23.6 kB]
```

OR

```
$ sudo apt-get install default-jdk
```

```
$ java -version
```

```
thirueswaran-v@thirueswaran-v-VirtualBox:~$ java -version
openjdk version "1.8.0_422"
OpenJDK Runtime Environment (build 1.8.0_422-8u422-b05-1~24.04-b05)
OpenJDK 64-Bit Server VM (build 25.422-b05, mixed mode)
```

Step 3 – Add a dedicated Hadoop user

\$ sudo addgroup hadoop

```
ubuntu@ubuntu-VirtualBox:~$ sudo addgroup hadoop
Adding group 'hadoop' (GID 1001) ...
Done.
```

\$ sudo adduser --ingroup hadoop hduser

```
ubuntu@ubuntu-VirtualBox:~$ sudo adduser --ingroup hadoop hduser
Adding user 'hduser' ...
Adding new user 'hduser' (1001) with group 'hadoop' ...
Creating home directory '/home/hduser' ...
Copying files from '/etc/skel' ...
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
Changing the user information for hduser
Enter the new value, or press ENTER for the default
  Full Name []:
  Room Number []:
  Work Phone []:
  Home Phone []:
  Other []:
Is the information correct? [Y/n] y
```

// Add hduser to sudo user group

\$ sudo adduser hduser sudo

```
ubuntu@ubuntu-VirtualBox:~$ sudo adduser hduser sudo
Adding user 'hduser' to group 'sudo' ...
Adding user hduser to group sudo
Done.
ubuntu@ubuntu-VirtualBox:~$
```

Step 4 – Install SSH and Create Certificates

\$ sudo apt-get install ssh

```
ubuntu@ubuntu-VirtualBox:~$ sudo apt-get install ssh
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libntdb1 python-ntdb
Use 'apt-get autoremove' to remove them.
The following extra packages will be installed:
  libck-connector0 ncurses-term openssh-server openssh-sftp-server
  ssh-import-id
Suggested packages:
  rssh molly-guard monkeysphere
The following NEW packages will be installed:
  libck-connector0 ncurses-term openssh-server openssh-sftp-server ssh
  ssh-import-id
0 upgraded, 6 newly installed, 0 to remove and 8 not upgraded.
Need to get 661 kB of archives.
```

\$ su hduser

```
ubuntu@ubuntu-VirtualBox:~$ su hduser
Password:
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
```

\$ ssh-keygen -t rsa -P ""

```
hduser@ubuntu-VirtualBox:~$ ssh-keygen -t rsa -P ""
Generating public/private rsa key pair.
Enter file in which to save the key (/home/hduser/.ssh/id_rsa):
Created directory '/home/hduser/.ssh'.
Your identification has been saved in /home/hduser/.ssh/id_rsa.
Your public key has been saved in /home/hduser/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:K/F5oNmAqhY02Axp0vzew4EnrN+UGgDTgxIiFPHpT7Q hduser@ubuntu-VirtualBox
The key's randomart image is:
+---[RSA 2048]---+
|=@o
|@.*
|=* * o
|.o= *.+
|. .=.EooS
|...= *B +
|o. *+.= .
|o o ..
|o
+-----[SHA256]-----+
```

// Set Environmental variables

\$ cat \$HOME/.ssh/id_rsa.pub >> \$HOME/.ssh/authorized_keys

```
hduser@ubuntu-VirtualBox:~$ cat $HOME/.ssh/id_rsa.pub >> $HOME/.ssh/authorized_keys
```

Step 6 – Install Hadoop

\$ wget https://archive.apache.org/dist/hadoop/core/hadoop-2.8.4/hadoop-2.8.4.tar.gz

// Extract Hadoop-2.8.4

\$ sudo tar xvzf hadoop-2.8.4.tar.gz

```
hduser@ubuntu-VirtualBox:~$ tar xvzf hadoop-2.7.2.tar.gz
```

// Create a folder 'hadoop' in /usr/local

\$ sudo mkdir -p /usr/local/hadoop

