# BIG DATA AND BUSINESS ANALYTICS

## LAB MANUAL

| | | |
|---|---|---|
| **Academic Year** | **:** | **2019 - 2020** |
| **Course Code** | **:** | **ACS111** |
| **Regulations** | **:** | **R16** |
| **Semester** | **:** | **VII** |
| **Branch** | **:** | **IT** |

**Prepared by**

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## 1. PROGRAM OUTCOMES:

| PROGRAM OUTCOMES (POs) | |
|---|---|
| **PO-1:** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**). |
| **PO-2:** | Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).** |
| **PO-3:** | Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).** |
| **PO-4:** | Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).** |
| **PO-5:** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).** |
| **PO-6:** | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).** |
| **PO-7:** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).** |
| **PO-8:** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).** |
| **PO-9:** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).** |
| **PO-10:** | Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).** |
| **PO-11:** | Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO-12**: | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).** |

## 2. PROGRAM SPECIFIC OUTCOMES (PSOs):

| PROGRAM SPECIFIC OUTCOMES (PSO'S) | |
|---|---|
| PSO – I | **Professional Skills:** The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexity. |
| PSO – II | **Problem-Solving Skills:** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success. |
| PSO – III | **Successful Career and Entrepreneurship:** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies. |

## 3. ATTAINMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

| WEEK.NO | Experiment | Program Outcomes Attained | Program Specific Outcomes Attained |
|---|---|---|---|
| 1. | INSTALL VMWARE | PO1, PO2, PO5 | PSO2 |
| 2. | HADOOP MODES | PO1, PO2, PO5 | PSO2 |
| 3. | USING LINUX OPERATING SYSTEM | PO1, PO2, PO5 | PSO2 |
| 4. | FILE MANAGEMENT IN HADOOP | PO1, PO2, PO5 | PSO2 |
| 5. | MAPREDUCE PROGRAM 1 | PO1, PO2, PO5 | PSO2 |
| 6. | MAPREDUCE PROGRAM 2 | PO1, PO2, PO3, PO4, PO12 | PSO1, PSO2 |
| 7. | MAPREDUCE PROGRAM 3 | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |
| 8. | PIG LATIN LANGUAGE - PIG | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |
| 9. | PIG COMMANDS | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |
| 10. | PIG LATIN MODES, PROGRAMS | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |

| | | | |
|---|---|---|---|
| 11. | HIVE | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |
| 12. | HIVE OPERATIONS | PO1, PO2, PO3, PO4, PO5, PO12 | PSO1, PSO2 |

## 4. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

| Course Objectives (COs) | Program Outcomes (POs) | | | | | | | | | | | Program Specific Outcomes (PSOs) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO 2 | PSO3 |
| I | √ | √ | √ | | | | | | | | | | √ | | |
| II | √ | √ | | √ | √ | | | | | | | | √ | | |
| III | | | √ | | √ | | | | | | | √ | √ | √ | |
| IV | √ | √ | √ | | | | | | | | | √ | | √ | |

## 5. SYLLABUS:

### BIG DATA AND BUSINESS ANALYTICS LABORATORY

**VII Semester: CSE/IT**

| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| ACS111 | Core | L | T | P | C | CIA | SEE | Total |
| | | - | - | 3 | 2 | 30 | 70 | 100 |
| Contact Classes: Nil | Tutorial Classes: Nil | Practical Classes:36 | | | | Total Classes: 36 | | |

**COURSE OBJECTIVES:**

**The course should enable the students to:**

I. Optimize business decisions and create competitive advantage with Big data analytics
II. Practice java concepts required for developing map reduce programs.
III. Impart the architectural concepts of Hadoop and introducing map reduce paradigm.
IV. Practice programming tools PIG and HIVE in Hadoop eco system.
V. Implement best practices for Hadoop development.

**COURSE LEARNING OUTCOMES (CLOs):**

1. Understand the installation of VMWare
2. Understand and apply the Perform setting up and Installing Hadoop in its three operating modes.
3. Implementing the basic commands of LINUX Operating System
4. Implement the file management tasks in Hadoop.
5. Understand Map Reduce Paradigm.
6. Apply Map Reduce program that mines weather data.
7. Implement matrix multiplication with Hadoop MapReduce
8. Apply Map Reduce program that makes the dataset to be compressed.
9. Understand the installation of PIG.
10. Understand Pig Latin scripts sort, group, join, project, and filter your data.
11. Implement the Pig Latin scripts in two different modes
12. Understand the installation of HIVE
13. Apply Hive to create, alter, and drop databases, tables, views, functions, and indexes.

**Week-1** **INSTALL VMWARE**

Installation of VMWare to setup the Hadoop environment and its ecosystems.

**Week-2** **HADOOP MODES**

a. Perform setting up and Installing Hadoop in its three operating modes.
   i. Standalone.
   ii. Pseudo distributed.
   iii. Fully distributed.
b. Use web based tools to monitor your Hadoop setup.

**Week-3** **USING LINUX OPERATING SYSTEM**

Implementing the basic commands of LINUX Operating System – File/Directory creation, deletion, update operations.

**Week-4** **FILE MANAGEMENT IN HADOOP**

| | |
|---|---|
| Implement the following file management tasks in Hadoop:<br>i. Adding files and directories<br>ii. Retrieving files<br>iii. Deleting files<br>Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities. | |
| **Week-5** | **MAPREDUCE PROGRAM 1** |
| Run a basic word count Map Reduce program to understand Map Reduce Paradigm. | |
| **Week-6** | **MAPREDUCE PROGRAM 2** |
| Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented | |
| **Week-7** | **MAPREDUCE PROGRAM 3** |
| Implement matrix multiplication with Hadoop Map Reduce. | |
| **Week-8** | **PIG LATIN LANGUAGE – PIG** |
| Installation of PIG. | |
| **Week-9** | **PIG COMMANDS** |
| Write Pig Latin scripts sort, group, join, project, and filter your data. | |
| **Week-10** | **PIG LATIN MODES, PROGRAMS** |
| a. Run the Pig Latin Scripts to find Word Count<br>b. Run the Pig Latin Scripts to find a max temp for each and every year. | |
| **Week-11** | **HIVE** |
| Installation of HIVE. | |
| **Week-12** | **HIVE OPERATIONS** |
| Use Hive to create, alter, and drop databases, tables, views, functions, and indexes. | |
| **Reference Books:** | |
| Jay Liebowitz, ―Big Data And Business Analytics Laboratory, CRC Press. | |

## 6. INDEX:

## WEEK-1

## INSTALL VMWARE

### 1.1 OBJECTIVE:

To Install VMWare.

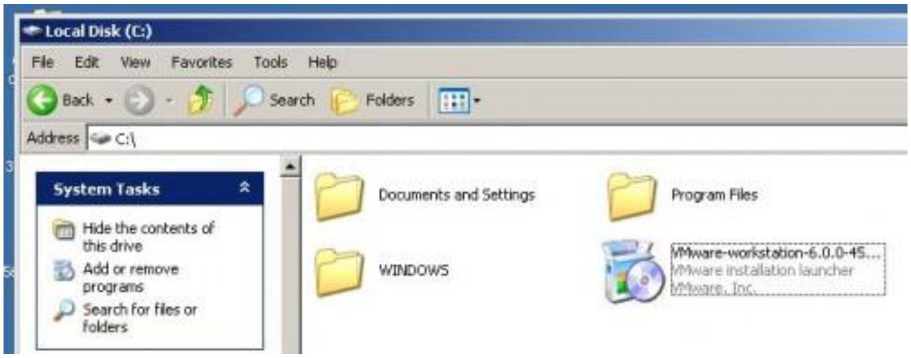
### 1.2 RESOURCES:

VMWare stack, 4 GB RAM, Web browser,Hard Disk 80 GB.

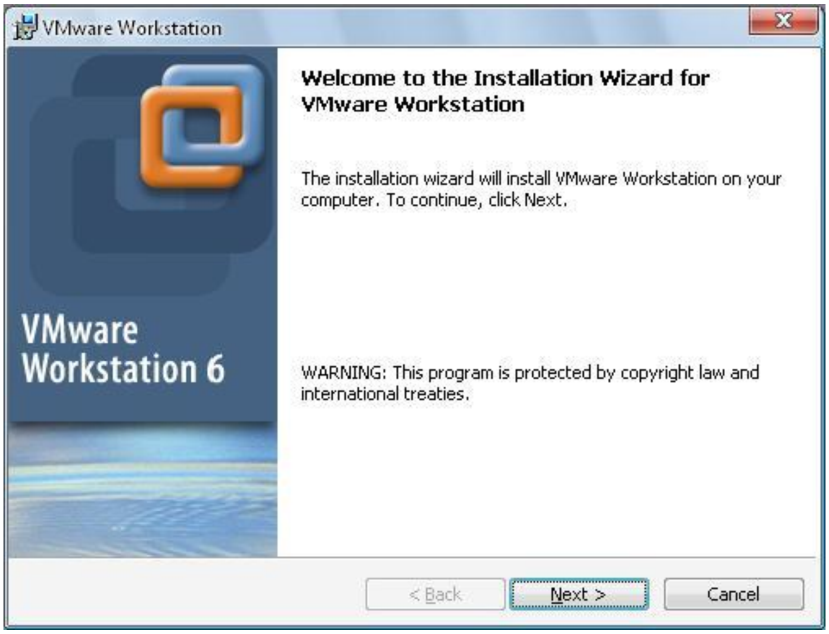
### 1.3 PROGRAM LOGIC:

STEP 1. First of all, enter to the official site of VMware and download VMware Workstation https://www.vmware.com/tryvmware/?p=workstation-w

STEP 2. After downloading VMware workstation, install it on your PC


Local Disk (C:)
File Edit View Favorites Tools Help
Back Search Folders
Address C:\
System Tasks
Hide the contents of this drive
Add or remove programs
Search for files or folders
Documents and Settings
Program Files
WINDOWS
VMware-workstation-6.0.0-45...
VMware installation launcher
VMware, Inc.

STEP 3. Setup will open Welcome Screen

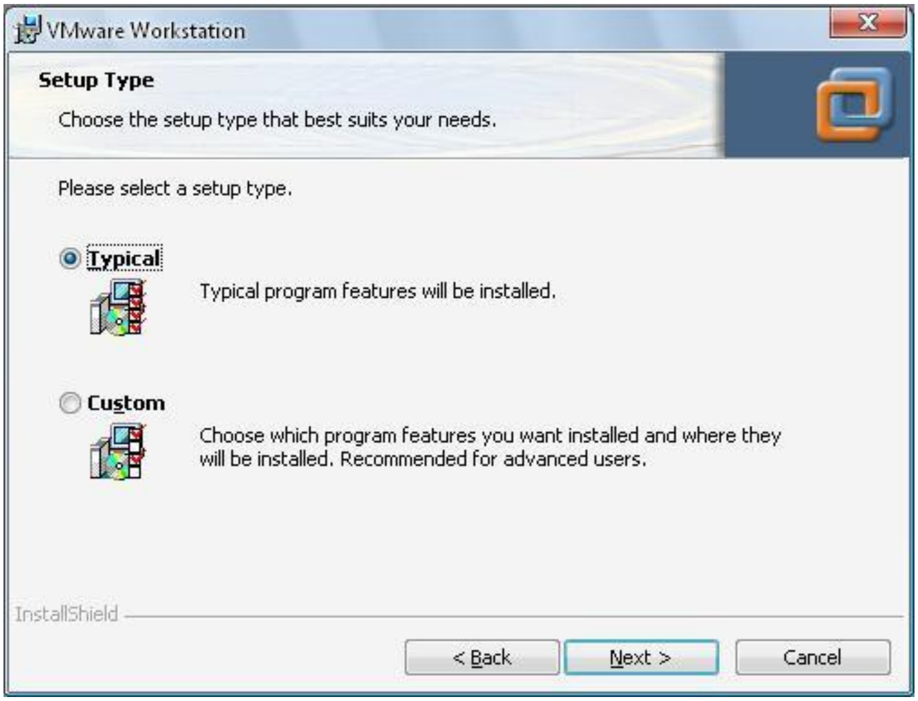


Welcome to the Installation Wizard for VMware Workstation

The installation wizard will install VMware Workstation on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

Click on **Next** button and choose **Typical** option



VMware Workstation

**Setup Type**

Choose the setup type that best suits your needs.

