KUMARAGURU COLLEGE OF TECHNOLOGY

U18ISI5202- BIG DATA LABORATORY MANUAL

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LAB EXERCISE-1

Title of the exercise/experiment: Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, fully distributed

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

- Installationof HadoopFramework,it'scomponentsandstudythe HadoopEcosystem.
- Performsettingup andInstallingHadoopin itsthreeoperating modes:Standalone, Pseudo distributed,fullydistributed.

THEORY:

Hadoop is an open-source framework that allows to store and process big data in a distributed environment across clusters of computers using simple programming models.

Hadoop software can be installed in three modes of operation:

- Stand Alone Mode: Hadoop is a distributed software and is designed to run on a commodity of machines. However, we can install it on a single node in stand-alone mode. In this mode, Hadoop software runs as a single monolithic java process. This mode is extremely useful for debugging purpose. You can first

  test run your Map-Reduce application in this mode on small data, before actually executing it on cluster with big data.

- Pseudo Distributed Mode: In this mode also, Hadoop software is installed on a Single Node. Various daemons of Hadoop will run on the same machine as separate java processes. Hence all the daemons namely Name Node, DataNode, SecondaryNameNode, Job Tracker, Task Tracker run on single machine.
- Fully Distributed Mode: In Fully Distributed Mode, the daemons Name Node, Job Tracker, SecondaryNameNode (Optional and can be run on a separate node) run on the Master Node. The daemons DataNode and Task Tracker run on the Slave Node.

b) Procedure for doing the exercise/experiment:

Installation Steps: – Hadoop Installation: Ubuntu Operating System in stand-alone mode

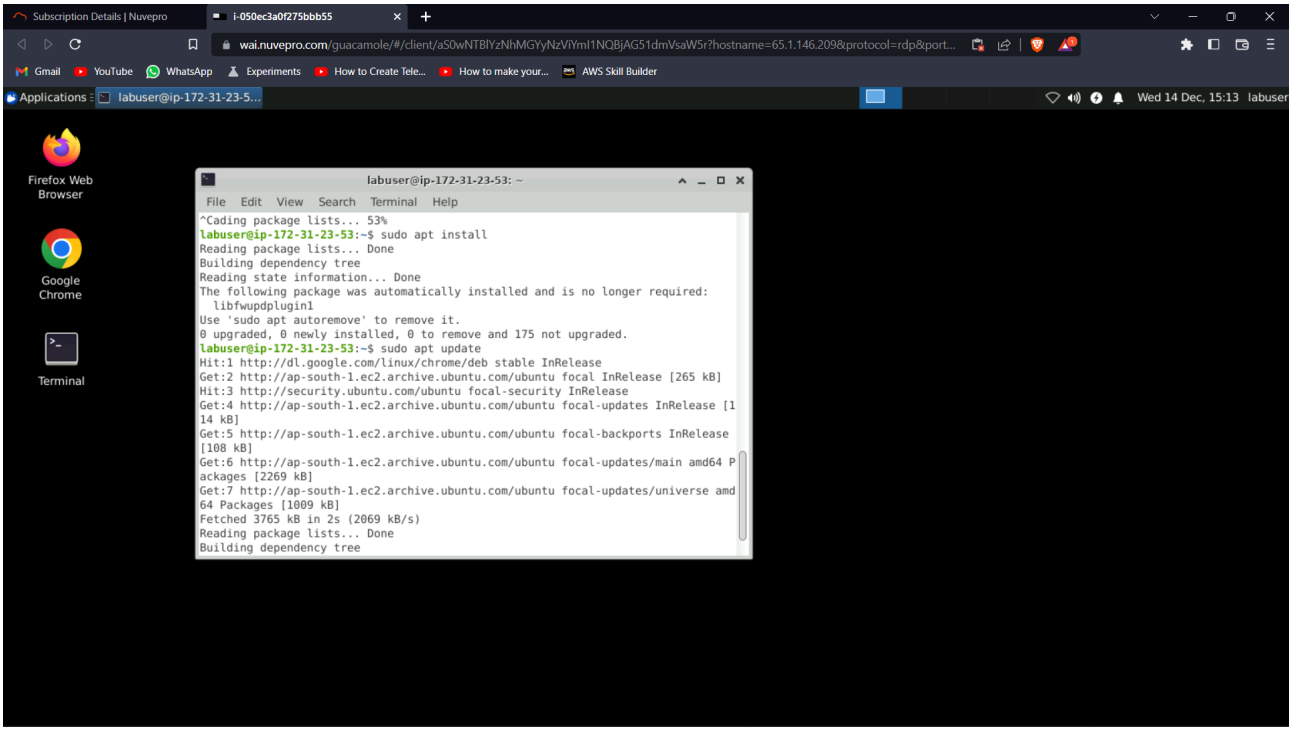
Step 1: Install OpenJDK on

Ubuntu COMMANDS:

1. Sudo apt

install 2.Sudo apt

update



STEP 2:

In this step, we will install latest version of JDK on the machine.

Apache Hadoop 3.x fully supports Java 8. The OpenJDK 8 package in Ubuntu contains both the runtime environment and development kit.

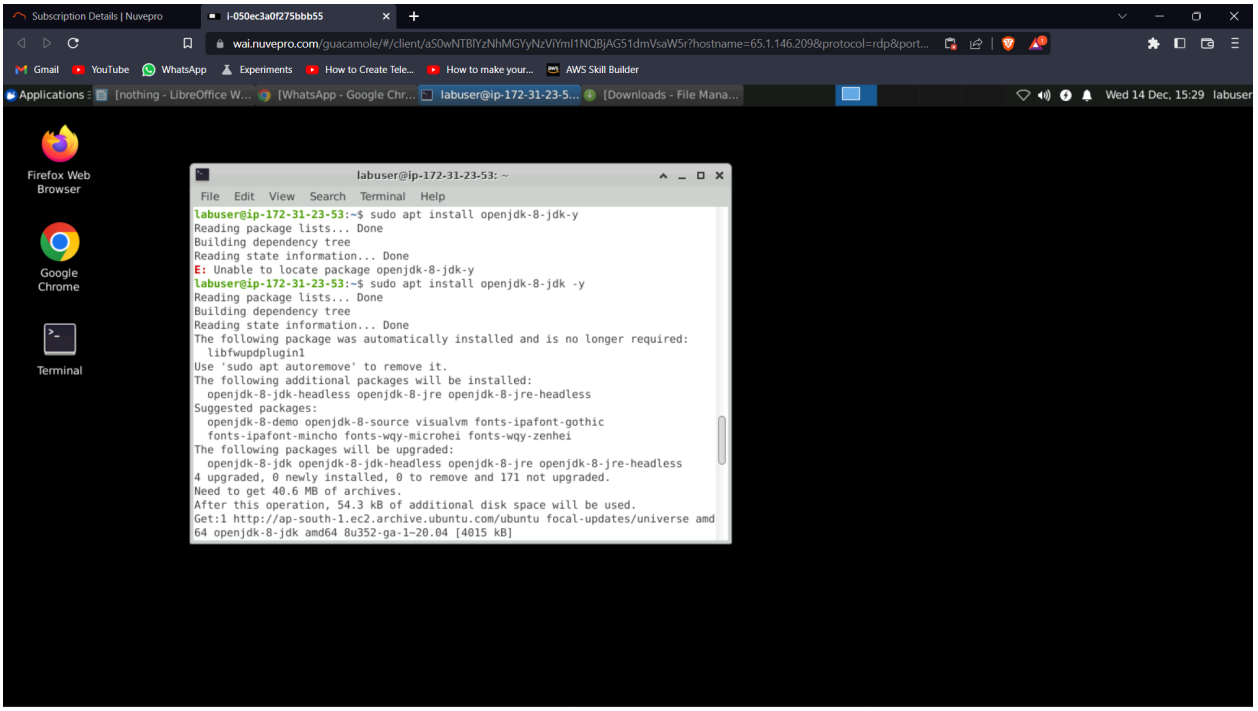
These commands install the specified version of java on your VM. The “sudo” command enables installation as an administrator. When you use the sudo command, the system asks for your password.

During the installation, the installer identifies the amount of disc space that is required and asks for your permission to continue. Input “y” to continue

Type the following command in your terminal to install OpenJDK 8:

COMMAND:

sudo apt install openjdk-8-jdk -y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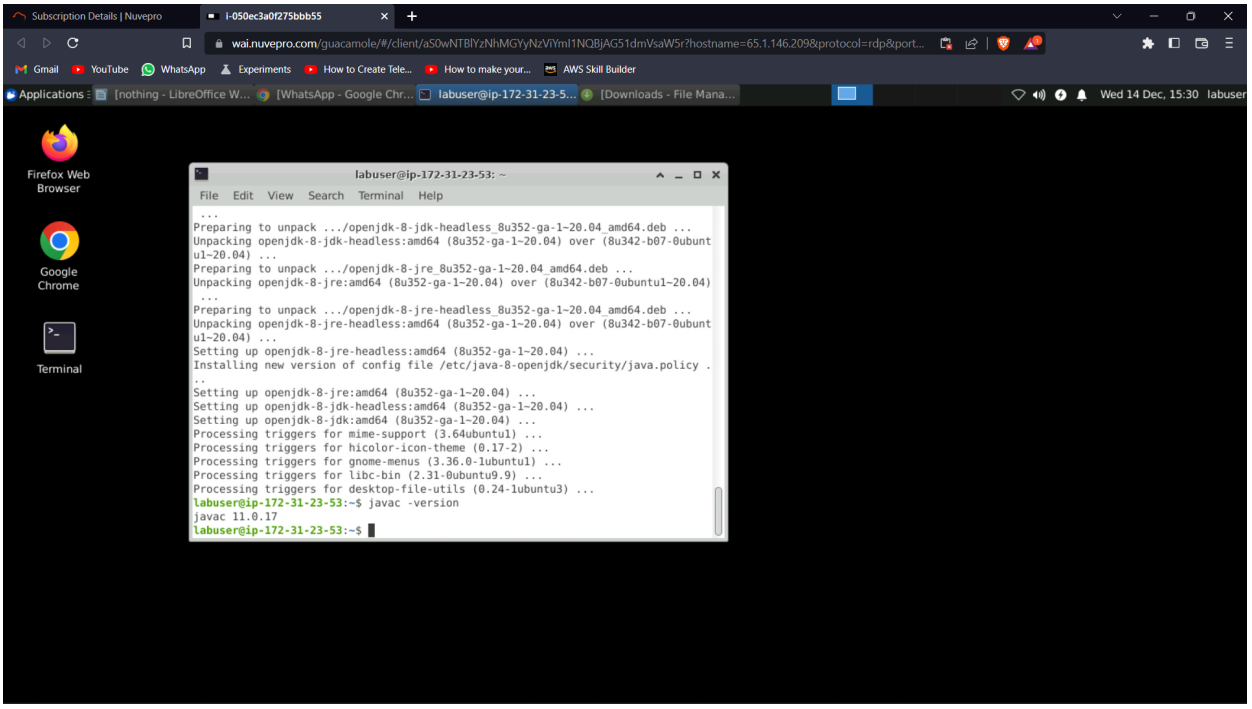
Gmail
YouTube
WhatsApp
Experiments
How to Create Tele...
How to make your...
AWS Skill Builder
Applications
[nothing - LibreOffice W...
[WhatsApp - Google Chr...
labuser@ip-172-31-23-5...
[Downloads - File Mana...
Wed 14 Dec, 15:29
labuser
Firefox Web Browser
Google Chrome
Terminal
labuser@ip-172-31-23-53: ~
File Edit View Search Terminal Help
labuser@ip-172-31-23-53:~$ sudo apt install openjdk-8-jdk-y
Reading package lists... Done
Building dependency tree
Reading state information... Done
E: Unable to locate package openjdk-8-jdk-y
labuser@ip-172-31-23-53:~$ sudo apt install openjdk-8-jdk -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
libfwupdplugin1
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
openjdk-8-jdk-headless openjdk-8-jre openjdk-8-jre-headless
Suggested packages:
openjdk-8-demo openjdk-8-source visualvm fonts-ipafont-gothic
fonts-ipafont-mincho fonts-wqy-microhei fonts-wqy-zenhei
The following packages will be upgraded:
openjdk-8-jdk openjdk-8-jdk-headless openjdk-8-jre openjdk-8-jre-headless
4 upgraded, 0 newly installed, 0 to remove and 171 not upgraded.
Need to get 40.6 MB of archives.
After this operation, 54.3 kB of additional disk space will be used.
Get:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu focal-updates/universe amd64 openjdk-8-jdk amd64 8u352-ga-1~20.04 [4015 kB]

STEP 3: Verify Java Installation

To check the installation of Java, you can check the version of the installed Java with the following command.

COMMAND: javac version



Set Up a Non-Root User for Hadoop Environment

STEP 4: Setup password less ssh

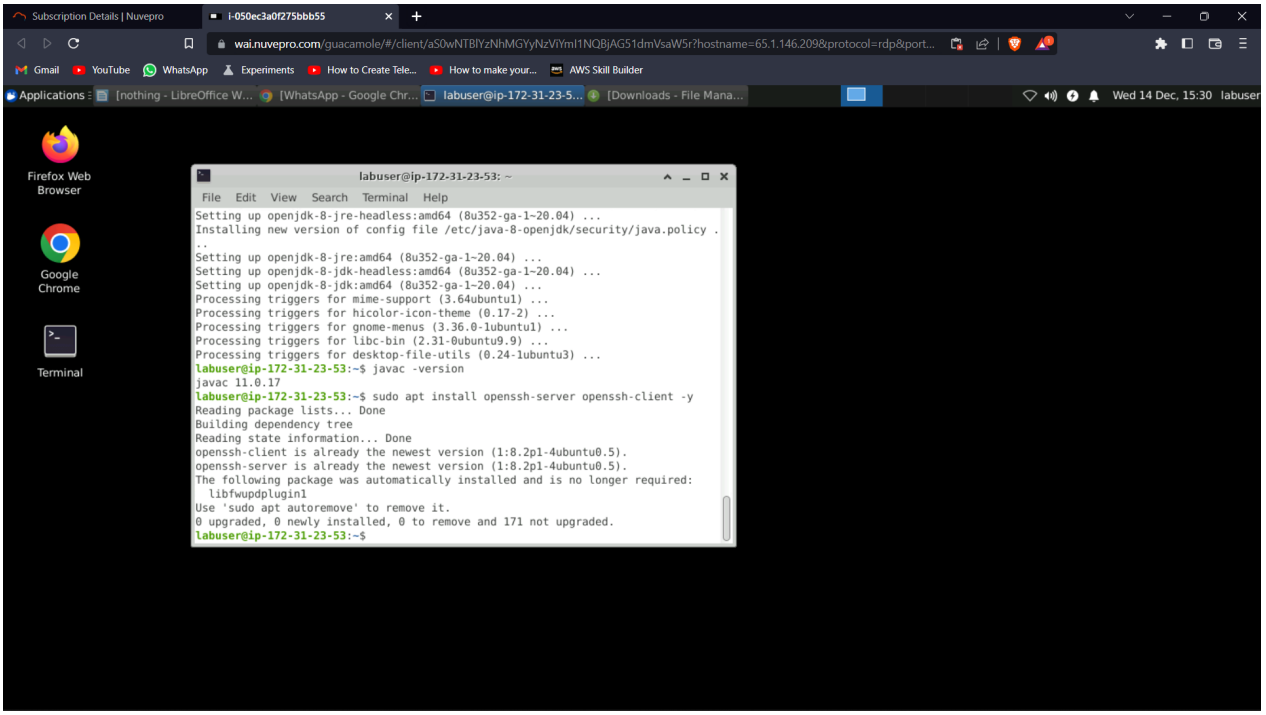
Install Open SSH Server and Open SSH Client

The next step is installation of ssh server which is needed for management of the communication with localhost. The following commands download and install the related files for the ssh server.

We will now setup the password less ssh client with the following command.

COMMAND:

sudo apt install openssh-server openssh-client -y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Gmail
YouTube
WhatsApp
Experiments
How to Create Tele...
How to make your...
AWS Skill Builder
Applications
[nothing - LibreOffice W...
[WhatsApp - Google Chr...
labuser@ip-172-31-23-5...
[Downloads - File Mana...
Wed 14 Dec, 15:30
labuser
Firefox Web Browser
Google Chrome
Terminal
labuser@ip-172-31-23-53: ~
File Edit View Search Terminal Help
Setting up openjdk-8-jre-headless:amd64 (8u352-ga-1~20.04) ...
Installing new version of config file /etc/java-8-openjdk/security/java.policy ...
Setting up openjdk-8-jre:amd64 (8u352-ga-1~20.04) ...
Setting up openjdk-8-jdk-headless:amd64 (8u352-ga-1~20.04) ...
Setting up openjdk-8-jdk:amd64 (8u352-ga-1~20.04) ...
Processing triggers for mime-support (3.64ubuntu1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for gnome-menus (3.36.0-1ubuntu1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.9) ...
Processing triggers for desktop-file-utils (0.24-1ubuntu3) ...
labuser@ip-172-31-23-53:~$ javac -version
javac 11.0.17
labuser@ip-172-31-23-53:~$ sudo apt install openssh-server openssh-client -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
openssh-client is already the newest version (1:8.2p1-4ubuntu0.5).
openssh-server is already the newest version (1:8.2p1-4ubuntu0.5).
The following package was automatically installed and is no longer required:
libfwupdplugin1
Use 'sudo apt autoremove' to remove it.
0 upgraded, 0 newly installed, 0 to remove and 171 not upgraded.
labuser@ip-172-31-23-53:~$

STEP 5: Create Hadoop User:

Let's create a separate user for Hadoop so we have isolation between the Hadoop file system and the Unix file system.

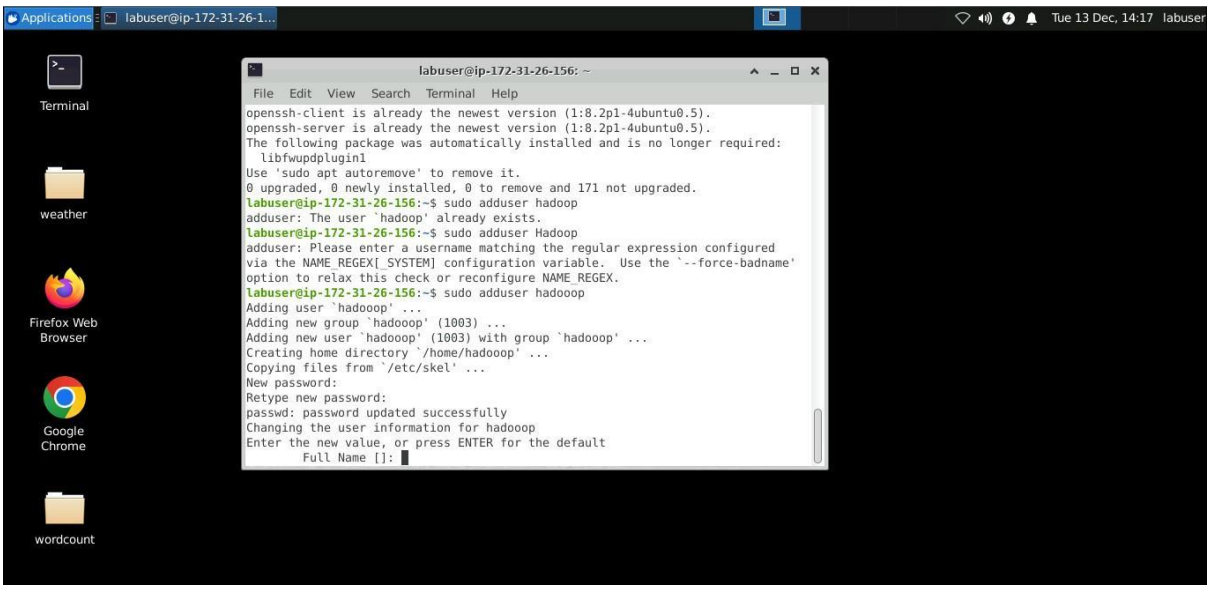
This step is optional, but recommended because it gives you flexibility to have a separate account for Hadoop installation by separating this installation from other software installation.

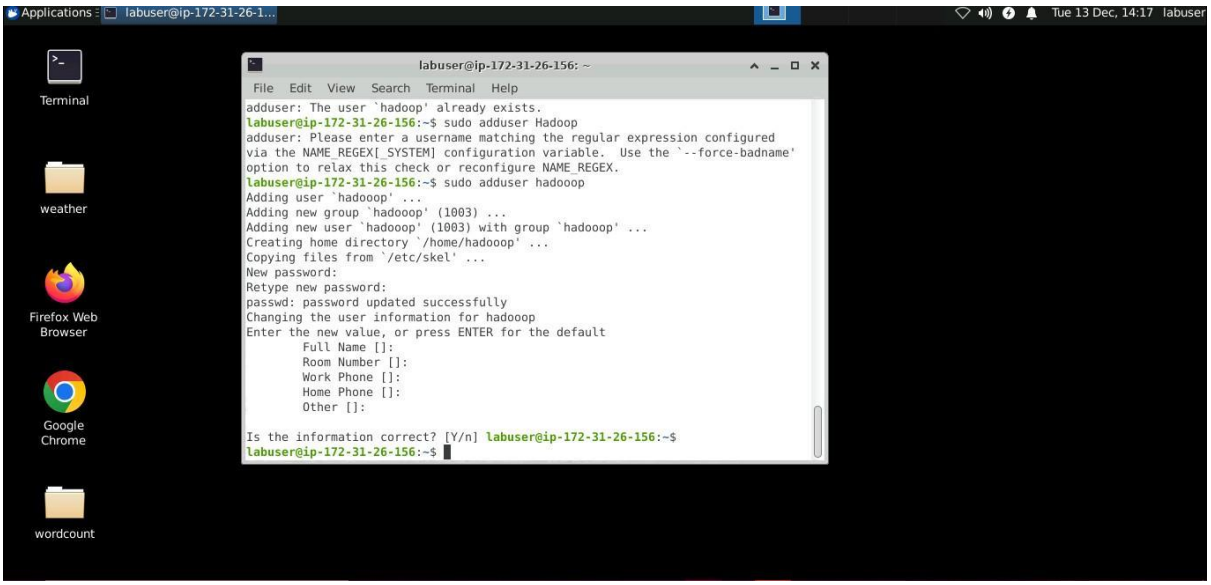
You can use a different group name and user name based on your preferences. Once the user is identified, the system asks for her password and other information including name, last name, etc. Since this is a trial installation, you can enter a simple password and press enter to skip these question

Run the following command to create a new user with name hadoop:

COMMAND:

sudo adduser hadoop





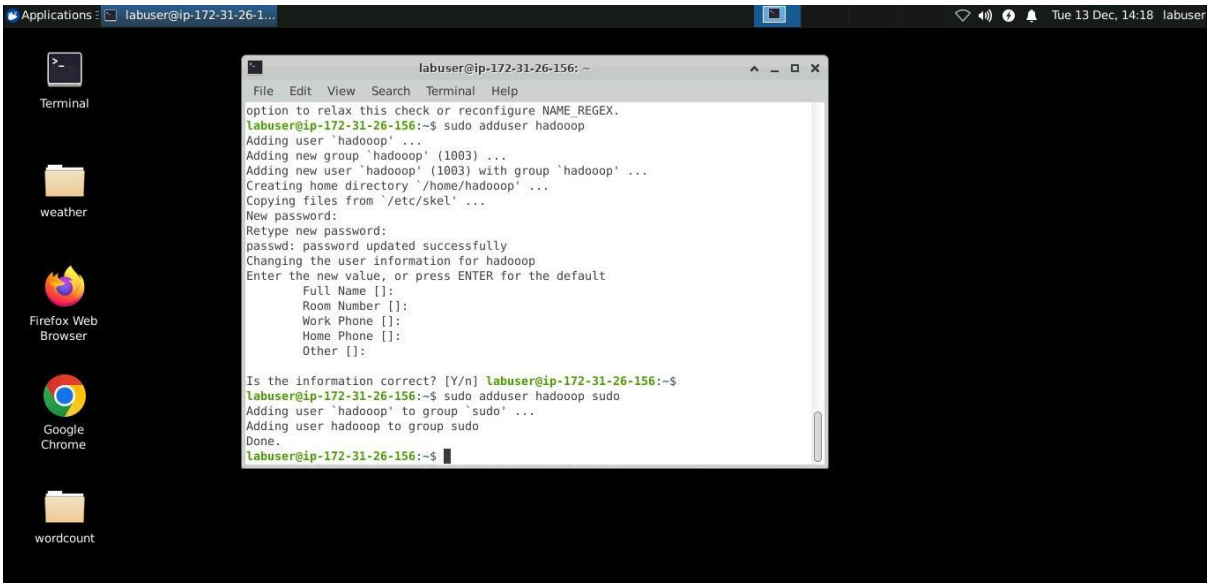
STEP 6: GET A PERMISSION:

The new user needs to have sudo privileges to be able to run the programs as administrator. Once the sudo privilege is set, we can continue with the new user logged in.

Also run these commands from an admin privileged user present on the machine.

COMMAND:

sudo adduser hadoop sudo

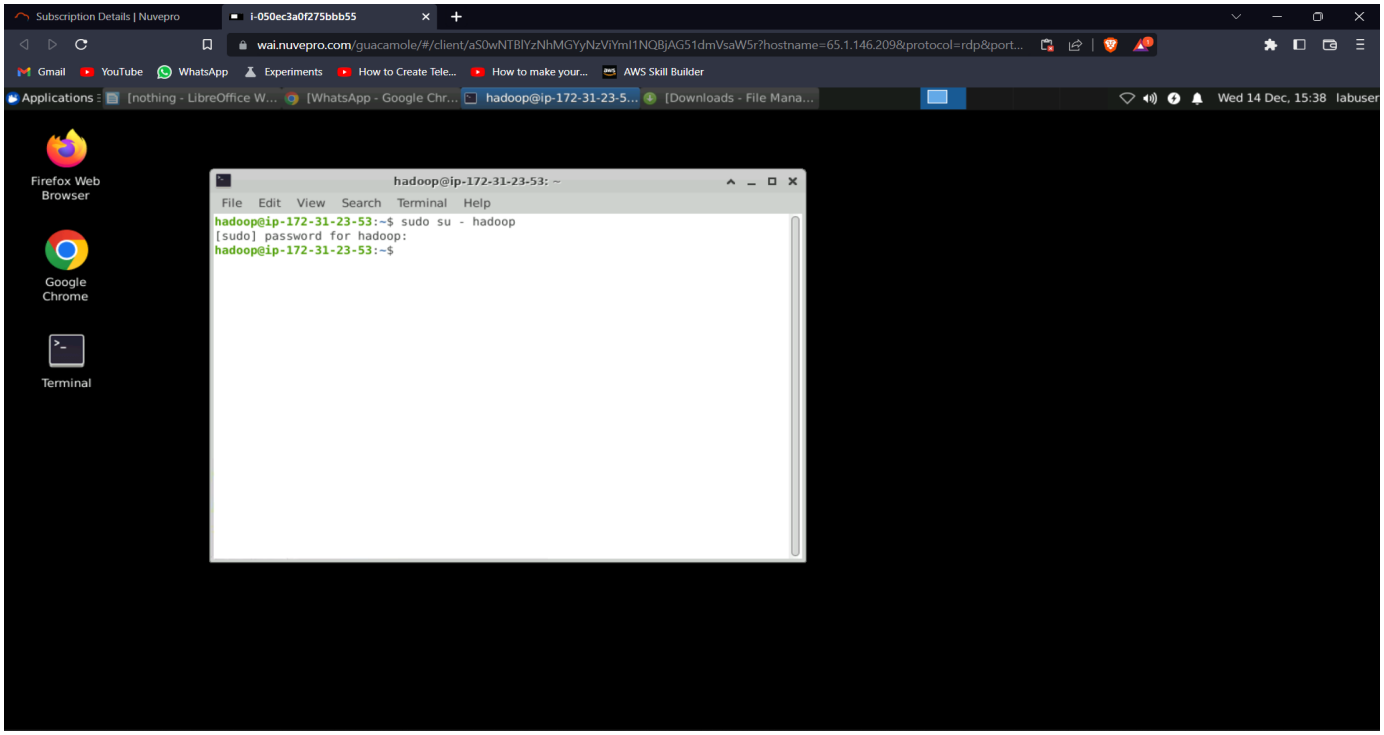


STEP 7: Switches the user from current user to the new user created.

To login with gokilanm, the system asks for its password which we identified in previous step.Switch to the newly created user and enter the corresponding password

COMMAND:

Sudo su -hadoop



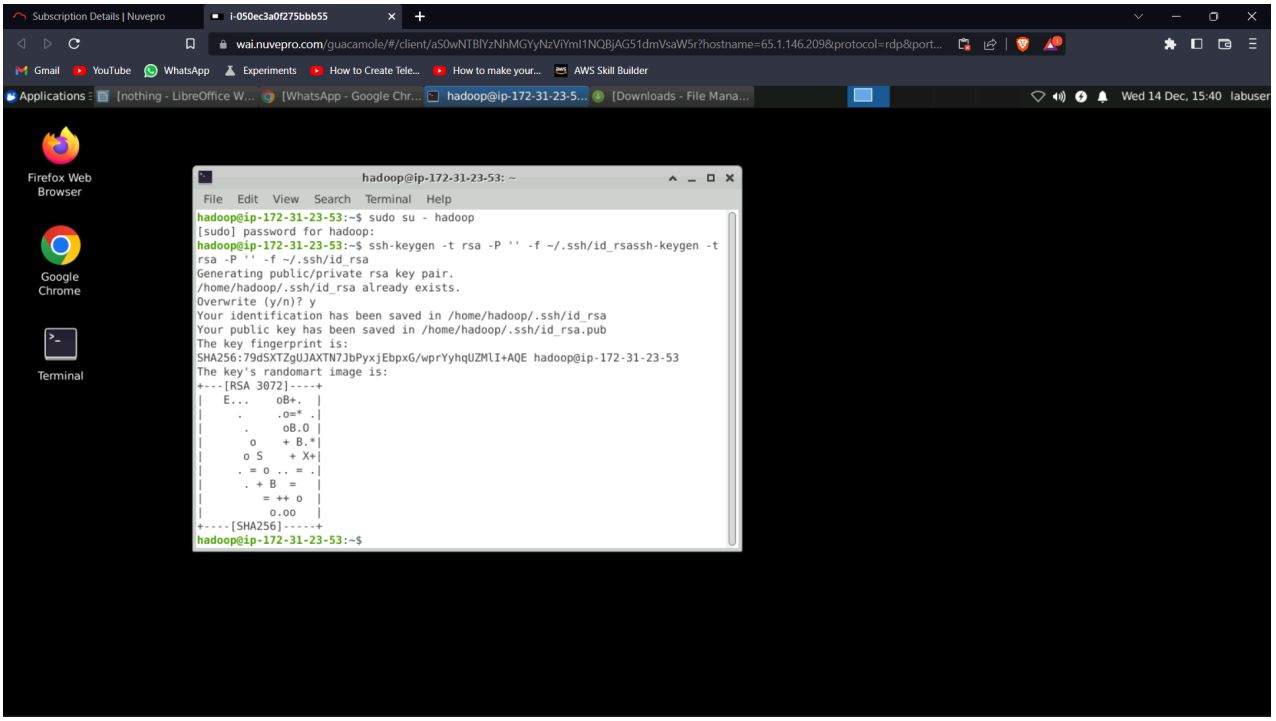
STEP 8: Generate Public & Private Key Pairs Enable

Passwordless SSH for Hadoop User

Once the user is added, generate SS key pair for the user.Generate an SSH key pair and define the location is to be stored in:

COMMAND:

ssh-keygen -t rsa -P '' -f ~/.ssh/id_rsa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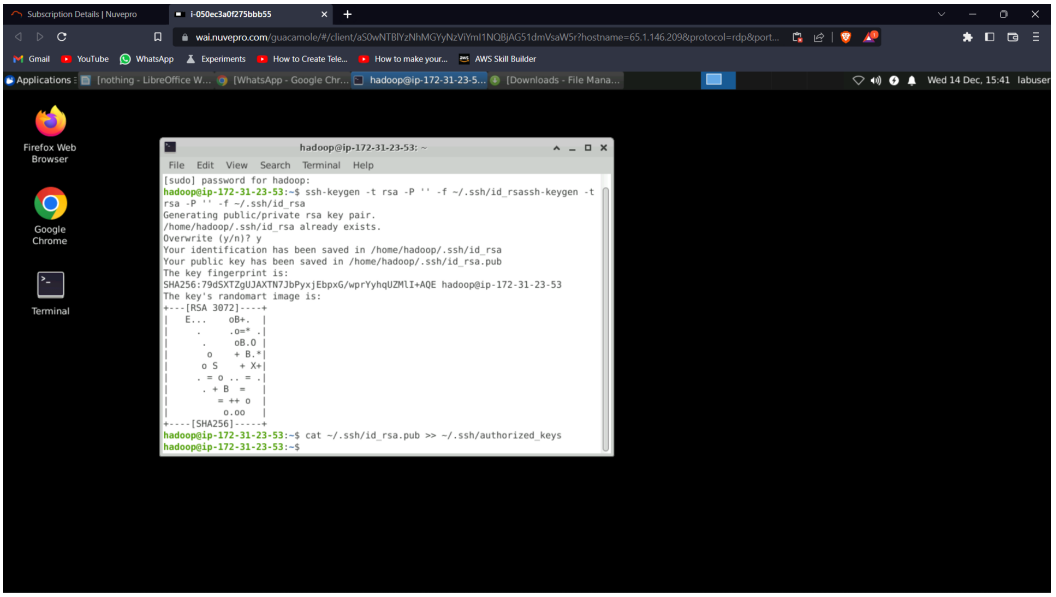
Gmail
YouTube
WhatsApp
Experiments
How to Create Tele...
How to make your...
AWS Skill Builder
Applications
[nothing - LibreOffice W...
[WhatsApp - Google Chr...
hadoop@ip-172-31-23-5...
[Downloads - File Mana...
Wed 14 Dec, 15:40
labuser
Firefox Web Browser
Google Chrome
Terminal
hadoop@ip-172-31-23-53: ~
File Edit View Search Terminal Help
hadoop@ip-172-31-23-53:~$ sudo su - hadoop
[sudo] password for hadoop:
hadoop@ip-172-31-23-53:~$ ssh-keygen -t rsa -P '' -f ~/.ssh/id_rsassh-keygen -t rsa -P '' -f ~/.ssh/id_rsa
Generating public/private rsa key pair.
/home/hadoop/.ssh/id_rsa already exists.
Overwrite (y/n)? y
Your identification has been saved in /home/hadoop/.ssh/id_rsa
Your public key has been saved in /home/hadoop/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:79dSXTZgUJAXTN7JbPyxjEbpxG/wprYyhqUZMlI+AQE hadoop@ip-172-31-23-53
The key's randomart image is:
+---[RSA 3072]----+
| E...   oB+. |
| .   .o=* .|
| .   oB.O |
| o   + B.*|
| o S   + X+|
| . = o .. = .|
| . + B = |
| = ++ o |
| o.oo |
+----[SHA256]-----+
hadoop@ip-172-31-23-53:~$

STEP 9: Enable SSH access to local machine using this key.