```
hduser@ubuntu-VirtualBox:~$ sudo mkdir -p /usr/local/hadoop
[sudo] password for hduser:
```


// Move the Hadoop folder to /usr/local/hadoop

\$ sudo mv hadoop-2.8.4 /usr/local/hadoop

A terminal window screenshot showing the command 'sudo mv hadoop-2.7.2 /usr/local/hadoop' being executed by the user 'hduser' on a system named 'ubuntu-VirtualBox'.

// Assigning read and write access to Hadoop folder

\$ sudo chown -R hduser:hadoop /usr/local/hadoop

A terminal window screenshot showing the command 'sudo chown hduser:hadoop -R /usr/local/hadoop' being executed by the user 'hduser' from the directory '/usr/local/hadoop/hadoop-2.7.2'.

Step 7 - Modify Hadoop config files

//Hadoop Environmental variable setting – The following files will be modified

1. ~/.bashrc
2. /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/hadoop-env.sh
3. /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/core-site.xml
4. /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/hdfs-site.xml
5. /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/yarn-site.xml
6. /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/mapred-site.xml.template

\$ sudo nano ~/.bashrc

// Add the following lines at the end of the file

export JAVA_HOME=/usr/lib/jvm/java-8-oracle

export HADOOP_HOME=/usr/local/hadoop/hadoop-2.8.4 export

PATH=\$PATH:\$HADOOP_HOME/bin

export PATH=\$PATH:\$HADOOP_HOME/sbin

export HADOOP_MAPRED_HOME=\$HADOOP_HOME export

HADOOP_COMMON_HOME=\$HADOOP_HOME export

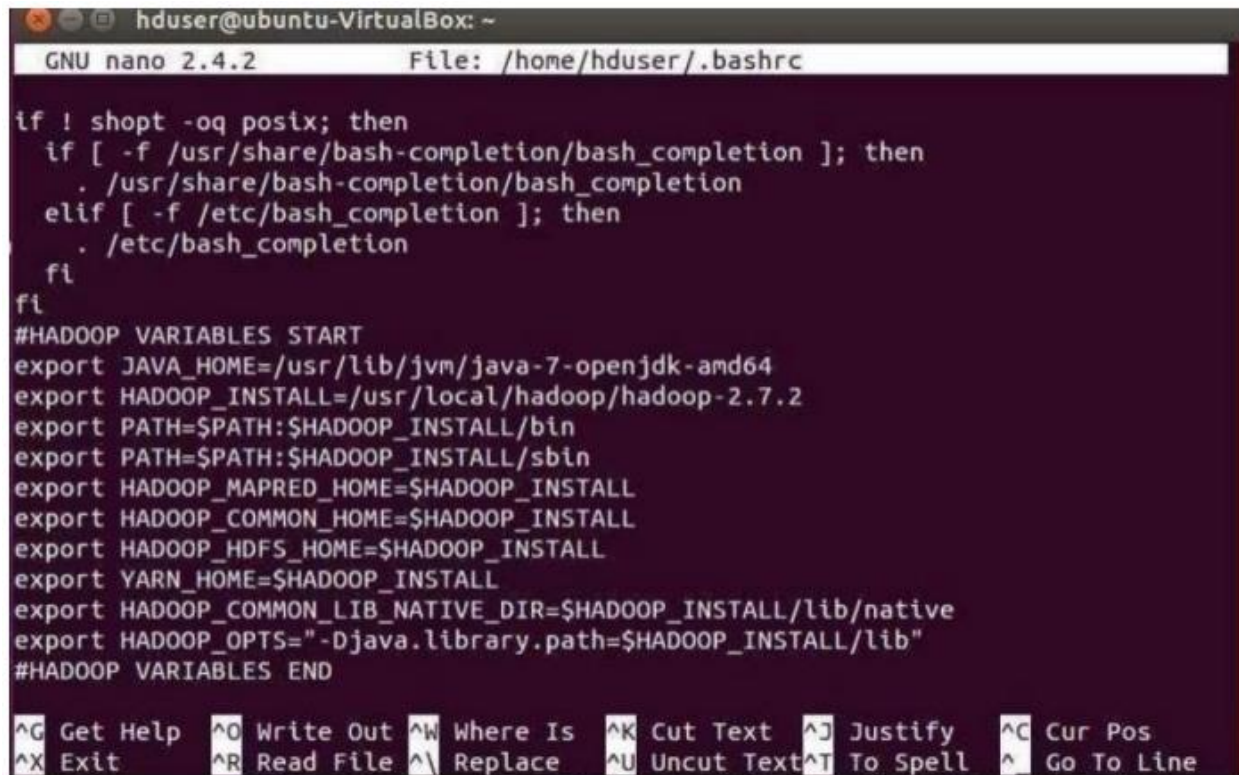
HADOOP_HDFS_HOME=\$HADOOP_HOME

export YARN_HOME=\$HADOOP_HOME

HADOOP_COMMON_LIB_NATIVE_DIR=\$HADOOP_HOME/lib/native export

HADOOP_OPTS="-Djava.library.path=\$HADOOP_HOME/lib" export

PATH=\$PATH:/usr/local/hadoop/hadoop-2.8.4/bin



The screenshot shows a terminal window titled 'hduser@ubuntu-VirtualBox: ~' with the GNU nano 2.4.2 editor open to the file '/home/hduser/.bashrc'. The file contains configuration for Hadoop and Yarn. The configuration includes a conditional block for bash completion, followed by a section titled '#HADOOP VARIABLES START' which sets various environment variables like JAVA_HOME, HADOOP_INSTALL, PATH, HADOOP_MAPRED_HOME, HADOOP_COMMON_HOME, HADOOP_HDFS_HOME, YARN_HOME, HADOOP_COMMON_LIB_NATIVE_DIR, and HADOOP_OPTS. The section ends with '#HADOOP VARIABLES END'. At the bottom of the terminal, there is a row of keyboard shortcuts for nano: ^G Get Help, ^O Write Out, ^W Where Is, ^K Cut Text, ^J Justify, ^C Cur Pos, ^X Exit, ^R Read File, ^\ Replace, ^U Uncut Text, ^T To Spell, and ^_ Go To Line.