Please select a setup type.

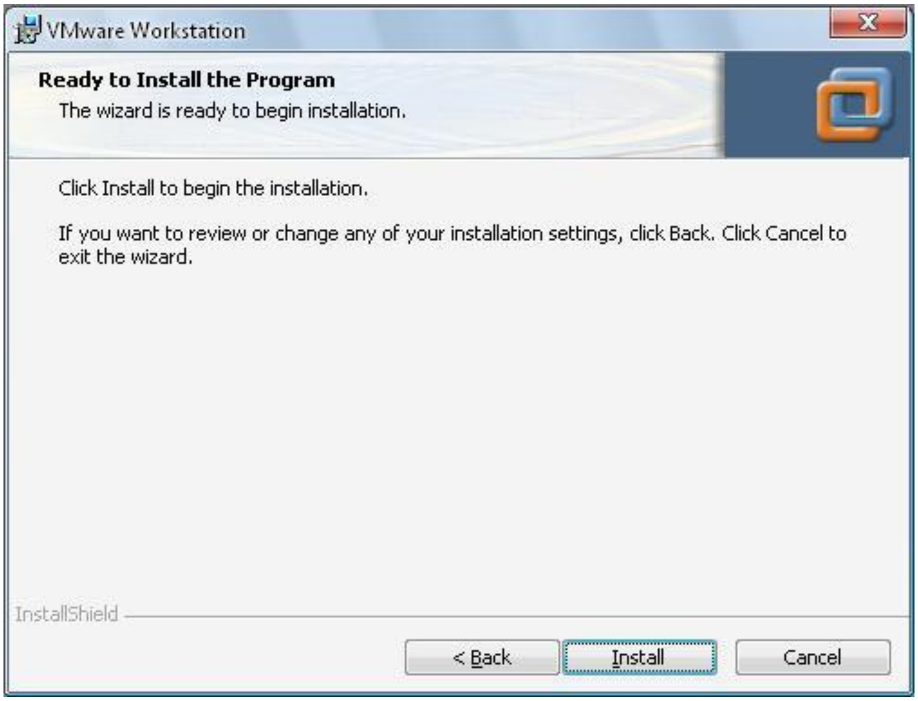
● **Typical**

Typical program features will be installed.

○ **Custom**

Choose which program features you want installed and where they will be installed. Recommended for advanced users.

STEP 4. By clicking "**Next**" buttons, to begin the installation, click on **Install** button at the end



VMware Workstation

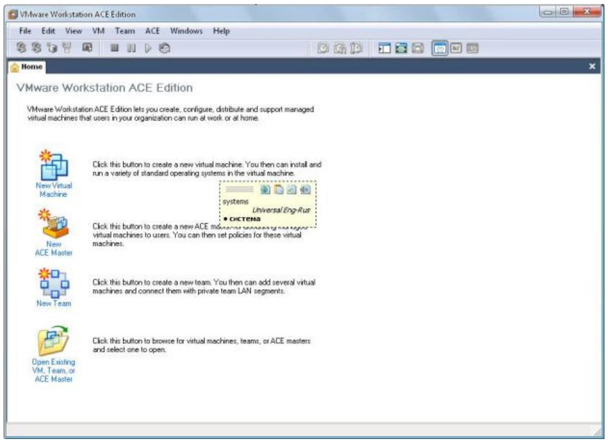
**Ready to Install the Program**

The wizard is ready to begin installation.

Click Install to begin the installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

STEP 5. This will install VMware Workstation software on your PC, After installation complete, click on **Finish** button. Then restart your PC. Then open this software


VMware Workstation ACE Edition
File Edit View VM Team ACE Windows Help
Home
New Virtual Machine
New ACE Master
New Team
Open Existing VM, Team, or ACE Master
systems
Universal Eng-Rus
• система

VMware Workstation ACE Edition

VMware Workstation ACE Edition lets you create, configure, distribute and support managed virtual machines that users in your organization can run at work or at home.

Click this button to create a new virtual machine. You then can install and run a variety of standard operating systems in the virtual machine.

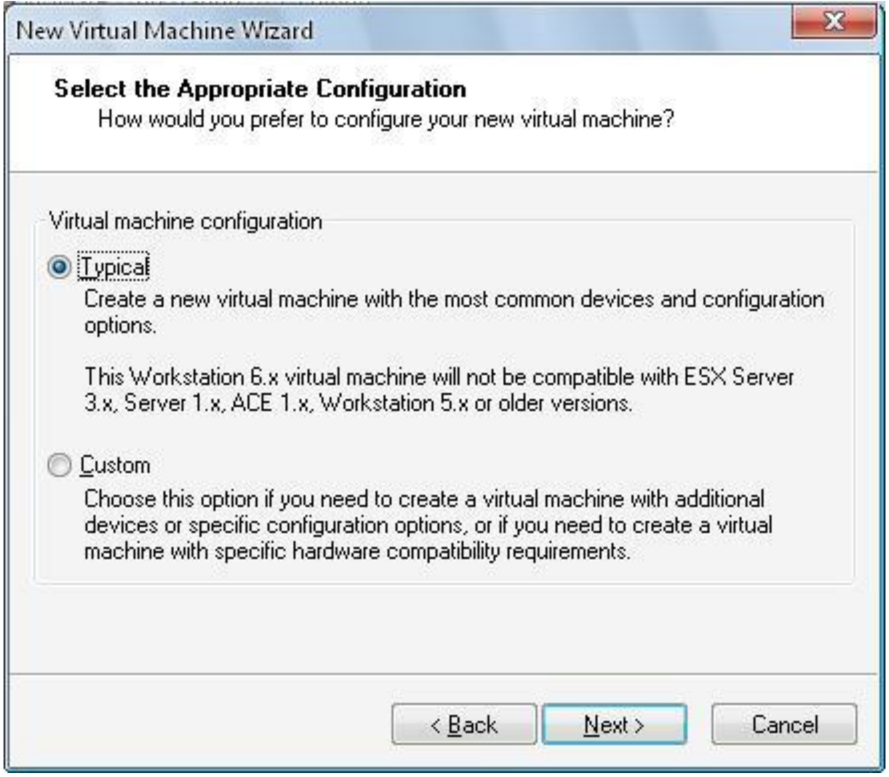
Click this button to create a new ACE virtual machines to users. You can then set policies for these virtual machines.

Click this button to create a new team. You then can add several virtual machines and connect them with private team LAN segments.

Click this button to browse for virtual machines, teams, or ACE masters and select one to open.

6. In this step we try to create new "virtual machine". Enter to File menu, then New-> Virtual Machine

Click on **Next** button, then check **Typical** option as below



**Select the Appropriate Configuration**

How would you prefer to configure your new virtual machine?

Virtual machine configuration

● Typical

Create a new virtual machine with the most common devices and configuration options.

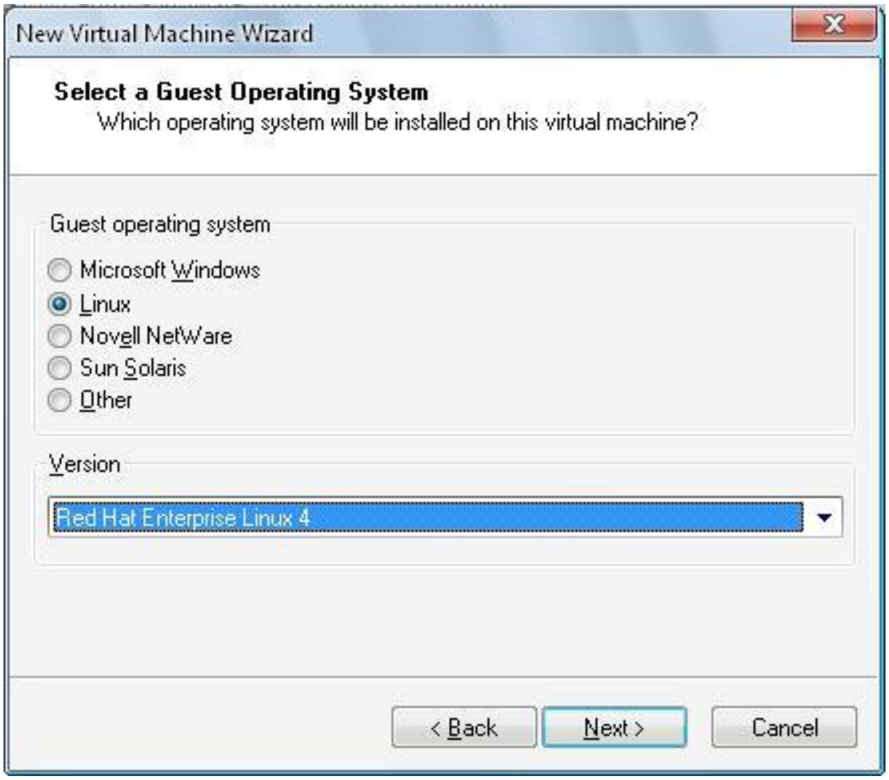
This Workstation 6.x virtual machine will not be compatible with ESX Server 3.x, Server 1.x, ACE 1.x, Workstation 5.x or older versions.

○ Custom

Choose this option if you need to create a virtual machine with additional devices or specific configuration options, or if you need to create a virtual machine with specific hardware compatibility requirements.