Use the cat command to store the public key as authorized keys in the ssh directory:

COMMAND:

cat ~/.ssh/id_rsa.pub >> ~/.ssh/authorized_keys

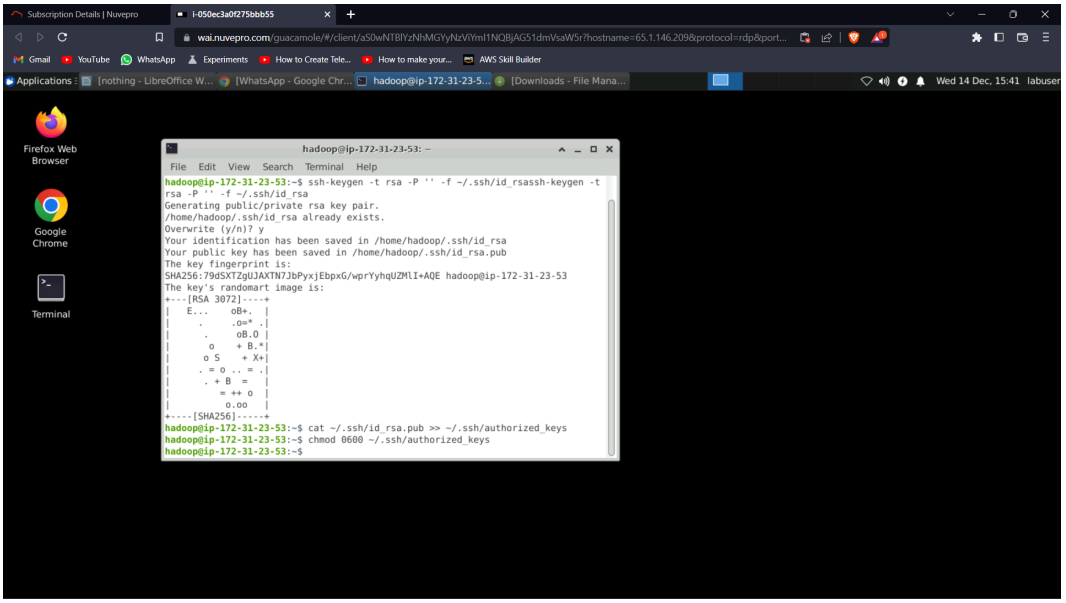


STEP 10:

Set the permissions for your user with the chmod command:

COMMAND:

chmod 0600 ~/.ssh/authorized_keys

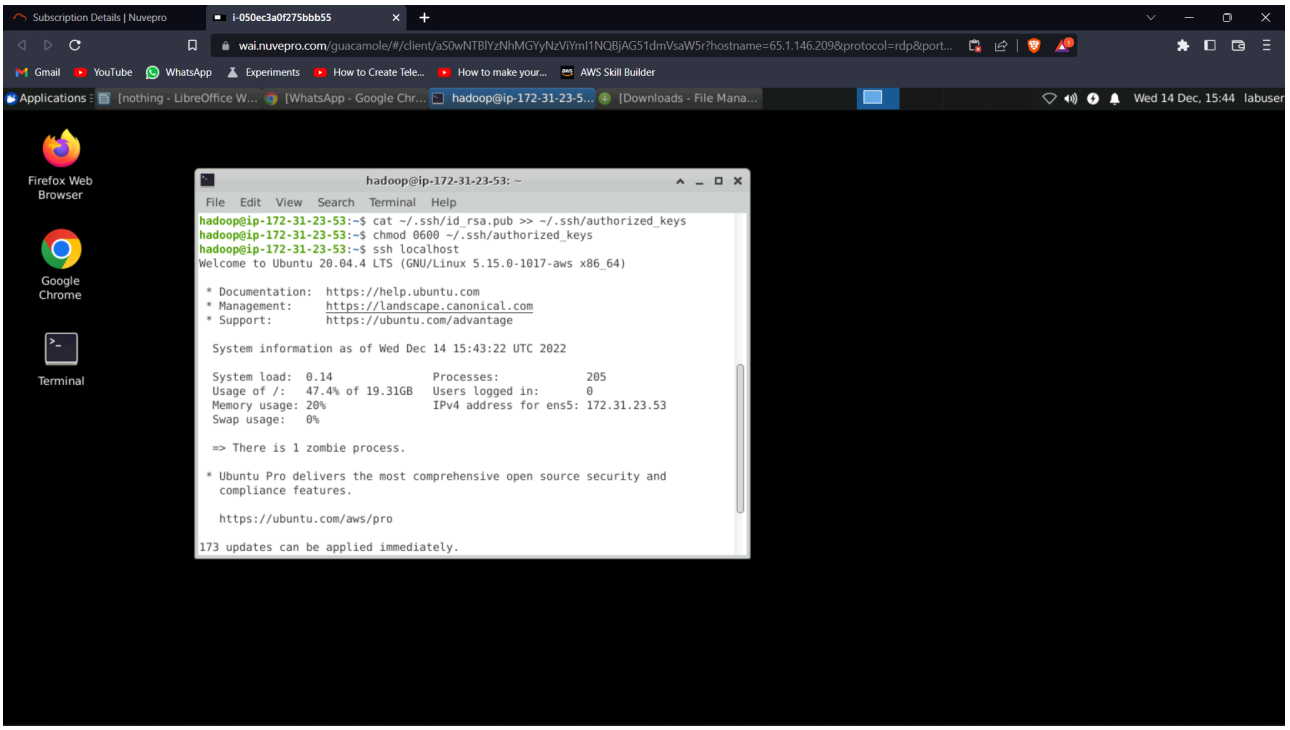


STEP 11:

The new user is now able to SSH without needing to enter a password every time. Verify everything is set up correctly by using the hdoop user to SSH to localhost:

Let's verify key based login

COMMAND: ssh localhost



STEP 12:INSTALL HADOOP:

Download link(s): https://www.apache.org/dyn/closer.cgi/hadoop/common/hadoop-3.2.2/hadoop- 3.2.2.tar.gz

File size 210 MB

Install size Variable Requirements Virtualbox

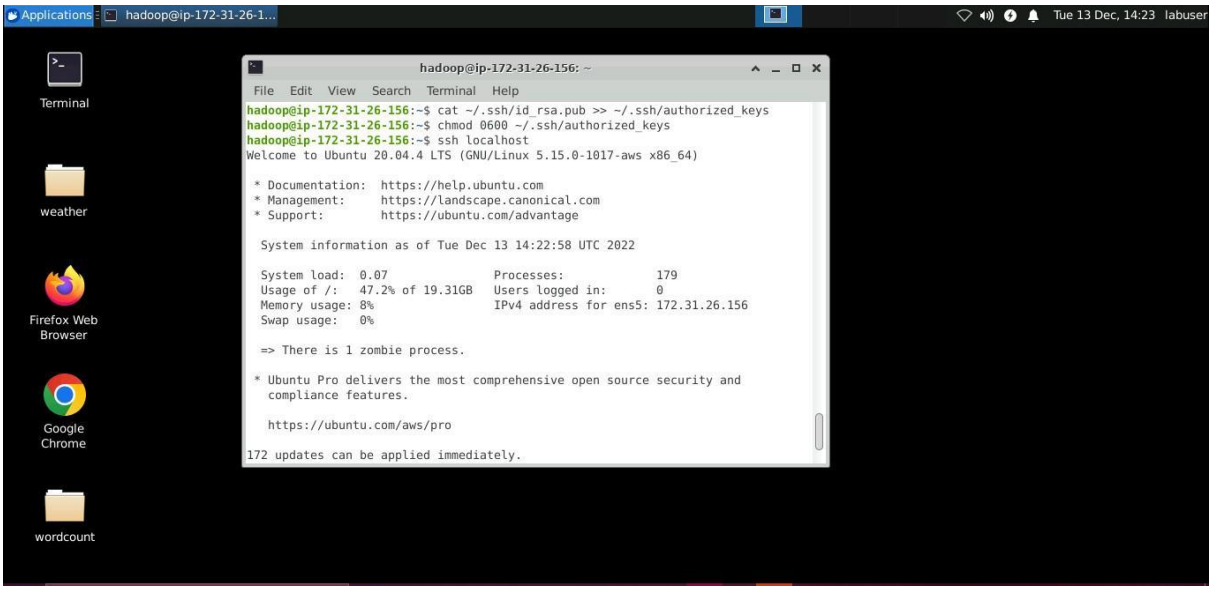
:Ubuntu 10.04 LTS or higher

Visit the official Apache Hadoop project page, and select the version of Hadoop you want to implement.

COMMAND:

wget

https://www.apache.org/dyn/closer.cgi/hadoop/common/hadoop- 3.3.0/hadoop-3.3.0.tar.gz



STEP 14: Untar the Tarball

Once downloaded, extract the downloaded file:

COMMAND:

tar xzf hadoop-3.3.0.tar.gz

STEP 15:Single Node Hadoop Deployment (Pseudo-Distributed Mode)

Hadoop excels when deployed in a fully distributed mode on a large cluster of networked servers. However, if you are new to Hadoop and want to explore basic commands or test applications, you can configure Hadoop on a single node.

This setup, also called pseudo-distributed mode, allows each Hadoop daemon to run as a single Java process. A Hadoop environment is configured by editing a set of configuration files:

- bashrc
- hadoop-env.sh
- core-site.xml
- hdfs-site.xml
- mapred-site-xml
- yarn-site.xml

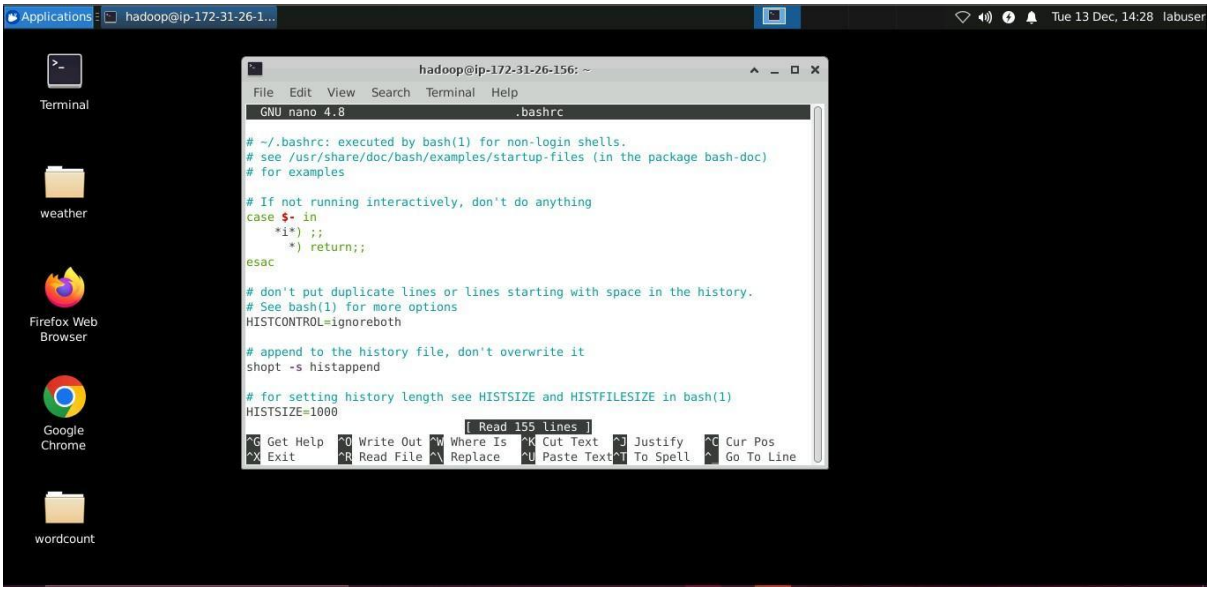
Configure Hadoop

We can add only the minimum property in the Hadoop configuration. The user can add more properties to it.

a) Setting Up the environment variables

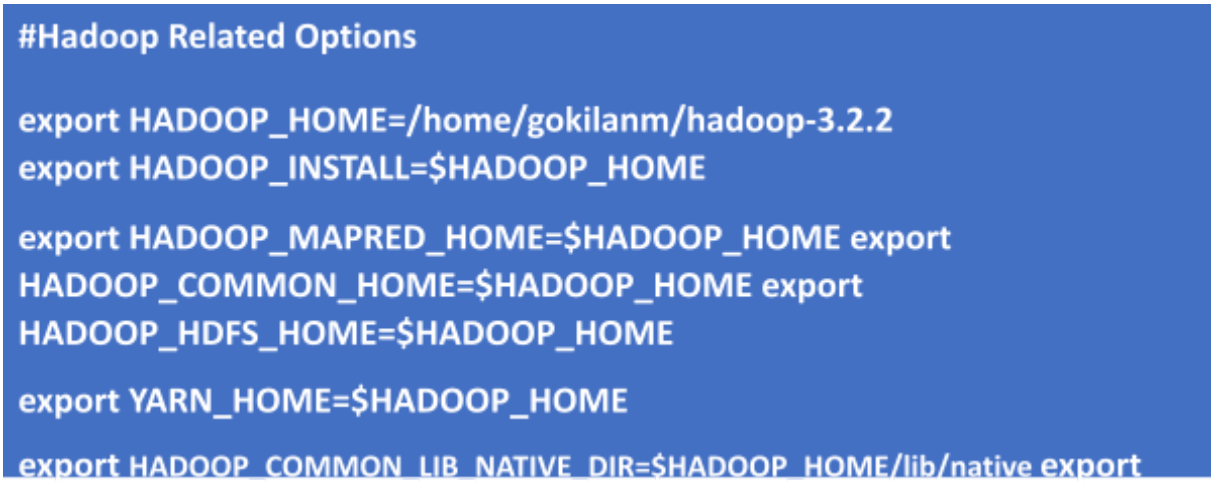
Step 16) Modify ~/.bashrc file

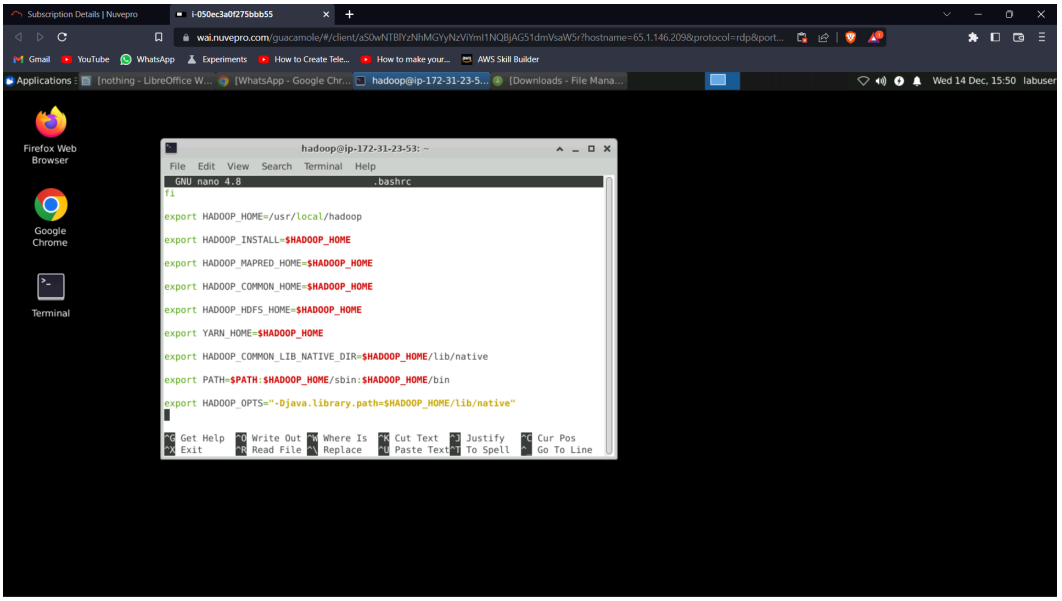
COMMAND: sudo nano .bashrc



This command opens a window. Navigate to the end of the window and paste the following lines to it. Then hold CTRL+x to exit. Type “y” and press enter to save the file.

Define the Hadoop environment variables by adding the following content to the end of the file:



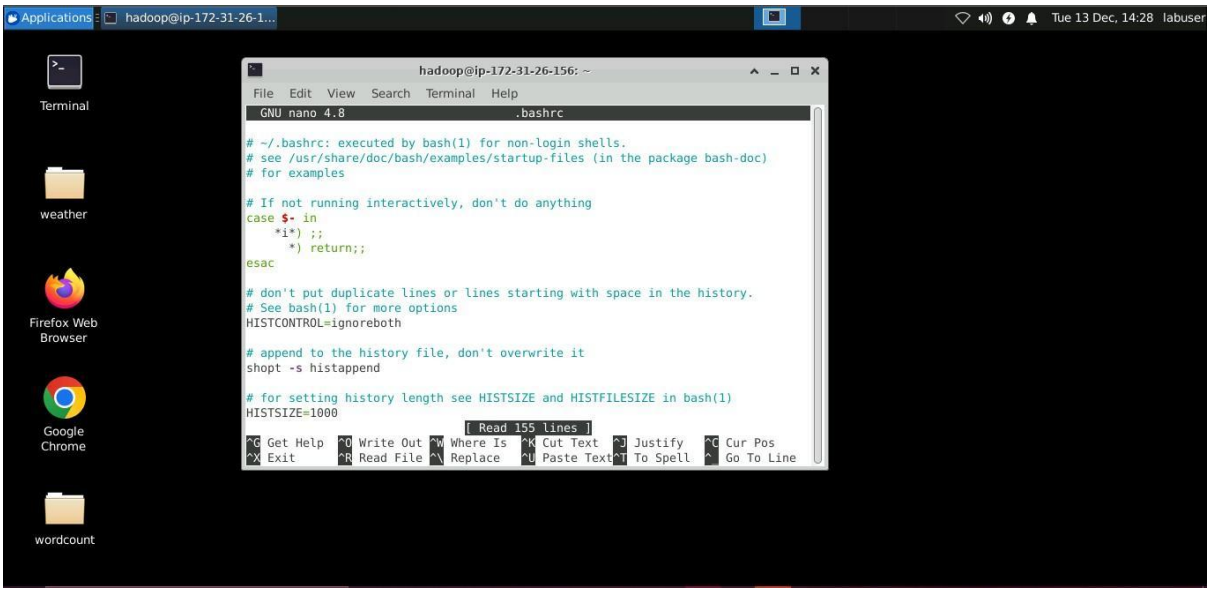


Once you add the variables, save and exit the .bashrc file.

It is vital to apply the changes to the current running environment by using the following command:

COMMAND:

source ~/.bashrc



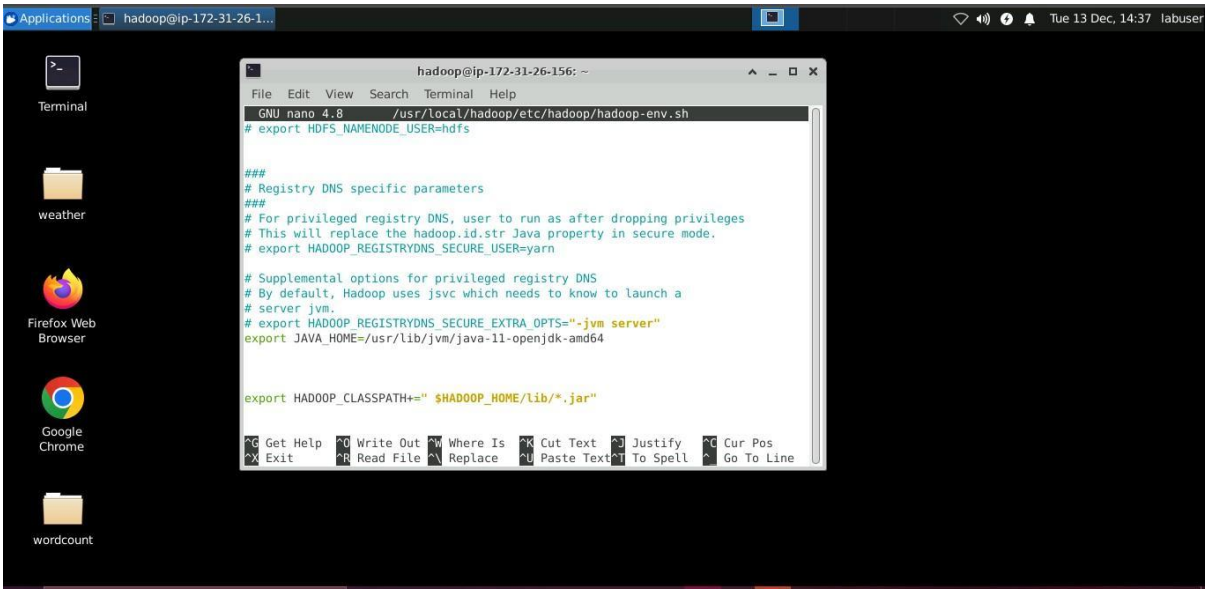
STEP:17 Configurations related to HDFS

The hadoop-env.sh file serves as a master file to configure YARN, HDFS, MapReduce, and Hadoop-related project settings.

When setting up a single node Hadoop cluster, you need to define which Java implementation is to be utilized. Use the previously created $HADOOP_HOME variable to access the hadoop-env.sh file:

COMMANDS
17. sudo nano $HADOOP_HOME/etc/hadoop/hadoop-env.sh

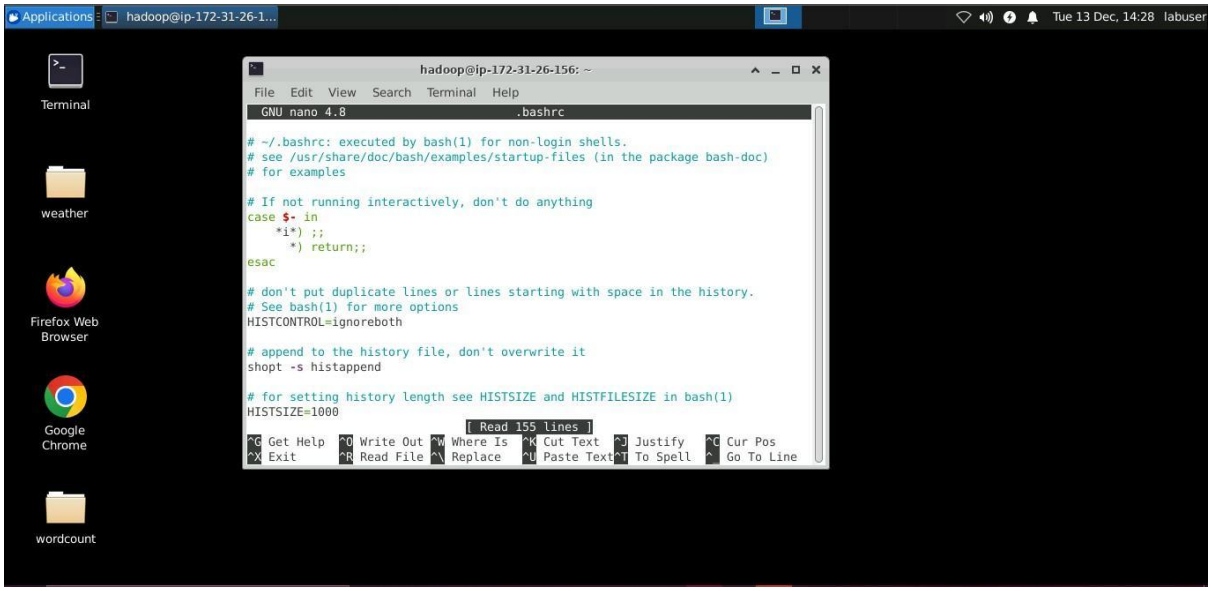
TERMINAL:



OpenJDK installation on your system. If you have installed the same version as presented in the
first part of this tutorial, add the following line:

export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-amd64

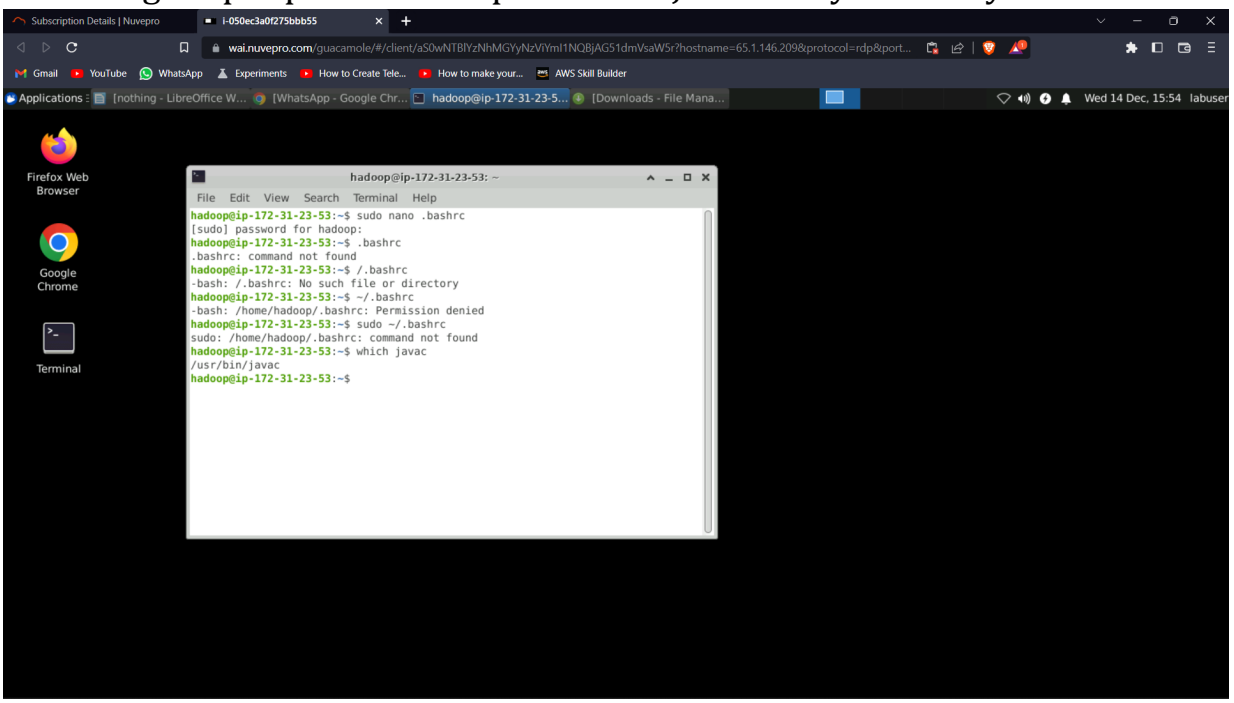
The path needs to match the location of the Java installation on your system



If you need help to locate the correct Java path, run the following command in your terminal window:

COMMANDS
18. which javac

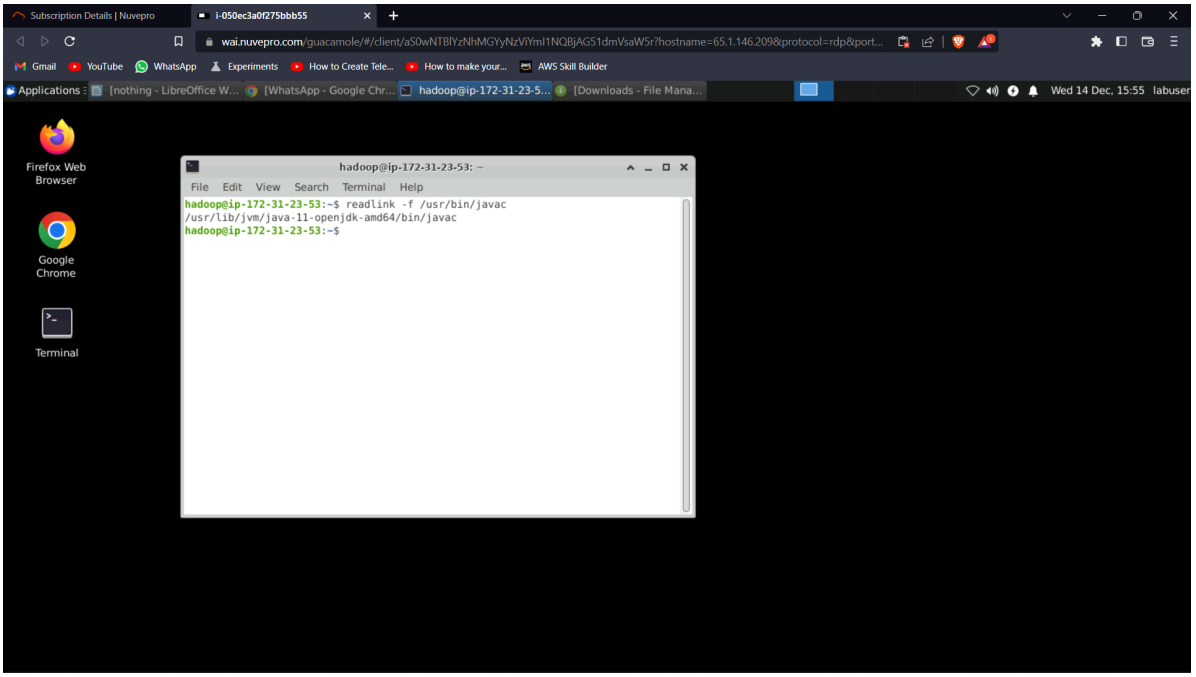
The resulting output provides the path to the Java binary directory.



Use the provided path to find the OpenJDK directory with the following command:

OpenJDK installation on your system. If you have installed the same version as presented in the

COMMANDS
19. readlink -f /usr/bin/javac



The section of the path just before the */bin/javac* directory needs to be assigned to the **$JAVA_HOME** variable.

STEP 18:Edit core-site.xml File

The core-site.xml file defines HDFS and Hadoop core properties.

To set up Hadoop in a pseudo-distributed mode, you need to specify the URL for your NameNode, and the temporary directory Hadoop uses for the map and reduce process.

COMMANDS
20. sudo nano $HADOOP_HOME/etc/hadoop/core-site.xml

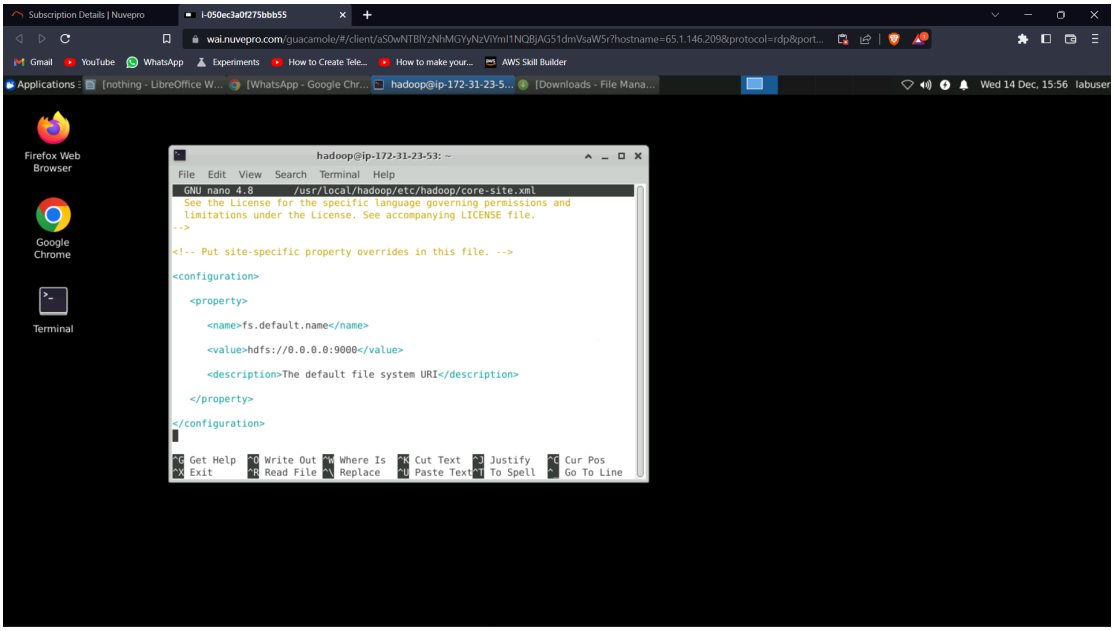
```
hadoop@ip-172-31-26-156:~$ which javac
/usr/bin/javac
hadoop@ip-172-31-26-156:~$ readlink -f /usr/bin/javac
/usr/lib/jvm/java-8-openjdk-amd64/bin/javac
hadoop@ip-172-31-26-156:~$ sudo nano $HADOOP_HOME/etc/hadoop/core-site.xml
```

Open the core-site.xml file in a text editor:

Add the following configuration to override the default values for the temporary directory and add your HDFS URL to replace the default local file system setting:

```
<configuration>

<property>
 <name>hadoop.tmp.dir</name>
 <value>/home/gokilanm/tmpdata</value>
</property>
```

TERMINAL:



This example uses values specific to the local system. You should use values that match your systems requirements. The data needs to be consistent throughout the configuration process.

STEP 19: Edit hdfs-site.xml File

The properties in the hdfs-site.xml file govern the location for storing node metadata, fsimage file, and edit log file. Configure the file by defining the NameNode and DataNode storage directories.Additionally, the default dfs.replication value of 3 needs to be changed to 1 to match the single node setup.Use the following command to open the hdfs-site.xml file for editing:

COMMANDS
21. sudo nano $HADOOP_HOME/etc/hadoop/hdfs-site.xml

```
hadoop@ip-172-31-26-156:~$ sudo nano $HADOOP_HOME/etc/hadoop/core-site.xml
hadoop@ip-172-31-26-156:~$ sudo nano $HADOOP_HOME/etc/hadoop/hdfs-site.xml
```

Add the following configuration to the file and, if needed, adjust the NameNode and DataNode directories to your custom locations:

```
<configuration>

<property>
 <name>dfs.data.dir</name>
 <value>/home/gokilanm/dfsdata/namenode</value>
</property>
<property>
 <name>dfs.data.dir</name>
 <value>/home/gokilanm/dfsdata/datanode</value>
</property>
```

If necessary, create the specific directories you defined for the dfs.data.dir value.