```
GNU nano 2.4.2 File: /home/hduser/.bashrc

if ! shopt -oq posix; then
  if [ -f /usr/share/bash-completion/bash_completion ]; then
    . /usr/share/bash-completion/bash_completion
  elif [ -f /etc/bash_completion ]; then
    . /etc/bash_completion
  fi
fi

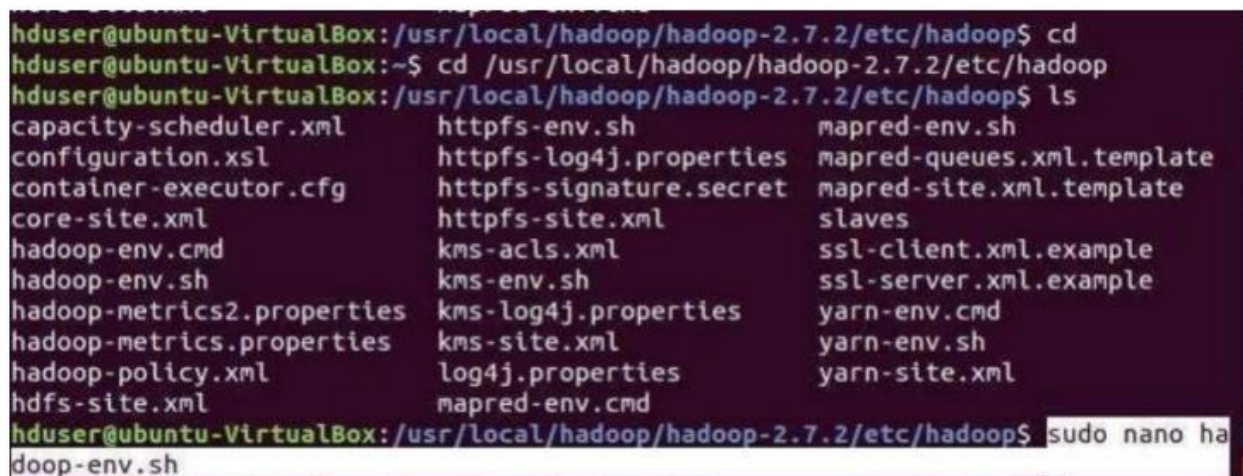
#HADOOP VARIABLES START
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-amd64
export HADOOP_INSTALL=/usr/local/hadoop/hadoop-2.7.2
export PATH=$PATH:$HADOOP_INSTALL/bin
export PATH=$PATH:$HADOOP_INSTALL/sbin
export HADOOP_MAPRED_HOME=$HADOOP_INSTALL
export HADOOP_COMMON_HOME=$HADOOP_INSTALL
export HADOOP_HDFS_HOME=$HADOOP_INSTALL
export YARN_HOME=$HADOOP_INSTALL
export HADOOP_COMMON_LIB_NATIVE_DIR=$HADOOP_INSTALL/lib/native
export HADOOP_OPTS="-Djava.library.path=$HADOOP_INSTALL/lib"
#HADOOP VARIABLES END