Then click **Next** button, and check your OS version. In this example, as we're going to setup Oracle server on CentOS, we'll check **Linux** option and from "*version*" option we'll check **Red Hat**

**Enterprise Linux 4**



New Virtual Machine Wizard

**Select a Guest Operating System**

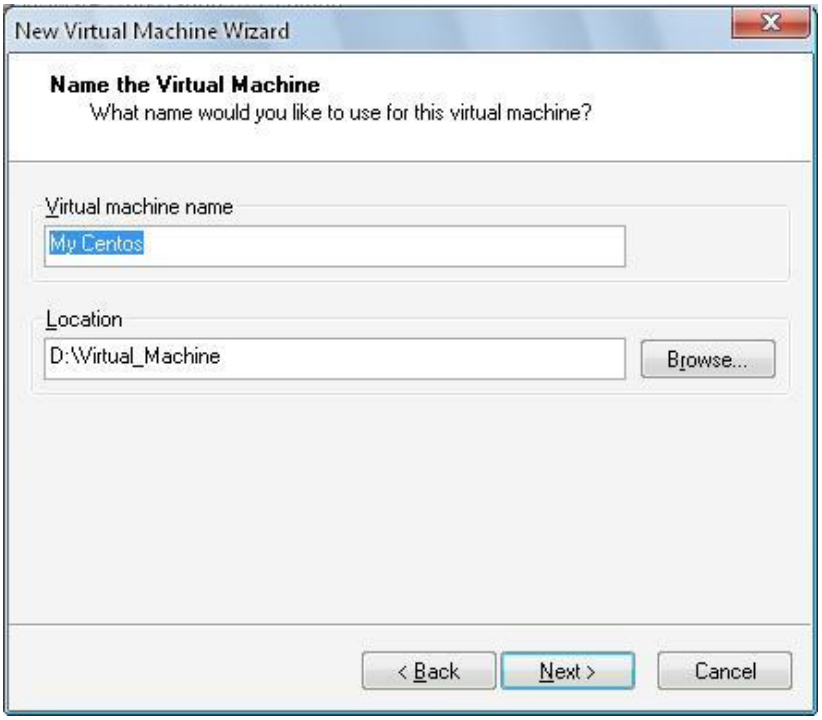
Which operating system will be installed on this virtual machine?

Guest operating system

○ Microsoft Windows
● Linux
○ Novell NetWare
○ Sun Solaris
○ Other

Version: Red Hat Enterprise Linux 4

By clicking **Next** button, we'll give a name to our virtual machine, and give directory to create this new virtual machine



New Virtual Machine Wizard

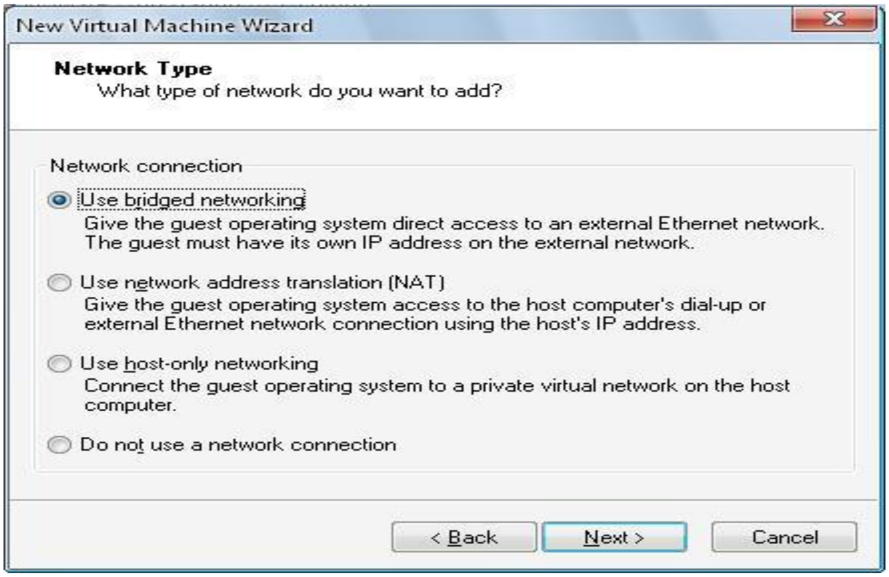
**Name the Virtual Machine**

What name would you like to use for this virtual machine?

Virtual machine name: My Centos

Location: D:\Virtual_Machine

Then select **Use bridged networking** option and click **Next**.



**Network Type**
What type of network do you want to add?

Network connection

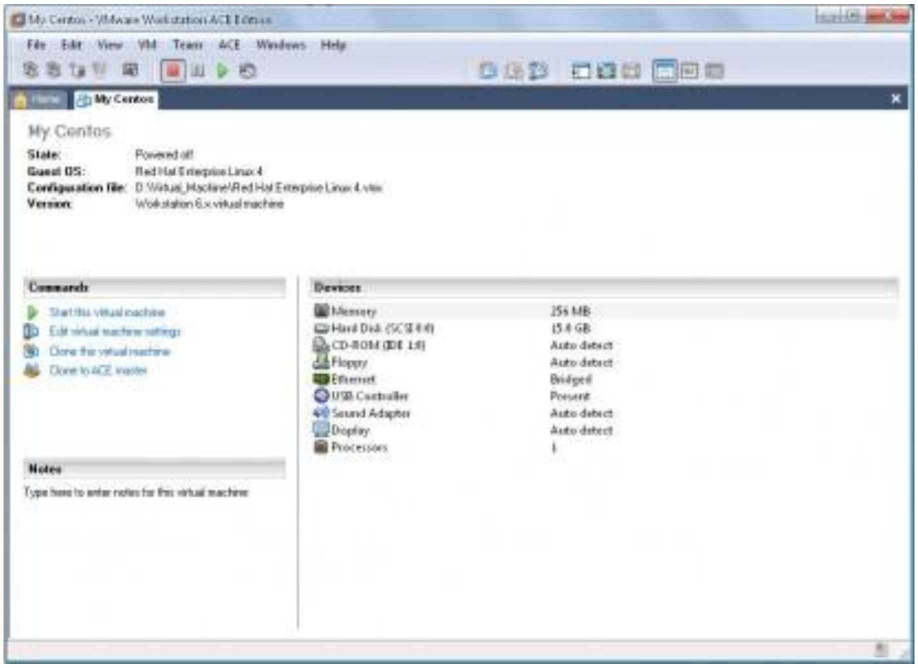
● Use bridged networking
Give the guest operating system direct access to an external Ethernet network. The guest must have its own IP address on the external network.

○ Use network address translation (NAT)
Give the guest operating system access to the host computer's dial-up or external Ethernet network connection using the host's IP address.

○ Use host-only networking
Connect the guest operating system to a private virtual network on the host computer.

○ Do not use a network connection

Then you've to define size of hard disk by entering its size. I'll give 15 GB hard disk space and please check **Allocate all disk space now** option


My Centos - VMware Workstation ACE Edition
File
Edit
View
VM
Team
ACE
Windows
Help
Home
My Centos
Commands
Start this virtual machine
Edit virtual machine settings
Clone this virtual machine
Clone to ACE master

My Centos

**State:** Powered off
**Guest OS:** Red Hat Enterprise Linux 4
**Configuration file:** D:\Virtual_Machine\Red Hat Enterprise Linux 4.vmx
**Version:** Workstation 6.x virtual machine

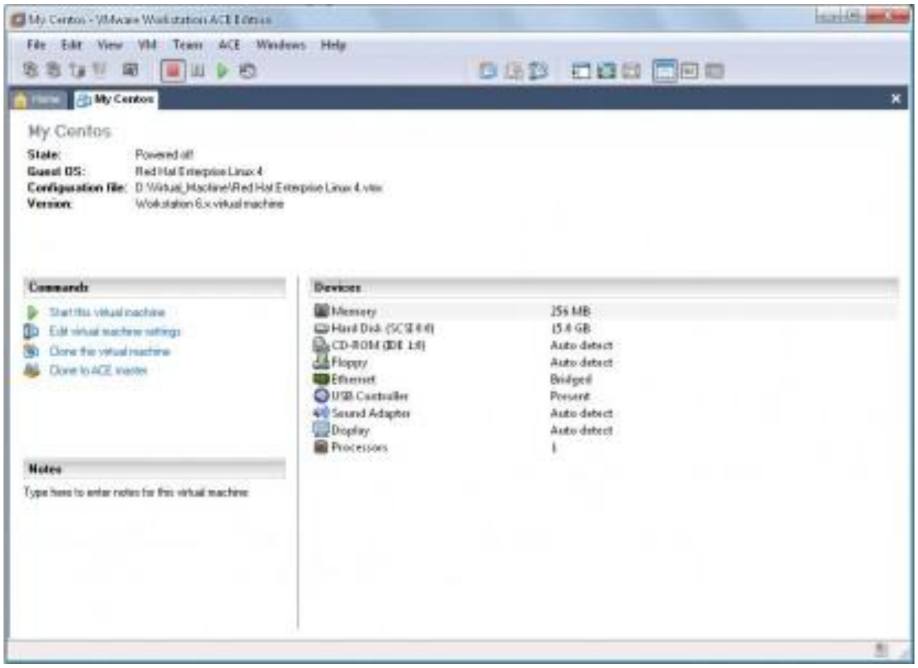
| Devices | |
|---|---|
| Memory | 256 MB |
| Hard Disk (SCSI 0:0) | 15.4 GB |
| CD-ROM (IDE 1:0) | Auto detect |
| Floppy | Auto detect |
| Ethernet | Bridged |
| USB Controller | Present |
| Sound Adapter | Auto detect |
| Display | Auto detect |
| Processors | 1 |

Notes

Type here to enter notes for this virtual machine

Here, you can delete **Sound Adapter, Floppy and USB Controller** by entering "Edit virtual machine settings"**.** If you're going to setup Oracle Server, please make sure you've increased your Memory (RAM) to 1GB.

## 1.4 INPUT/OUTPUT



My Centos

| | |
|---|---|
| **State:** | Powered off |
| **Guest OS:** | Red Hat Enterprise Linux 4 |
| **Configuration file:** | D:\Virtual_Machine\Red Hat Enterprise Linux 4.vmx |
| **Version:** | Workstation 6.x virtual machine |

**Commands**

- Start this virtual machine
- Edit virtual machine settings
- Clone this virtual machine
- Clone to ACE master

**Devices**

| | |
|---|---|
| Memory | 256 MB |
| Hard Disk (SCSI 0:0) | 15.4 GB |
| CD-ROM (IDE 1:0) | Auto detect |
| Floppy | Auto detect |
| Ethernet | Bridged |
| USB Controller | Present |
| Sound Adapter | Auto detect |
| Display | Auto detect |
| Processors | 1 |

**Notes**

Type here to enter notes for this virtual machine

## 1.5 PRE LAB VIVA QUESTIONS:

1. What is VMWare stack?
2. List out various data formats?
3. List out the characteristics of big data?

## 1.6 LAB ASSIGNMENT:

1. Install Pig?
2. Install Hive?

## 1.7 POST LAB VIVA QUESTIONS:

1. List out various terminologies in Big Data environments?
2. Define big data analytics?

## WEEK - 2

## HADOOP MODES

### 2.1 OBJECTIVE:

1) Perform setting up and Installing Hadoop in its three operating modes.
   Standalone.
   Pseudo distributed
   Fully distributed.

2) Use web based tools to monitor your Hadoop setup.

### 2.2 RESOURCES:

VMWare stack, 4 GB RAM, Hard Disk 80 GB.