STEP 20: Edit mapred-site.xml File

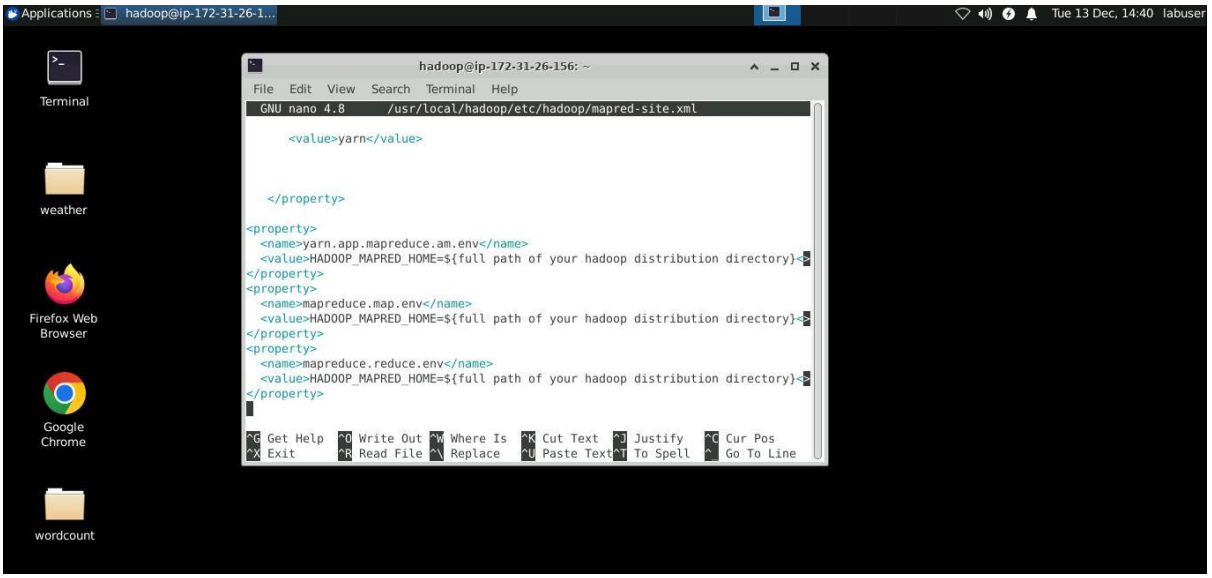
Use the following command to access the mapred-site.xml file and define MapReduce values:

COMMANDS
20. sudo nano $HADOOP_HOME/etc/hadoop/mapred-site.xml

Add the following configuration to change the default MapReduceframework name value to yarn:

```
<configuration>

<property>
 <name>mapreduce.framework.name</name>
 <value>yarn</value>
```

TERMINAL:



STEP 21:Edit yarn-site.xml File

The yarn-site.xml file is used to define settings relevant to YARN. It contains configurations for the Node Manager, Resource Manager, Containers, and Application Master.

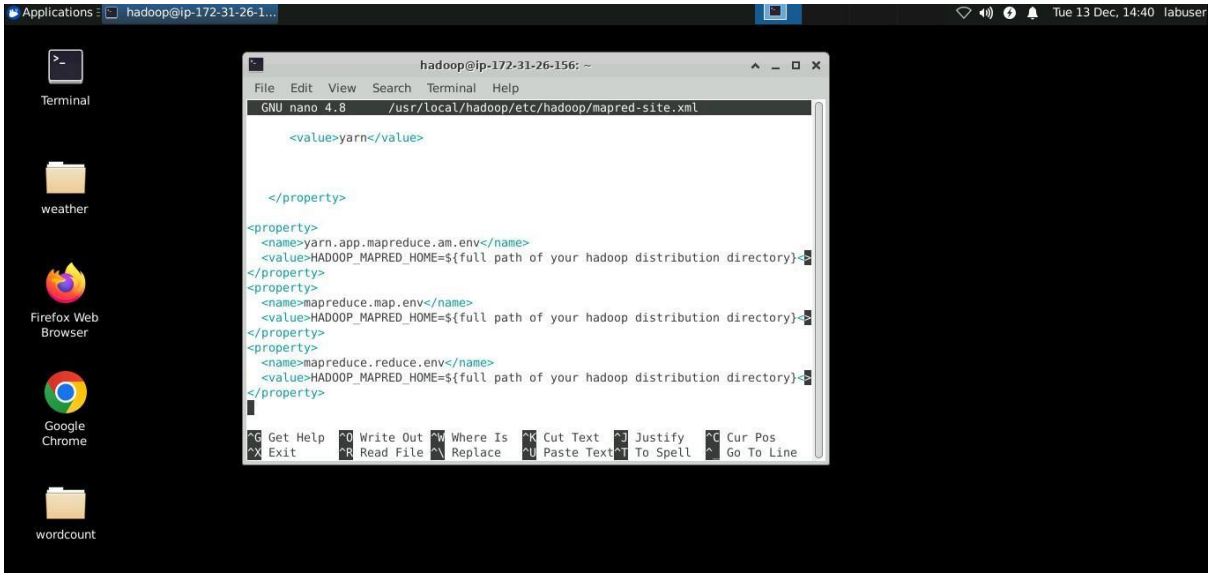
Open the yarn-site.xml file in a text editor:

COMMANDS
23. sudo nano $HADOOP_HOME/etc/hadoop/yarn-site.xml

TERMINAL:

```
<configuration>

<property>
  <name>yarn.nodemanager.aux-services</name>
  <value>mapreduce_shuffle</value>
</property>
  <value>org.apache.hadoop.mapred.ShuffleHandler</value>
</property>
<property>
  <name>yarn.resourcemanager.hostname</name>
  <value>127.0.0.1</value>
</property>
<property>
  <name>yarn.acl.enable</name>
  <value>0</value>
</property>
<property>
```

TERMINAL:

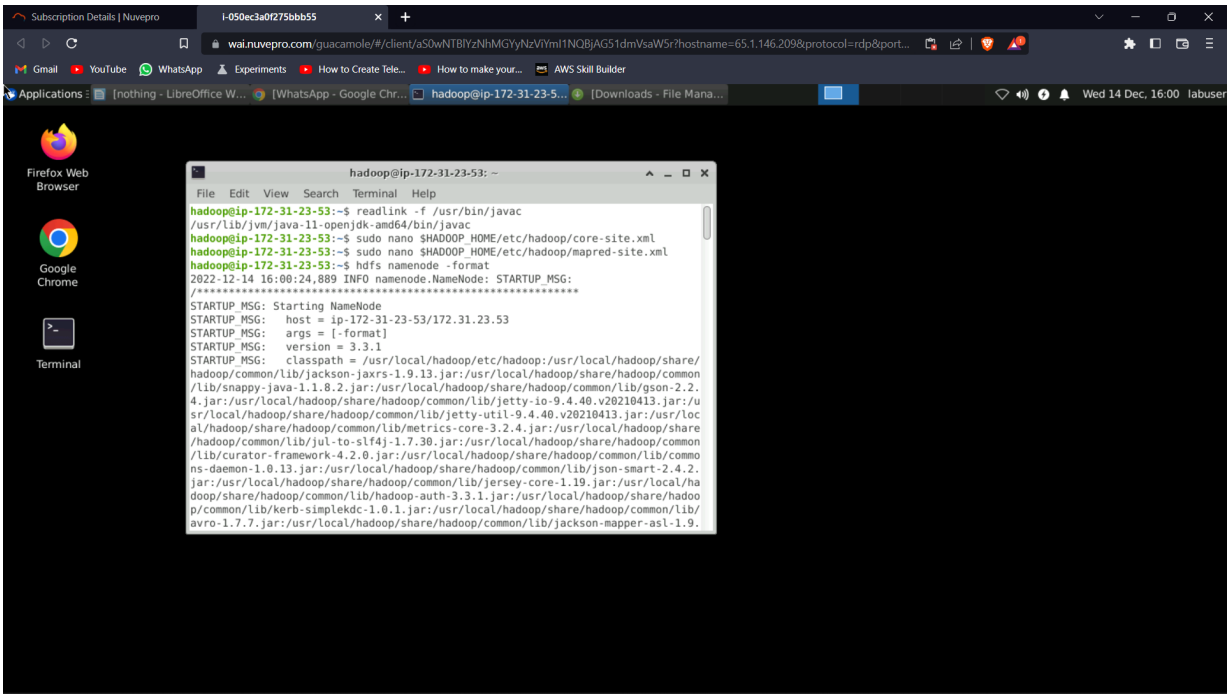


STEP 22: Format HDFS NameNode

Now format the namenode using the following command, make sure that Storage directory is hdfs namenode -format

It is important to format the NameNode before starting Hadoop services for the first time:

COMMANDS
24. hdfs namenode -format



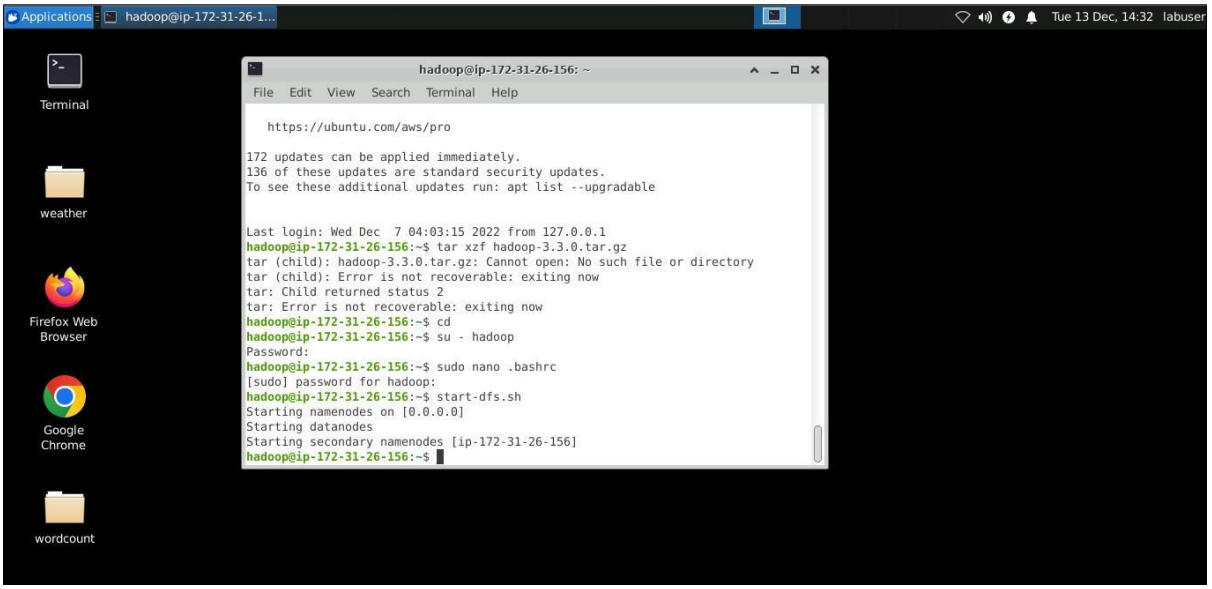
The shutdown notification signifies the end of the NameNode format process.

STEP 23:Start Hadoop Cluster

Navigate to the hadoop-3.2.1/sbin directory and execute the following commands to start the NameNode and DataNode:

The system takes a few moments to initiate the necessary nodes.

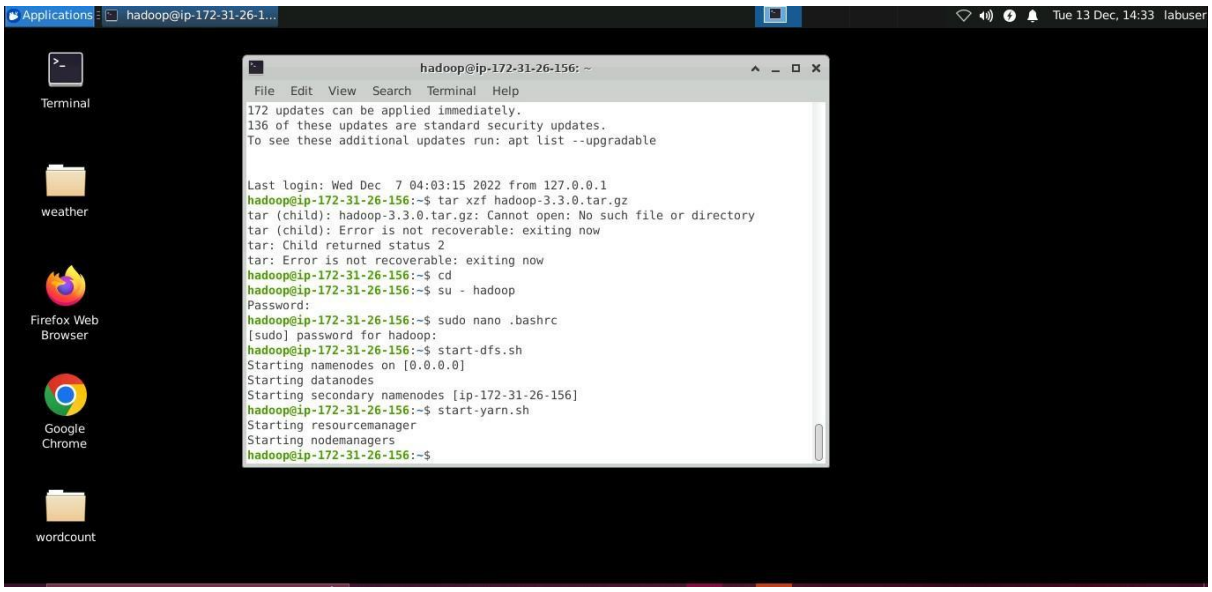
COMMANDS
25.cd hadoop-3.3.0 26.cd sbin 27./start-dfs.sh



Once the namenode, datanodes, and secondary namenode are up and running, start the YARN resource and nodemanagers by typing:

COMMANDS
28. ./start-yarn.sh

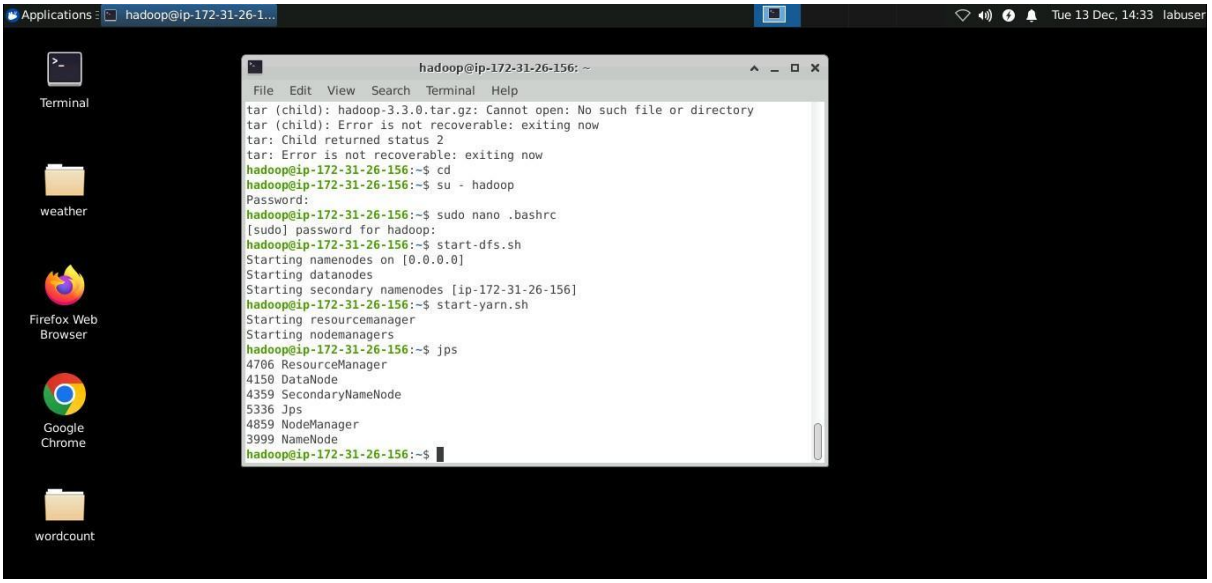
As with the previous command, the output informs you that the processes are starting.



Type this simple command to check if all the daemons are active and running as Java processes:

COMMANDS
29.jps

If everything is working as intended, the resulting list of running Java processes contains all the HDFS and YARN daemons.



STEP 24: Access Hadoop UI from Browser

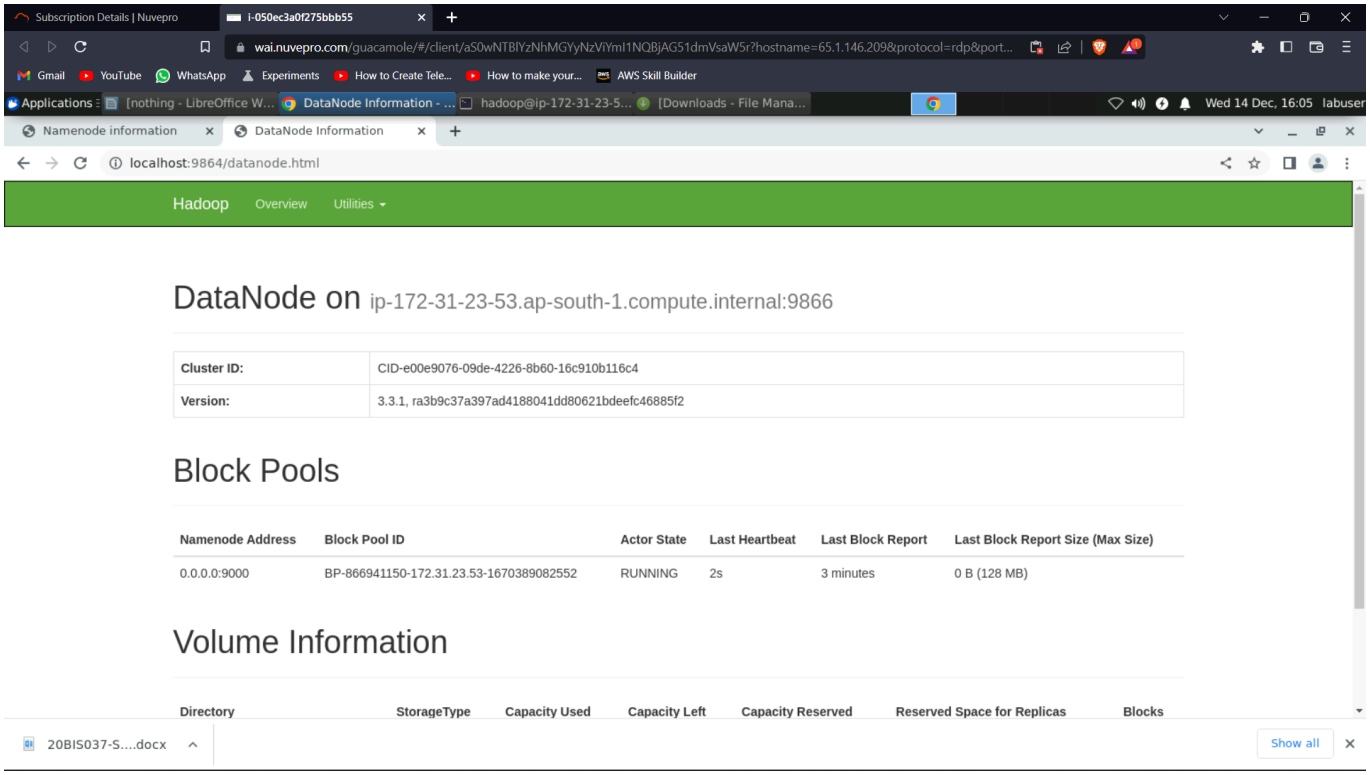
The default port number 9870 gives you access to the Hadoop NameNode UI:

http://localhost:9870

The NameNode user interface provides a comprehensive overview of the entire cluster.

The default port **9864** is used to access individual DataNodes directly from your browser:

http://localhost:9864

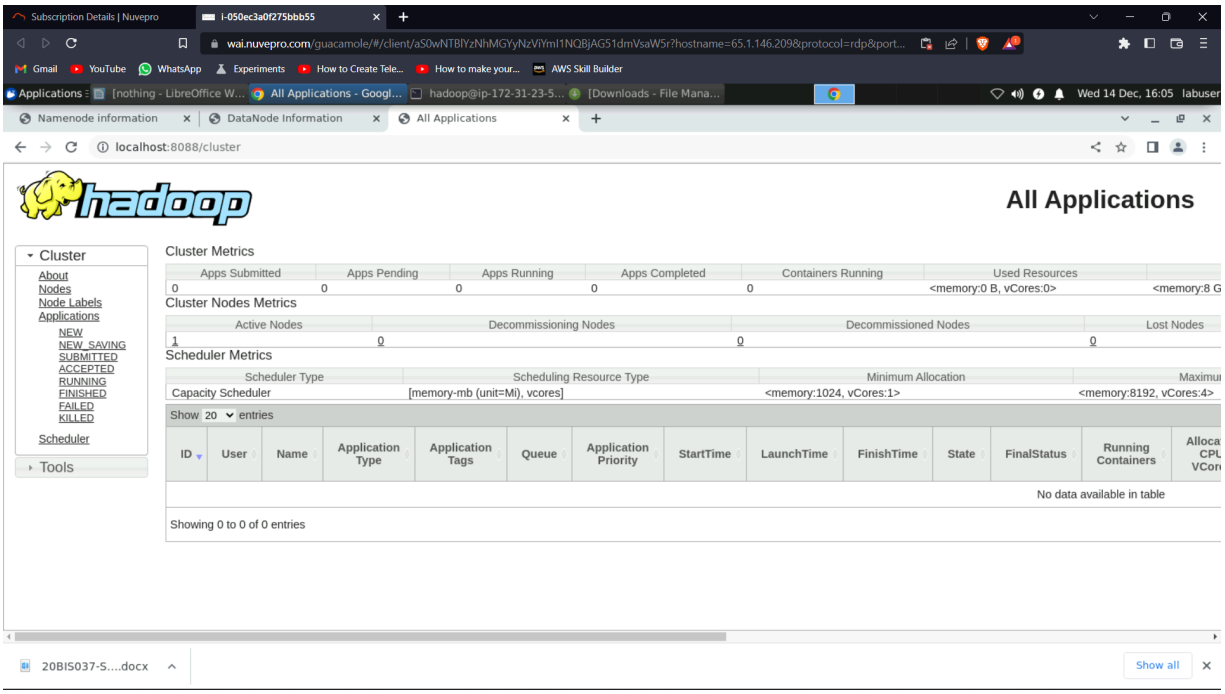


The YARN Resource Manager is accessible on port **8088**:

The Resource Manager is an invaluable tool that allows you to monitor all running

processes in your Hadoop cluster.

http://localhost:8088



RESULT:

Hadoop is powerful because it is extensible and it is easy to integrate with any component. Its popularity is due in part to its ability to store, analyze and access large amounts of data, quickly and cost effectively across clusters of commodity hardware. You have successfully installed Hadoop on Ubuntu and deployed it in a pseudo-distributed mode. A single node Hadoop deployment is an excellent starting point to explore basic HDFS commands and acquire the experience you need to design a fully distributed Hadoop cluster.

LAB EXERCISE-2

Title of the exercise/experiment: Implement the following file management tasks in Hadoop:

- Adding files and directories
- Retrieving files
- Deleting files

THEORY:

Hadoop File System was developed using distributed file system design. It is run on commodity hardware. Unlike other distributed systems, HDFS is highly fault tolerant and designed using low-cost hardware.

HDFS holds very large amount of data and provides easier access. To store such huge data, the files are stored across multiple machines.

These files are stored in redundant fashion to rescue the system from possible data losses in case of failure. HDFS also makes applications available to parallel processing.

FILE OPERATIONS IN HADOOP:

1. Create a directory in HDFS at given path(s).

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/sample
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

2. List the contents of a directory.

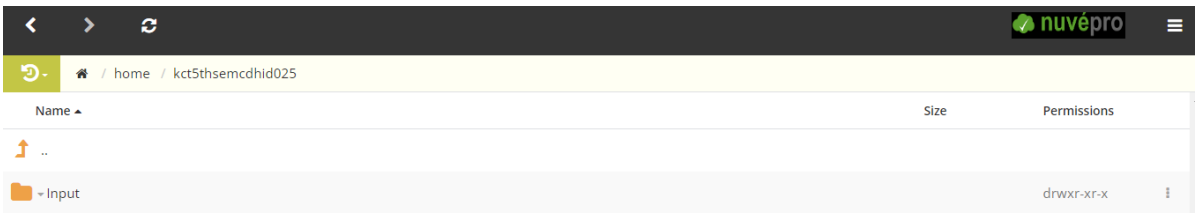
```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -ls /
Found 7 items
drwxr-xr-x   - hbase hbase               0 2022-10-24 06:41 /hbase
drwxrwxrwx   - hdfs  supergroup          0 2022-09-04 20:19 /markovData
drwxrwxr-x   - solr  solr                0 2022-07-13 08:06 /solr
drwxr-xr-x   - hdfs  supergroup          0 2021-05-22 18:21 /system
drwxrwxrwt   - hdfs  supergroup          0 2022-12-11 15:50 /tmp
drwxr-xr-x   - hdfs  supergroup          0 2022-12-13 09:28 /user
drwxr-xr-x   - hdfs  supergroup          0 2021-10-29 14:36 /userTest2
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

3. Upload and download a file in H Upload:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -put '/home/kct5thsemcdhid025/input.txt' '/user/kct5thsemcdhid025/sample'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

Hadoop fs -get:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -get '/user/kct5thsemcdhid025/matrix/Input' '/home/kct5thsemcdhid025/'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```



4. See contents of a file:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -cat '/user/kct5thsemcdhid025/sample/*'
Hai
Good
Hadoop
Wordcount
Flume
Bigdata
Spark
HadoopGood
Sparl
Hive
Spark[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

5. Copy a file from source to destination

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -cp '/home/kct5thsemcdhid025/Input' '/user/kct5thsemcdhid025/sample'
```

6. Copy a file from/To Local file system to HDFS

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -copyFromLocal '/home/kct5thsemcdhid025/Input' '/user/kct5thsemcdhid025/sample/'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

7. copyToLocal

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -copyToLocal '/user/kct5thsemcdhid025/MATRIX' '/home/kct5thsemcdhid025/'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

8. Remove a file or directory in HDFS.

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -rm '/user/kct5thsemcdhid025/sample/input.txt'
22/12/13 11:24:31 INFO fs.TrashPolicyDefault: Moved: 'hdfs://nameservice1/user/kct5thsemcdhid025/sample/input.txt' to trash at: hdfs://nameservice1/user/kct5thsemcdhi
d025/.Trash/Current/user/kct5thsemcdhid025/sample/input.txt
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

9. Display last few lines of a file.

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -tail '/user/kct5thsemcdhid025/sample/Input/Input.txt'
M,0,0,1
M,0,1,2
M,1,0,3
M,1,1,4
N,0,2,3
N,3,4,2
N,1,2,3
N,3,1,2
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

10. Display the aggregate length of a file.

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -du '/user/kct5thsemcdhid025/sample/Input/Input.txt'
64  192  /user/kct5thsemcdhid025/sample/Input/Input.txt
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

Result:

All the file operations can be implemented in hadoop.

LAB EXERCISE-3

Title of the exercise/experiment: Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

Implementing distinct word count problem using Map-Reduce

Theory:

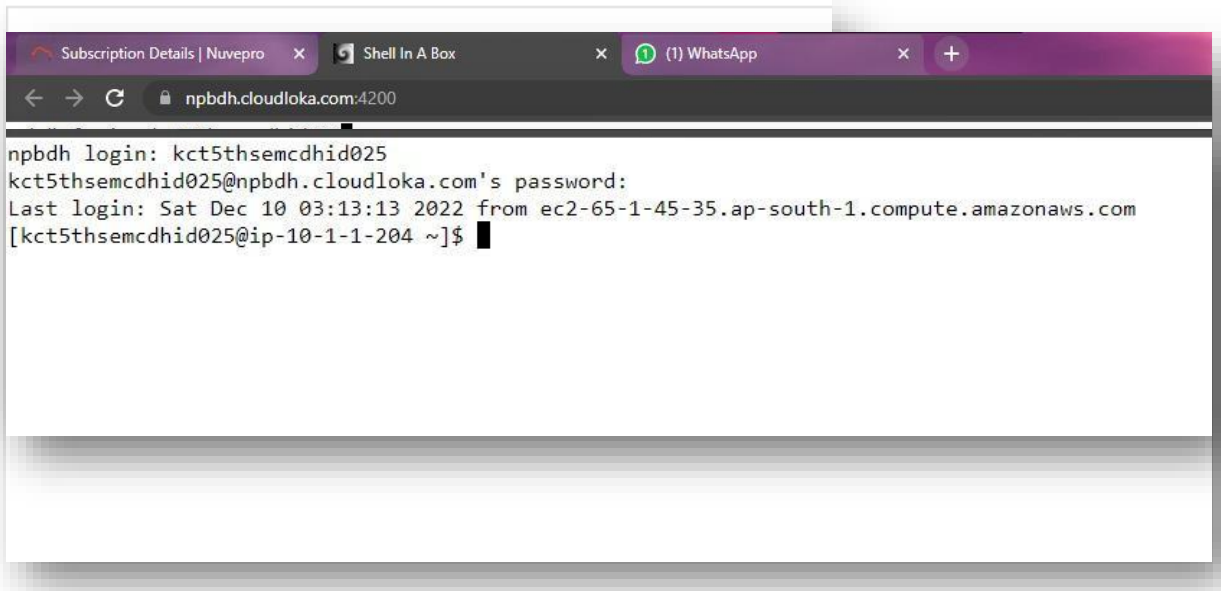
To run a MapReduce job, users should furnish a map function, a reduce function, input data, and an output data location.

When executed, Hadoop carries out the following steps:

1. Hadoop breaks the input data into multiple data items by new lines and runs the map function once for each data item, giving the item as the input for the function. When executed, the map function outputs one or more key- value pairs.
2. Hadoop collects all the key-value pairs generated from the map function, sorts them by the key, and groups together the values with the same key.
3. For each distinct key, Hadoop runs the reduce function once while passing the key and list of values for that key as input.
4. The reduce function may output one or more key-value pairs, and Hadoop writes them to a file as the final result.