^G Get Help  ^O Write Out  ^W Where Is  ^K Cut Text  ^J Justify  ^C Cur Pos
^X Exit      ^R Read File  ^\ Replace   ^U Uncut Text ^T To Spell  ^_ Go To Line
```

// Configure Hadoop Files

\$ cd /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/

\$ sudo nano hadoop-env.sh



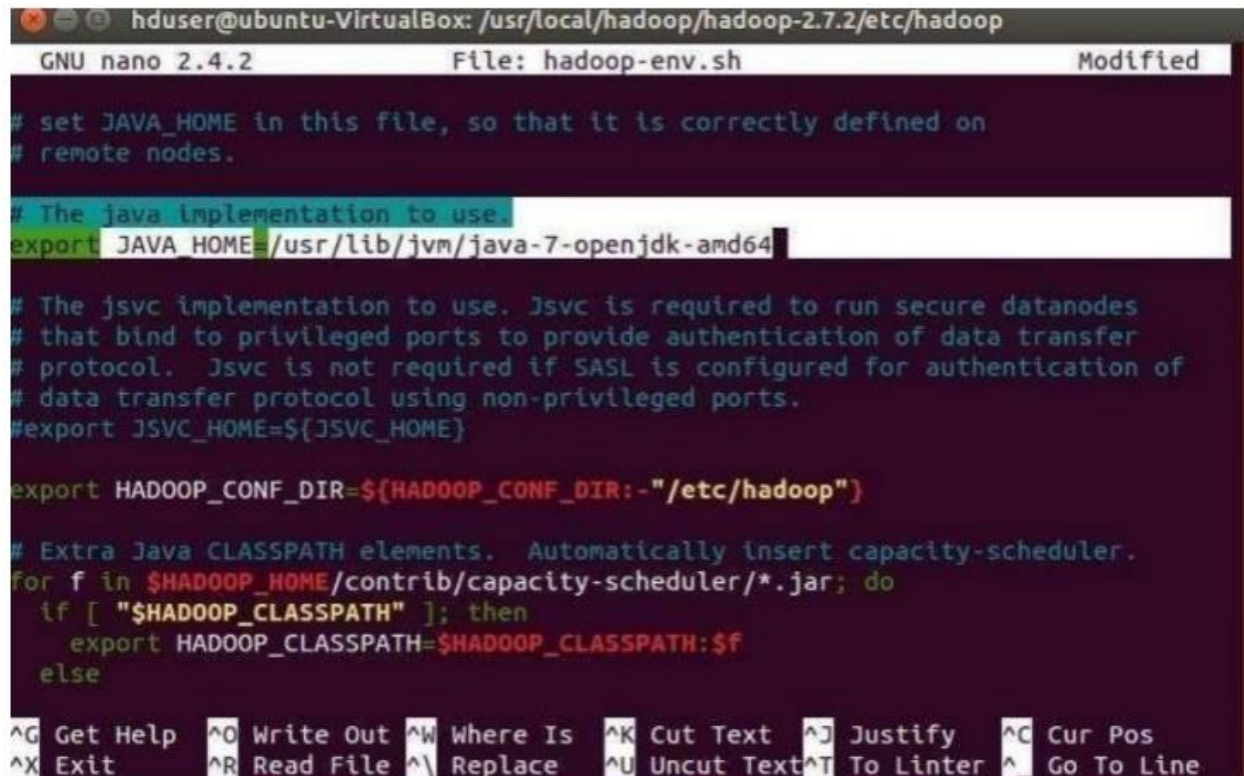
The screenshot shows a terminal window titled 'hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop\$'. The user has executed 'cd /usr/local/hadoop/hadoop-2.7.2/etc/hadoop' and then 'ls'. The output of 'ls' is a long list of files and directories, including configuration files like capacity-scheduler.xml, configuration.xsl, container-executor.cfg, core-site.xml, hadoop-env.sh, hadoop-metrics2.properties, hadoop-metrics.properties, hadoop-policy.xml, hdfs-site.xml, httpfs-env.sh, httpfs-log4j.properties, httpfs-signature.secret, httpfs-site.xml, kms-acls.xml, kms-env.sh, kms-log4j.properties, kms-site.xml, log4j.properties, mapred-env.sh, mapred-env.cmd, mapred-queues.xml.template, mapred-site.xml.template, slaves, ssl-client.xml.example, ssl-server.xml.example, yarn-env.cmd, yarn-env.sh, and yarn-site.xml. The prompt is now 'hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop\$' and the user has started typing 'sudo nano ha' followed by 'doop-env.sh' on the next line.