### 2.3 PROGRAM LOGIC:

**a) STANDALONE MODE:**

- ➢ Installation of jdk 7

**Command:** sudo apt-get install openjdk-7-jdk

- ➢ Download and extract Hadoop

**Command:** wget http://archive.apache.org/dist/hadoop/core/hadoop-1.2.0/hadoop-1.2.0.tar.gz
**Command:** tar -xvf hadoop-1.2.0.tar.gz
**Command:** sudo mv hadoop-1.2.0 /usr/lib/hadoop

- ➢ Set the path for java and hadoop

**Command:** sudo gedit $HOME/.bashrc

```
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-i386
export PATH=$PATH:$JAVA_HOME/bin
export HADOOP_COMMON_HOME=/usr/lib/hadoop
export HADOOP_MAPRED_HOME=/usr/lib/hadoop
export PATH=$PATH:$HADOOP_COMMON_HOME/bin
export PATH=$PATH:$HADOOP_COMMON_HOME/Sbin
```

- ➢ Checking of java and hadoop

**Command:** java -version
**Command:** hadoop version

**b) PSEUDO MODE:**

Hadoop single node cluster runs on single machine. The namenodes and datanodes are performing on the one machine. The installation and configuration steps as given below:

- ➢ Installation of secured shell

**Command:** sudo apt-get install openssh-server

- Create a ssh key for passwordless ssh configuration

**Command:** ssh-keygen -t rsa –P ""

- Moving the key to authorized key

**Command:** cat $HOME/.ssh/id_rsa.pub >> $HOME/.ssh/authorized_keys

/**************RESTART THE COMPUTER********************/

- Checking of secured shell login

**Command:** ssh localhost

- Add JAVA_HOME directory in hadoop-env.sh file

**Command:** sudo gedit /usr/lib/hadoop/conf/hadoop-env.sh

```
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-i386
```

- Creating namenode and datanode directories for hadoop

**Command:** sudo mkdir -p /usr/lib/hadoop/dfs/namenode

**Command:** sudo mkdir -p /usr/lib/hadoop/dfs/datanode

- Configure core-site.xml

**Command:** sudo gedit /usr/lib/hadoop/conf/core-site.xml

```
<property>
<name>fs.default.name</name>
<value>hdfs://localhost:8020</value>
</property>
```

- Configure hdfs-site.xml

**Command:** sudo gedit /usr/lib/hadoop/conf/hdfs-site.xml

```
<property>
<name>dfs.replication</name>
<value>1</value>
</property>
<property>
<name>dfs.permissions</name>
<value>false</value>
</property>
<property>
<name>dfs.name.dir</name>
<value>/usr/lib/hadoop/dfs/namenode</value>
</property>
<property>
<name>dfs.data.dir</name>
<value>/usr/lib/hadoop/dfs/datanode</value>
</property>
```

- Configure mapred-site.xml

**Command:** sudo gedit /usr/lib/hadoop/conf/mapred-site.xml

```
<property>
<name>mapred.job.tracker</name>
```

<value>localhost:8021</value>
</property>

- Format the name node

**Command:** hadoop namenode -format

- Start the namenode, datanode

**Command:** start-dfs.sh

- Start the task tracker and job tracker

**Command:** start-mapred.sh

- To check if Hadoop started correctly

**Command:** jps

```
namenode
secondarynamenode
datanode
jobtracker
tasktracker
```

**c) FULLY DISTRIBUTED MODE:**

All the demons like namenodes and datanodes are runs on different machines. The data will replicate according to the replication factor in client machines. The secondary namenode will store the mirror images of namenode periodically. The namenode having the metadata where the blocks are stored and number of replicas in the client machines. The slaves and master communicate each other periodically. The configurations of multinode cluster are given below:

- Configure the hosts in all nodes/machines

**Command:** sudo gedit /etc/hosts/

```
192.168.1.58 pcetcse1
192.168.1.4 pcetcse2
192.168.1.5 pcetcse3
192.168.1.7 pcetcse4
192.168.1.8 pcetcse5
```

- Passwordless Ssh Configuration

Create ssh key on namenode/master.

**Command:** ssh-keygen -t rsa -p “”

Copy the generated public key all datanodes/slaves.

**Command:** ssh-copy-id -i ~/.ssh/id_rsa.pub huser@pcetcse2
**Command:** ssh-copy-id -i ~/.ssh/id_rsa.pub huser@pcetcse3
**Command:** ssh-copy-id -i ~/.ssh/id_rsa.pub huser@pcetcse4
**Command:** ssh-copy-id -i ~/.ssh/id_rsa.pub huser@pcetcse5

/**************RESTART ALL NODES/COMPUTERS/MACHINES ************/

**NOTE**: Verify the passwordless ssh environment from namenode to all datanodes as “huser” user.

- Login to master node

**Command:** ssh pcetcse1
**Command:** ssh pcetcse2
**Command:** ssh pcetcse3
**Command:** ssh pcetcse4
**Command:** ssh pcetcse5

- Add JAVA_HOME directory in hadoop-env.sh file in all nodes/machines

**Command:** sudo gedit /usr/lib/hadoop/conf/hadoop-env.sh
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-i386

- Creating namenode directory in namenode/master

**Command:** sudo mkdir -p /usr/lib/hadoop/dfs/namenode

- Creating namenode directory in datanonodes/slaves

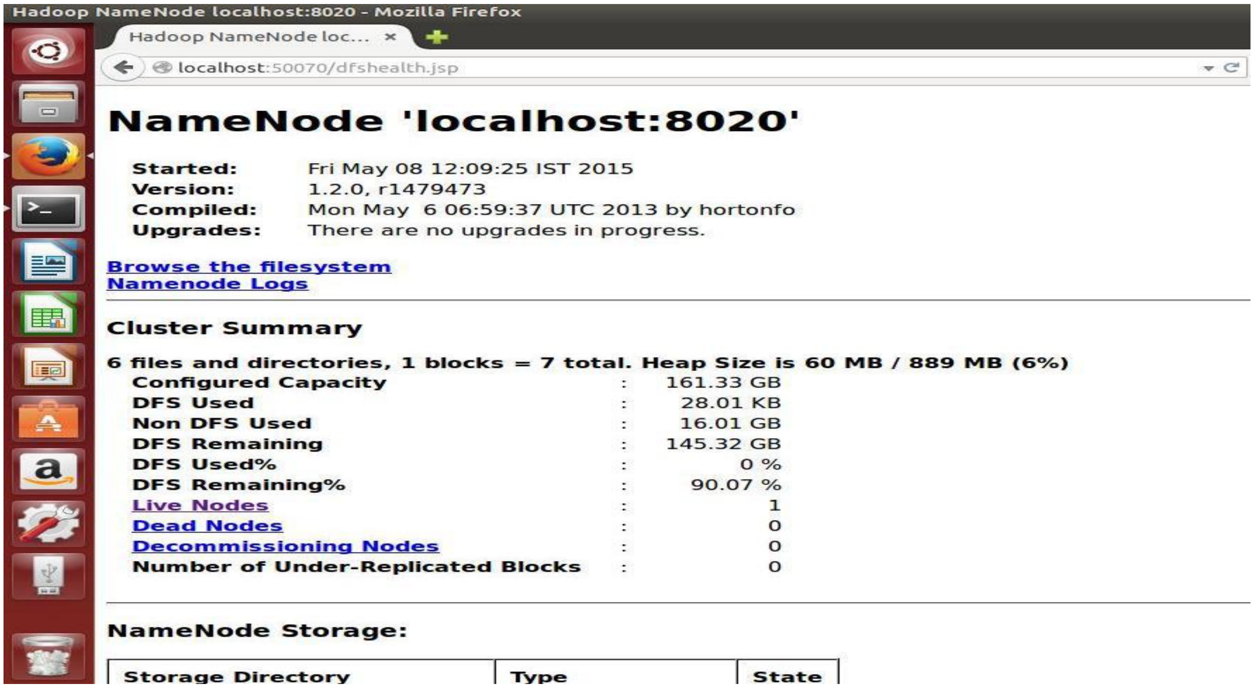
**Command:** sudo mkdir -p /usr/lib/hadoop/dfs/datanode Close HTML tag.

Use web based tools to monitor your Hadoop setup.

HDFS Namenode on UI
http://locahost:50070/

**2.4 INPUT/OUTPUT:**
ubuntu @localhost> jps

```
    Data node, name nodem
    Secondary name node, NodeManager, Resource Manager
```


Hadoop NameNode localhost:8020 - Mozilla Firefox
Hadoop NameNode loc...
localhost:50070/dfshealth.jsp

NameNode 'localhost:8020'

| | |
|---|---|
| **Started:** | Fri May 08 12:09:25 IST 2015 |
| **Version:** | 1.2.0, r1479473 |
| **Compiled:** | Mon May 6 06:59:37 UTC 2013 by hortonfo |
| **Upgrades:** | There are no upgrades in progress. |

Browse the filesystem
Namenode Logs

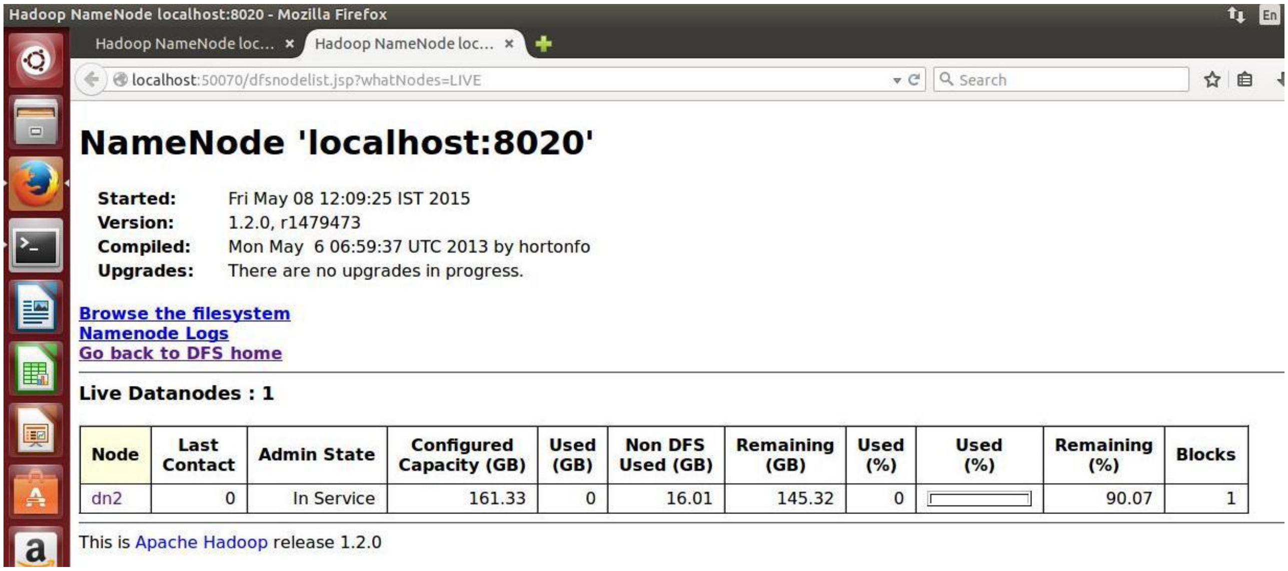
**Cluster Summary**

**6 files and directories, 1 blocks = 7 total. Heap Size is 60 MB / 889 MB (6%)**

| | | |
|---|---|---|
| **Configured Capacity** | : | 161.33 GB |
| **DFS Used** | : | 28.01 KB |
| **Non DFS Used** | : | 16.01 GB |
| **DFS Remaining** | : | 145.32 GB |
| **DFS Used%** | : | 0 % |
| **DFS Remaining%** | : | 90.07 % |
| **Live Nodes** | : | 1 |
| **Dead Nodes** | : | 0 |
| **Decommissioning Nodes** | : | 0 |
| **Number of Under-Replicated Blocks** | : | 0 |