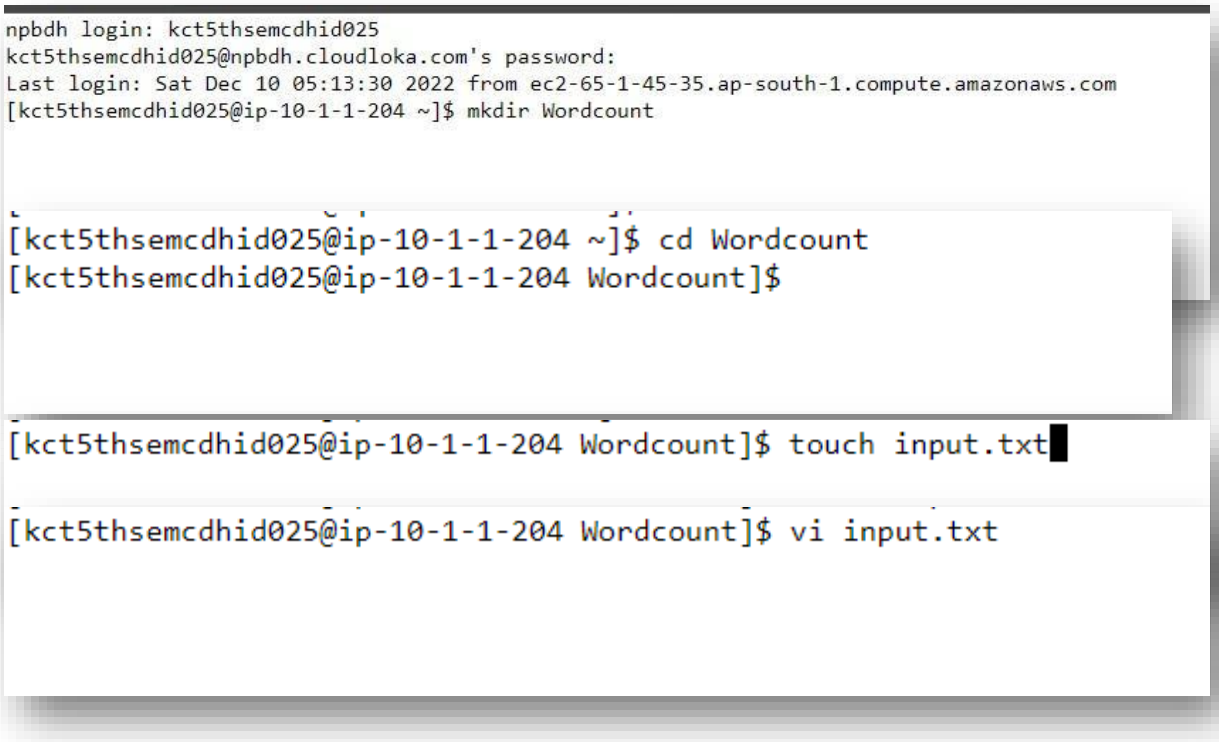
WORDCOUNT EXERCISE:

1) LOGIN TO THE WEB SHELL USING THE USERNAME AND PAAWORD

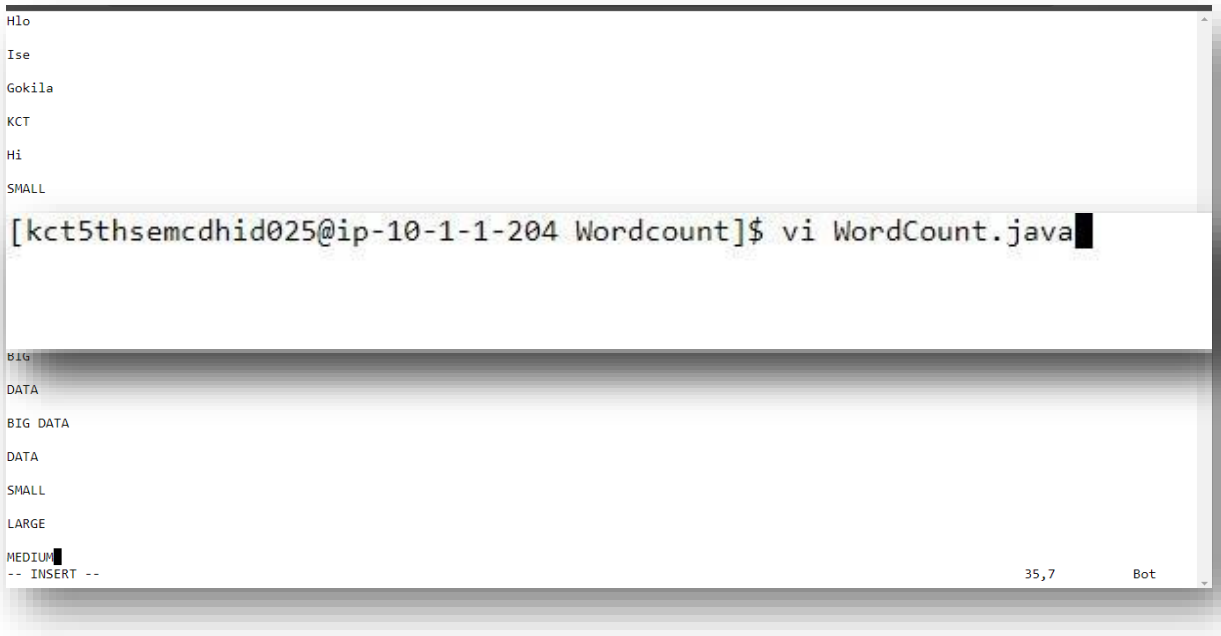

Subscription Details | Nuvepro
Shell In A Box
(1) WhatsApp
npbdh.cloudloka.com:4200
npbdh login: kct5thsemcdhid025
kct5thsemcdhid025@npbdh.cloudloka.com's password:
Last login: Sat Dec 10 03:13:13 2022 from ec2-65-1-45-35.ap-south-1.compute.amazonaws.com
[kct5thsemcdhid025@ip-10-1-1-204 ~]$

2) CREATE A FOLDER/ DIRECTORY FOR WORDCOUNT IN HOME

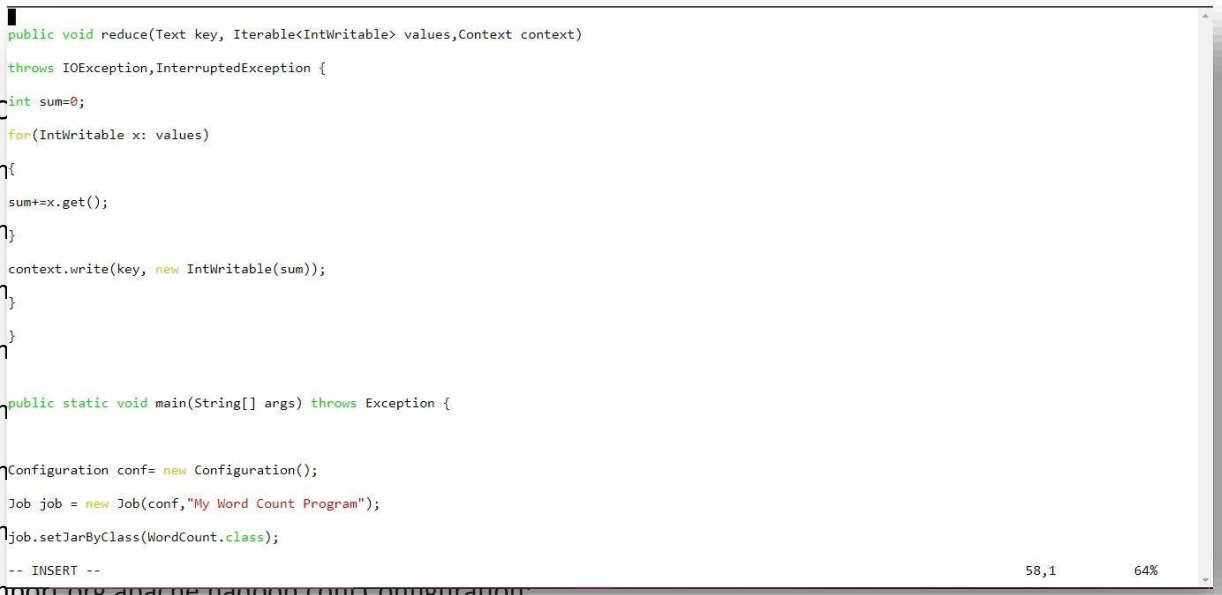
COMMAND: mkdir wordcount



PASTE THE INPUT IN THE INPUT FILE:



PASTE THE SOURCE CODE IN THE FILE:



```
public void reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException {
int sum=0;
for(IntWritable x: values)
{
sum+=x.get();
}
context.write(key, new IntWritable(sum));
}
}

public static void main(String[] args) throws Exception {

Configuration conf= new Configuration();
Job job = new Job(conf,"My Word Count Program");
job.setJarByClass(WordCount.class);
-- INSERT --                                                    58,1          64%
```

SC

im

im

im

im

im

im

import org.apache.hadoop.conf.Configuration;

import org.apache.hadoop.mapreduce.Job;

import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;

import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;

import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;

import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

import org.apache.hadoop.fs.Path;

public class WordCount

{

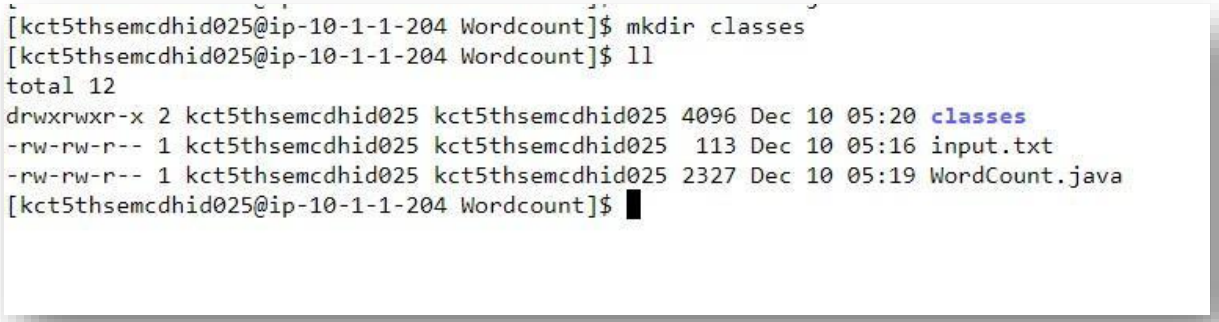
public static class Map extends Mapper<LongWritable,Text,Text,IntWritable> {

public void map(LongWritable key, Text value,Context context) throws

```
IOException,InterruptedException{
String line = value.toString();
StringTokenizer tokenizer = new StringTokenizer(line);
while (tokenizer.hasMoreTokens()) {
value.set(tokenizer.nextToken());
context.write(value, new IntWritable(1));
}
}
}
public static class Reduce extends Reducer<Text,IntWritable,Text,IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException {
int sum=0;
for(IntWritable x: values)
{
sum+=x.get();
}
context.write(key, new IntWritable(sum));
}
}

public static void main(String[] args) throws Exception {

Configuration conf= new Configuration();
Job job = new Job(conf,"My Word Count Program");
job.setJarByClass(WordCount.class);
job.setMapperClass(Map.class);
job.setReducerClass(Reduce.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
job.setInputFormatClass(TextInputFormat.class);
job.setOutputFormatClass(TextOutputFormat.class);
Path outputPath = new Path(args[1]);
//Configuring the input/output path from the filesystem into the job
FileInputFormat.addInputPath(job, new Path(args[0]));
```

```
FileOutputFormat.setOutputPath(job, new Path(args[1]));
//deleting the output path automatically from hdfs so that we don't have to delete it explicitly
outputPath.getFileSystem(conf).delete(outputPath);
//exiting the job only if the flag value becomes false
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
}
```

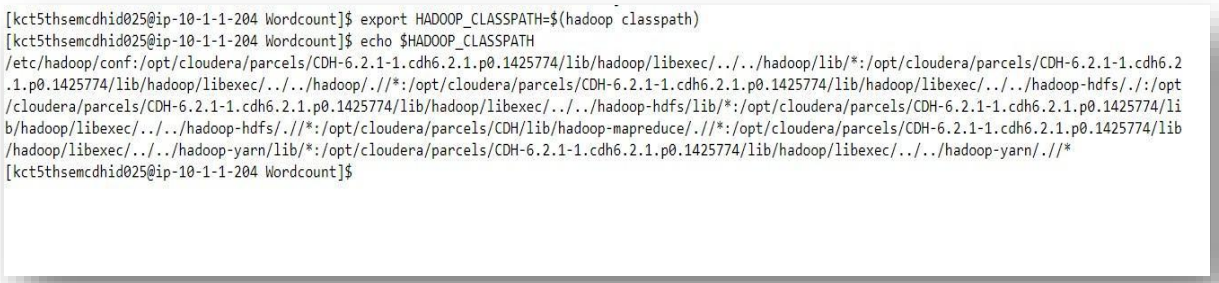
6) CREATE A DIRECTORY/ FOLDER CLASSES INSIDE THE WORDCOUNT FOLDER:



6) SET THE PATH FOR JAVA FILE

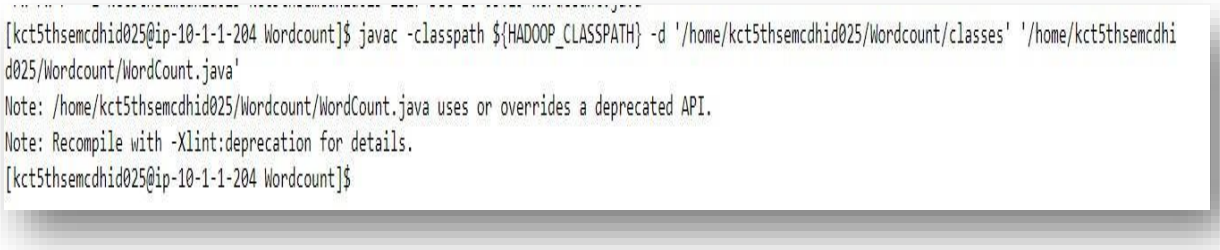
COMMAND: export HADOOP_CLASSPATH=$(hadoop classpath)

echo $HADOOP_CLASSPATH



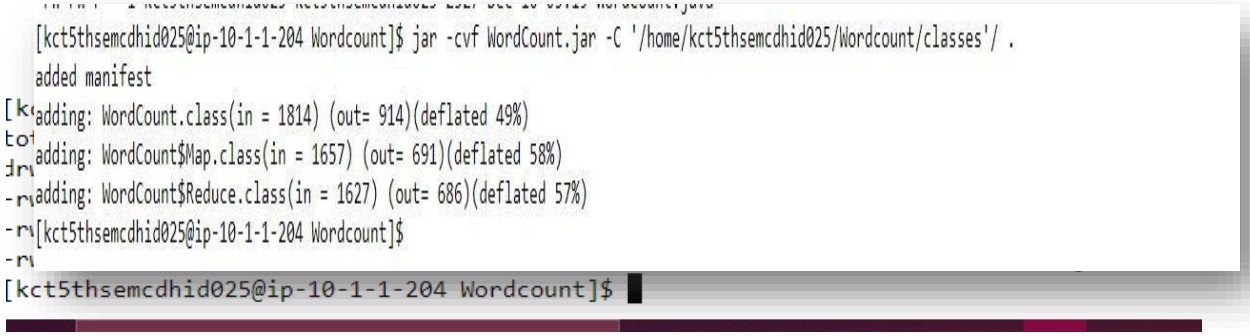
7) COMPILE THE JAVAFILE:

COMMAND: javac -classpath ${HADOOP_CLASSPATH} -d '/home/<NAME>/wordcount/classes' '/home/<NAME>/wordcount/WordCount.java'

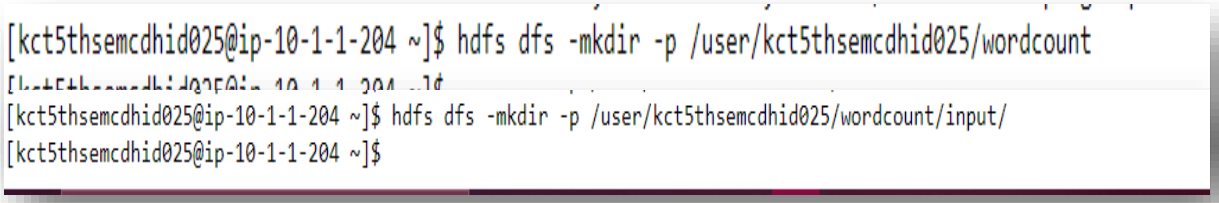


8) CREATE A JAR FILE:

COMMAND: jar -cvf WordCount.jar -C '/home/<NAME>/wordcount/classes'/ .



9) CREATE A DIRECTORY IN HADOOP



10) PUT THE INPUT FILE IN LOCAL SYSTEM TO HADOOP DIRECTORY:

12) RUN THE MAP REDUCE PROGRAM:

COMMAND: hadoop jar /home/<NAME>/wordcount/WordCount.jar' WordCount /user/<NAME>/wordcount/input /user/<NAME>/wordcount/output

```
[kct5thsemcdhid025@ip-10-1-1-204 Wordcount]$ hadoop jar /home/kct5thsemcdhid025/Wordcount/WordCount.jar WordCount /user/kct5thsemcdhid025/wordcount/i
nput /user/kct5thsemcdhid025/wordcount/output
WARNING: Use "yarn jar" to launch YARN applications.
22/12/10 05:39:41 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/10 05:39:42 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your
 application with ToolRunner to remedy this.
22/12/10 05:39:42 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/kct5thsemcdhid025/.staging/job_1663041244711_19338
22/12/10 05:39:42 INFO input.FileInputFormat: Total input files to process : 1
22/12/10 05:39:42 INFO mapreduce.JobSubmitter: number of splits:1
22/12/10 05:39:42 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metri
cs-publisher.enabled
22/12/10 05:39:42 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1663041244711_19338
22/12/10 05:39:42 INFO mapreduce.JobSubmitter: Executing with tokens: []
22/12/10 05:39:42 INFO conf.Configuration: resource-types.xml not found
22/12/10 05:39:42 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
22/12/10 05:39:42 INFO impl.YarnClientImpl: Submitted application application_1663041244711_19338
22/12/10 05:39:42 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711
_19338/
22/12/10 05:39:42 INFO mapreduce.Job: Running job: job_1663041244711_19338
22/12/10 05:39:51 INFO mapreduce.Job: Job job_1663041244711_19338 running in uber mode : false
22/12/10 05:39:51 INFO mapreduce.Job:  map 0% reduce 0%
22/12/10 05:39:57 INFO mapreduce.Job:  map 100% reduce 0%
22/12/10 05:40:11 INFO mapreduce.Job:  map 100% reduce 40%
22/12/10 05:40:12 INFO mapreduce.Job:  map 100% reduce 60%
22/12/10 05:40:13 INFO mapreduce.Job:  map 100% reduce 80%
22/12/10 05:40:14 INFO mapreduce.Job:  map 100% reduce 100%
22/12/10 05:40:14 INFO mapreduce.Job: Job job_1663041244711_19338 completed successfully
22/12/10 05:40:14 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=262
                FILE: Number of bytes written=1338661
                FILE: Number of read operations=0
```

```
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=1
                Launched reduce tasks=5
                Data-local map tasks=1
                Total time spent by all maps in occupied slots (ms)=3503
                Total time spent by all reduces in occupied slots (ms)=66189
                Total time spent by all map tasks (ms)=3503
                Total time spent by all reduce tasks (ms)=66189
                Total vcore-milliseconds taken by all map tasks=3503
                Total vcore-milliseconds taken by all reduce tasks=66189
                Total megabyte-milliseconds taken by all map tasks=3587072
                Total megabyte-milliseconds taken by all reduce tasks=67777536
        Map-Reduce Framework
                Map input records=35
                Map output records=19
                Map output bytes=172
                Map output materialized bytes=242
                Input split bytes=133
                Combine input records=0
                Combine output records=0
                Reduce input groups=11
                Reduce shuffle bytes=242
                Reduce input records=19
                Reduce output records=11
                Spilled Records=38
                Shuffled Maps =5
                Failed Shuffles=0
                Merged Map outputs=5
                GC time elapsed (ms)=1742
                CPU time spent (ms)=8020
                Physical memory (bytes) snapshot=1794891776
                Virtual memory (bytes) snapshot=15591702528
                Total committed heap usage (bytes)=2802843648
                Peak Map Physical memory (bytes)=519364608
```

13) VERIFY THE OUTPUT:

COMMAND: hdfs dfs -cat /user/<Name>/wordcount/output/*

```
                Bytes Written=78
[kct5thsemcdhid025@ip-10-1-1-204 Wordcount]$ hdfs dfs -cat /user/kct5thsemcdhid025/wordcount/output/*
Ise     1
BIG     2
Hello   1
Gokila  1
Hlo     1
KCT     2
MEDIUM  2
DATA    3
Hi      2
SMALL   2
LARGE   2
[kct5thsemcdhid025@ip-10-1-1-204 Wordcount]$
```

LAB EXERCISE-4

Title of the exercise/experiment: Implementation of Matrix Multiplication using MapReduce

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

Implementation of Matrix Multiplication using MapReduce

Theory:

In mathematics, matrix multiplication or the matrix

product is a binary operation that produces a matrix from two matrices. In more detail, if A is an n × m matrix and B is an m × p matrix, their matrix product AB is an n × p matrix, in which the m entries across a row of A are multiplied with the m entries down a column of B and summed to produce an entry of AB. When two linear transformations are represented by matrices, then the matrix product represents the composition of the two transformations.

Source Code:

```
import java.io.IOException;
import java.util.*;
import java.util.AbstractMap.SimpleEntry; import
java.util.Map.Entry;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.conf.*; import
org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat; import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
```

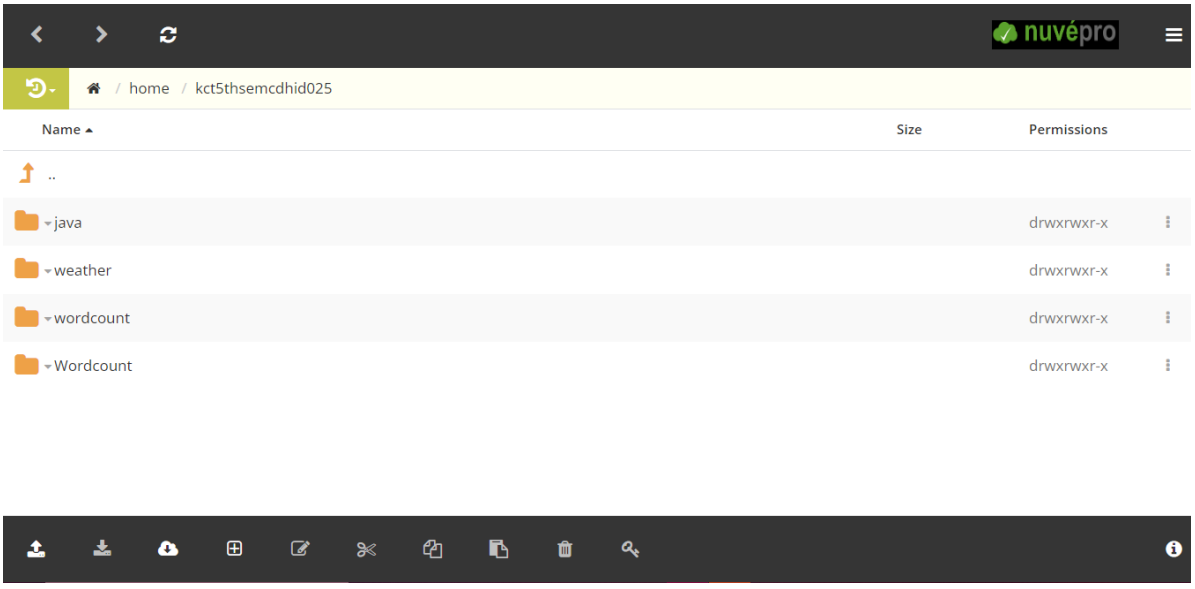
```
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
public class TwoStepMatrixMultiplication {
    public static class Map extends Mapper<LongWritable, Text, Text, Text> {
     public void map(LongWritable key, Text value, Context context)
    throws IOException, InterruptedException { String line =
    value.toString();
     String[] indicesAndValue = line.split(","); Text
     outputKey = new Text();
     Text outputValue = new Text();
     if (indicesAndValue[0].equals("A")) {
    outputKey.set(indicesAndValue[2]); outputValue.set("A," +
    indicesAndValue[1] + "," + indicesAndValue[3]);
     context.write(outputKey, outputValue);
     } else { outputKey.set(indicesAndValue[1]);
    outputValue.set("B," + indicesAndValue[2] + "," +
    indicesAndValue[3]);
     context.write(outputKey, outputValue);
     }
     }
     }
     public static class Reduce extends Reducer<Text, Text, Text, Text> {
     public void reduce(Text key, Iterable<Text> values,
```

```
Context context) throws IOException, InterruptedException { String[]
 value;
 ArrayList<Entry<Integer, Float>> listA = new
ArrayList<Entry<Integer, Float>>();
ArrayList<Entry<Integer, Float>> listB = new
ArrayList<Entry<Integer, Float>>();
 for (Text val : values) {
 value = val.toString().split(",");
 if (value[0].equals("A")) { listA.add(new
 SimpleEntry<Integer,
Float>(Integer.parseInt(value[1]), Float.parseFloat(value[2])));
 } else {
 listB.add(new SimpleEntry<Integer, Float>(Integer.parseInt(value[1]),
Float.parseFloat(value[2])));
 }
 }
 String i;
 float a_ij;
 String k;
 float b_jk;
 Text outputValue = new Text();
 for (Entry<Integer, Float> a : listA) { i =
 Integer.toString(a.getKey());
 a_ij = a.getValue();
 for (Entry<Integer, Float> b : listB) { k =
 Integer.toString(b.getKey()); b_jk =
 b.getValue();
```

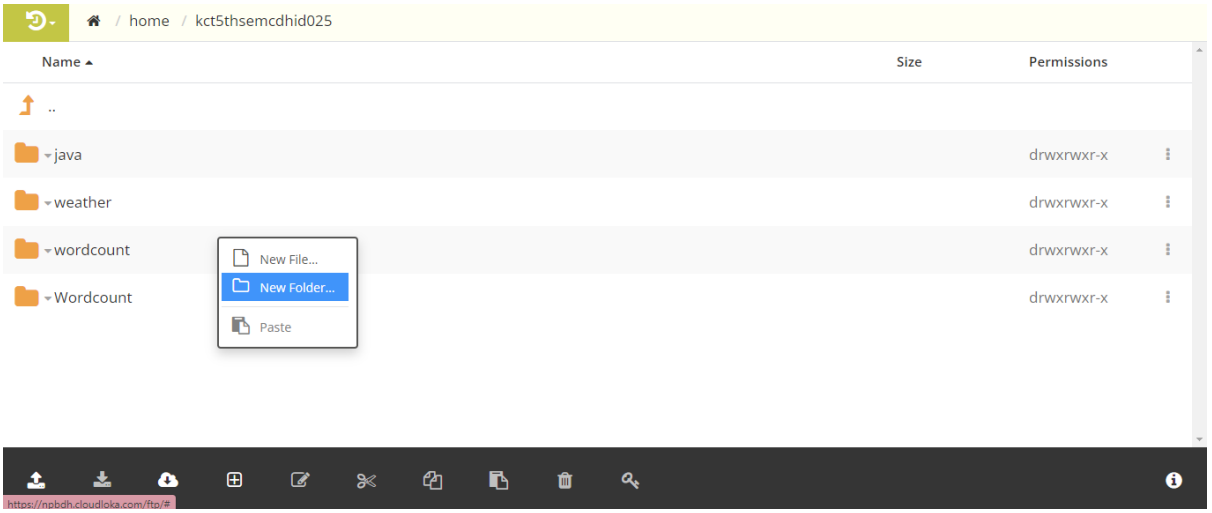
```
 outputValue.set(i + "," + k + "," +
Float.toString(a_ij*b_jk));
context.write(null, outputValue);
 }
 }
 }
 }
 public static void main(String[] args) throws Exception {
 Configuration conf = new Configuration();
 Job job = new Job(conf, "MatrixMatrixMultiplicationTwoSteps");
job.setJarByClass(TwoStepMatrixMultiplication.class);
job.setOutputKeyClass(Text.class); job.setOutputValueClass(Text.class);
job.setMapperClass(Map.class); job.setReducerClass(Reduce.class);
job.setInputFormatClass(TextInputFormat.class);
job.setOutputFormatClass(TextOutputFormat.class);
FileInputFormat.addInputPath(job, new Path("hdfs://
127.0.0.1:9000/matrixin"));
 FileOutputFormat.setOutputPath(job, new
Path("hdfs://127.0.0.1:9000/matrixout"));
 job.waitForCompletion(true);
 }
}
```

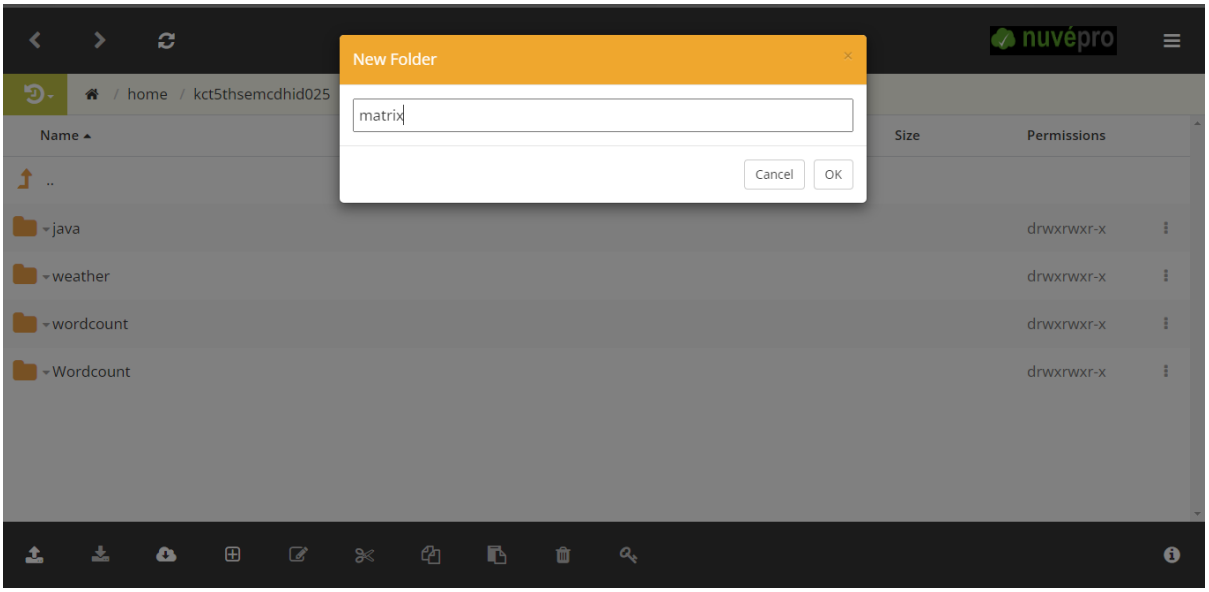
MATRIX MULTIPLICATION:

1) LOGIN WITH THE USERNAME AND PASSWORD

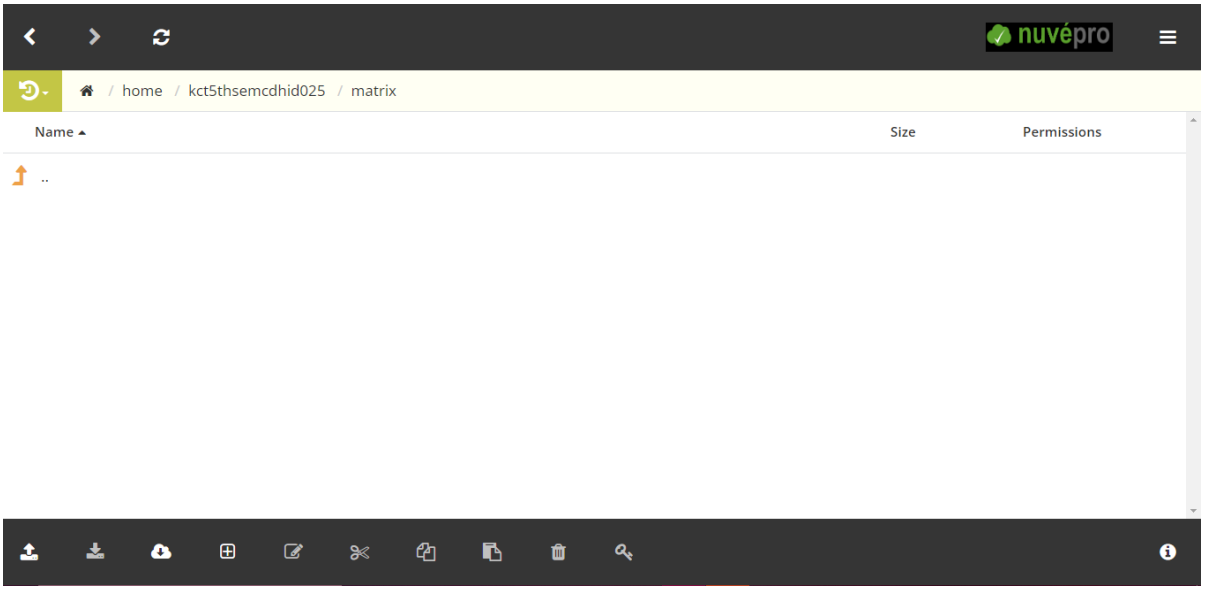


CREATE A FOLDER FOR MATRIX

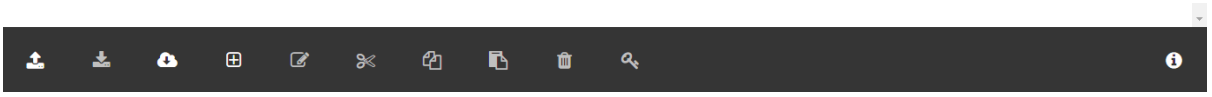


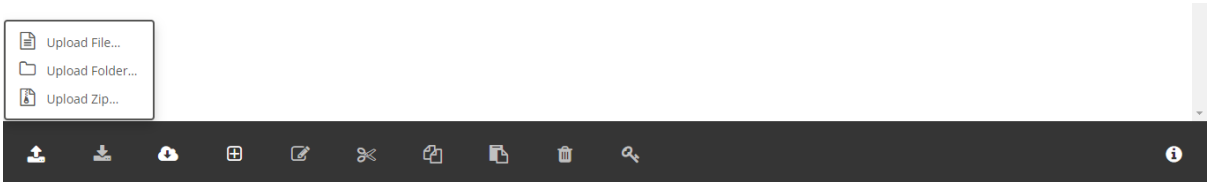


INSIDE THE MATRIX FOLDER UPLOAD THE INPUT FILE AND JAVA FILE

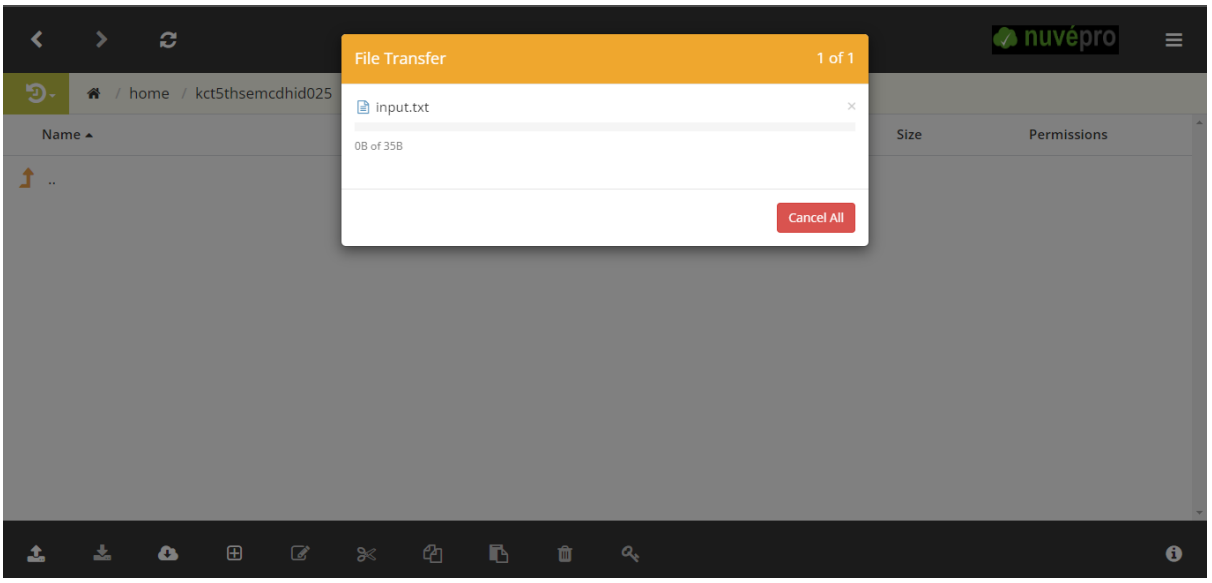


CAN UPLOAD/EDIT/DELETE THE FILES BY USING THESE OPTIONS:

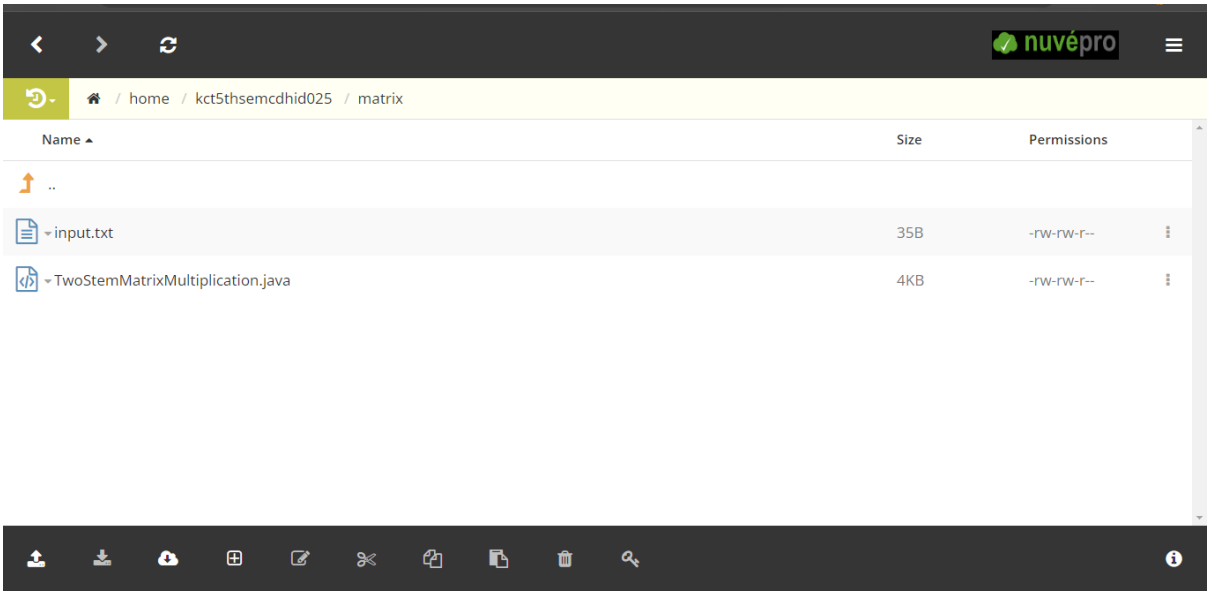




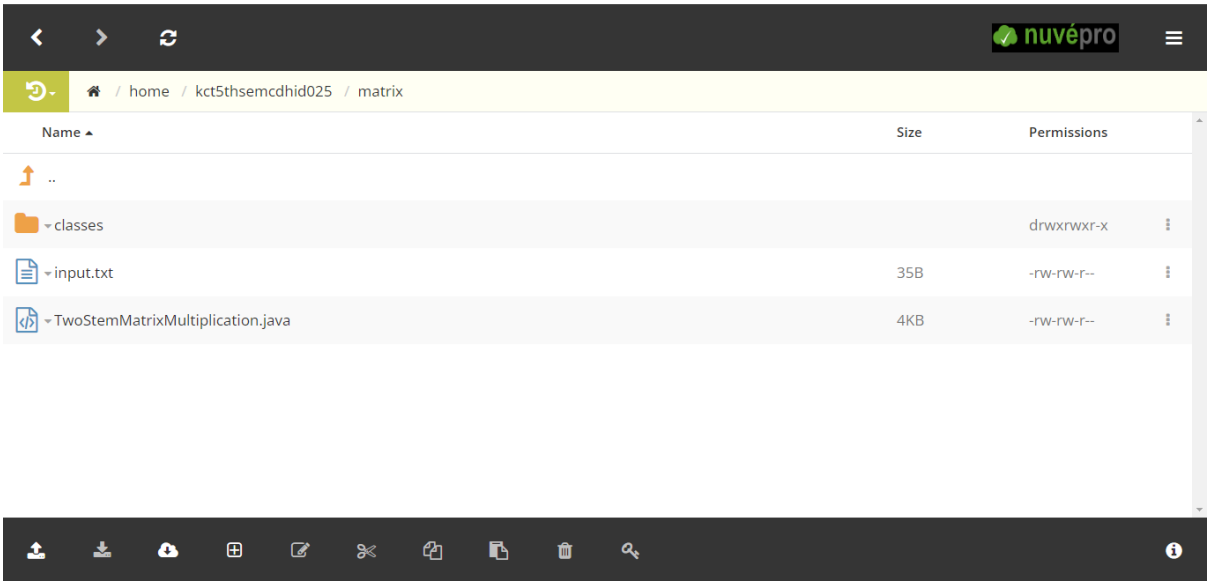
UPLOAD THE INPUT FILE:



UPLOAD THE JAVA FILE:



CREATE A CLASS FOLDER:



IN WEB SHELL GO TO THE MATRIX FOLDER:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ cd matrix
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ ll
total 12
drwxrwxr-x 2 kct5thsemcdhid025 kct5thsemcdhid025 4096 Dec 12 05:50 classes
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   35 Dec 12 05:47 input.txt
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 3666 Dec 12 05:50 TwoStemMatrixMultiplication.java
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$
```

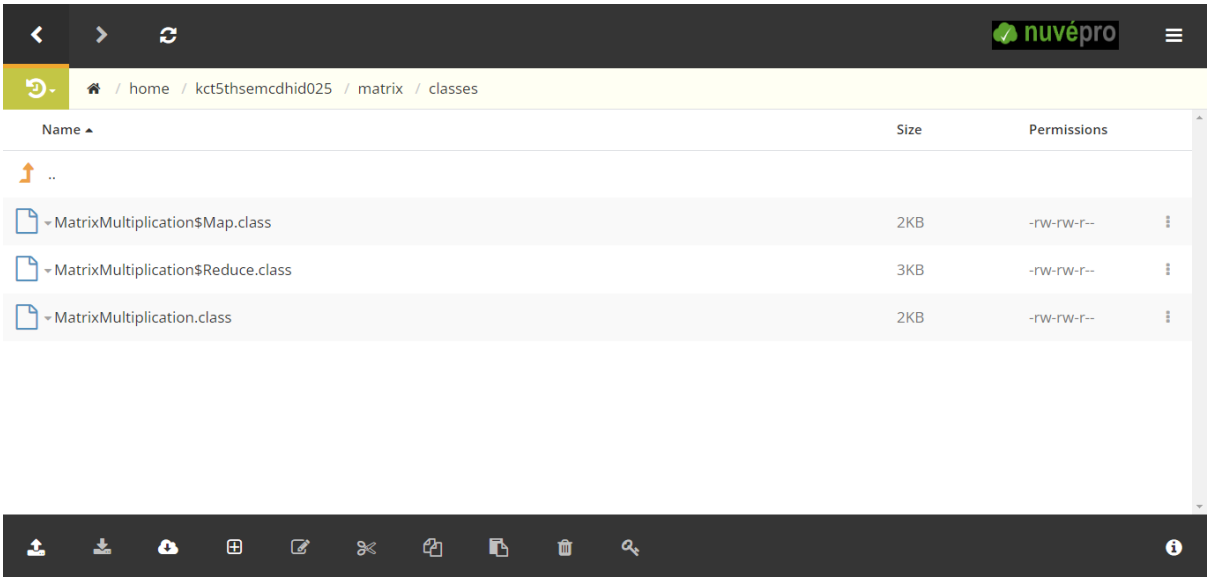
SET THE PATH FOR JAVA FILE:

```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ export HADOOP_CLASSPATH=$(hadoop classpath)
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ echo $HADOOP_CLASSPATH
/etc/hadoop/conf:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2
.1.p0.1425774/lib/hadoop/libexec/../../hadoop/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/./:/opt
/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/li
b/hadoop/libexec/../../hadoop-hdfs/.//*:/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib
/hadoop/libexec/../../hadoop-yarn/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/.//*
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$
```

COMPILE THE JAVA FILE

javac -classpath ${HADOOP_CLASSPATH} -d '/home/<NAME> / matrix /classes' '/home/<NAME>/ matrix / TwoStepMatrixMultiplication.java'

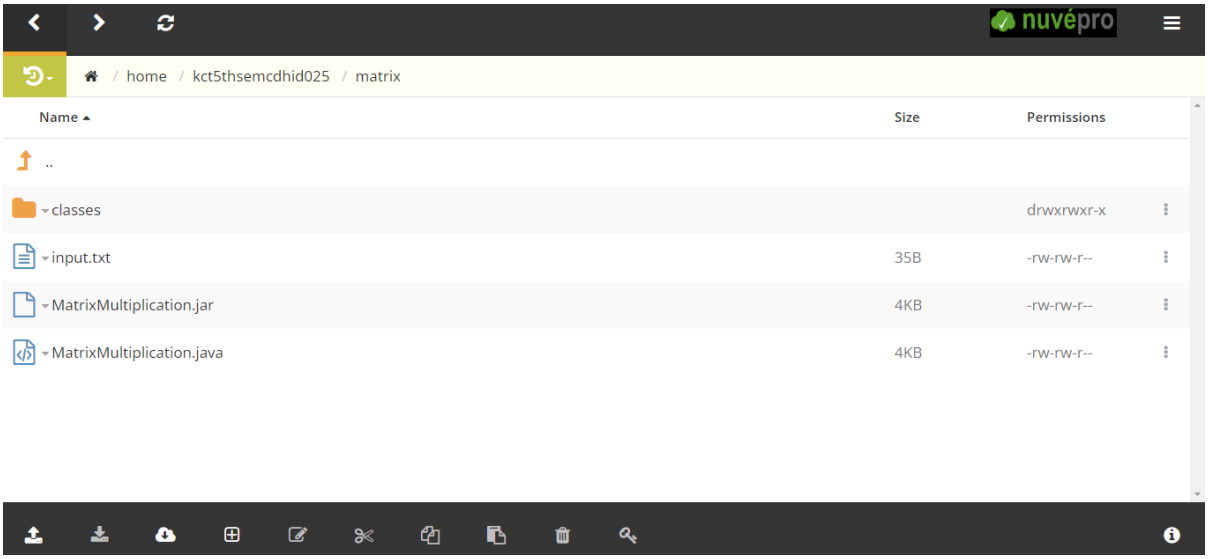
```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ javac -classpath ${HADOOP_CLASSPATH} -d '/home/kct5thsemcdhid025/matrix/classes'   '/home/kct5thsemcdhid025
/matrix/TwoStepMatrixMultiplication.java'
Note: /home/kct5thsemcdhid025/matrix/TwoStepMatrixMultiplication.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$
```



CREATE A JAR FILE

jar -cvf TwoStepMatrixMultiplication.jar -C '/home/<NAME>/ matrix /classes'/ .

```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ jar -cvf MatrixMultiplication.jar -C '/home/kct5thsemcdhid025/matrix/classes'/ .
added manifest
adding: MatrixMultiplication$Reduce.class(in = 2985) (out= 1292)(deflated 56%)
adding: MatrixMultiplication.class(in = 1845) (out= 954)(deflated 48%)
adding: MatrixMultiplication$Map.class(in = 2411) (out= 1012)(deflated 58%)
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$
```




```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/matrix
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

CREATE An INPUT AND OUTPUT FOLDER INSIDE THE DIRECTORY:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/matrix/input
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/matrix/output
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

PUT THE INPUT TEXT FILE INSIDE THE INPUT FOLDER:

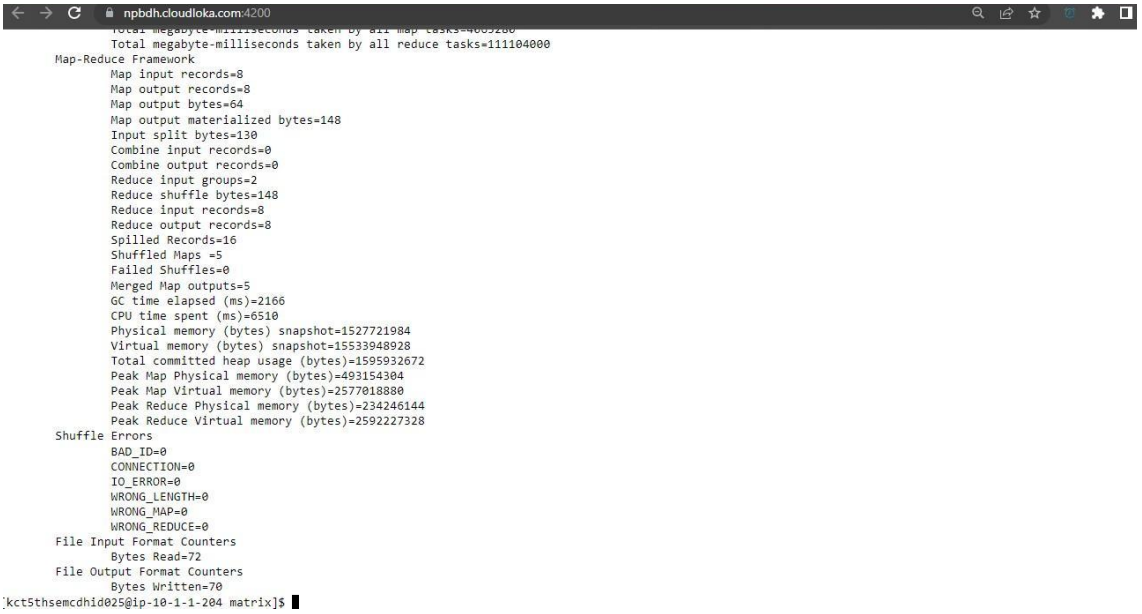
```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -put '/home/kct5thsemcdhid025/matrix/input.txt' '/user/kct5thsemcdhid025/matrix/input/'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

CHECK THE INPUT FILE

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -cat /user/kct5thsemcdhid025/matrix/input/*
M,0,0,1

M,0,1,2

M,1,0,3

M,1,1,4
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ hadoop jar /home/kct5thsemcdhid025/matrix/MatMul.jar MatMul  /user/kct5thsemcdhid025/Matrix/input  /user/kc
t5thsemcdhid025/Matrix/output
WARNING: Use "yarn jar" to launch YARN applications.
22/12/12 15:42:14 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/12 15:42:14 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your
 application with ToolRunner to remedy this.
22/12/12 15:42:14 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/kct5thsemcdhid025/.staging/job_1663041244711_21353
22/12/12 15:42:15 INFO input.FileInputFormat: Total input files to process : 1
22/12/12 15:42:15 INFO mapreduce.JobSubmitter: number of splits:1
22/12/12 15:42:15 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metri
cs-publisher.enabled
22/12/12 15:42:15 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1663041244711_21353
22/12/12 15:42:15 INFO mapreduce.JobSubmitter: Executing with tokens: []
22/12/12 15:42:15 INFO conf.Configuration: resource-types.xml not found
22/12/12 15:42:15 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
22/12/12 15:42:15 INFO impl.YarnClientImpl: Submitted application application_1663041244711_21353
22/12/12 15:42:15 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711
_21353/
22/12/12 15:42:15 INFO mapreduce.Job: Running job: job_1663041244711_21353
```

```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ hadoop jar /home/kct5thsemcdhid025/matrix/MatMul.jar MatMul /user/kct5thsemcdhid025/MATRIX/input /user/kct5thsemcdhid025/MAT
RIX/output
WARNING: Use "yarn jar" to launch YARN applications.
22/12/13 10:46:55 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 10:46:56 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with
 ToolRunner to remedy this.
22/12/13 10:46:56 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/kct5thsemcdhid025/.staging/job_1663041244711_21821
22/12/13 10:46:56 INFO input.FileInputFormat: Total input files to process : 1
22/12/13 10:46:56 INFO mapreduce.JobSubmitter: number of splits:1
22/12/13 10:46:56 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metrics-publisher.enab
led
22/12/13 10:46:56 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1663041244711_21821
22/12/13 10:46:56 INFO mapreduce.JobSubmitter: Executing with tokens: []
22/12/13 10:46:56 INFO conf.Configuration: resource-types.xml not found
22/12/13 10:46:56 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
22/12/13 10:46:56 INFO impl.YarnClientImpl: Submitted application application_1663041244711_21821
22/12/13 10:46:56 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21821/
22/12/13 10:46:56 INFO mapreduce.Job: Running job: job_1663041244711_21821
22/12/13 10:47:05 INFO mapreduce.Job: Job job_1663041244711_21821 running in uber mode : false
22/12/13 10:47:05 INFO mapreduce.Job:  map 0% reduce 0%
22/12/13 10:47:11 INFO mapreduce.Job:  map 100% reduce 0%
```



OUTPUT:

```
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$ hdfs dfs -cat /user/kct5thsemcdhid025/MATRIX/output/*
1,1,3.0
1,0,4.0
0,1,21.0
0,0,28.0
1,1,18.0
1,0,45.0
0,1,12.0
0,0,30.0
[kct5thsemcdhid025@ip-10-1-1-204 matrix]$
```

RESULT:

Thus the multiplication program were executed successfully by the use of Map and Reduce tasks.

LAB EXERCISE-5

Title of the exercise/experiment: Implement a Map Reduce Program to analyse time-temperature statistics and generate report with max/min temperature

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

To implement a Map, Reduce Program to analyse time-temperature statistics and generate report with max/min temperature

PROBLEM STATEMENT:

1. The system receives temperatures of various cities(Austin, Boston,etc) of USA captured at regular intervals of time on each day in an input file.

2. System will process the input data file and generates a report with Maximum and Minimum temperatures of each day along with time.

3. Generates a separate output report for eachcity. Ex:

Austin-r-00000

Boston-r-00000

Newjersy-r-00000

Baltimore-r-0000

0

California-r-00000

Newyork-r-00000

THEORY:

The very first thing which is required for any map reduce problem is to understand what will be the type of keyIn, ValueIn, KeyOut,ValueOut for the given Mapper class and followed by type of map method parameters.

- public class WhetherForcastMapper extends Mapper <Object, Text, Text, Text>
- Object (keyIn) - Offset for each line, line number 1, 2...
- Text (ValueIn) - Whole string for each line (CA_25-Jan-2014 00:12:345)
- Text (KeyOut) - City information with date information as string
- Text (ValueOut) - Temperature and time information which need to be passed to reducer as string.
- public void map(Object keyOffset, Text dayReport, Context con) { }

- KeyOffset is like line number for each line in input file.

- dayreport is input to map method - whole string present in one line of input file.
- con is context where we write mapper output and it is used by reducer.

Reducer class and reducer method:-

Similarly,we have to decide what will be the type of keyIn, ValueIn, KeyOut,ValueOut for the given Reducer class and followed by type of reducer method parameters.

- public class WhetherForcastReducer extends Reducer<Text, Text, Text, Text>
- Text(keyIn) - it is same as keyOut of Mapper.
- Text(ValueIn)- it is same as valueOut of Mapper.
- Text(KeyOut)- date as string
- text(ValueOut) - reducer writes max and min temperature with time as string
- public void reduce(Text key, Iterable<Text> values, Context context)

- Text key is value of mapper output. i.e:- City & date information
- Iterable<Text> values - values stores multiple temperature values for a given city and date. context object is where reducer write it's processed outcome and finally written in file.

MultipleOutputs:-

In general, reducer generates output file(i.e: part_r_0000), however in this use case we want to generate multiple output files. In order to deal with such scenario we need to use MultipleOutputs of "org.apache.hadoop.mapreduce.lib.output.MultipleOutputs" which provides a way to write multiple file depending on reducer outcome. For each reducer task multipleoutput object is created and key/result is written to appropriate file.

SOURCE CODE:

```
import java.io.IOException; import
java.util.StringTokenizer; import
org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper; import
org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.output.MultipleOutputs; import
org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat; import
org.apache.hadoop.mapreduce.lib.output.FileOutputFormat; import
org.apache.hadoop.mapreduce.lib.output.TextOutputFormat; public class
CalculateMaxAndMinTemeratureWithTime {
public static String calOutputName ="California"; public
static String nyOutputName = "Newyork"; public static
```

```
String njOutputName = "Newjersy"; public static String
ausOutputName = "Austin"; public static String
bosOutputName = "Boston";


public static String balOutputName ="Baltimore"; public
static class WhetherForcastMapper extends Mapper<Object,
Text, Text, Text> {
public void map(Object keyOffset, Text dayReport, Context con)throws IOException,
InterruptedException {
 StringTokenizer strTokens = new
StringTokenizer( dayReport.toString(),
"\t");
 int counter = 0;
 Float currnetTemp = null;
 Float minTemp = Float.MAX_VALUE; Float
 maxTemp = Float.MIN_VALUE; String date =
 null;
 String currentTime = null;
 String minTempANDTime = null; String
 maxTempANDTime = null; while
 (strTokens.hasMoreElements()) { if (counter
 == 0) {
 date = strTokens.nextToken();
 } else {
 if (counter % 2 == 1) {
 currentTime = strTokens.nextToken();
 } else {
 currnetTemp =Float.parseFloat(strTokens.nextToken()); if
 (minTemp > currnetTemp) {
 minTemp = currnetTemp; minTempANDTime =
minTemp + "AND" + currentTime;
```

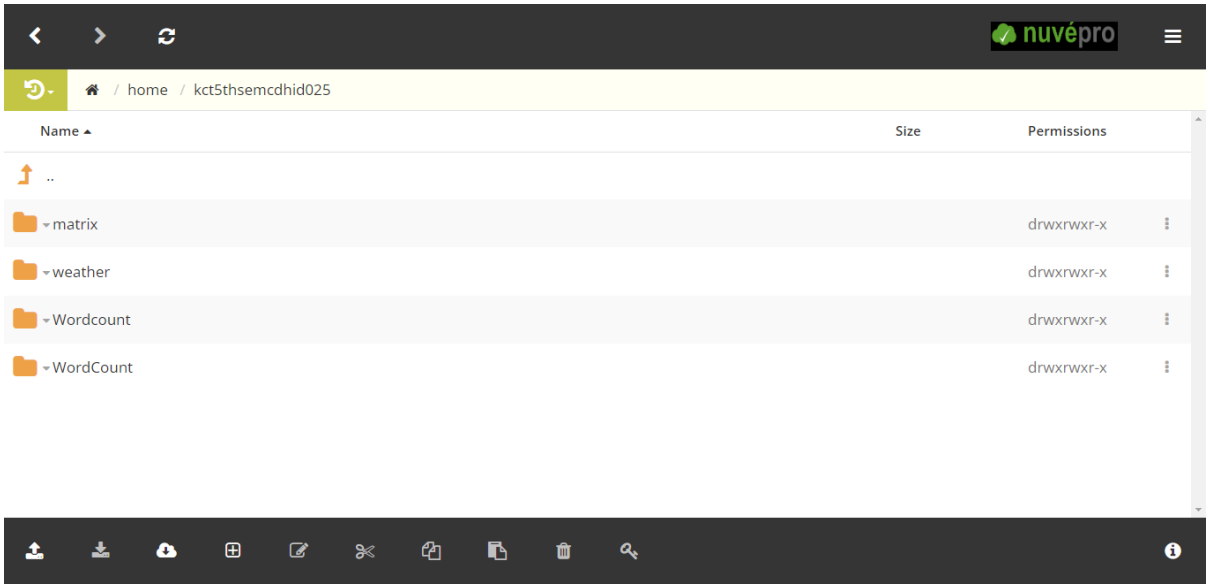
```
 }
 if (maxTemp < currnetTemp) {
 maxTemp = currnetTemp;
 maxTempANDTime = maxTemp + "AND" +
currentTime;
 }
 }
 }
 counter++;
 }
 // Write to context - MinTemp, MaxTemp and
corresponding time
 Text temp = new Text();
 temp.set(maxTempANDTime); Text
 dateText = new Text();
 dateText.set(date);
 try {
 con.write(dateText, temp);
 } catch (Exception e) {
 e.printStackTrace();
 }
 temp.set(minTempANDTime);
 dateText.set(date);
 con.write(dateText, temp);
}
}
public static class WhetherForcastReducer extends Reducer<Text, Text, Text, Text> {

 MultipleOutputs<Text, Text> mos; public
void setup(Context context) { mos = new
MultipleOutputs<Text, Text>(context);
}
public void reduce(Text key, Iterable<Text> values,
Context context)
 throws IOException, InterruptedException { int
```

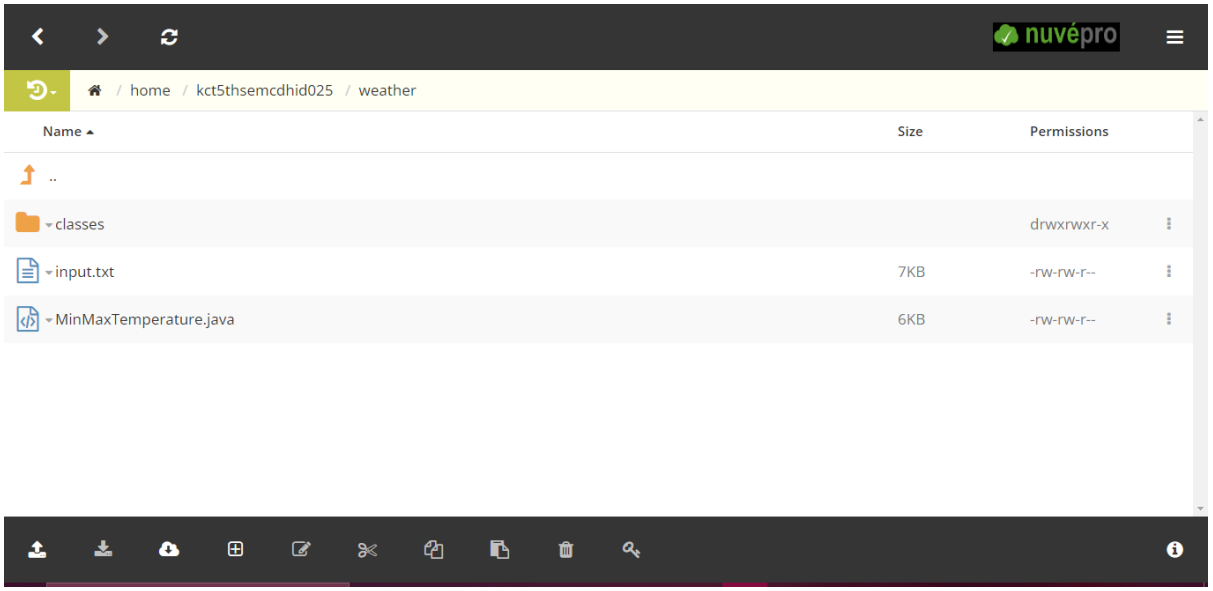
```
 counter = 0;
 String reducerInputStr[] = null;
 String f1Time = "";
 String f2Time = ""; String f1 =
 "", f2 = ""; Text result = new
 Text(); for (Text value : values)
 { if (counter == 0) {
reducerInputStr =
value.toString().split("AND"); f1 =
reducerInputStr[0]; f1Time =
reducerInputStr[1];
 }
 else {
 reducerInputStr =
value.toString().split("AND"); f2 =
 reducerInputStr[0]; f2Time =
 reducerInputStr[1];
 }

 counter = counter + 1;
 }
 if (Float.parseFloat(f1) >
Float.parseFloat(f2)) {
 result = new Text("Time: " + f2Time + " MinTemp: " + f2 + "\t" + "Time: " + f1Time + "
MaxTemp: " + f1);
 }
else {

 result = new Text("Time: " + f1Time + " MinTemp: " + f1 + "\t"+ "Time: " + f2Time + "
MaxTemp: " + f2);
 }
 String fileName = "";
 if (key.toString().substring(0, 2).equals("CA"))
{
 fileName =CalculateMaxAndMinTemeratureTime.calOutputName;
 } else if (key.toString().substring(0,
2).equals("NY")) {
 fileName =CalculateMaxAndMinTemeratureTime.nyOutputName;
 } else if (key.toString().substring(0,
```

```
2).equals("NJ")) {
 fileName =CalculateMaxAndMinTemeratureTime.njOutputName;
 } else if (key.toString().substring(0,
3).equals("AUS")) {
 fileName =CalculateMaxAndMinTemeratureTime.ausOutputName;
 } else if (key.toString().substring(0,
3).equals("BOS")) {
 fileName =CalculateMaxAndMinTemeratureTime.bosOutputName;


 } else if (key.toString().substring(0,
3).equals("BAL")) {
 fileName =CalculateMaxAndMinTemeratureTime.balOutputName;
 }
 String strArr[] = key.toString().split("_");
 key.set(strArr[1]); //Key is date value
 mos.write(fileName, key, result);
}
@Override
public void cleanup(Context context) throws
IOException,
 InterruptedException {
 mos.close();
}
}
public static void main(String[] args) throws
IOException,
 ClassNotFoundException,
InterruptedException {
 Configuration conf = new Configuration(); Job job =
Job.getInstance(conf, "Wheather Statistics of USA");
job.setJarByClass(CalculateMaxAndMinTemeratureW
ithTime.class);
job.setMapperClass(WhetherForcastMapper.class);
job.setReducerClass(WhetherForcastReducer.class);
job.setMapOutputKeyClass(Text.class);
```

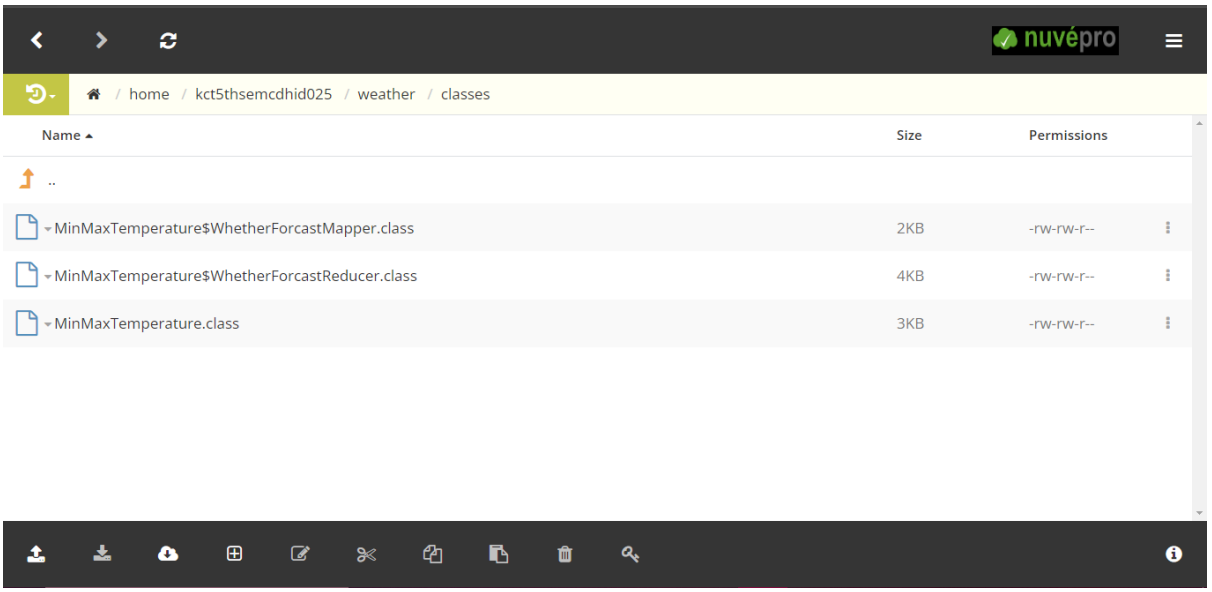
```
 job.setMapOutputValueClass(Text.class);
 job.setOutputKeyClass(Text.class);
 job.setOutputValueClass(Text.class);
MultipleOutputs.addNamedOutput(job,calOutputName,TextOutputFormat.class
, Text.class,Text.class);
MultipleOutputs.addNamedOutput(job,nyOutputName,TextOutputFormat.class, Text.class,Text.class);
MultipleOutputs.addNamedOutput(job,njOutputName,TextOutputFormat.class, Text.class,Text.class);

MultipleOutputs.addNamedOutput(job,bosOutputName,TextOutputFormat.clas s,
Text.class,Text.class);

MultipleOutputs.addNamedOutput(job,ausOutputName,TextOutputFormat.clas s,
Text.class,Text.class);
MultipleOutputs.addNamedOutput(job,balOutputName,TextOutputFormat.class
, Text.class,Text.class);
// FileInputFormat.addInputPath(job, new Path(args[0]));
// FileOutputFormat.setOutputPath(job, new Path(args[1]));
 Path pathInput = new Path("hdfs://192.168.213.133:54310/weatherInputData/
input_temp.txt");
 Path pathOutputDir = new Path( "hdfs://192.168.213.133:54310/user/hduser1/
testfs/output_mapred3");
 FileInputFormat.addInputPath(job, pathInput);
FileOutputFormat.setOutputPath(job,pathOutputDir); try {
System.exit(job.waitForCompletion(true) ? 0 :1);
} catch (Exception e) {
 // TODO Auto-generated catch block
 e.printStackTrace();

}
}
}
```

Create a folder weather

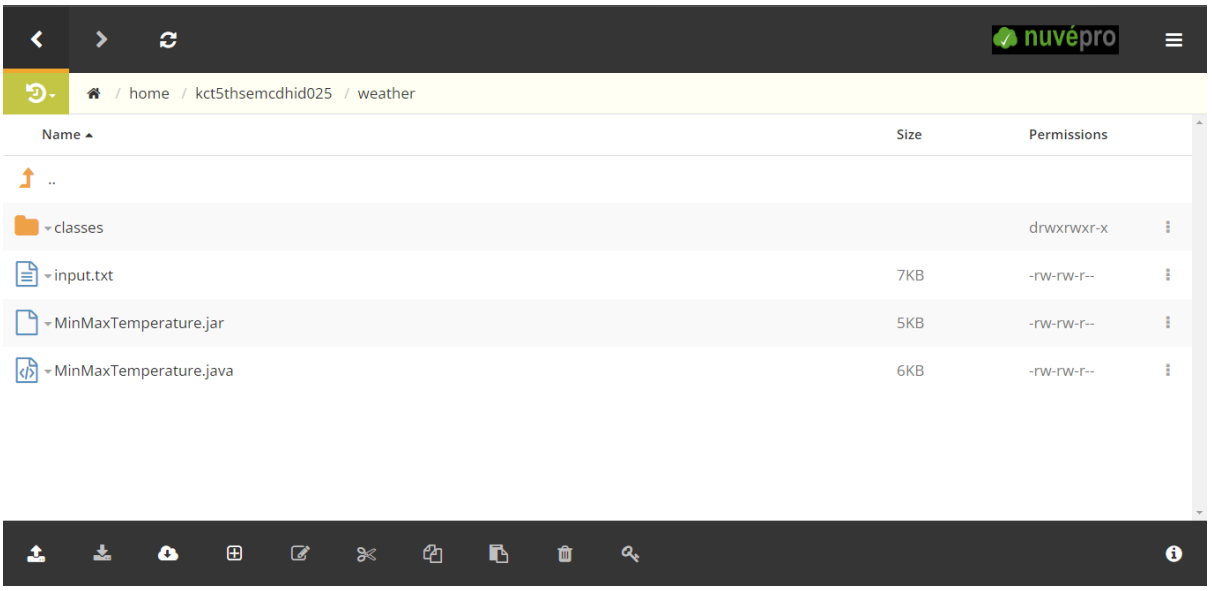





```
npbdh login: kct5thsemcdhid025
kct5thsemcdhid025@npbdh.cloudloka.com's password:
Last login: Mon Dec 12 14:51:57 2022 from ec2-65-1-45-35.ap-south-1.compute.amazonaws.com
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ cd weather
[kct5thsemcdhid025@ip-10-1-1-204 weather]$ export HADOOP_CLASSPATH=$(hadoop classpath)
[kct5thsemcdhid025@ip-10-1-1-204 weather]$ echo $HADOOP_CLASSPATH
/etc/hadoop/conf:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2
.1.p0.1425774/lib/hadoop/libexec/../../hadoop/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/./:/opt
/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/li
b/hadoop/libexec/../../hadoop-hdfs/.//*:/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib
/hadoop/libexec/../../hadoop-yarn/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/.//*
[kct5thsemcdhid025@ip-10-1-1-204 weather]$
```




```
[kct5thsemcdhid025@ip-10-1-1-204 weather]$ jar -cvf MinMaxTemperature.jar -C '/home/kct5thsemcdhid025/weather/classes'/ .
added manifest
adding: MinMaxTemperature$WhetherForcastReducer.class(in = 3651) (out= 1546)(deflated 57%)
adding: MinMaxTemperature$WhetherForcastMapper.class(in = 2437) (out= 1143)(deflated 53%)
adding: MinMaxTemperature.class(in = 2734) (out= 1349)(deflated 50%)
[kct5thsemcdhid025@ip-10-1-1-204 weather]$
```




```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -ls /user/kct5thsemcdhid025/Weather
Found 2 items
drwxr-xr-x   - kct5thsemcdhid025 kct5thsemcdhid025          0 2022-12-12 06:10 /user/kct5thsemcdhid025/Weather/input
drwxr-xr-x   - kct5thsemcdhid025 kct5thsemcdhid025          0 2022-12-12 06:10 /user/kct5thsemcdhid025/Weather/output
```