```
hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop$ cd
hduser@ubuntu-VirtualBox: ~$ cd /usr/local/hadoop/hadoop-2.7.2/etc/hadoop
hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop$ ls
capacity-scheduler.xml      httpfs-env.sh              mapred-env.sh
configuration.xsl          httpfs-log4j.properties   mapred-queues.xml.template
container-executor.cfg     httpfs-signature.secret   mapred-site.xml.template
core-site.xml              httpfs-site.xml           slaves
hadoop-env.cmd             kms-acls.xml              ssl-client.xml.example
hadoop-env.sh              kms-env.sh                ssl-server.xml.example
hadoop-metrics2.properties kms-log4j.properties      yarn-env.cmd
hadoop-metrics.properties kms-site.xml              yarn-env.sh
hadoop-policy.xml          log4j.properties          yarn-site.xml
hdfs-site.xml              mapred-env.cmd
hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop$ sudo nano ha
doop-env.sh
```

// Add following line in hadoop-env.sh – Set JAVA variable in Hadoop

The java implementation to use.

export JAVA_HOME=/usr/lib/jvm/java-8-oracle



```
hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop
GNU nano 2.4.2 File: hadoop-env.sh Modified

# set JAVA_HOME in this file, so that it is correctly defined on
# remote nodes.

# The java implementation to use.
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-amd64

# The jsvc implementation to use. Jsvc is required to run secure datanodes
# that bind to privileged ports to provide authentication of data transfer
# protocol. Jsvc is not required if SASL is configured for authentication of
# data transfer protocol using non-privileged ports.
#export JSVC_HOME=${JSVC_HOME}

export HADOOP_CONF_DIR=${HADOOP_CONF_DIR:-"/etc/hadoop"}

# Extra Java CLASSPATH elements. Automatically insert capacity-scheduler.
for f in $HADOOP_HOME/contrib/capacity-scheduler/*.jar; do
    if [ "$HADOOP_CLASSPATH" ]; then
        export HADOOP_CLASSPATH=$HADOOP_CLASSPATH:$f
    else

```

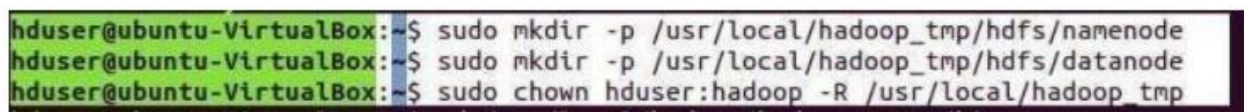
// Create datanode and namenode

\$ sudo mkdir -p /usr/local/hadoop_tmp/hdfs/namenode

\$ sudo mkdir -p /usr/local/hadoop_tmp/hdfs/datanode

// Changing ownership to hadoop_tmp

\$ sudo chown -R hduser:hadoop /usr/local/hadoop_tmp



```
hduser@ubuntu-VirtualBox:~$ sudo mkdir -p /usr/local/hadoop_tmp/hdfs/namenode
hduser@ubuntu-VirtualBox:~$ sudo mkdir -p /usr/local/hadoop_tmp/hdfs/datanode
hduser@ubuntu-VirtualBox:~$ sudo chown hduser:hadoop -R /usr/local/hadoop_tmp
```

// Edit hdfs-site.xml

\$ sudo nano hdfs-site.xml

// Add the following lines between <configuration> </configuration>