**NameNode Storage:**

| Storage Directory | Type | State |
|---|---|---|


Hadoop NameNode localhost:8020 - Mozilla Firefox
En
Hadoop NameNode loc...
Hadoop NameNode loc...
localhost:50070/dfsnodelist.jsp?whatNodes=LIVE
Search

NameNode 'localhost:8020'

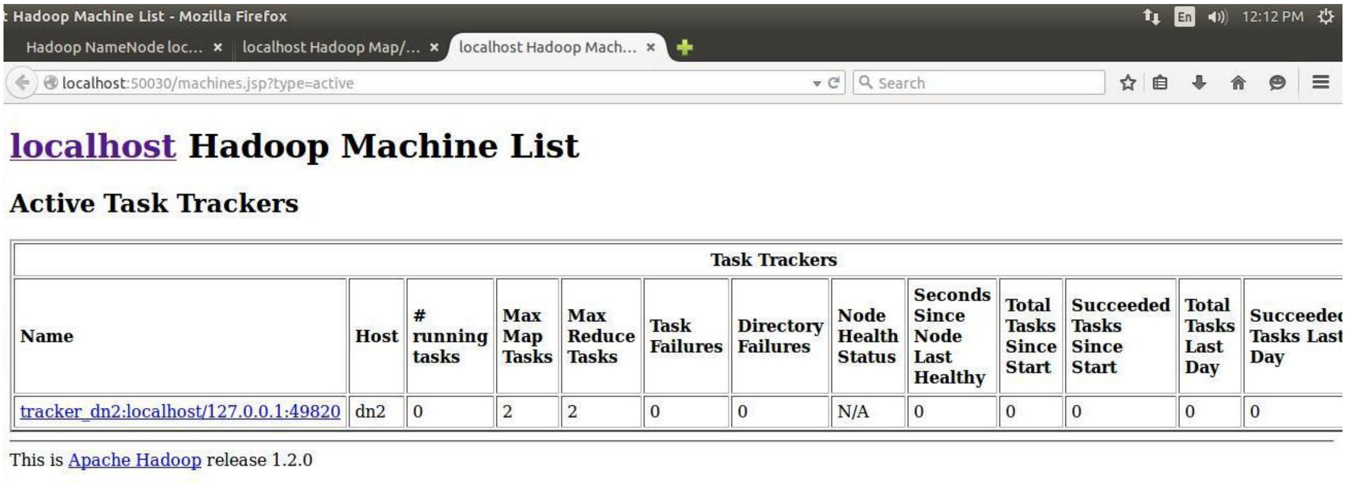
| | |
|---|---|
| **Started:** | Fri May 08 12:09:25 IST 2015 |
| **Version:** | 1.2.0, r1479473 |
| **Compiled:** | Mon May 6 06:59:37 UTC 2013 by hortonfo |
| **Upgrades:** | There are no upgrades in progress. |

Browse the filesystem
Namenode Logs
Go back to DFS home

**Live Datanodes : 1**

| Node | Last Contact | Admin State | Configured Capacity (GB) | Used (GB) | Non DFS Used (GB) | Remaining (GB) | Used (%) | Used (%) | Remaining (%) | Blocks |
|---|---|---|---|---|---|---|---|---|---|---|
| dn2 | 0 | In Service | 161.33 | 0 | 16.01 | 145.32 | 0 | | 90.07 | 1 |

This is Apache Hadoop release 1.2.0



# localhost Hadoop Machine List

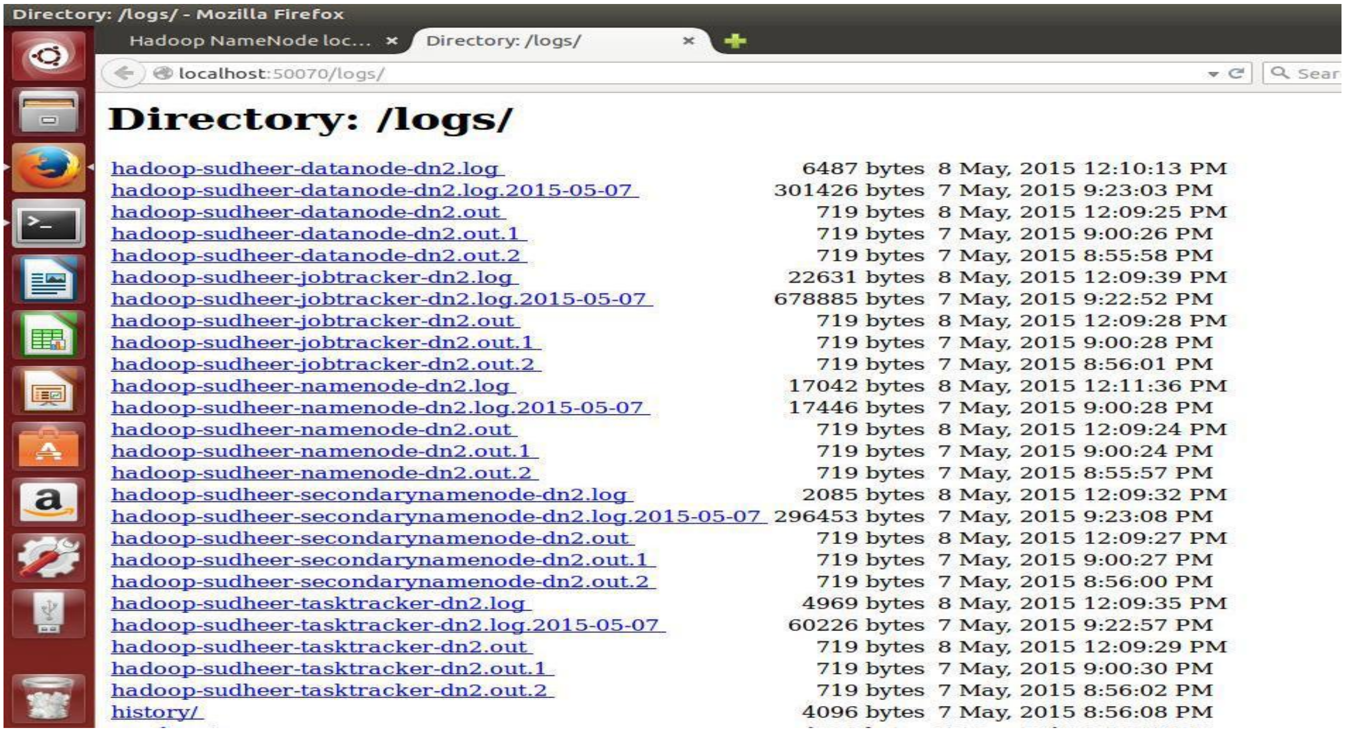
## Active Task Trackers

| Task Trackers | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Host | # running tasks | Max Map Tasks | Max Reduce Tasks | Task Failures | Directory Failures | Node Health Status | Seconds Since Node Last Healthy | Total Tasks Since Start | Succeeded Tasks Since Start | Total Tasks Last Day | Succeedec Tasks Last Day |
| tracker_dn2:localhost/127.0.0.1:49820 | dn2 | 0 | 2 | 2 | 0 | 0 | N/A | 0 | 0 | 0 | 0 | 0 |