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -put '/home/kct5thsemcdhid025/weather/input.txt' '/user/kct5thsemcdhid025/Weather/input'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

```
[kct5thsemcdhid025@ip-10-1-1-204 weather]$ hadoop jar /home/kct5thsemcdhid025/weather/MinMaxTemperature.jar MinMaxTemperature  /user/kct5thsemcdhid02
5/Weather/input  /user/kct5thsemcdhid025/Weather/output
WARNING: Use "yarn jar" to launch YARN applications.
22/12/12 15:36:48 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/12 15:36:49 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your
 application with ToolRunner to remedy this.
22/12/12 15:36:49 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/kct5thsemcdhid025/.staging/job_1663041244711_21350
22/12/12 15:36:49 INFO input.FileInputFormat: Total input files to process : 1
22/12/12 15:36:49 INFO mapreduce.JobSubmitter: number of splits:1
22/12/12 15:36:49 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metri
cs-publisher.enabled
22/12/12 15:36:49 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1663041244711_21350
22/12/12 15:36:49 INFO mapreduce.JobSubmitter: Executing with tokens: []
22/12/12 15:36:49 INFO conf.Configuration: resource-types.xml not found
22/12/12 15:36:49 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
22/12/12 15:36:49 INFO impl.YarnClientImpl: Submitted application application_1663041244711_21350
22/12/12 15:36:49 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711
_21350/
22/12/12 15:36:49 INFO mapreduce.Job: Running job: job_1663041244711_21350
```

```
_21350/
22/12/12 15:36:49 INFO mapreduce.Job: Running job: job_1663041244711_21350
22/12/12 15:36:58 INFO mapreduce.Job: Job job_1663041244711_21350 running in uber mode : false
22/12/12 15:36:58 INFO mapreduce.Job:  map 0% reduce 0%
22/12/12 15:37:05 INFO mapreduce.Job:  map 100% reduce 0%
22/12/12 15:37:28 INFO mapreduce.Job:  map 100% reduce 40%
22/12/12 15:37:29 INFO mapreduce.Job:  map 100% reduce 80%
22/12/12 15:37:30 INFO mapreduce.Job:  map 100% reduce 100%
22/12/12 15:37:30 INFO mapreduce.Job: Job job_1663041244711_21350 completed successfully
22/12/12 15:37:30 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=906
                FILE: Number of bytes written=1364303
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=7393
                HDFS: Number of bytes written=1752
                HDFS: Number of read operations=40
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=34
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=1
                Launched reduce tasks=5
                Data-local map tasks=1
                Total time spent by all maps in occupied slots (ms)=4156
                Total time spent by all reduces in occupied slots (ms)=108370
                Total time spent by all map tasks (ms)=4156
                Total time spent by all reduce tasks (ms)=108370
                Total vcore-milliseconds taken by all map tasks=4156
                Total vcore-milliseconds taken by all reduce tasks=108370
                Total megabyte-milliseconds taken by all map tasks=4255744
                Total megabyte-milliseconds taken by all reduce tasks=110970880
        Map-Reduce Framework
```

```
                Map output bytes=1584
                Map output materialized bytes=886
                Input split bytes=131
                Combine input records=0
                Combine output records=0
                Reduce input groups=24
                Reduce shuffle bytes=886
                Reduce input records=48
                Reduce output records=0
                Spilled Records=96
                Shuffled Maps =5
                Failed Shuffles=0
                Merged Map outputs=5
                GC time elapsed (ms)=2036
                CPU time spent (ms)=7400
                Physical memory (bytes) snapshot=1538908160
                Virtual memory (bytes) snapshot=15550607360
                Total committed heap usage (bytes)=1847590912
                Peak Map Physical memory (bytes)=527560704
                Peak Map Virtual memory (bytes)=2589716480
                Peak Reduce Physical memory (bytes)=244539392
                Peak Reduce Virtual memory (bytes)=2592980992
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=7262
        File Output Format Counters
                Bytes Written=0
[kct5thsemcdhid025@ip-10-1-1-204 weather]$
```

OUTPUT:

```
[kct5thsemcdhid025@ip-10-1-1-204 weather]$ hdfs dfs -cat /user/kct5thsemcdhid025/Weather/output/*
25-Jan-2014     Time: 12:34:542 MinTemp: -22.3  Time: 05:12:345 MaxTemp: 35.7
26-Jan-2014     Time: 22:00:093 MinTemp: -27.0  Time: 05:12:345 MaxTemp: 55.7
27-Jan-2014     Time: 02:34:542 MinTemp: -22.3  Time: 05:12:345 MaxTemp: 55.7
29-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 62.9
30-Jan-2014     Time: 22:00:093 MinTemp: -27.0  Time: 05:12:345 MaxTemp: 49.2
31-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 03:12:187 MaxTemp: 56.0
29-Jan-2014     Time: 14:00:093 MinTemp: -27.0  Time: 05:12:345 MaxTemp: 49.2
30-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 52.9
31-Jan-2014     Time: 15:12:345 MinTemp: -15.7  Time: 03:12:187 MaxTemp: 56.0
28-Jan-2014     Time: 11:19:345 MinTemp: -23.3  Time: 05:12:345 MaxTemp: 35.7
29-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 52.9
30-Jan-2014     Time: 15:12:345 MinTemp: -15.7  Time: 03:12:187 MaxTemp: 56.0
25-Jan-2014     Time: 12:34:542 MinTemp: -22.3  Time: 05:12:345 MaxTemp: 35.7
26-Jan-2014     Time: 04:00:093 MinTemp: -14.0  Time: 05:12:345 MaxTemp: 55.7
27-Jan-2014     Time: 02:34:542 MinTemp: -22.3  Time: 00:14:045 MaxTemp: 35.7
28-Jan-2014     Time: 11:19:345 MinTemp: -23.3  Time: 05:12:345 MaxTemp: 35.7
29-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 52.9
30-Jan-2014     Time: 15:12:345 MinTemp: -15.7  Time: 03:12:187 MaxTemp: 56.0
31-Jan-2014     Time: 22:00:093 MinTemp: -27.0  Time: 05:12:345 MaxTemp: 49.2
29-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 52.9
30-Jan-2014     Time: 15:12:345 MinTemp: -15.7  Time: 03:12:187 MaxTemp: 56.0
29-Jan-2014     Time: 14:00:093 MinTemp: -17.0  Time: 02:34:542 MaxTemp: 52.9
30-Jan-2014     Time: 15:12:345 MinTemp: -15.7  Time: 03:12:187 MaxTemp: 56.0
31-Jan-2014     Time: 22:00:093 MinTemp: -27.0  Time: 05:12:345 MaxTemp: 49.2
[kct5thsemcdhid025@ip-10-1-1-204 weather]$
```

RESULT:

Thus the minimum and maximum temperature of city is found successfully by the use of Map and Reduce tasks.

LAB EXERCISE-6

Title of the exercise/experiment: Perform Joining data with streaming in Hadoop using Map Reduce

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

- To Performa Joiningdata with streaming in Hadoopusing Map Reduce

THEORY:

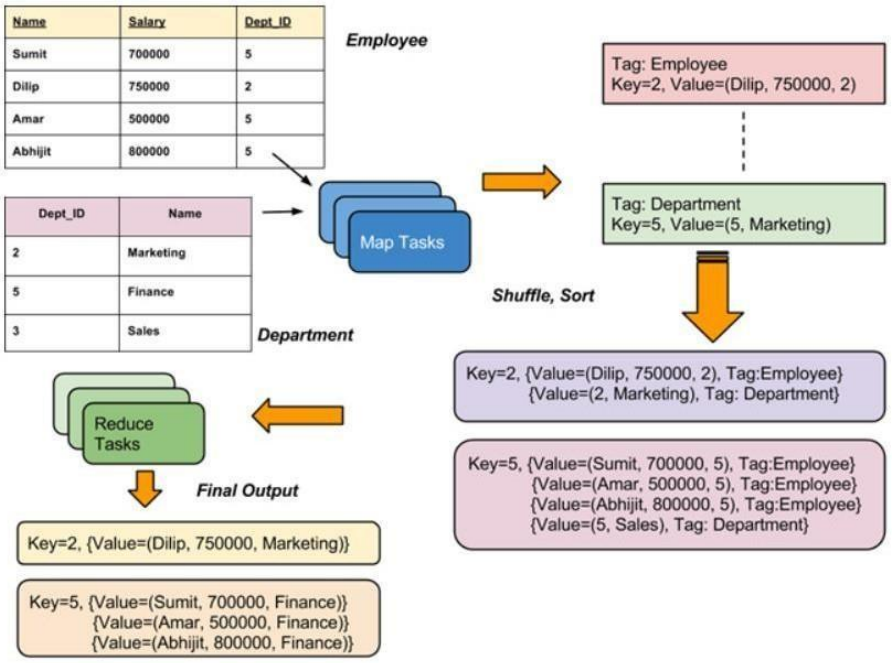
- Mapreduce Join operation is used to combine two large datasets. However, this process involves writing lots of code to perform the actual join operation. Joining two datasets begins by comparing the size of each dataset. If one dataset is smaller as compared to the other dataset then smaller dataset is distributed to every data node in thecluster.
- Once a join in MapReduce is distributed, either Mapper or Reducer uses the smaller dataset to perform a lookup for matching records from the large dataset and then combine those records to form output records

Types of Join

Depending upon the place where the actual join is performed, joins in Hadoop are classified into-

1. Map-side join – When the join is performed by the mapper, it is called as map-side join. In this type, the join is performed before data is actually consumed by the map function. It is mandatory that the input to each map is in the form of a partition and is in sorted order. Also, there must be an equal number of partitions and it must be sorted by the join key.
2. Reduce-side join – When the join is performed by the reducer, it is called as reduce-side join. There is no necessity in this join to have a dataset in a structured form (or partitioned).

Here, map side processing emits join key and corresponding tuples of both the tables. As an effect of this processing, all the tuples with same join key fall into the same reducer which then joins the records with same join key.



Types of Joins in Hadoop MapReduce

SOURCE CODE:

TextPair.java

```
package MapReduceJoin;
import java.io.*;
import org.apache.hadoop.io.*;
public class TextPair implements WritableComparable<TextPair> { private Text
  first;
  private Text second;
  public TextPair() {
    set(new Text(), new Text());
  }


  public TextPair(String first, String second) { set(new
    Text(first), new Text(second));
  }
  public TextPair(Text first, Text second) { set(first,
    second);
  }
  public void set(Text first, Text second) { this.first
    = first;
    this.second = second;
```

```
}
public Text getFirst() {
  return first;
}
public Text getSecond() {
  return second;
}
@Override
public void write(DataOutput out) throws IOException {
  first.write(out);
  second.write(out);
}
@Override
public void readFields(DataInput in) throws IOException {
  first.readFields(in);
  second.readFields(in);
}
@Override

public int hashCode() {
  return first.hashCode() * 163 + second.hashCode();
}
@Override
public boolean equals(Object o) { if
  (o instanceof TextPair) { TextPair tp
  = (TextPair) o;
    return first.equals(tp.first) && second.equals(tp.second);
  }
  return false;
}

@Override
public String toString() { return
  first + "\t" + second;
```

```
  @Override
  public int compareTo(TextPair tp) { int cmp
    = first.compareTo(tp.first); if (cmp != 0) {
      return cmp;
    }
    return second.compareTo(tp.second);
  }
  // ^^ TextPair


  // vv TextPairComparator
  public static class Comparator extends WritableComparator {


    private static final Text.Comparator TEXT_COMPARATOR = new
Text.Comparator();


    public Comparator() {
      super(TextPair.class);
    }


    @Override
    public int compare(byte[] b1, int s1, int l1, byte[]
                       b2, int s2, int l2) {


      try {
        int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1); int firstL2 =
        WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2);
        int cmp = TEXT_COMPARATOR.compare(b1, s1, firstL1, b2, s2, firstL2);
        if (cmp != 0) {
          return cmp;
        }
        return TEXT_COMPARATOR.compare(b1, s1 + firstL1, l1 - firstL1, b2, s2 + firstL2, l2
                                       - firstL2);
      } catch (IOException e) {
        throw new IllegalArgumentException(e);
      }
```

```
  }

  static {
    WritableComparator.define(TextPair.class, new Comparator());
  }
  // ^^ TextPairComparator

  // vv TextPairFirstComparator
  public static class FirstComparator extends WritableComparator {

    private static final Text.Comparator TEXT_COMPARATOR = new
Text.Comparator();

    public FirstComparator() {
      super(TextPair.class);
    }

    @Override
    public int compare(byte[] b1, int s1, int l1, byte[]
                       b2, int s2, int l2) {
      try {
        int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1); int firstL2 =
        WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2); return
        TEXT_COMPARATOR.compare(b1, s1, firstL1, b2, s2, firstL2);
      } catch (IOException e) {
        throw new IllegalArgumentException(e);
      }
    }

    @Override
    public int compare(WritableComparable a, WritableComparable b) { if (a
      instanceof TextPair && b instanceof TextPair) {
        return ((TextPair) a).first.compareTo(((TextPair) b).first);
      }
      return super.compare(a, b);
```

```
    }
  }
  // ^^ TextPairFirstComparator
// vv TextPair
}
```

JOIN DRIVER.java:

```
package MapReduceJoin;
import org.apache.hadoop.conf.Configured; import
org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text; import
org.apache.hadoop.mapred.*;
import org.apache.hadoop.mapred.lib.MultipleInputs; import
org.apache.hadoop.util.*;
public class JoinDriver extends Configured implements Tool {
        public static class KeyPartitioner implements Partitioner<TextPair, Text>
{
                @Override
                public void configure(JobConf job) {}
                @Override


                public int getPartition(TextPair key, Text value, intnumPartitions)
{
                        return (key.getFirst().hashCode() & Integer.MAX_VALUE)
% numPartitions;
                }
        }
        @Override
        public int run(String[] args) throws Exception { if
                (args.length != 3) {
                        System.out.println("Usage: <Department Emp Strength input>
<Department Name input> <output>");
                        return -1;
                }
                JobConf conf = new JobConf(getConf(), getClass()); conf.setJobName("Join
                'Department Emp Strength input' with
```

```
'Department Name input'");

                Path AInputPath = new Path(arg[0]); Path

                BInputPath = new Path(arg[1]); Path

                outputPath = new Path(args[2]);

                MultipleInputs.addInputPath(conf,
AInputPath, TextInputFormat.class, DeptEmpStrengthMapper.class);

                MultipleInputs.addInputPath(conf, BInputPath,
TextInputFormat.class, DeptNameMapper.class);

                FileOutputFormat.setOutputPath(conf, outputPath);

                conf.setPartitionerClass(KeyPartitioner.class);
                conf.setOutputValueGroupingComparator(TextPair.FirstComparator.clas
s);

                conf.setMapOutputKeyClass(TextPair.class);

                conf.setReducerClass(JoinReducer.class);

                conf.setOutputKeyClass(Text.class);
```

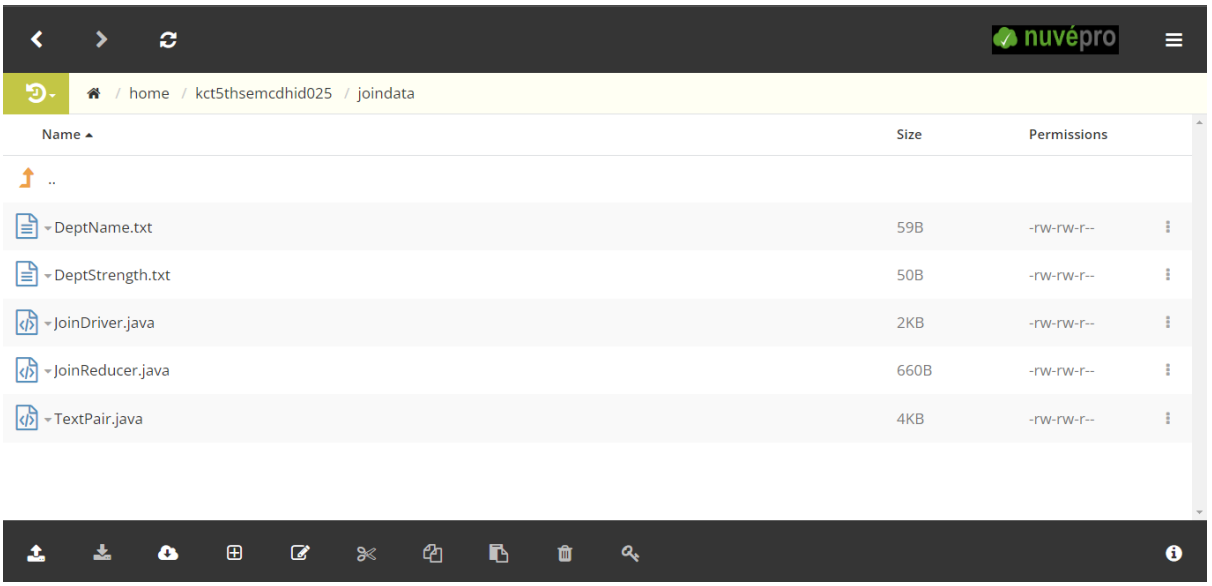
```
                JobClient.runJob(conf)
                ; return 0;
        }
        public static void main(String[] args) throws Exception {
                int exitCode = ToolRunner.run(new JoinDriver(), args);
                System.exit(exitCode);
        }
}
```

JoinReducer.java:

```
package MapReduceJoin; import
java.io.IOException; import java.util.Iterator;
        import org.apache.hadoop.io.Text; import
        org.apache.hadoop.mapred.*;

        public class JoinReducer extends MapReduceBase implements Reducer<TextPair,
        Text, Text, Text> {
                @Override
                public void reduce (TextPair key, Iterator<Text> values,
        OutputCollector<Text, Text> output, Reporter reporter)
                                throws IOException
                {


                        Text nodeId = new Text(values.next()); while
                        (values.hasNext()) {
                                Text node = values.next();
```

```
                                                    Text outValue = new Text(nodeId.toString() + "\t\t"
        + node.toString());
                                                    output.collect(key.getFirst(), outValue);
                    }
            }
    }
```

INPUT FILES



Steps to execute MapReduce word count example

1. Set up the path and configure the java environment:

COMMANDS
1. export HADOOP_CLASSPATH=$(hadoop classpath) 2. echo $HADOOP_CLASSPATH

```
[kct5thsemcdhid025@ip-10-1-1-204 joindata]$ export HADOOP_CLASSPATH=$(hadoop classpath)
[kct5thsemcdhid025@ip-10-1-1-204 joindata]$ echo $HADOOP_CLASSPATH
/etc/hadoop/conf:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2
.1.p0.1425774/lib/hadoop/libexec/../../hadoop/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/./:/opt
/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/li
b/hadoop/libexec/../../hadoop-hdfs/.//*:/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib
/hadoop/libexec/../../hadoop-yarn/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/.//*:/opt/cloudera
/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/accessors-smart-1.2.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.14
25774/lib/hadoop/libexec/../../hadoop/lib/activation-1.1.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/
lib/asm-5.0.4.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/audience-annotations-0.5.0.jar:/opt/cloud
era/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/avro.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/ha
doop/libexec/../../hadoop/lib/aws-java-sdk-bundle-1.11.271.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/
lib/azure-data-lake-store-sdk-2.2.9.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/commons-beanutils-1
```

1. Create an input directory in HDFS.

COMMAND:

hdfs dfs -mkdir / MapReduceJoin/

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/MapReduceJoin
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

COMMANDS
hdfs dfs -mkdir / MapReduceJoin /input

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/MapReduceJoin/input
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

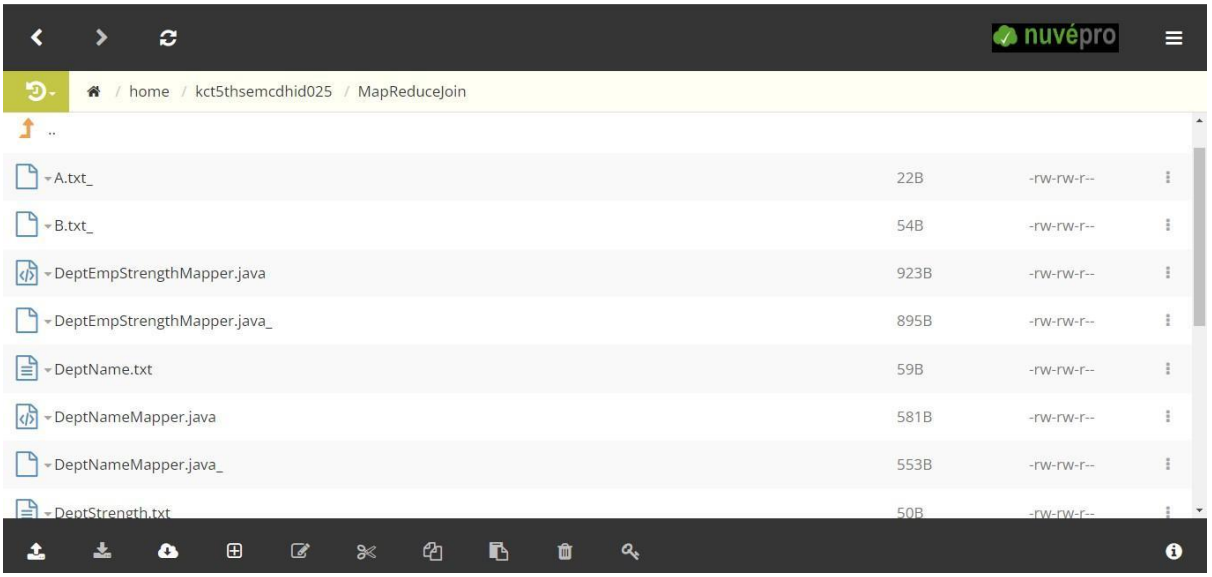
2. Copy the 2 input text file in the input directory (matrixmultiplication) of HDFS.

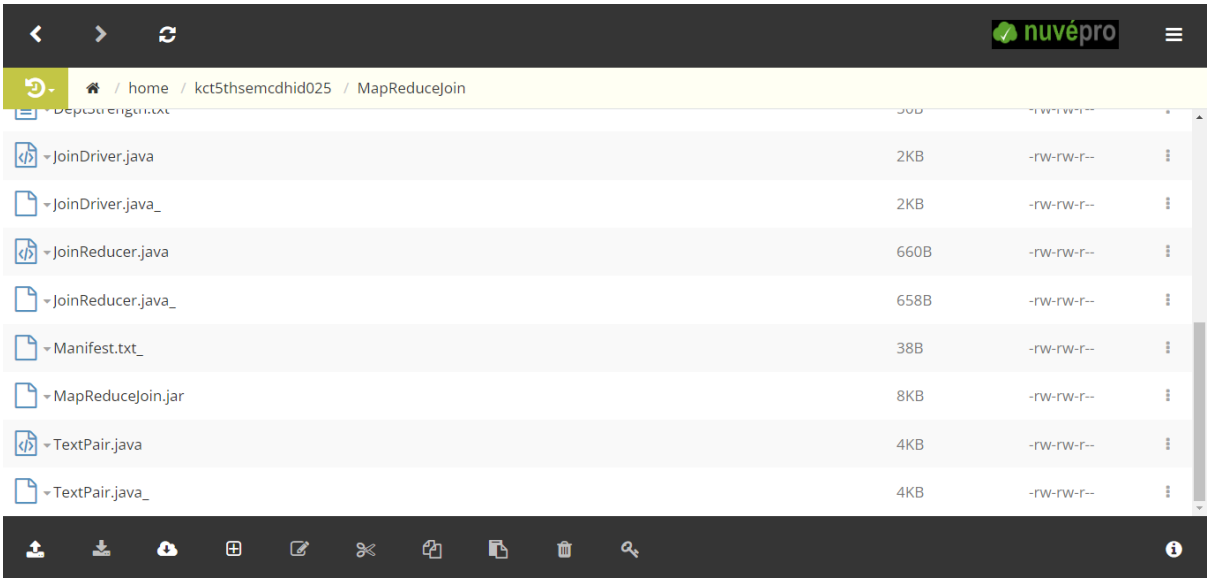
Copy some text file to hadoop filesystem inside input directory. Here I am copying a input.txt to it. You can copy more that one files.

COMMANDS
1. hdfs dfs -put '/home/gokilanm/MapReduceJoin/DeptName.txt' / MapReduceJoin /input/ 2. hdfs dfs -put '/home/gokilanm/MapReduceJoin/DeptStrength.txt' / MapReduceJoin /input/

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -put '/home/kct5thsemcdhid025/joindata/DeptName.txt' '/user/kct5thsemcdhid025/MapReduceJoin/input'
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -put '/home/kct5thsemcdhid025/joindata/DeptStrength.txt' '/user/kct5thsemcdhid025/MapReduceJoin/input'
```

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -cat '/user/kct5thsemcdhid025/MapReduceJoin/input/*'
Dept_ID Dept_Name
A11     Finance
B12     HR
C13     Manufacturing
Dept_ID Total_Employee
A11     50
B12     100
C13     250
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```






```
[kct5thsemcdhid025@ip-10-1-1-204 MapReduceJoin]$ ll
total 80
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   22 Dec 12 16:06 A.txt_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   54 Dec 12 16:05 B.txt_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  923 Dec 12 16:05 DeptEmpStrengthMapper.java
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  895 Dec 12 16:04 DeptEmpStrengthMapper.java_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   50 Dec 12 16:11 DeptEmpStrength.txt
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  581 Dec 12 16:04 DeptNameMapper.java
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  553 Dec 12 16:03 DeptNameMapper.java_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   59 Dec 12 15:49 DeptName.txt
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   50 Dec 12 15:49 DeptStrength.txt
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 1905 Dec 12 15:51 JoinDriver.java
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 1903 Dec 12 16:03 JoinDriver.java_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  660 Dec 12 15:52 JoinReducer.java
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025  658 Dec 12 16:06 JoinReducer.java_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   38 Dec 12 16:13 Manifest (1).txt_
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025   38 Dec 12 16:06 Manifest.txt_
drwxrwxr-x 2 kct5thsemcdhid025 kct5thsemcdhid025 4096 Dec 12 16:15 MapReduceJoin
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 7831 Dec 12 16:09 MapReduceJoin.jar
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 3678 Dec 12 15:53 TextPair.java
-rw-rw-r-- 1 kct5thsemcdhid025 kct5thsemcdhid025 3650 Dec 12 16:06 TextPair.java_
[kct5thsemcdhid025@ip-10-1-1-204 MapReduceJoin]$
```

STEP-9:

Run the program using below command-

$HADOOP_HOME/bin/hadoop jar MapReduceJoin.jar MapReduceJoin/JoinDriver/DeptStrength.txt /DeptName.txt /output_mapreducejoin

```
        at org.apache.hadoop.util.RunJar.main(RunJar.java:227)
[kct5thsemcdhid025@ip-10-1-1-204 MapReduceJoin]$ hadoop jar MapReduceJoin.jar /user/kct5thsemcdhid025/MapReduceJoin/input/DeptStrength.txt /user/kct5
thsemcdhid025/MapReduceJoin/input/DeptName.txt /user/kct5thsemcdhid025/MapReduceJoin/output_mapreducejoin
```

```
[kct5thsemcdhid025@ip-10-1-1-204 MapReduceJoin]$ hadoop jar MapReduceJoin.jar /user/kct5thsemcdhid025/MapReduceJoin/input/DeptStrength.txt /user/kct5
thsemcdhid025/MapReduceJoin/input/DeptName.txt /user/kct5thsemcdhid025/MapReduceJoin/output_mapreducejoin
WARNING: Use "yarn jar" to launch YARN applications.
22/12/13 05:38:48 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 05:38:48 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 05:38:49 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/kct5thsemcdhid025/.staging/job_1663041244711_21565
22/12/13 05:38:49 INFO mapred.FileInputFormat: Total input files to process : 1
22/12/13 05:38:49 INFO mapred.FileInputFormat: Total input files to process : 1
22/12/13 05:38:49 INFO mapreduce.JobSubmitter: number of splits:4
22/12/13 05:38:49 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metri
cs-publisher.enabled
22/12/13 05:38:49 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1663041244711_21565
22/12/13 05:38:49 INFO mapreduce.JobSubmitter: Executing with tokens: []
22/12/13 05:38:49 INFO conf.Configuration: resource-types.xml not found
22/12/13 05:38:49 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
22/12/13 05:38:50 INFO impl.YarnClientImpl: Submitted application application_1663041244711_21565
22/12/13 05:38:50 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711
_21565/
22/12/13 05:38:50 INFO mapreduce.Job: Running job: job_1663041244711_21565
22/12/13 05:38:58 INFO mapreduce.Job: Job job_1663041244711_21565 running in uber mode : false
22/12/13 05:38:58 INFO mapreduce.Job:  map 0% reduce 0%
22/12/13 05:39:13 INFO mapreduce.Job:  map 25% reduce 0%
22/12/13 05:39:14 INFO mapreduce.Job:  map 50% reduce 0%
22/12/13 05:39:15 INFO mapreduce.Job:  map 100% reduce 0%
```


```
        File System Counters
                FILE: Number of bytes read=224
                FILE: Number of bytes written=2015094
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=1158
                HDFS: Number of bytes written=85
                HDFS: Number of read operations=37
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=10
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=4
                Launched reduce tasks=5
                Data-local map tasks=4
                Total time spent by all maps in occupied slots (ms)=56440
                Total time spent by all reduces in occupied slots (ms)=66136
                Total time spent by all map tasks (ms)=56440
                Total time spent by all reduce tasks (ms)=66136
                Total vcore-milliseconds taken by all map tasks=56440
                Total vcore-milliseconds taken by all reduce tasks=66136
                Total megabyte-milliseconds taken by all map tasks=57794560
                Total megabyte-milliseconds taken by all reduce tasks=67723264
        Map-Reduce Framework
                Map input records=8
                Map output records=8
                Map output bytes=117
                Map output materialized bytes=453
                Input split bytes=994
                Combine input records=0
                Combine output records=0
                Reduce input groups=4
                Reduce shuffle bytes=453
                Reduce input records=8
```