```
<configuration>

<property>

<name>dfs.replication</name>

<value>1</value>

</property>

<property>

<name>dfs.namenode.name.dir</name>

<value>file:/usr/local/hadoop_tmp/hdfs/namenode</value>

</property>

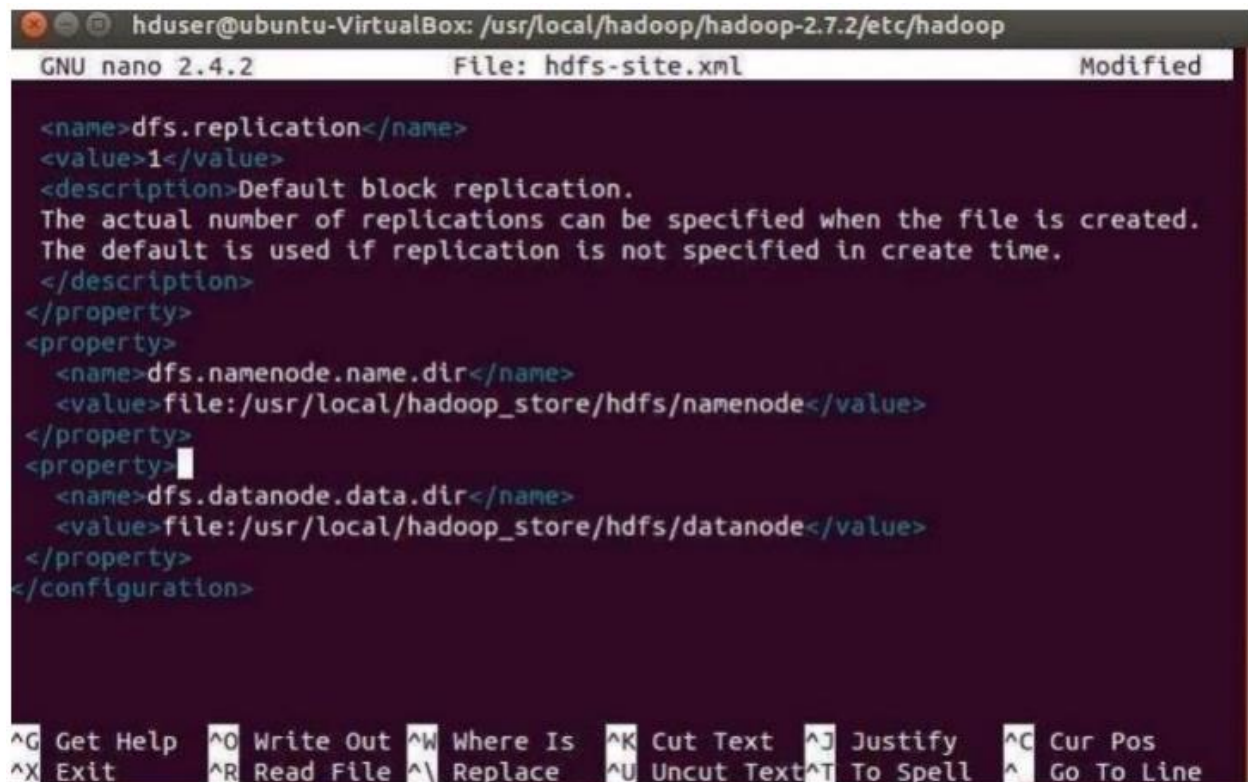
<property>

<name>dfs.datanode.data.dir</name>

<value>file:/usr/local/hadoop_tmp/hdfs/datanode</value>

</property>

</configuration>
```



```
hduser@ubuntu-VirtualBox: /usr/local/hadoop/hadoop-2.7.2/etc/hadoop
GNU nano 2.4.2      File: hdfs-site.xml      Modified

<name>dfs.replication</name>
<value>1</value>
<description>Default block replication.
The actual number of replications can be specified when the file is created.
The default is used if replication is not specified in create time.
</description>
</property>
<property>
  <name>dfs.namenode.name.dir</name>
  <value>file:/usr/local/hadoop_store/hdfs/namenode</value>
</property>
<property>
  <name>dfs.datanode.data.dir</name>
  <value>file:/usr/local/hadoop_store/hdfs/datanode</value>
</property>
</configuration>

^G Get Help  ^O Write Out  ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit      ^R Read File  ^\ Replace   ^U Uncut Text ^T To Spell  ^_ Go To Line
```