This is Apache Hadoop release 1.2.0

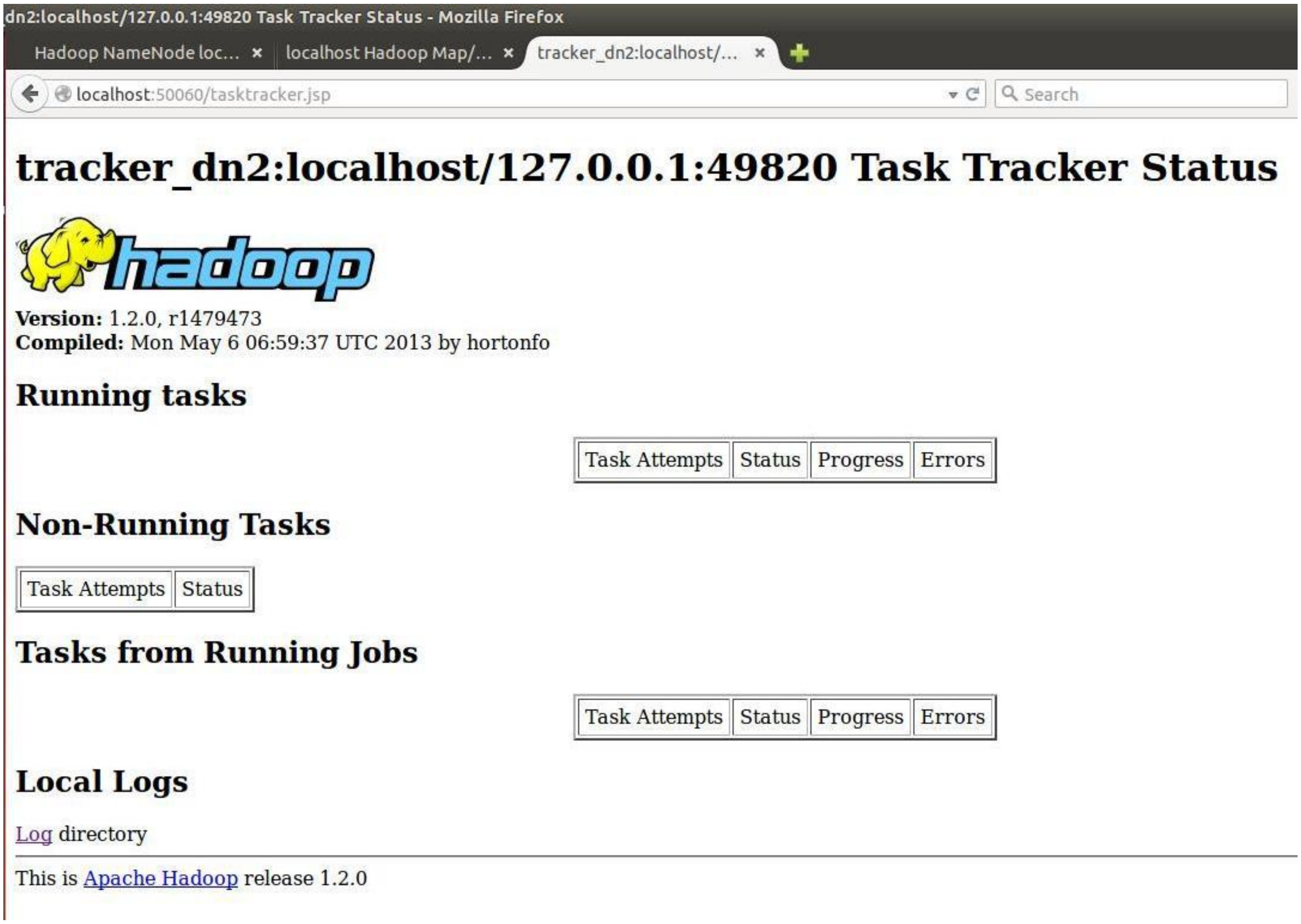
HDFS Jobtracker
http://locahost:50030/

HDFS Logs
http://locahost:50070/logs/



# Directory: /logs/

```
hadoop-sudheer-datanode-dn2.log                             6487 bytes  8 May, 2015 12:10:13 PM
hadoop-sudheer-datanode-dn2.log.2015-05-07                301426 bytes  7 May, 2015 9:23:03 PM
hadoop-sudheer-datanode-dn2.out                              719 bytes  8 May, 2015 12:09:25 PM
hadoop-sudheer-datanode-dn2.out.1                            719 bytes  7 May, 2015 9:00:26 PM
hadoop-sudheer-datanode-dn2.out.2                            719 bytes  7 May, 2015 8:55:58 PM
hadoop-sudheer-jobtracker-dn2.log                          22631 bytes  8 May, 2015 12:09:39 PM
hadoop-sudheer-jobtracker-dn2.log.2015-05-07              678885 bytes  7 May, 2015 9:22:52 PM
hadoop-sudheer-jobtracker-dn2.out                            719 bytes  8 May, 2015 12:09:28 PM
hadoop-sudheer-jobtracker-dn2.out.1                          719 bytes  7 May, 2015 9:00:28 PM
hadoop-sudheer-jobtracker-dn2.out.2                          719 bytes  7 May, 2015 8:56:01 PM
hadoop-sudheer-namenode-dn2.log                            17042 bytes  8 May, 2015 12:11:36 PM
hadoop-sudheer-namenode-dn2.log.2015-05-07                 17446 bytes  7 May, 2015 9:00:28 PM
hadoop-sudheer-namenode-dn2.out                              719 bytes  8 May, 2015 12:09:24 PM
hadoop-sudheer-namenode-dn2.out.1                            719 bytes  7 May, 2015 9:00:24 PM
hadoop-sudheer-namenode-dn2.out.2                            719 bytes  7 May, 2015 8:55:57 PM
hadoop-sudheer-secondarynamenode-dn2.log                    2085 bytes  8 May, 2015 12:09:32 PM
hadoop-sudheer-secondarynamenode-dn2.log.2015-05-07 296453 bytes  7 May, 2015 9:23:08 PM
hadoop-sudheer-secondarynamenode-dn2.out                     719 bytes  8 May, 2015 12:09:27 PM
hadoop-sudheer-secondarynamenode-dn2.out.1                   719 bytes  7 May, 2015 9:00:27 PM
hadoop-sudheer-secondarynamenode-dn2.out.2                   719 bytes  7 May, 2015 8:56:00 PM
hadoop-sudheer-tasktracker-dn2.log                          4969 bytes  8 May, 2015 12:09:35 PM
hadoop-sudheer-tasktracker-dn2.log.2015-05-07              60226 bytes  7 May, 2015 9:22:57 PM
hadoop-sudheer-tasktracker-dn2.out                           719 bytes  8 May, 2015 12:09:29 PM
hadoop-sudheer-tasktracker-dn2.out.1                         719 bytes  7 May, 2015 9:00:30 PM
hadoop-sudheer-tasktracker-dn2.out.2                         719 bytes  7 May, 2015 8:56:02 PM
history/                                                    4096 bytes  7 May, 2015 8:56:08 PM
```



dn2:localhost/127.0.0.1:49820 Task Tracker Status - Mozilla Firefox
Hadoop NameNode loc...
localhost Hadoop Map/...
tracker_dn2:localhost/...
localhost:50060/tasktracker.jsp
Search

# tracker_dn2:localhost/127.0.0.1:49820 Task Tracker Status

**Version:** 1.2.0, r1479473
**Compiled:** Mon May 6 06:59:37 UTC 2013 by hortonfo

## Running tasks

| Task Attempts | Status | Progress | Errors |
|---|---|---|---|

## Non-Running Tasks

| Task Attempts | Status |
|---|---|

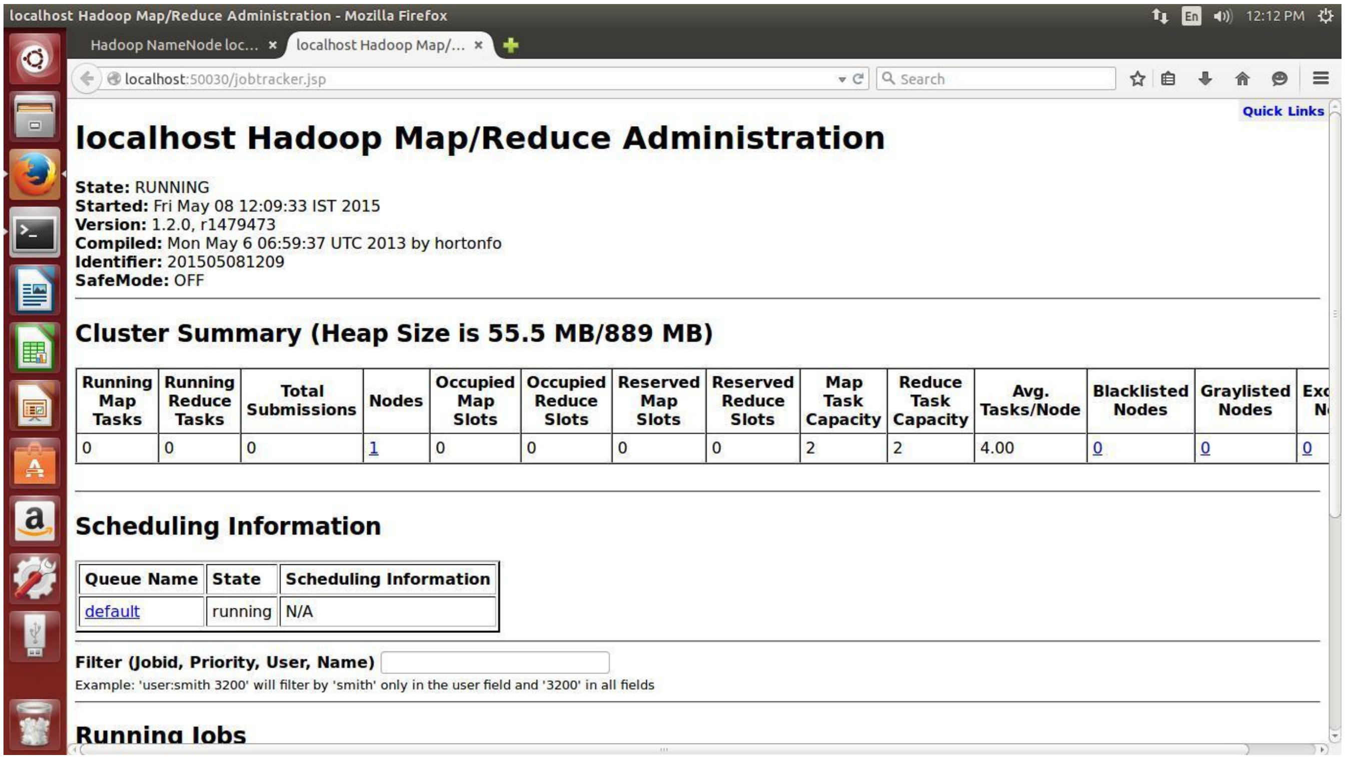
## Tasks from Running Jobs

| Task Attempts | Status | Progress | Errors |
|---|---|---|---|

## Local Logs

Log directory

This is Apache Hadoop release 1.2.0


localhost Hadoop Map/Reduce Administration - Mozilla Firefox
12:12 PM
Hadoop NameNode loc...
localhost Hadoop Map/...
localhost:50030/jobtracker.jsp
Search
Quick Links

# localhost Hadoop Map/Reduce Administration

**State:** RUNNING
**Started:** Fri May 08 12:09:33 IST 2015
**Version:** 1.2.0, r1479473
**Compiled:** Mon May 6 06:59:37 UTC 2013 by hortonfo
**Identifier:** 201505081209
**SafeMode:** OFF

## Cluster Summary (Heap Size is 55.5 MB/889 MB)

| Running Map Tasks | Running Reduce Tasks | Total Submissions | Nodes | Occupied Map Slots | Occupied Reduce Slots | Reserved Map Slots | Reserved Reduce Slots | Map Task Capacity | Reduce Task Capacity | Avg. Tasks/Node | Blacklisted Nodes | Graylisted Nodes | Exc N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 4.00 | 0 | 0 | 0 |

## Scheduling Information

| Queue Name | State | Scheduling Information |
|---|---|---|
| default | running | N/A |

**Filter (Jobid, Priority, User, Name)**

Example: 'user:smith 3200' will filter by 'smith' only in the user field and '3200' in all fields

## Running Jobs

## 2.5 PRE LAB VIVA QUESTIONS:

1. What does _jps‘ command do?
2. How to restart Namenode?
3. Differentiate between Structured and Unstructured data?

## 2.6 LAB ASSIGNMENT:

1 How to configure the daemons in the browser.

## 2.7 POST LAB VIVA QUESTIONS:

1. What are the main components of a Hadoop Application?
2. Explain the difference between NameNode, Backup Node and Checkpoint NameNode.

## WEEK- 3

## USING LINUX OPERATING SYSTEM

### 3.1 OBJECTIVE:

1. Implementing the basic commands of LINUX Operating System – File/Directory creation, deletion, update operations.

### 3.2 RESOURCES:

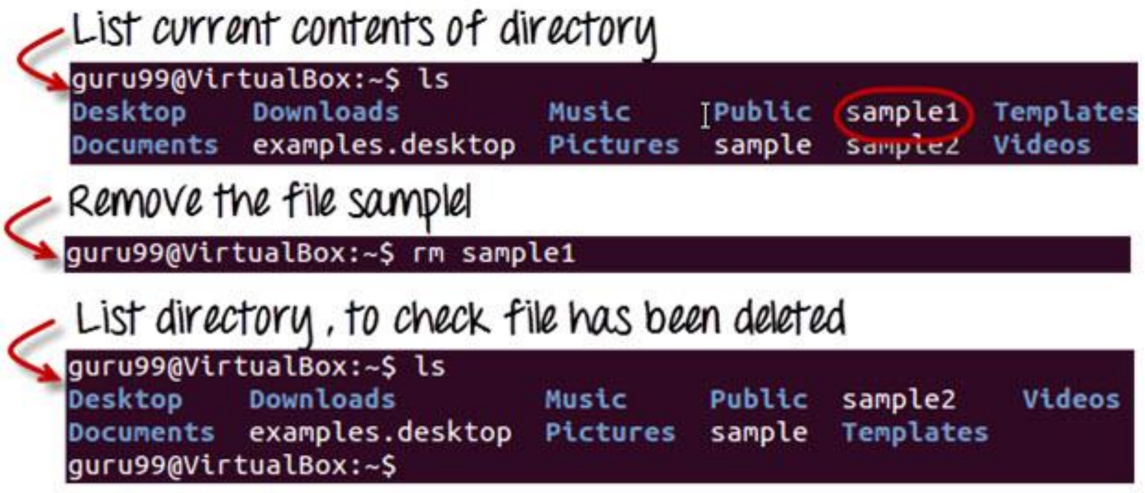
VMWare stack, 4 GB RAM, Hard Disk 80 GB.

### 3.3 PROGRAM LOGIC:

1. cat > filename
2. Add content
3. Press 'ctrl + d' to return to command prompt.