```
npbdh.cloudloka.com:4200
                Map output bytes=117
                Map output materialized bytes=453
                Input split bytes=994
                Combine input records=0
                Combine output records=0
                Reduce input groups=4
                Reduce shuffle bytes=453
                Reduce input records=8
                Reduce output records=4
                Spilled Records=16
                Shuffled Maps =20
                Failed Shuffles=0
                Merged Map outputs=20
                GC time elapsed (ms)=2557
                CPU time spent (ms)=9050
                Physical memory (bytes) snapshot=3217526784
                Virtual memory (bytes) snapshot=23309123584
                Total committed heap usage (bytes)=4028628992
                Peak Map Physical memory (bytes)=496230400
                Peak Map Virtual memory (bytes)=2578976768
                Peak Reduce Physical memory (bytes)=257028096
                Peak Reduce Virtual memory (bytes)=2601594880
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=0
        File Output Format Counters
                Bytes Written=85
[kct5thsemcdhid025@ip-10-1-1-204 MapReduceJoin]$
```

OUTPUT:

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -cat /user/kct5thsemcdhid025/MapReduceJoin/output_mapreducejoin/*
B12     100             HR
C13     250             Manufacturing
Dept_ID Total_Employee          Dept_Name
A11     50              Finance
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

RESULT:

The join operation in the streaming data can be implemented successfully.

LAB EXERCISE-7

Title of the exercise/experiment: Collect, aggregate and transport large amount of streaming data from Twitter data using Apache Flume

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

To understand how Flume helps in streaming data from various sources.

THEORY:

Apache Flume is a tool for data ingestion in HDFS. It collects, aggregates and transports large amount of streaming data such as log files, events from various sources like network traffic, social media, email messages etc. to HDFS. Flume is a highly reliable & distributed. The main idea behind the Flume's design is to capture streaming data from various web servers to HDFS. It has simple and flexible architecture based on streaming data flows. It is fault-tolerant and provides reliability mechanism for Fault tolerance & failure recovery.

Apache Flume

Apache Flume is an open-source tool for collecting, aggregating, and moving huge amounts of streaming data from the external web servers to the central store, say HDFS, HBase, etc. It is a highly available and reliable service which has tunable recovery mechanisms. The main purpose of designing Apache Flume is to move streaming data generated by various applications to Hadoop Distributed FileSystem

Features of Apache Flume

- Apache Flume is a robust, fault-tolerant, and highly available service.
- It is a distributed system with tunable reliability mechanisms for fail- over and recovery.
- Apache Flume is horizontally scalable.
- Apache Flume supports complex data flows such as multi-hop flows, fan-in flows, fan-out flows. Contextual routing etc.
- Apache Flume provides support for large sets of sources, channels, and sinks.
- Apache Flume can efficiently ingest log data from various servers into a centralized repository.
- With Flume, we can collect data from different web servers in real- time as well as in batch mode.
- We can import large volumes of data generated by social networking sites and e-commerce sites into Hadoop DFS using Apache Flume.

Flume Event

A Flume event is a basic unit of data that needs to be transferred from source to destination.

Flume Agent

Flume agent is an independent JVM process (JVM) in Apache Fl

Source

A source receives data from the data generators. It transfers the received data to one or more channels in the form of events. Flume provides support for several types of sources.

Example – Exec source, Thrift source, Avro source, twitter 1% source, etc. Channel

A channel receives the data or events from the flume source and buffers them till the sinks consume them. It is a transient store. Flume supports different types of channels.

Example – Memory channel, File system channel, JDBC channel, etc. Sink

A sink consumes data from the channel and stores them into the destination. The destination can be a centralized store or other flume agents.

Example – HDFS sink.

Additional Components of Flume Agent

There are few more components other than described above that play a significant role in transferring the events.

Interceptors

They alter or inspect flume events transferred between the flume source and channel.

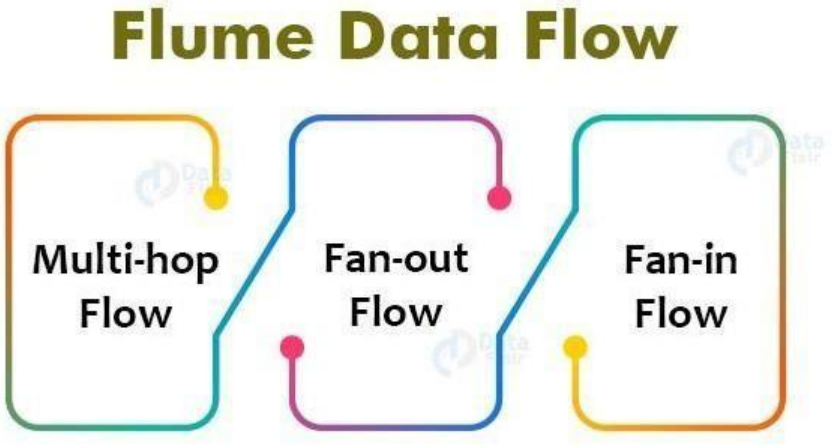
Channel Selectors

They determine which channel is to be chosen for transferring the data when multiple channels exist. Channel selectors are of two types- Default and multiplexing.

Sink Processors

Sink Processors invoke a particular sink from the group of sinks. Apache

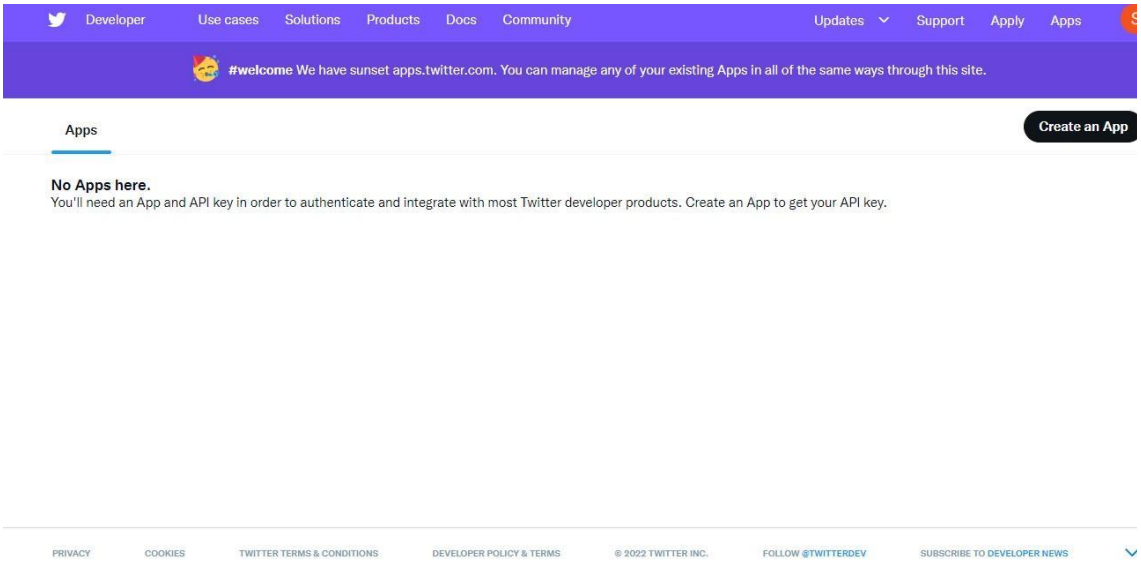
Flume – Data Flow

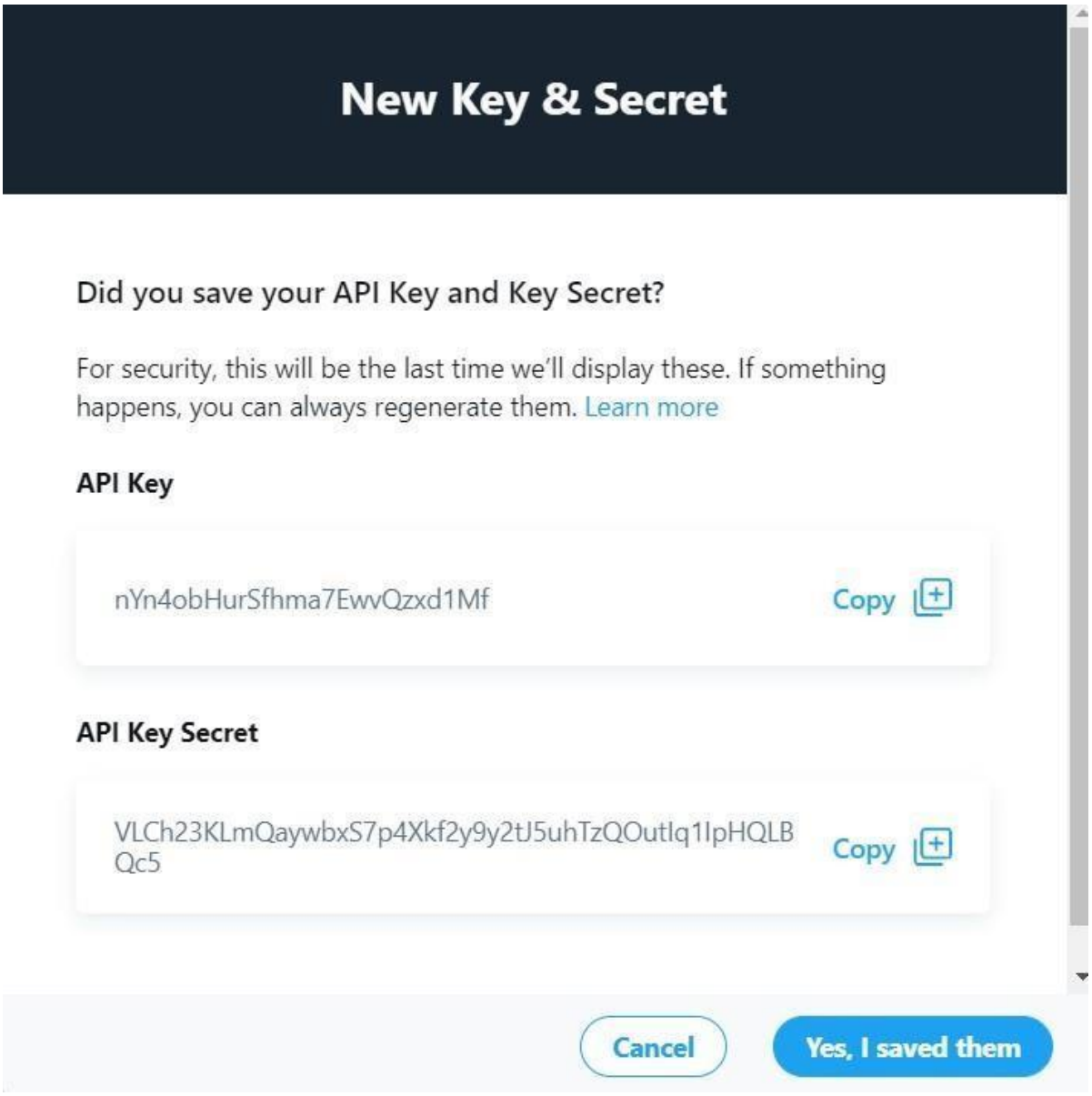


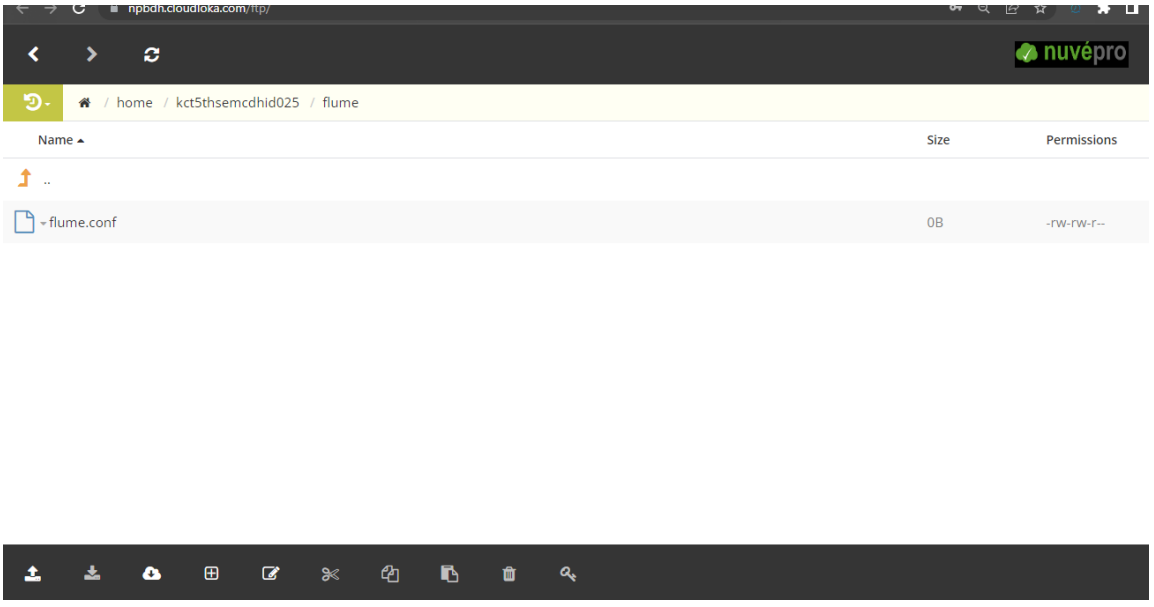
Data ingestion is the initial & important step in order to process & analyze data and then derive business values out of it. There are be multiple sources from which data is gathered in an organization.

Collect, aggregate and transport large amount of streaming data from Twitter data using Apache Flume

Apache Flume: Streaming Twitter Data




New Key & Secret
Did you save your API Key and Key Secret?
For security, this will be the last time we'll display these. If something happens, you can always regenerate them. Learn more
API Key
nYn4obHurSfhma7EwvQzxd1Mf
Copy
API Key Secret
VLCh23KLmQaywbxS7p4Xkf2y9y2tJ5uhTzQOutIq1IpHQLBQc5
Copy
Cancel
Yes, I saved them


nuvepro
home
kct5thsemcdhid025
flume
Name
Size
Permissions
..
flume.conf
0B
-rw-rw-r--

SOURCE CODE:

Naming the components on the current agent.

TwitterAgent.sources = Twitter TwitterAgent.channels =

MemChannel TwitterAgent.sinks = HDFS

TwitterAgent.sources.Twitter.channels = MemChannel

TwitterAgent.sinks.HDFS.channel = MemChannel

Describing/Configuring the source

TwitterAgent.sources.Twitter.type=
org.apache.flume.source.twitter.TwitterSource

TwitterAgent.sources.Twitter.consumerKey= SN5f21STlXEV8ZC1wuL78Aftc

TwitterAgent.sources.Twitter.consumerSecret=
bounWv4jpXqjshIdUcKH1BL08lU4GvAV3ax2RoRXRDNaf2uYNb

TwitterAgent.sources.Twitter.accessToken= 1352556616415989761-
aDJel5M1kFdxKMjyuJL2grEFONlkJt

TwitterAgent.sources.Twitter.accessTokenSecret=
Bx9J53CqeJbyKdWvnUh1t9OH0v313Ia4XgofTH0Lf3WLP

TwitterAgent.sources.Twitter.keywords= tutorials point,java, nosql #

Describing/Configuring the sink

TwitterAgent.sinks.HDFS.type = hdfs TwitterAgent.sinks.HDFS.hdfs.path =

hdfs://localhost:9000/twitter TwitterAgent.sinks.HDFS.hdfs.fileType =

DataStream TwitterAgent.sinks.HDFS.hdfs.writeFormat = Text

TwitterAgent.sinks.HDFS.hdfs.batchSize = 1000

TwitterAgent.sinks.HDFS.hdfs.rollSize = 0

TwitterAgent.sinks.HDFS.hdfs.rollCount = 10000

TwitterAgent.sinks.HDFS.hdfs.rollCount = 600 #

Describing/Configuring the channel

TwitterAgent.channels.MemChannel.type = memory

TwitterAgent.channels.MemChannel.capacity = 10000

TwitterAgent.channels.MemChannel.byteCapacity = 6912212

TwitterAgent.channels.MemChannel.transactionCapacity = 1000

```
TwitterAgent.sources = Twitter
TwitterAgent.channels = MemChannel
TwitterAgent.sinks = HDFS

TwitterAgent.sources.Twitter.type = com.cloudera.flume.source.TwitterSource
TwitterAgent.sources.Twitter.channels = MemChannel
TwitterAgent.sources.Twitter.consumerKey = 6YJdPBEpjm1yQpwCRGo0slF67
TwitterAgent.sources.Twitter.consumerSecret = jQclPG2ruWyfKjDhh9hh0D3VShgoNpWgeiW79tkwvj5GjXYTvG
TwitterAgent.sources.Twitter.accessToken = 1596724410051723265-MnEaSLlctfP6kOjlqUSrg9oa7eie2b
TwitterAgent.sources.Twitter.accessTokenSecret = Lg2Ow4cO7uDQ5Udri6ujWjhJKQdqmhnjE0buitYICTks1
TwitterAgent.sources.Twitter.keywords = theinterview, 17YearsOfNash, Warnock, RioCompetition, cpfc, Palace, London, Christmas, New Years

################## SINK ################################
TwitterAgent.sinks.HDFS.channel = MemChannel
TwitterAgent.sinks.HDFS.type = hdfs
TwitterAgent.sinks.HDFS.hdfs.path = hdfs:///user/abhinav9884/Tweets
TwitterAgent.sinks.HDFS.hdfs.fileType = DataStream
TwitterAgent.sinks.HDFS.hdfs.writeFormat = Text

TwitterAgent.sinks.HDFS.hdfs.batchSize = 10
TwitterAgent.sinks.HDFS.hdfs.rollSize = 0
TwitterAgent.sinks.HDFS.hdfs.rollInterval = 600
TwitterAgent.sinks.HDFS.hdfs.rollCount = 10000

################## CHANNEL ########################
TwitterAgent.channels.MemChannel.type = memory
TwitterAgent.channels.MemChannel.capacity = 100
#default - TwitterAgent.channels.MemChannel.capacity = 100
TwitterAgent.channels.MemChannel.transactionCapacity = 100
```

/home/kct5thsemcdhid025/flume/flume.conf

nuvepro Auto-save Save

```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/flume
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hdfs dfs -mkdir /user/kct5thsemcdhid025/flume/tweets
[kct5thsemcdhid025@ip-10-1-1-204 ~]$
```

Browse through the Flume home directory and execute the application as shown below.

COMMANDS
flume-ng agent -n TwitterAgent ./conf/ -f $FLUME_HOME/conf/twitter.conf

```
[kct5thsemcdhid025@ip-10-1-1-204 flume]$ flume-ng agent -n TwitterAgent ./conf/ -f /home/kct5thsemcdhid025/flume/flume.conf
Warning: No configuration directory set! Use --conf <dir> to override.
Info: Including Hadoop libraries found via (/bin/hadoop) for HDFS access
Info: Including HBASE libraries found via (/bin/hbase) for HBASE access
Java HotSpot(TM) 64-Bit Server VM warning: Using incremental CMS is deprecated and will likely be removed in a future release
Error: Could not find or load main class org.apache.hadoop.hbase.util.GetJavaProperty
Info: Including Hive libraries found via () for Hive access
+ exec /usr/java/jdk1.8.0_181-cloudera/bin/java -Xmx20m -cp '/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/lib/*:/etc/hadoop/conf:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/./:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/.//*:/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../conf:/usr/java/jdk1.8.0_181-cloudera/lib/tools.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/..:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/shaded-clients/hbase-shaded-client-byo-hadoop-2.1.0-cdh6.2.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/audience-annotations-0.5.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/commons-logging-1.2.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/findbugs-annotations-1.3.9-1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/htrace-core4-4.2.0-incubating.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/log4j-1.2.17.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/client-facing-thirdparty/slf4j-api-1.7.25.jar:/etc/hadoop/conf:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/./:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-hdfs/.//*:/opt/cloudera/parcels/CDH/lib/hadoop-mapreduce/.//*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/libexec/../../hadoop-yarn/.//*:/etc/hadoop/conf/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/bin/../lib/hadoop/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/bin/../lib/hadoop/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/bin/../lib/zookeeper/*::/conf:/lib/*:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/antlr4-runtime-4.5.1-1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/argparse4j-0.4.3.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/asm-5.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/asm-commons-5.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/audience-annotations-0.7.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/avatica-core-1.10.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/avro.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/caffeine-2.4.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/calcite-core-1.13.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/calcite-linq4j-1.13.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-beanutils-1.9.3.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-cli-1.2.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-codec-1.11.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-collections-3.2.2.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-compiler-2.7.6.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-compress-1.18.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-configuration2-2.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-exec-1.3.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-fileupload-1.3.3.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/commons-io-2.5.jar:/opt/cloudera/parcels/CDH-6.
```

```
oudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/ua-parser-1.3.0.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/woodstox-core-5.0.3.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/woodstox-core-asl-4.4.1.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/xz-1.6.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../search/lib/zookeeper.jar:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/flume-ng/../kudu//kudu-flume-sink.jar' -Djava.library.path=:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/lib/native:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/bin/../lib/hadoop/lib/native:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hbase/bin/../lib/native/Linux-amd64-64 org.apache.flume.node.Application -n TwitterAgent ./conf/ -f /home/kct5thsemcdhid025/flume/flume.conf
22/12/13 13:58:03 INFO node.PollingPropertiesFileConfigurationProvider: Configuration provider starting
22/12/13 13:58:03 INFO node.PollingPropertiesFileConfigurationProvider: Reloading configuration file:/home/kct5thsemcdhid025/flume/flume.conf
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:MemChannel
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:MemChannel
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:MemChannel
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Added sinks: HDFS Agent: TwitterAgent
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:Twitter
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Processing:HDFS
22/12/13 13:58:03 WARN conf.FlumeConfiguration: Agent configuration for 'TwitterAgent' has no configfilters.
22/12/13 13:58:03 INFO conf.FlumeConfiguration: Post-validation flume configuration contains configuration for agents: [TwitterAgent]
22/12/13 13:58:03 INFO node.AbstractConfigurationProvider: Creating channels
22/12/13 13:58:03 INFO channel.DefaultChannelFactory: Creating instance of channel MemChannel type memory
22/12/13 13:58:03 INFO node.AbstractConfigurationProvider: Created channel MemChannel
22/12/13 13:58:03 INFO source.DefaultSourceFactory: Creating instance of source Twitter, type org.apache.flume.source.twitter.TwitterSource
22/12/13 13:58:03 ERROR node.AbstractConfigurationProvider: Source Twitter has been removed due to an error during configuration
java.lang.InstantiationException: Incompatible source and channel settings defined. source's batch size is greater than the channels transaction capacity. Source: Twitter, batch size = 1000, channel MemChannel, transaction capacity = 100
        at org.apache.flume.node.AbstractConfigurationProvider.checkSourceChannelCompatibility(AbstractConfigurationProvider.java:386)
        at org.apache.flume.node.AbstractConfigurationProvider.getSourceChannels(AbstractConfigurationProvider.java:367)
```

OUTPUT:

Show 25 entries Search:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	gokilanm	supergroup	814.34 KB	Oct 18 22:07	1	128 MB	FlumeData.1634574999285
-rw-r--r--	gokilanm	supergroup	640.03 KB	Oct 18 22:07	1	128 MB	FlumeData.1634575037854
-rw-r--r--	gokilanm	supergroup	618.03 KB	Oct 18 22:08	1	128 MB	FlumeData.1634575068996
-rw-r--r--	gokilanm	supergroup	679.27 KB	Oct 18 22:08	1	128 MB	FlumeData.1634575099883
-rw-r--r--	gokilanm	supergroup	684.98 KB	Oct 18 22:09	1	128 MB	FlumeData.1634575130889
-rw-r--r--	gokilanm	supergroup	627.18 KB	Oct 18 22:09	1	128 MB	FlumeData.1634575161735
-rw-r--r--	gokilanm	supergroup	619.51 KB	Oct 18 22:10	1	128 MB	FlumeData.1634575191955
-rw-r--r--	gokilanm	supergroup	664.31 KB	Oct 18 22:10	1	128 MB	FlumeData.1634575222988
-rw-r--r--	gokilanm	supergroup	416.28 KB	Oct 18 22:11	1	128 MB	FlumeData.1634575254025
-rw-r--r--	gokilanm	supergroup	0 B	Oct 18 22:11	1	128 MB	FlumeData.1634575310070
-rw-r--r--	gokilanm	supergroup	0 B	Oct 18 22:12	1	128 MB	FlumeData.1634575335146
-rw-r--r--	gokilanm	supergroup	746.78 KB	Oct 18 22:13	1	128 MB	FlumeData.1634575366627
-rw-r--r--	gokilanm	supergroup	0 B	Oct 18 22:13	1	128 MB	FlumeData.1634575401149.tmp

Showing 1 to 13 of 13 entries Previous 1 Next

RESULT:

In short, Apache Flume is an open-source tool for collecting, aggregating, and moving huge amounts of data from the external web servers to the central store. Apache Flume is a highly available and reliable service. Apache Flume can be used for ingesting data from various applications to HDFS.It is useful for various e-commerce sites for understanding customer behavior. The Apache Flume Tutorial had explained the Flume architecture, data flow. It had also enlisted flume features, advantages, and disadvantages.

LAB EXERCISE-8

Title of the exercise/experiment: Perform simple join using Mapper in Spark

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

To Perform simple join using Mapper in Spark.

THEORY:

Spark DataFrame supports all basic SQL Join Types like INNER, LEFT OUTER, RIGHT OUTER, LEFT ANTI, LEFT SEMI, CROSS,

SELF JOIN. Spark SQL Joins are wider transformations that result in data shuffling over the network hence they have huge performance issues when not designed with care.

JOIN QUERY:

Queries can access multiple tables at once, or access the same table in such a way that multiple rows of the table are being processed at the same time. A query that accesses multiple rows of the same or different tables at one time is called a join query.

Parameters

Relation:Specifies the relation to be joined.

join_type:Specifies the join type.

Syntax:

[INNER] | CROSS | LEFT [OUTER] | [LEFT] SEMI | RIGHT [OUTER] | FULL [OUTER] | [LEFT] ANTI

join_criteria :Specifies how the rows from one relation will be combined with the rows of another relation.

Syntax:

ON boolean_expression | USING (column_name [, ...])

boolean_expression: Specifies an expression with a return type of boolean.

join Operators

join(right: Dataset[_]): DataFrame (1)

join(right: Dataset[_], usingColumn: String): DataFrame (2)

join(right: Dataset[_], usingColumns: Seq[String]): DataFrame (3)

join(right: Dataset[_], usingColumns: Seq[String], joinType: String): DataFrame (4)

join(right: Dataset[_], joinExprs: Column): DataFrame (5)

join(right: Dataset[_], joinExprs: Column, joinType: String): DataFrame

(6) Condition-less inner join

Inner join with a single column that exists onboth sides Inner join with columns that exist on both sides

Equi-join with explicit join type

Inner join

Join with explicit join type. Self-joins are acceptable.

Perform simple join using Mapper in Spark

1) MOVE INTO THE SPARK SCALA

```
npbdh login: kct5thsemcdhid025
kct5thsemcdhid025@npbdh.cloudloka.com's password:
Last login: Tue Dec 13 05:03:03 2022 from ec2-65-1-45-35.ap-south-1.compute.amazonaws.com
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ spark shell
-bash: spark: command not found
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ spark-shell
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
22/12/13 05:47:25 WARN cluster.YarnSchedulerBackend$YarnSchedulerEndpoint: Attempted to request executors before the AM has registered!
Spark context available as 'sc' (master = yarn, app id = application_1663041244711_21570).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.4.0-cdh6.2.1
      /_/

Using Scala version 2.11.12 (Java HotSpot(TM) 64-Bit Server VM, Java 1.8.0_181)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

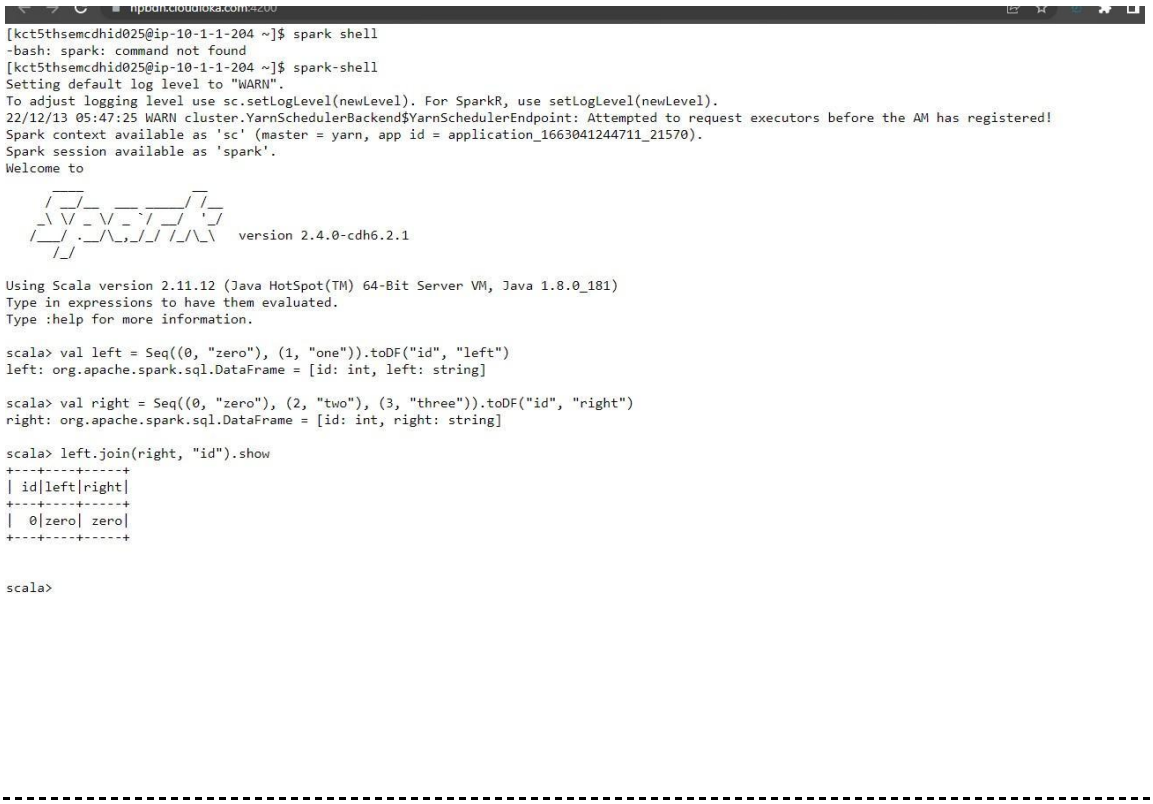
2) EXECUTE THE COMMANDS IN SCALA:

1) <u>INNER JOIN:</u>

Syntax:

relation [INNER] JOIN relation [join_criteria]

COMMANDS
1. val left = Seq((0, "zero"), (1, "one")).toDF("id", "left") 2. val right = Seq((0, "zero"), (2, "two"), (3, "three")).toDF("id", "right") 3.left.join(right, "id").show



```
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ spark shell
-bash: spark: command not found
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ spark-shell
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
22/12/13 05:47:25 WARN cluster.YarnSchedulerBackend$YarnSchedulerEndpoint: Attempted to request executors before the AM has registered!
Spark context available as 'sc' (master = yarn, app id = application_1663041244711_21570).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.4.0-cdh6.2.1
      /_/

Using Scala version 2.11.12 (Java HotSpot(TM) 64-Bit Server VM, Java 1.8.0_181)
Type in expressions to have them evaluated.
Type :help for more information.

scala> val left = Seq((0, "zero"), (1, "one")).toDF("id", "left")
left: org.apache.spark.sql.DataFrame = [id: int, left: string]

scala> val right = Seq((0, "zero"), (2, "two"), (3, "three")).toDF("id", "right")
right: org.apache.spark.sql.DataFrame = [id: int, right: string]

scala> left.join(right, "id").show
+---+----+-----+
| id|left|right|
+---+----+-----+
|  0|zero| zero|
+---+----+-----+


scala>
```

```
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.4.0-cdh6.2.1
      /_/

Using Scala version 2.11.12 (Java HotSpot(TM) 64-Bit Server VM, Java 1.8.0_181)
Type in expressions to have them evaluated.
Type :help for more information.

scala> val left = Seq((0, "zero"), (1, "one")).toDF("id", "left")
left: org.apache.spark.sql.DataFrame = [id: int, left: string]

scala> val right = Seq((0, "zero"), (2, "two"), (3, "three")).toDF("id", "right")
right: org.apache.spark.sql.DataFrame = [id: int, right: string]

scala> left.join(right, "id").show
+---+----+-----+
| id|left|right|
+---+----+-----+
|  0|zero| zero|
+---+----+-----+


scala> left.join(right, "id").explain
== Physical Plan ==
*(1) Project [id#5, left#6, right#15]
+- *(1) BroadcastHashJoin [id#5], [id#14], Inner, BuildLeft
   :- BroadcastExchange HashedRelationBroadcastMode(List(cast(input[0, int, false] as bigint)))
   :  +- LocalTableScan [id#5, left#6]
   +- LocalTableScan [id#14, right#15]

scala>
```

2) FULL OUTER JOIN:

In SQL the FULL OUTER JOIN combines the results of both left and right outer joins and returns all (matched or unmatched) rows from the tables on both sides of the join clause.

The FULL OUTER JOIN keyword returns all records when there is a match in left (table1) or right (table2) table records.

COMMANDS
left.join(right, Seq("id"), "fullouter").show

COMMANDS
left.join(right, Seq("id"), "fullouter").explain

```
+---+----+-----+


scala> left.join(right, "id").explain
== Physical Plan ==
*(1) Project [id#5, left#6, right#15]
+- *(1) BroadcastHashJoin [id#5], [id#14], Inner, BuildLeft
   :- BroadcastExchange HashedRelationBroadcastMode(List(cast(input[0, int, false] as bigint)))
   :  +- LocalTableScan [id#5, left#6]
   +- LocalTableScan [id#14, right#15]

scala> left.join(right, Seq("id"), "fullouter").show
+---+----+-----+
| id|left|right|
+---+----+-----+
|  1| one| null|
|  3|null|three|
|  2|null|  two|
|  0|zero| zero|
+---+----+-----+


scala> left.join(right, Seq("id"), "fullouter").explain
== Physical Plan ==
*(3) Project [coalesce(id#5, id#14) AS id#54, left#6, right#15]
+- SortMergeJoin [id#5], [id#14], FullOuter
   :- *(1) Sort [id#5 ASC NULLS FIRST], false, 0
   :  +- Exchange hashpartitioning(id#5, 200)
   :     +- LocalTableScan [id#5, left#6]
   +- *(2) Sort [id#14 ASC NULLS FIRST], false, 0
      +- Exchange hashpartitioning(id#14, 200)
         +- LocalTableScan [id#14, right#15]

scala>
```

3) LEFT ANTI-JOIN

A left anti join returns that all rows from the first table which do not have a match in the second table.

COMMANDS
left.join(right, Seq("id"), "leftanti").show

COMMANDS
left.join(right, Seq("id"), "leftanti").explain

```
scala> left.join(right, Seq("id"), "leftanti").show
+---+----+
| id|left|
+---+----+
|  1| one|
+---+----+


scala>
```

```
        at io.netty.buffer.PooledUnsafeDirectByteBuf.setBytes(PooledUnsafeDirectByteBuf.java:288)
        at io.netty.buffer.AbstractByteBuf.writeBytes(AbstractByteBuf.java:1106)
        at io.netty.channel.socket.nio.NioSocketChannel.doReadBytes(NioSocketChannel.java:343)
        at io.netty.channel.nio.AbstractNioByteChannel$NioByteUnsafe.read(AbstractNioByteChannel.java:123)
        at io.netty.channel.nio.NioEventLoop.processSelectedKey(NioEventLoop.java:645)
        at io.netty.channel.nio.NioEventLoop.processSelectedKeysOptimized(NioEventLoop.java:580)
        at io.netty.channel.nio.NioEventLoop.processSelectedKeys(NioEventLoop.java:497)
        at io.netty.channel.nio.NioEventLoop.run(NioEventLoop.java:459)
        at io.netty.util.concurrent.SingleThreadEventExecutor$5.run(SingleThreadEventExecutor.java:858)
        at io.netty.util.concurrent.DefaultThreadFactory$DefaultRunnableDecorator.run(DefaultThreadFactory.java:138)
        at java.lang.Thread.run(Thread.java:748)
+---+----+
| id|left|
+---+----+
|  1| one|
+---+----+


scala> left.join(right, Seq("id"), "leftanti").show
+---+----+
| id|left|
+---+----+
|  1| one|
+---+----+


scala> left.join(right, Seq("id"), "leftanti").explain
== Physical Plan ==
*(1) BroadcastHashJoin [id#5], [id#14], LeftAnti, BuildRight
:- LocalTableScan [id#5, left#6]
+- BroadcastExchange HashedRelationBroadcastMode(List(cast(input[0, int, false] as bigint)))
   +- LocalTableScan [id#14]

scala>
```

4) BROADCAST JOIN

Spark SQL uses broadcast join (aka broadcast hash join) instead of hash join to optimize join queries when the size of one side data is below spark.sql.autoBroadcastJoinThreshold.

Broadcast join can be very efficient for joins between a large table (fact) with relatively small tables (dimensions) that could then be used to perform a star- schema join. It can avoid sending all data of the large table over the network.

You can use broadcast function or SQL's broadcast hints to mark a dataset to be broadcast when used in a join query.

broadcast join is also called a replicated join (in the distributed system community) or a map-side join (in the Hadoop community).

JoinSelection execution planning strategy uses spark.sql.autoBroadcastJoinThreshold property (default: 10M) to control the size of a dataset before broadcasting it to all worker nodes when performing a join.