```
// Edit core-site.xml

$ sudo nano core-site.xml

// Add the following lines between <configuration> ..... </configuration>

<configuration>

<property>

<name>fs.default.name</name>

<value>hdfs://localhost:9000</value>

</property>

</configuration>

// Edit yarn-site.xml

$ sudo nano yarn-site.xml

// Add the following lines between <configuration> ..... </configuration>

<configuration>

<property>

<name>yarn.nodemanager.aux-services</name>

<value>mapreduce_shuffle</value>

</property>

<property>

<name>yarn.nodemanager.aux-services.mapreduce.shuffle.class</name>

<value>org.apache.hadoop.mapred.Shuffle-Handler</value>

</property>

</configuration>

// Edit mapred-site.xml

$ cp /usr/local/hadoop/hadoop-2.8.4/etc/hadoop/mapred-site.xml.template

/usr/local/hadoop/hadoop-2.8.4/etc/hadoop/mapred-site.xml
```

```
hduser@ubuntu-VirtualBox:~$ cp /usr/local/hadoop/hadoop-2.7.2/etc/hadoop/mapred-site.xml.template /usr/local/hadoop/hadoop-2.7.2/etc/hadoop/mapred-site.xml
```

\$ sudo nano mapred-site.xml

// Add the following lines between <configuration> </configuration>

<configuration>

<property>

<name>mapreduce.framework.name</name>

<value>yarn</value>

</property>

</configuration>

Step 8 – Format Hadoop File System

\$ cd /usr/local/hadoop/hadoop-2.8.4/bin

\$ hadoop namenode -format

```
hduser@ubuntu-VirtualBox:/usr/local/hadoop$ hadoop namenode -format
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.

16/07/15 22:50:27 INFO namenode.NameNode: STARTUP_MSG:
/*****
STARTUP_MSG: Starting NameNode
```

Step 9 - Start Hadoop

\$ cd /usr/local/hadoop/hadoop-2.8.4/sbin

// Starting dfs services

\$ start-dfs.sh

```
hduser@ubuntu-VirtualBox:/usr/local/hadoop/hadoop-2.7.2/sbin$ start-dfs.sh
16/07/15 22:55:47 WARN util.NativeCodeLoader: Unable to load native-hadoop library
for your platform... using builtin-java classes where applicable
Starting namenodes on [localhost]
localhost: starting namenode, logging to /usr/local/hadoop/hadoop-2.7.2/logs/had
oop-hduser-namenode-ubuntu-VirtualBox.out
localhost: starting datanode, logging to /usr/local/hadoop/hadoop-2.7.2/logs/had
oop-hduser-datanode-ubuntu-VirtualBox.out
Starting secondary namenodes [0.0.0.0]
The authenticity of host '0.0.0.0 (0.0.0.0)' can't be established.
ECDSA key fingerprint is SHA256:+j+WF1JPso0Vl5mgcc7v9A/rU8jVQEHE8WfLmt2aEo8.
Are you sure you want to continue connecting (yes/no)? yes
0.0.0.0: Warning: Permanently added '0.0.0.0' (ECDSA) to the list of known hosts
.
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/hadoop-2.7.2/l
ogs/hadoop-hduser-secondarynamenode-ubuntu-VirtualBox.out
```

// Starting mapreduce services

\$ start-yarn.sh

```
hduser@ubuntu-VirtualBox:/usr/local/hadoop/hadoop-2.7.2/sbin$ start-yarn.sh
starting yarn daemons
starting resourcemanager, logging to /usr/local/hadoop/hadoop-2.7.2/logs/yarn-hd
user-resourcemanager-ubuntu-VirtualBox.out
localhost: starting nodemanager, logging to /usr/local/hadoop/hadoop-2.7.2/logs/
yarn-hduser-nodemanager-ubuntu-VirtualBox.out
```

\$ jps

```
hduser@ubuntu-VirtualBox:/usr/local/hadoop/hadoop-2.7.2/sbin$ jps
12425 SecondaryNameNode
12609 ResourceManager
12733 NodeManager
13131 Jps
12205 DataNode
12080 NameNode
```

Step 10 - Check Hadoop through web UI

Go to browser type <http://localhost:8088> – All Applications Hadoop Cluster

The screenshot shows the Hadoop All Applications web UI. The browser address bar displays localhost:8088/cluster. The page features the Hadoop logo and a sidebar with navigation links. The main content area displays Cluster Metrics and Scheduler Metrics.

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VC Total
0	0	0	0	0	0 B	8 GB	0 B	0	8

ID	User	Name	Application Type	Queue	StartTime	FinishTime	State
----	------	------	------------------	-------	-----------	------------	-------

Go to browser type <http://localhost:50070> – Hadoop Namenode

The screenshot shows the Hadoop Namenode Information web UI. The browser address bar displays localhost:50070/dfshealth.html#fs-tracks-overview. The page features the Hadoop logo and a sidebar with navigation links. The main content area has a green header and a footer indicating Hadoop 2015.

Step 11 - Stop Hadoop

```
$ stop-dfs.sh
```

```
$ stop-yarn.sh
```

RESULT:

Thus the procedure to install single-node Hadoop is executed successfully.