To remove a file use syntax - rm filename

### 1.4 INPUT/OUTPUT:



List current contents of directory

```
guru99@VirtualBox:~$ ls
Desktop     Downloads         Music     Public   sample1  Templates
Documents   examples.desktop  Pictures  sample   sample2  Videos
```

Remove the file sample1

```
guru99@VirtualBox:~$ rm sample1
```

List directory , to check file has been deleted

```
guru99@VirtualBox:~$ ls
Desktop     Downloads         Music     Public   sample2    Videos
Documents   examples.desktop  Pictures  sample   Templates
guru99@VirtualBox:~$
```

### 3.5 PRE-LAB VIVA QUESTIONS:

1. What is ls command?
2. What are the attributes of ls command?

### 3.6 LAB ASSIGNMENT:

1 Write a linux commands for Sed operations?

2 Write the linux commands for renaming a file?

### 3.7 POST-LAB VIVA QUESTIONS:

1. What is the purpose of rm command?
2. What is the difference between Linux and windows commands?

## WEEK-4

## FILE MANAGEMENT IN HADOOP

### 4.1 OBJECTIVE:

Implement the following file management tasks in Hadoop:

i. Adding files and directories
ii. Retrieving files
iii. Deleting files

Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

### 4.2 RESOURCES:

VMWare stack, 4 GB RAM, Hard Disk 80 GB.

### 4.3 PROGRAM LOGIC:

**Adding Files and Directories to HDFS**

Before you can run Hadoop programs on data stored in HDFS, you‘ll need to put the data into HDFS first. Let‘s create a directory and put a file in it. HDFS has a default working directory of /user/$USER, where $USER is your login user name. This directory isn‘t automatically created for you, though, so let‘s create it with the mkdir command. For the purpose of illustration, we use chuck. You should substitute your user name in the example commands.

```
hadoop fs -mkdir /user/chuck
```

```
hadoop fs -put
```

```
hadoop fs -put example.txt /user/chuck
```

**Retrieving Files from HDFS**

The Hadoop command get copies files from HDFS back to the local filesystem. To retrieve example.txt, we can run the following command:

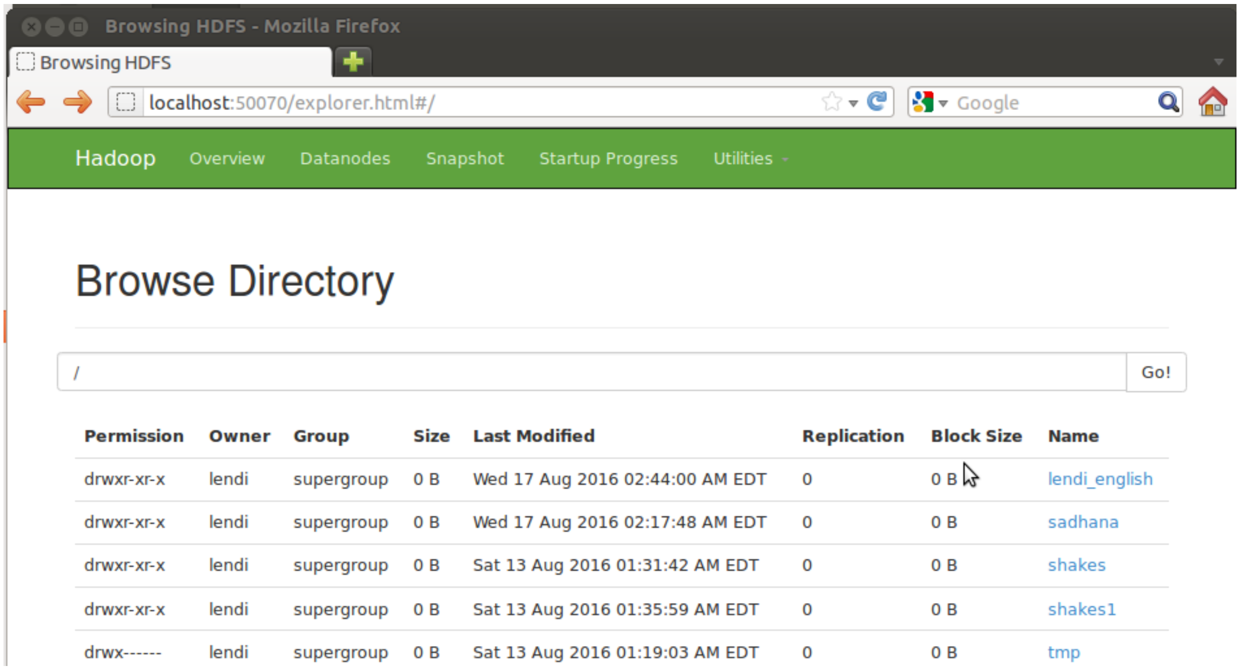
```
hadoop fs -cat example.txt
```

**Deleting files from HDFS**

```
hadoop fs -rm example.txt
```

- Command for creating a directory in hdfs is “hdfs dfs –mkdir /lendicse”.
- Adding directory is done through the command “hdfs dfs –put lendi_english /”.

## 4.4 INPUT/OUTPUT:



Browse Directory

/

| Permission | Owner | Group | Size | Last Modified | Replication | Block Size | Name |
|---|---|---|---|---|---|---|---|
| drwxr-xr-x | lendi | supergroup | 0 B | Wed 17 Aug 2016 02:44:00 AM EDT | 0 | 0 B | lendi_english |
| drwxr-xr-x | lendi | supergroup | 0 B | Wed 17 Aug 2016 02:17:48 AM EDT | 0 | 0 B | sadhana |
| drwxr-xr-x | lendi | supergroup | 0 B | Sat 13 Aug 2016 01:31:42 AM EDT | 0 | 0 B | shakes |
| drwxr-xr-x | lendi | supergroup | 0 B | Sat 13 Aug 2016 01:35:59 AM EDT | 0 | 0 B | shakes1 |
| drwx------ | lendi | supergroup | 0 B | Sat 13 Aug 2016 01:19:03 AM EDT | 0 | 0 B | tmp |

## 4.5 PRE LAB VIVA QUESTIONS:

1) Define Hadoop?

2) List out the various use cases of Hadoop?

## 4.6 LAB ASSIGNMENT

1) What is command used to list out directories of Data Node through web tool

## 4.7 POST LAB VIVA QUESTIONS:

1. Distinguish the Hadoop Ecosystem?
2. Demonstrate divide and conquer philosophy in Hadoop Cluster?

## WEEK-5

## MAPREDUCE PROGRAM 1

### 5.1 OBJECTIVE:

Run a basic word count Map Reduce program to understand Map Reduce Paradigm.

### 5.2 RESOURCES:

VMWare stack, 4 GB RAM, Web browser, Hard Disk 80 GB.

### 5.3 PROGRAM LOGIC:

WordCount is a simple program which counts the number of occurrences of each word in a given text input data set. WordCount fits very well with the MapReduce programming model making it a great example to understand the Hadoop Map/Reduce programming style. Our implementation consists of three main parts:

1. Mapper
2. Reducer
3. Driver

Step-1. Write a Mapper

A Mapper overrides the ―map‖ function from the Class "org.apache.hadoop.mapreduce.Mapper" which provides <key, value> pairs as the input. A Mapper implementation may output <key,value> pairs using the provided Context .

Input value of the WordCount Map task will be a line of text from the input data file and the key would be the line number <line_number, line_of_text> . Map task outputs <word, one> for each word in the line of text.

***Pseudo-code***

```
void Map (key, value){
        for each word x in value:
            output.collect(x,1);
}
```

Step-2. Write a Reducer

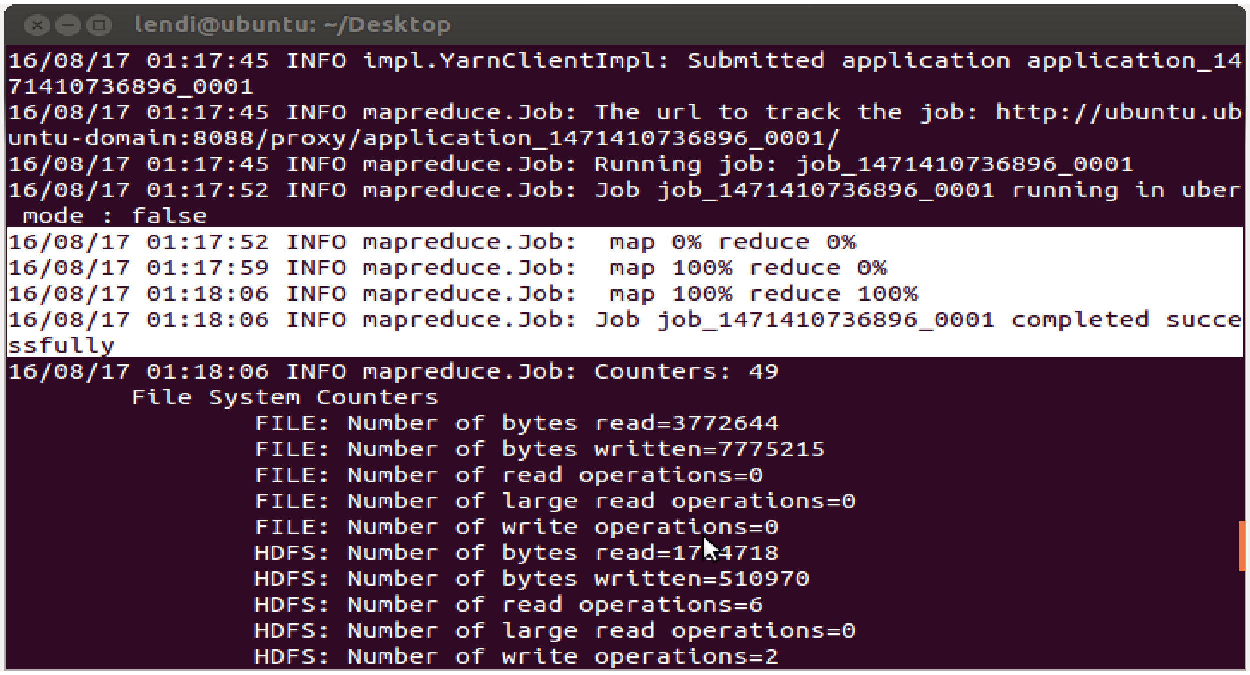
A Reducer collects the intermediate <key,value> output from multiple map tasks and assemble a single result. Here, the WordCount program will sum up the occurrence of each word to pairs as <word, occurrence>.

Pseudo-code

```
void Reduce (keyword, <list of value>){ for
    each x in <list of value>:
        sum+=x;
  final_output.collect(keyword, sum);

}
```

### 5.4 INPUT/OUTPUT:



```
16/08/17 01:17:45 INFO impl.YarnClientImpl: Submitted application application_14
71410736896_0001
16/08/17 01:17:45 INFO mapreduce.Job: The url to track the job: http://ubuntu.ub
untu-domain:8088/proxy/application_1471410736896_0001/
16/08/17 01:17:45 INFO mapreduce.Job: Running job: job_1471410736896_0001
16/08/17 01:17:52 INFO mapreduce.Job: Job job_1471410736896_0001 running in uber
 mode : false
16/08/17 01:17:52 INFO mapreduce.Job:  map 0% reduce 0%
16/08/17 01:17:59 INFO mapreduce.Job:  map 100% reduce 0%
16/08/17 01:18:06 INFO mapreduce.Job:  map 100% reduce 100%
16/08/17 01:18:06 INFO mapreduce.Job: Job job_1471410736896_0001 completed succe
ssfully
16/08/17 01:18:06 INFO mapreduce.Job: Counters: 49
        File System Counters
                FILE: Number of bytes read=3772644
                FILE: Number of bytes written=7775215
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=17[illegible]4718
                HDFS: Number of bytes written=510970
                HDFS: Number of read operations=6
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
```

### 5.5 PRE-LAB VIVA QUESTIONS:

1. Justify how hadoop technology satisfies the business insights now -a –days?
2. Define Filesystem?

## 5.6 LAB ASSIGNMENT:

Run a basic word count Map Reduce program to understand Map Reduce Paradigm.