COMMANDS

1. val threshold = spark.conf.get("spark.sql.autoBroadcastJoinThreshold").toInt 2.threshold / 1024 / 1024

3.val q = spark.range(100).as("a").join(spark.range(100).as("b")).where($"a.id" === $"b.id") 4.println(q.queryExecution.logical.numberedTreeString)

5. q.explain

6. spark.conf.set("spark.sql.autoBroadcastJoinThreshold ", -1)

7.spark.conf.get("spark.sql.autoBroadcastJoinThreshold")

```
scala> q.explain
== Physical Plan ==
*(5) SortMergeJoin [id#84L], [id#87L], Inner
:- *(2) Sort [id#84L ASC NULLS FIRST], false, 0
:  +- Exchange hashpartitioning(id#84L, 200)
:     +- *(1) Range (0, 100, step=1, splits=2)
+- *(4) Sort [id#87L ASC NULLS FIRST], false, 0
   +- ReusedExchange [id#87L], Exchange hashpartitioning(id#84L, 200)

scala>
<console>:1: error: ';' expected but 'val' found.
val qBroadcast = spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"===$"b.id")val qBroadcast =
                                                                                                              ^

scala> val qBroadcast =spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"=== $"b.id")
qBroadcast: org.apache.spark.sql.Dataset[org.apache.spark.sql.Row] = [id: bigint, id: bigint]

scala> qBroadcast.explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#94L], [id#97L], Inner, BuildRight
:- *(2) Range (0, 100, step=1, splits=2)
+- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
   +- *(1) Range (0, 100, step=1, splits=2)

scala>
```

COMMANDS

1. q.explain
2. val qBroadcast = spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id
"
=== $"b.id")
3. qBroadcast.explain
4. val qBroadcastLeft = """
   SELECT /*+ BROADCAST (lf) */ *
   FROM range(100) lf, range(1000) rt
   WHERE lf.id = rt.id
"""
5. scala> sql(qBroadcastLeft).explain

```
== Physical Plan ==
*(5) SortMergeJoin [id#84L], [id#87L], Inner
:- *(2) Sort [id#84L ASC NULLS FIRST], false, 0
:  +- Exchange hashpartitioning(id#84L, 200)
:     +- *(1) Range (0, 100, step=1, splits=2)
+- *(4) Sort [id#87L ASC NULLS FIRST], false, 0
   +- ReusedExchange [id#87L], Exchange hashpartitioning(id#84L, 200)

scala>
<console>:1: error: ';' expected but 'val' found.
val qBroadcast = spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"===$"b.id")val qBroadcast =
                                                                                                              ^

scala> val qBroadcast =spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"=== $"b.id")
qBroadcast: org.apache.spark.sql.Dataset[org.apache.spark.sql.Row] = [id: bigint, id: bigint]

scala> qBroadcast.explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#94L], [id#97L], Inner, BuildRight
:- *(2) Range (0, 100, step=1, splits=2)
+- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
   +- *(1) Range (0, 100, step=1, splits=2)

scala> val qBroadcastLeft = """SELECT /*+ BROADCAST (lf) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id"""
qBroadcastLeft: String = SELECT /*+ BROADCAST (lf) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id

scala>  sql(qBroadcastLeft).explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#109L], [id#110L], Inner, BuildLeft
:- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
:  +- *(1) Range (0, 100, step=1, splits=2)
+- *(2) Range (0, 1000, step=1, splits=2)

scala>
```

COMMANDS

1. val qBroadcastRight = """ SELECT /*+
 MAPJOIN (rt) */ * FROM range(100) lf,
 range(1000) rt WHERE lf.id = rt.id
"""

scala> sql(qBroadcastRight).explain

```
val qBroadcast = spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"===$"b.id")val qBroadcast =
                                                                                                              ^

scala> val qBroadcast =spark.range(100).as("a").join(broadcast(spark.range(100)).as("b")).where($"a.id"=== $"b.id")
qBroadcast: org.apache.spark.sql.Dataset[org.apache.spark.sql.Row] = [id: bigint, id: bigint]

scala> qBroadcast.explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#94L], [id#97L], Inner, BuildRight
:- *(2) Range (0, 100, step=1, splits=2)
+- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
   +- *(1) Range (0, 100, step=1, splits=2)

scala> val qBroadcastLeft = """SELECT /*+ BROADCAST (lf) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id"""
qBroadcastLeft: String = SELECT /*+ BROADCAST (lf) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id

scala>  sql(qBroadcastLeft).explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#109L], [id#110L], Inner, BuildLeft
:- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
:  +- *(1) Range (0, 100, step=1, splits=2)
+- *(2) Range (0, 1000, step=1, splits=2)

scala> val qBroadcastRight = """ SELECT /*+ MAPJOIN (rt) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id """
qBroadcastRight: String = " SELECT /*+ MAPJOIN (rt) */ * FROM range(100) lf, range(1000) rt WHERE lf.id = rt.id "

scala> sql(qBroadcastRight).explain
== Physical Plan ==
*(2) BroadcastHashJoin [id#116L], [id#117L], Inner, BuildRight
:- *(2) Range (0, 100, step=1, splits=2)
+- BroadcastExchange HashedRelationBroadcastMode(List(input[0, bigint, false]))
   +- *(1) Range (0, 1000, step=1, splits=2)

scala>
```

RESULT:

simple join using Mapper in Spark can be implemented.

LAB EXERCISE-9

Title of the exercise/experiment: Install and Run Hive then use Hive to create, alter, and drop databases, tables, views,functions, and indexes

a) OBJECTIVE OF THE EXERCISE/EXPERIMENT

Install and Run Hive then use Hive to create, alter, and drop databases, tables, views,functions, and indexes

HIVE-OPERATIONS

COMMANDS
cd $HIVE_HOME/bin hive

```
npbdh login: kct5thsemcdhid025
kct5thsemcdhid025@npbdh.cloudloka.com's password:
Last login: Tue Dec 13 05:46:50 2022 from ec2-65-1-45-35.ap-south-1.compute.amazonaws.com
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ hive
WARNING: Use "yarn jar" to launch YARN applications.
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/jars/log4j-slf4j-impl-2.8.2.jar!/org/slf4j/impl/StaticLoggerB
inder.class]
SLF4J: Found binding in [jar:file:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/jars/slf4j-log4j12-1.7.25.jar!/org/slf4j/impl/StaticLoggerBin
der.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.apache.logging.slf4j.Log4jLoggerFactory]
2022-12-13 06:11:28,766 main WARN JNDI lookup class is not available because this JRE does not support JNDI. JNDI string lookups will not be availabl
e, continuing configuration. Ignoring java.lang.ClassNotFoundException: org.apache.logging.log4j.core.lookup.JndiLookup

Logging initialized using configuration in jar:file:/opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/jars/hive-common-2.1.1-cdh6.2.1.jar!/hive-l
og4j2.properties Async: false

WARNING: Hive CLI is deprecated and migration to Beeline is recommended.
hive>
```

SHOW DATABASES:

1. SHOW A DATABASE:

At any time, you can see the databases that already exist as follows:

COMMANDS
Show databases;

```
hotel
hr
hr_data
hr_db
hr_db1
hr_dbrajat
hr_hw_amit
hrdata
hsdb
hsproject
hulk_db
ian
icg
icg1
icg2
icmr
ig
ikhlaque
ikhu_demo1234
imapala_project
impala
impala12
impala123
impala_pok
impala_proj
impala_project
impalaproject
impalaprojectpokemon
imshealth
incedo
indium
indium1
ineurion_db
ineuron_db
```

```
zlatan
zlatan1
zlikhith
zman
zpavan
zsachin
zsambit
zsambit_demo
zsarvesh
zsarvesh_demo
zsekhar
zsonu
zsuhail
zsuresh
zsureshassignment
zswar
zswaroop
zuned_05oct
zuned_test
zvvikram
zzabhinaw
zzassignment
zzassignmentt
zzkhush
zznaresh
zzsonu
zzsunairlines
zzsunretail
zzsunretail_
zzsunyoutube
zzzassignment
zzzzproject
Time taken: 1.653 seconds, Fetched: 3227 row(s)
hive>
```

1) Create database:

A database in Hive is a namespace or a collection of tables.

COMMANDS
Create database bigdata;

```
hive> create database samplebigdata;
OK
Time taken: 0.082 seconds
hive>
```

2) **LIST A DATABASE STARTS WITH A SPECIFIC LETTER**

```
hive> show databases like 's.*';
OK
s18
s19
s1_demo_retail
sabdar_db
sachin
sachin1
sachin_db
sachinlabs
safdar
safdar_db
sahadev
sahil
sahildemo
sahildemo1
sahil_practice
sai
sai1
saikat10dt87edu
saikatt
saikrishna
saimanvitha
sairohith
sairohithm
sak_123
sakshidani
sakshidani1
sakshidaniimp
sal
salarydb_ext
```

```
hive> show databases like 'sampleb.*';
OK
samplebigdata
Time taken: 0.045 seconds, Fetched: 1 row(s)
hive>
```

3. IF DATABASE ALREADY EXISTS:

```
hive> CREATE DATABASE IF NOT EXISTS lab;
OK
Time taken: 0.056 seconds
hive>
```

4. Add a creator name with date of database

```
hive> CREATE DATABASE mysamplebigdata WITH DBPROPERTIES('creator' = 'sankamethra', 'date'= '2022-12-13');
OK
Time taken: 0.061 seconds
hive>
```

5) DESCRIBE A DATABASE:

```
hive> DESCRIBE DATABASE mysamplebigdata;
OK
mysamplebigdata         hdfs://nameservice1/user/hive/warehouse/mysamplebigdata.db       kct5thsemcdhid025        USER
Time taken: 0.072 seconds, Fetched: 1 row(s)
hive>
```

6) DESCRIBE DATABASE EXTENDED

```
hive> DESCRIBE DATABASE EXTENDED mysamplebigdata;
OK
mysamplebigdata         hdfs://nameservice1/user/hive/warehouse/mysamplebigdata.db       kct5thsemcdhid025        USER    {date=2022-12-13, creator=san
kamethra}
Time taken: 0.045 seconds, Fetched: 1 row(s)
hive>
```

7) USE COMMAND

```
hive> use mysamplebigdata;
OK
Time taken: 0.032 seconds
hive>
```

8) SHOW TABLES:

```
hive> show tables;
OK
Time taken: 0.09 seconds
hive>
```

```
hive> create table stu_details(subject varchar(20), mark int, rollno int);
OK
Time taken: 0.255 seconds
hive> show tables;
OK
stu_details
Time taken: 0.063 seconds, Fetched: 1 row(s)
hive>
```

9) DEFAULT DATABASE:

```
hive> set hive.cli.print.current.db=true;
hive (mysamplebigdata)> USE default;
OK
Time taken: 0.033 seconds
hive (default)> set hive.cli.print.current.db=false;
hive>
```

10) DROP A DATABASE:

```
hive> drop table if exists stu_details;
OK
Time taken: 0.243 seconds
```

11) ALTER DATABASE:

```
hive> ALTER DATABASE mysamplebigdata SET DBPROPERTIES ('edited-by'= 'sankamethra');
OK
Time taken: 0.282 seconds
hive>
```

12) CREATING TABLE:

```
hive> CREATE TABLE IF NOT EXISTS mysamplebigdata.employees (name STRING COMMENT 'Employee name',salary FLOAT COMMENT 'Employee salary', subordinates ARRAY<STRING> COM
MENT 'Names of subordinates', deductions MAP<STRING, FLOAT>COMMENT 'Keys are deductions names, values are percentages', address STRUCT<street:STRING, city:STRING, sta
te:STRING, zip:INT>COMMENT 'Home address')COMMENT 'Description of the table'LOCATION '/user/hive/warehouse/bigdataise.db/employees' TBLPROPERTIES ('creator'='me', 'cr
eated_at'='2012-01-02 10:00:00');
OK
Time taken: 0.471 seconds
hive>
```

13) Copy the schema of an existing tables:

```
hive> CREATE TABLE IF NOT EXISTS mysamplebigdata.employees2 LIKE mysamplebigdata.employees;
OK
Time taken: 0.038 seconds
hive>
```

14) SHOW TABLES:

```
bureau_tm3
bureaut
business_bucket
bustomers_internal
bx_book_rating
bx_temp
bx_users
c
cab
cab4
cab_data
cab_data1
cab_data2
cab_ola
cabs
cabs_ola
calc
calc1
calc11
calc112
calc5
call
call8
calls
calls1
capstone1
capstone11
capstone12
capstone_hbase
capstone_project
capstoneproject
capstoneproject1
card1
cards
cards1
cards20
cards
```

```
hive> use default;
OK
Time taken: 0.032 seconds
hive> show tables in mysamplebigdata;
OK
employees
employees2
stu_details
Time taken: 0.042 seconds, Fetched: 3 row(s)
hive>
```

15) DESCRIBE:

```
hive> describe extended mysamplebigdata.employees;
OK
name                    string                  Employee name
salary                  float                   Employee salary
subordinates            array<string>           Names of subordinates
deductions              map<string,float>       Keys are deductions names, values are percentages
address                 struct<street:string,city:string,state:string,zip:int>  Home address

Detailed Table Information      Table(tableName:employees, dbName:mysamplebigdata, owner:kct5thsemcdhid025, createTime:1670913367, lastAccessTime:0, retention:0, sd:S
torageDescriptor(cols:[FieldSchema(name:name, type:string, comment:Employee name), FieldSchema(name:salary, type:float, comment:Employee salary), FieldSchema(name:sub
ordinates, type:array<string>, comment:Names of subordinates), FieldSchema(name:deductions, type:map<string,float>, comment:Keys are deductions names, values are perc
entages), FieldSchema(name:address, type:struct<street:string,city:string,state:string,zip:int>, comment:Home address)], location:hdfs://nameservice1/user/hive/wareho
use/bigdataise.db/employees, inputFormat:org.apache.hadoop.mapred.TextInputFormat, outputFormat:org.apache.hadoop.hive.ql.io.HiveIgnoreKeyTextOutputFormat, compressed
:false, numBuckets:-1, serdeInfo:SerDeInfo(name:null, serializationLib:org.apache.hadoop.hive.serde2.lazy.LazySimpleSerDe, parameters:{serialization.format=1}), bucke
tCols:[], sortCols:[], parameters:{}, skewedInfo:SkewedInfo(skewedColNames:[], skewedColValues:[], skewedColValueLocationMaps:{}), storedAsSubDirectories:false), part
itionKeys:[], parameters:{transient_lastDdlTime=1670913367, created_at=2012-01-02 10:00:00, creator=me, comment=Description of the table}, viewOriginalText:null, view
ExpandedText:null, tableType:MANAGED_TABLE, ownerType:USER)
Time taken: 0.097 seconds, Fetched: 7 row(s)
hive>
```

```
hive> describe mysamplebigdata.employees salary;
OK
salary                  float                   from deserializer
Time taken: 0.078 seconds, Fetched: 1 row(s)
hive>
```

16) EXTERNAL TABLES:

```
hive> CREATE EXTERNAL TABLE IF NOT EXISTS mysamplebigdata.employees3
    > LIKE mysamplebigdata.employees
    > LOCATION '/data/';
```

17) Partitioned, Managed Tables

```
hive> CREATE TABLE employeedetails ( name STRING, salary FLOAT, subordinates ARRAY<STRING>, deductions MAP<STRING, FLOAT>, address STRUCT<street:STRING, city:STRING,
state:STRING, zip:INT>) PARTITIONED BY (country STRING, state STRING);
OK
Time taken: 0.1 seconds
hive>
```

18) External Partitioned Tables

```
hive> CREATE EXTERNAL TABLE IF NOT EXISTS log_messages ( hms INT,severity STRING, server STRING, process_id INT, message STRING) PARTITIONED BY (year INT, month INT,
day INT) ROW FORMAT DELIMITED FIELDS TERMINATED BY '\t';
OK
Time taken: 0.083 seconds
hive>
```

19) DESCRIBE PARTITIONS:

```
hive> describe extended log_messages;
OK
hms                     int
severity                string
server                  string
process_id              int
message                 string
year                    int
month                   int
day                     int

# Partition Information
# col_name              data_type               comment

year                    int
month                   int
day                     int

Detailed Table Information      Table(tableName:log_messages, dbName:default, owner:kct5thsemcdhid025, createTime:1670915193, lastAccessTime:0, retention:0, sd:Storag
eDescriptor(cols:[FieldSchema(name:hms, type:int, comment:null), FieldSchema(name:severity, type:string, comment:null), FieldSchema(name:server, type:string, comment:
null), FieldSchema(name:process_id, type:int, comment:null), FieldSchema(name:message, type:string, comment:null), FieldSchema(name:year, type:int, comment:null), Fie
ldSchema(name:month, type:int, comment:null), FieldSchema(name:day, type:int, comment:null)], location:hdfs://nameservice1/user/hive/warehouse/log_messages, inputForm
at:org.apache.hadoop.mapred.TextInputFormat, outputFormat:org.apache.hadoop.hive.ql.io.HiveIgnoreKeyTextOutputFormat, compressed:false, numBuckets:-1, serdeInfo:SerDe
Info(name:null, serializationLib:org.apache.hadoop.hive.serde2.lazy.LazySimpleSerDe, parameters:{serialization.format=\t, field.delim=\t}), bucketCols:[], sortCols:[]
, parameters:{}, skewedInfo:SkewedInfo(skewedColNames:[], skewedColValues:[], skewedColValueLocationMaps:{}), storedAsSubDirectories:false), partitionKeys:[FieldSchem
a(name:year, type:int, comment:null), FieldSchema(name:month, type:int, comment:null), FieldSchema(name:day, type:int, comment:null)], parameters:{totalSize=0, EXTERN
AL=TRUE, numRows=0, rawDataSize=0, COLUMN_STATS_ACCURATE={\"BASIC_STATS\":\"true\"}, numFiles=0, numPartitions=0, transient_lastDdlTime=1670915193, numFilesErasureCod
ed=0}, viewOriginalText:null, viewExpandedText:null, tableType:EXTERNAL_TABLE, ownerType:USER)
Time taken: 0.085 seconds, Fetched: 17 row(s)
hive>
```

20) IEW

```
hive> Create VIEW Sample_View AS SELECT * FROM mysamplebigdata.employees2 WHERE salary>25000;
OK
Time taken: 0.158 seconds
hive>
```

FUNCTIONS:

USER DEFINED FUNCTIONS:

Create:

```
hive> create table employee_data (Id int, Name string , Salary float)  row format delimited fields terminated by ',' ;
OK
Time taken: 0.083 seconds
hive>
```

Load data:

```
hive> load data local inpath '/home/kct5thsemcdhid025/iris.csv' into table employee_data;
Loading data to table default.employee_data
OK
Time taken: 0.978 seconds
hive>
```

Select the data:

```
Time taken: 0.978 seconds
hive> select * from employee_data;
OK
5       3.5     1.4
4       3.0     1.4
4       3.2     1.3
4       3.1     1.5
5       3.6     1.4
5       3.9     1.7
4       3.4     1.4
5       3.4     1.5
4       2.9     1.4
4       3.1     1.5
5       3.7     1.5
4       3.4     1.6
4       3.0     1.4
4       3.0     1.1
5       4.0     1.2
5       4.4     1.5
5       3.9     1.3
5       3.5     1.4
5       3.8     1.7
5       3.8     1.5
5       3.4     1.7
5       3.7     1.5
4       3.6     1.0
5       3.3     1.7
4       3.4     1.9
5       3.0     1.6
5       3.4     1.6
5       3.5     1.5
5       3.4     1.4
4       3.2     1.6
4       3.1     1.6
5       3.4     1.5
5       4.1     1.5
5       4.2     1.4
4       3.1     1.5
```

Mathematical Functions:

```
hive> select Id, Name, sqrt(Salary) from employee_data ;
Query ID = kct5thsemcdhid025_20221213072422_6a60cc1c-95ea-4a40-b5b7-0f43ee1a1c2f
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks is set to 0 since there's no reduce operator
22/12/13 07:24:23 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:24:23 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21632, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21632/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21632
```

```
Launching Job 1 out of 1
Number of reduce tasks is set to 0 since there's no reduce operator
22/12/13 07:24:23 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:24:23 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21632, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21632/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21632
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2022-12-13 07:24:34,371 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:24:45,801 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 4.23 sec
MapReduce Total cumulative CPU time: 4 seconds 230 msec
Ended Job = job_1663041244711_21632
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 4.23 sec   HDFS Read: 12917 HDFS Write: 6812 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 4 seconds 230 msec
OK
NULL    FIRST_NAME      NULL
198     Donald  NULL
199     Douglas NULL
200     Jennifer        NULL
201     Michael NULL
202     Pat     NULL
203     Susan   NULL
204     Hermann NULL
205     Shelley NULL
206     William NULL
100     Steven  NULL
101     Neena   NULL
102     Lex     NULL
103     Alexander       NULL
104     Bruce   NULL
105     David   NULL
106     Valli   NULL
107     Diana   NULL
108     Nancy   NULL
109     Daniel  NULL
110     John    NULL
111     Ismael  NULL
112     Jose Manuel     NULL
```

Select max salary from employee table:

```
hive> select max(Salary) from employee_data;
Query ID = kct5thsemcdhid025_20221213072532_1b329c9f-43cc-4b88-b19e-0a29f3457eeb
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>
22/12/13 07:25:32 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:25:32 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21635, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21635/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21635
```

```
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:25:42,747 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:25:59,269 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 3.21 sec
2022-12-13 07:26:08,662 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 6.13 sec
MapReduce Total cumulative CPU time: 6 seconds 130 msec
Ended Job = job_1663041244711_21635
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 6.13 sec   HDFS Read: 16673 HDFS Write: 103 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 6 seconds 130 msec
OK
6.9
Time taken: 38.516 seconds, Fetched: 1 row(s)
hive>
```

Select min salary from employee table:

```
hive> select min(Salary) from employee_data;
Query ID = kct5thsemcdhid025_20221213072659_cd934593-d735-4c54-aa1e-d8df6dc14d7c
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>
22/12/13 07:27:00 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:27:00 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21640, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21640/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21640
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:27:22,317 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:27:35,762 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.91 sec
2022-12-13 07:27:45,085 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.69 sec
MapReduce Total cumulative CPU time: 5 seconds 690 msec
Ended Job = job_1663041244711_21640
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.69 sec   HDFS Read: 16673 HDFS Write: 103 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 690 msec
OK
1.0
Time taken: 47.26 seconds, Fetched: 1 row(s)
hive>
```

Select average salary from employee table:

```
hive> select avg(Salary) from employee_data;
Query ID = kct5thsemcdhid025_20221213072827_ef1406f3-e9c8-4d1d-b40a-159d9e5c860d
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>
22/12/13 07:28:28 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:28:28 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21643, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21643/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21643
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:28:41,604 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:28:49,914 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.32 sec
2022-12-13 07:28:57,294 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.17 sec
MapReduce Total cumulative CPU time: 5 seconds 170 msec
Ended Job = job_1663041244711_21643
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.17 sec   HDFS Read: 17131 HDFS Write: 118 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 170 msec
OK
3.7586666552225747
Time taken: 31.574 seconds, Fetched: 1 row(s)
Query ID = kct5thsemcdhid025_20221213072859_06698cb5-646a-4144-900d-849f21d69df8
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>
```

```
2022-12-13 07:28:49,914 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.32 sec
2022-12-13 07:28:57,294 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.17 sec
MapReduce Total cumulative CPU time: 5 seconds 170 msec
Ended Job = job_1663041244711_21643
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.17 sec   HDFS Read: 17131 HDFS Write: 118 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 170 msec
OK
3.7586666552225747
Time taken: 31.574 seconds, Fetched: 1 row(s)
Query ID = kct5thsemcdhid025_20221213072859_06698cb5-646a-4144-900d-849f21d69df8
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>
22/12/13 07:28:59 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:28:59 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21644, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21644/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21644
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:29:19,391 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:29:27,597 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.44 sec
2022-12-13 07:29:41,079 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 6.15 sec
MapReduce Total cumulative CPU time: 6 seconds 150 msec
Ended Job = job_1663041244711_21644
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 6.15 sec   HDFS Read: 17131 HDFS Write: 118 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 6 seconds 150 msec
OK
3.7586666552225747
Time taken: 43.73 seconds, Fetched: 1 row(s)
hive>
```

SUM OF SALARY:

```
hive> select sum(Salary) from employee_data;select sum(Salary) from employee_data;
Query ID = kct5thsemcdhid025_20221213073016_bac54ff9-d579-4c15-8160-77cd00254536
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>
22/12/13 07:30:16 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:30:16 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21647, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21647/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21647
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:30:28,524 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:30:36,766 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.44 sec
2022-12-13 07:30:44,001 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.42 sec
MapReduce Total cumulative CPU time: 5 seconds 420 msec
Ended Job = job_1663041244711_21647
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.42 sec   HDFS Read: 16860 HDFS Write: 117 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 420 msec
OK
563.7999982833862
Time taken: 28.754 seconds, Fetched: 1 row(s)
Query ID = kct5thsemcdhid025_20221213073045_e17acb8c-d2a1-4424-9817-0321cc12c450
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:
```

```
Total MapReduce CPU Time Spent: 5 seconds 420 msec
OK
563.7999982833862
Time taken: 28.754 seconds, Fetched: 1 row(s)
Query ID = kct5thsemcdhid025_20221213073045_e17acb8c-d2a1-4424-9817-0321cc12c450
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>
22/12/13 07:30:45 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:30:45 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21649, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21649/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21649
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:30:55,408 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:31:07,685 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.81 sec
2022-12-13 07:31:28,121 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 4.67 sec
MapReduce Total cumulative CPU time: 4 seconds 670 msec
Ended Job = job_1663041244711_21649
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 4.67 sec   HDFS Read: 16867 HDFS Write: 117 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 4 seconds 670 msec
OK
563.7999982833862
Time taken: 45.12 seconds, Fetched: 1 row(s)
hive>
```

COUNT:

```
hive> select Count(*) from employee_data;
Query ID = kct5thsemcdhid025_20221213073208_38b199a4-2923-46d3-8338-845ac2fbe574
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>
22/12/13 07:32:08 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:32:08 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21653, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21653/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21653
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:32:22,202 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:32:32,564 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.75 sec
2022-12-13 07:32:41,765 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.43 sec
MapReduce Total cumulative CPU time: 5 seconds 430 msec
Ended Job = job_1663041244711_21653
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.43 sec   HDFS Read: 16596 HDFS Write: 103 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 430 msec
OK
202
Time taken: 35.698 seconds, Fetched: 1 row(s)
Query ID = kct5thsemcdhid025_20221213073243_a681cc71-e64a-4b8c-9c3e-71aee1ac2b01
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:



In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
22/12/13 07:32:44 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:32:44 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21654, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21654/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21654
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:32:54,003 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:33:05,253 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.47 sec
2022-12-13 07:33:16,597 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.26 sec
MapReduce Total cumulative CPU time: 5 seconds 260 msec
Ended Job = job_1663041244711_21654
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.26 sec   HDFS Read: 16596 HDFS Write: 103 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 260 msec
OK
202
Time taken: 33.775 seconds, Fetched: 1 row(s)
hive>
```

To fetch the employees whose salary is greather than 25000

```
hive> select sum(Salary) from employee_data;
Query ID = kct5thsemcdhid025_20221213073410_f62e4d2f-395f-471b-a352-cb3302d4e2d9
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>
22/12/13 07:34:10 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
22/12/13 07:34:10 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
Starting Job = job_1663041244711_21657, Tracking URL = http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1663041244711_21657/
Kill Command = /opt/cloudera/parcels/CDH-6.2.1-1.cdh6.2.1.p0.1425774/lib/hadoop/bin/hadoop job  -kill job_1663041244711_21657
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2022-12-13 07:34:28,686 Stage-1 map = 0%,  reduce = 0%
2022-12-13 07:34:37,894 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.79 sec
2022-12-13 07:34:48,260 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.66 sec
MapReduce Total cumulative CPU time: 5 seconds 660 msec
Ended Job = job_1663041244711_21657
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.66 sec   HDFS Read: 16867 HDFS Write: 117 HDFS EC Read: 0 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 660 msec
OK
563.7999982833862
Time taken: 40.295 seconds, Fetched: 1 row(s)
hive>
```

RESULT:

The Hive operations like create, alter, and drop databases, tables, views,functions, and indexes are implemented successfully.

LAB EXERCISE-10

Title of the exercise/experiment : Verify, Sparse and perform advance join of data using spark

Verify, Sparse and perform advance join of data using spark

```
npbdh login: kct5thsemcdhid025
kct5thsemcdhid025@npbdh.cloudloka.com's password:
Last login: Tue Dec 13 06:05:39 2022 from ec2-65-1-45-35.ap-south-1.compute.amazonaws.com
[kct5thsemcdhid025@ip-10-1-1-204 ~]$ spark-shell
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
22/12/13 07:36:25 WARN cluster.YarnSchedulerBackend$YarnSchedulerEndpoint: Attempted to request executors before the AM has registered!
Spark context available as 'sc' (master = yarn, app id = application_1663041244711_21659).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 2.4.0-cdh6.2.1
      /_/

Using Scala version 2.11.12 (Java HotSpot(TM) 64-Bit Server VM, Java 1.8.0_181)
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

1) Broadcast Hash Join

```
scala> spark.conf.get("spark.sql.autoBroadcastJoinThreshold")
res0: String = 10485760

scala>
```

```
scala> val data1 = Seq(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)
data1: Seq[Int] = List(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)

scala>
```

```
scala> val df1 = data1.toDF("id1")
df1: org.apache.spark.sql.DataFrame = [id1: int]

scala>
```

```
scala> val data2 = Seq(30, 20, 40, 50)
data2: Seq[Int] = List(30, 20, 40, 50)

scala>
```

```
scala> val df2 = data2.toDF("id2")
df2: org.apache.spark.sql.DataFrame = [id2: int]

scala>
```

```
scala> val dfJoined = df1.join(df2, $"id1" === $"id2")
dfJoined: org.apache.spark.sql.DataFrame = [id1: int, id2: int]

scala>
```

```
scala> dfJoined.queryExecution.executedPlan
res1: org.apache.spark.sql.execution.SparkPlan =
*(1) BroadcastHashJoin [id1#3], [id2#8], Inner, BuildRight
:- LocalTableScan [id1#3]
+- BroadcastExchange HashedRelationBroadcastMode(List(cast(input[0, int, false] as bigint)))
   +- LocalTableScan [id2#8]

scala>
```

```
scala> dfJoined.show
+---+---+
|id1|id2|
+---+---+
| 20| 20|
| 20| 20|
| 30| 30|
| 40| 40|
| 40| 40|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 50| 50|
+---+---+

scala>
```

2) Shuffle Hash Join

```
scala> spark.conf.set("spark.sql.autoBroadcastJoinThreshold", 2)

scala> spark.conf.set("spark.sql.join.preferSortMergeJoin", "false")

scala> spark.conf.get("spark.sql.join.preferSortMergeJoin")
res5: String = false

scala>
```

```
scala> spark.conf.get("spark.sql.autoBroadcastJoinThreshold")
res6: String = 2

scala>
```

```
scala> val data1 = Seq(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)
data1: Seq[Int] = List(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)

scala>
```

```
scala> val df1 = data1.toDF("id1")
df1: org.apache.spark.sql.DataFrame = [id1: int]

scala>
```

```
scala> val df1 = data1.toDF("id1")
df1: org.apache.spark.sql.DataFrame = [id1: int]

scala> val data2 = Seq(30, 20, 40, 50)
data2: Seq[Int] = List(30, 20, 40, 50)

scala>
```

```
scala> val df2 = data2.toDF("id2")
df2: org.apache.spark.sql.DataFrame = [id2: int]

scala> val dfJoined = df1.join(df2, $"id1" === $"id2")
dfJoined: org.apache.spark.sql.DataFrame = [id1: int, id2: int]

scala>
```

We are setting spark.sql.autoBroadcastJoinThreshold to -1 to disable broadcast.

COMMANDS
1. scala> spark.conf.get("spark.sql.join.preferSortMergeJoin") res1: String = true 2. scala> spark.conf.get("spark.sql.autoBroadcastJoinThreshold") res2: String = -1 3.scala> val data1 = Seq(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50) data1: Seq[Int] = List(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50) 4.scala> val df1 = data1.toDF("id1") df1: org.apache.spark.sql.DataFrame = [id1: int] 5.scala> val data2 = Seq(30, 20, 40, 50) data2: Seq[Int] = List(30, 20, 40, 50) 6.scala> val df2 = data2.toDF("id2") df2: org.apache.spark.sql.DataFrame = [id2: int]

```
scala> dfJoined.queryExecution.executedPlan
res7: org.apache.spark.sql.execution.SparkPlan =
ShuffledHashJoin [id1#26], [id2#31], Inner, BuildRight
:- Exchange hashpartitioning(id1#26, 200)
:  +- LocalTableScan [id1#26]
+- Exchange hashpartitioning(id2#31, 200)
   +- LocalTableScan [id2#31]

scala> dfJoined.show
+---+---+
|id1|id2|
+---+---+
| 40| 40|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 40| 40|
| 50| 50|
| 30| 30|
+---+---+


scala>
```

COMMANDS
scala> val dfJoined = df1.join(df2, $"id1" >= $"id2") dfJoined: org.apache.spark.sql.DataFrame = [id1: int, id2: int]

COMMANDS
scala> dfJoined.queryExecution.executedPlan scala> dfJoined.show

```
scala> val df1 = data1.toDF("id1")
df1: org.apache.spark.sql.DataFrame = [id1: int]

scala> val data2 = Seq(30, 20, 40, 50)
data2: Seq[Int] = List(30, 20, 40, 50)

scala> val df2 = data2.toDF("id2")
df2: org.apache.spark.sql.DataFrame = [id2: int]

scala> val dfJoined = df1.join(df2, $"id1" === $"id2")
dfJoined: org.apache.spark.sql.DataFrame = [id1: int, id2: int]

scala> dfJoined.queryExecution.executedPlan
res7: org.apache.spark.sql.execution.SparkPlan =
ShuffledHashJoin [id1#26], [id2#31], Inner, BuildRight
:- Exchange hashpartitioning(id1#26, 200)
:  +- LocalTableScan [id1#26]
+- Exchange hashpartitioning(id2#31, 200)
   +- LocalTableScan [id2#31]

scala> dfJoined.show
+---+---+
|id1|id2|
+---+---+
| 40| 40|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 40| 40|
| 50| 50|
| 30| 30|
+---+---+

scala>
```

3) CARTESIAN PRODUCT JOIN

```
scala> spark.conf.get("spark.sql.join.preferSortMergeJoin")
res9: String = false

scala> spark.conf.get("spark.sql.autoBroadcastJoinThreshold")
res10: String = 2

scala> val data1 = Seq(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)
data1: Seq[Int] = List(10, 20, 20, 30, 40, 10, 40, 20, 20, 20, 20, 50)

scala> val df1 = data1.toDF("id1")
df1: org.apache.spark.sql.DataFrame = [id1: int]

scala> val data2 = Seq(30, 20, 40, 50)
data2: Seq[Int] = List(30, 20, 40, 50)

scala> val df2 = data2.toDF("id2")
df2: org.apache.spark.sql.DataFrame = [id2: int]

scala>
```

```
scala> val df2 = data2.toDF("id2")
df2: org.apache.spark.sql.DataFrame = [id2: int]

scala> val dfJoined = df1.join(df2, $"id1" >= $"id2")
dfJoined: org.apache.spark.sql.DataFrame = [id1: int, id2: int]

scala> dfJoined.queryExecution.executedPlan
res11: org.apache.spark.sql.execution.SparkPlan =
CartesianProduct (id1#49 >= id2#54)
:- LocalTableScan [id1#49]
+- LocalTableScan [id2#54]

scala> dfJoined.show
+---+---+
|id1|id2|
+---+---+
| 20| 20|
| 20| 20|
| 30| 30|
| 30| 20|
| 40| 30|
| 40| 20|
| 40| 40|
| 40| 30|
| 40| 20|
| 20| 20|
| 20| 20|
| 20| 20|
| 50| 30|
| 50| 20|
| 40| 40|
| 50| 40|
| 50| 50|
+---+---+


scala>
```

Conclusion:

To Verify, Sparse and perform advance join of data using spark can be implemented.