## 5.7 POST-LAB VIVA QUESTIONS:

1. Define what is block in HDFS?
2. Why is a block in HDFS so large?

# WEEK-6

## MAPREDUCE PROGRAM 2

### 6.1 OBJECTIVE:

Write a Map Reduce program that mines weather data. Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

### 6.2 RESOURCES:

VMWare, Web browser, 4 GB RAM, Hard Disk 80 GB.

### 6.3 PROGRAM LOGIC:

WordCount is a simple program which counts the number of occurrences of each word in a given text input data set. WordCount fits very well with the MapReduce programming model making it a great example to understand the Hadoop Map/Reduce programming style. Our implementation consists of three main parts:

1. Mapper
2. Reducer
3. Main program

**Step-1. Write a Mapper**

A Mapper overrides the ―map function from the Class "org.apache.hadoop.mapreduce.Mapper" which provides <key, value> pairs as the input. A Mapper implementation may output <key,value> pairs using the provided Context .

Input value of the WordCount Map task will be a line of text from the input data file and the key would be the line number <line_number, line_of_text> . Map task outputs <word, one> for each word in the line of text.

**Pseudo-code**

```
void Map (key, value){
for each max_temp x in value:
output.collect(x, 1);
}
void Map (key, value){
    for each min_temp x in value:

output.collect(x, 1);
}
```

### Step-2 Write a Reducer

A Reducer collects the intermediate <key,value> output from multiple map tasks and assemble a single result. Here, the WordCount program will sum up the occurrence of each word to pairs as <word, occurrence>.

**Pseudo-code**

```
void Reduce (max_temp, <list of value>){
    for each x in <list of value>:
        sum+=x;
    final_output.collect(max_temp, sum);
}
void Reduce (min_temp, <list of value>){
    for each x in <list of value>:
        sum+=x;
    final_output.collect(min_temp, sum);
}
```

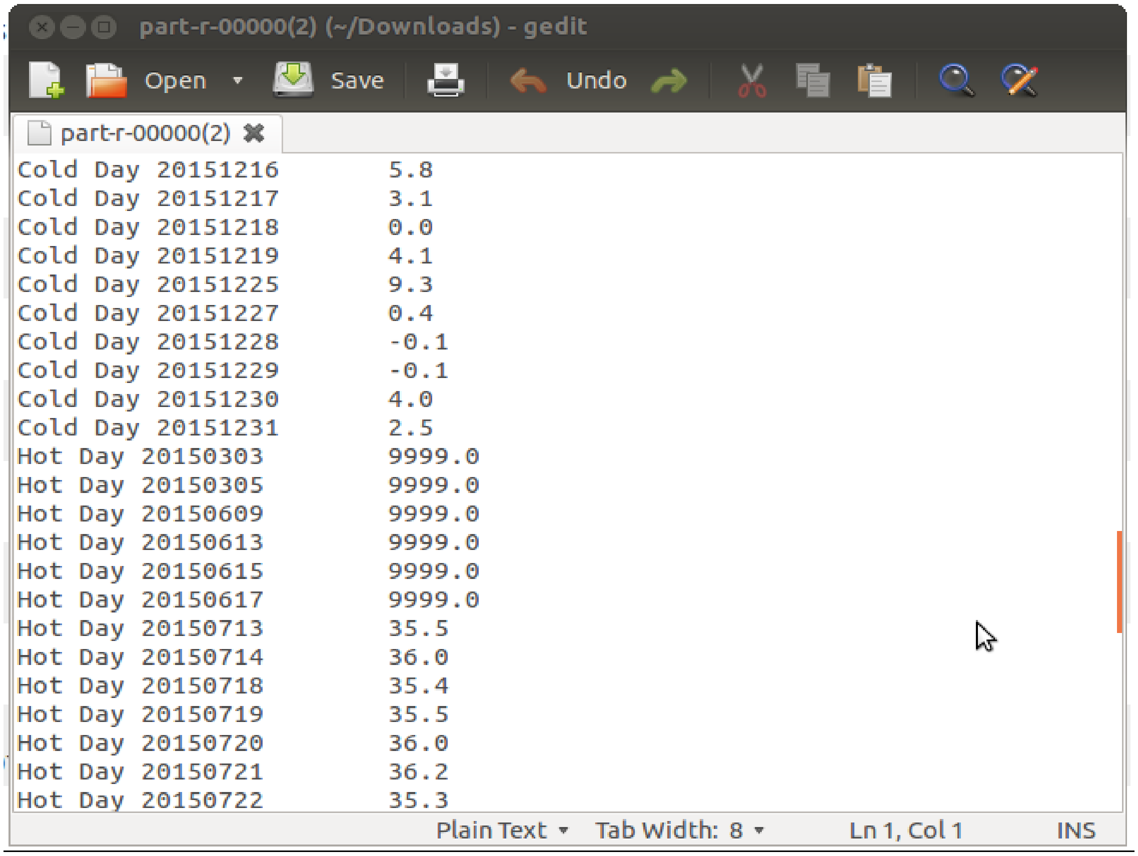
### 3. Write Driver

The Driver program configures and run the MapReduce job. We use the main program to perform basic configurations such as:

Job Name : name of this Job Executable (Jar)
Class: the main executable class. For here, WordCount.
Mapper Class: class which overrides the "map" function. For here, Map.
Reducer: class which override the "reduce" function. For here , Reduce.
Output Key: type of output key. For here, Text.Output
Value: type of output value. For here, IntWritable.
File Input Path
File Output Path

### 6.4 INPUT/OUTPUT:

Set of Weather Data over the years



```
Cold Day 20151216	5.8
Cold Day 20151217	3.1
Cold Day 20151218	0.0
Cold Day 20151219	4.1
Cold Day 20151225	9.3
Cold Day 20151227	0.4
Cold Day 20151228	-0.1
Cold Day 20151229	-0.1
Cold Day 20151230	4.0
Cold Day 20151231	2.5
Hot Day 20150303	9999.0
Hot Day 20150305	9999.0
Hot Day 20150609	9999.0
Hot Day 20150613	9999.0
Hot Day 20150615	9999.0
Hot Day 20150617	9999.0
Hot Day 20150713	35.5
Hot Day 20150714	36.0
Hot Day 20150718	35.4
Hot Day 20150719	35.5
Hot Day 20150720	36.0
Hot Day 20150721	36.2
Hot Day 20150722	35.3
```

### 6.5 PRE-LAB VIVA QUESTIONS:

1) Explain the function of MapReducer partitioner?
2) What is the difference between an Input Split and HDFS Block?
3) What is Sequencefileinputformat?

### 6.6 LAB ASSIGNMENT:

1. Using Map Reduce job to Identify language by merging multi language dictionary files into a single dictionary file.
2. Join multiple datasets using a MapReduce Job.

### 6.7 POST-LAB VIVA QUESTIONS:

1) In Hadoop what is InputSplit?
2) Explain what is a sequence file in Hadoop?

# WEEK-7

## MAPREDUCE PROGRAM 3

### 7.1 OBJECTIVE:

Implement matrix multiplication with Hadoop Map Reduce.

### 7.2 RESOURCES:

VMWare, Web browser, 4 GB RAM, Hard Disk 80 GB.

### 7.3 PROGRAM LOGIC:

We assume that the input files for A and B are streams of (key,value) pairs in sparse matrix format, where each key is a pair of indices (i,j) and each value is the corresponding matrix element value. The output files for matrix C=A*B are in the same format.

**We have the following input parameters:**

The path of the input file or directory for matrix A.
The path of the input file or directory for matrix B.

The path of the directory for the output files for matrix C.
strategy = 1, 2, 3 or 4.
R = the number of reducers.
I = the number of rows in A and C.
K = the number of columns in A and rows in B.
J = the number of columns in B and C.
IB = the number of rows per A block and C block.
KB = the number of columns per A block and rows per B block.
JB = the number of columns per B block and C block.

In the pseudo-code for the individual strategies below, we have intentionally avoided factoring common code for the purposes of clarity. Note that in all the strategies the memory footprint of both the mappers and the reducers is flat at scale.

Note that the strategies all work reasonably well with both dense and sparse matrices. For sparse matrices we do not emit zero elements. That said, the simple pseudo-code for multiplying the individual blocks shown here is certainly not optimal for sparse matrices. As a learning exercise, our focus here is on mastering the MapReduce complexities, not on optimizing the sequential matrix multipliation algorithm for the individual blocks.

**Steps**

```
1. setup ()
2. var NIB = (I-1)/IB+1
3. var NKB = (K-1)/KB+1
4. var NJB = (J-1)/JB+1
5. map (key, value)
```

6. if from matrix A with key=(i,k) and value=a(i,k)
7. for 0 <= jb < NJB
8. emit (i/IB, k/KB, jb, 0), (i mod IB, k mod KB, a(i,k))
9. if from matrix B with key=(k,j) and value=b(k,j)
10. for 0 <= ib < NIB
emit (ib, k/KB, j/JB, 1), (k mod KB, j mod JB, b(k,j))
Intermediate keys (ib, kb, jb, m) sort in increasing order first by ib, then by kb, then by jb, then by m. Note that m = 0 for A data and m = 1 for B data.

**The partitioner maps intermediate key (ib, kb, jb, m) to a reducer r as follows:**

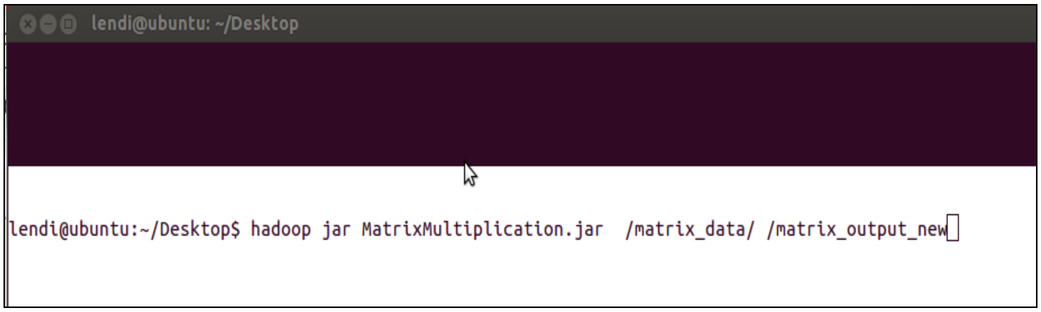
11. r = ((ib*JB + jb)*KB + kb) mod R
12. These definitions for the sorting order and partitioner guarantee that each reducer R[ib,kb,jb] receives the data it needs for blocks A[ib,kb] and B[kb,jb], with the data for the A block immediately preceding the data for the B block.
13. var A = new matrix of dimension IBxKB
14. var B = new matrix of dimension KBxJB
15. var sib = -1
16. var skb = -1

**Reduce (key, valueList)**

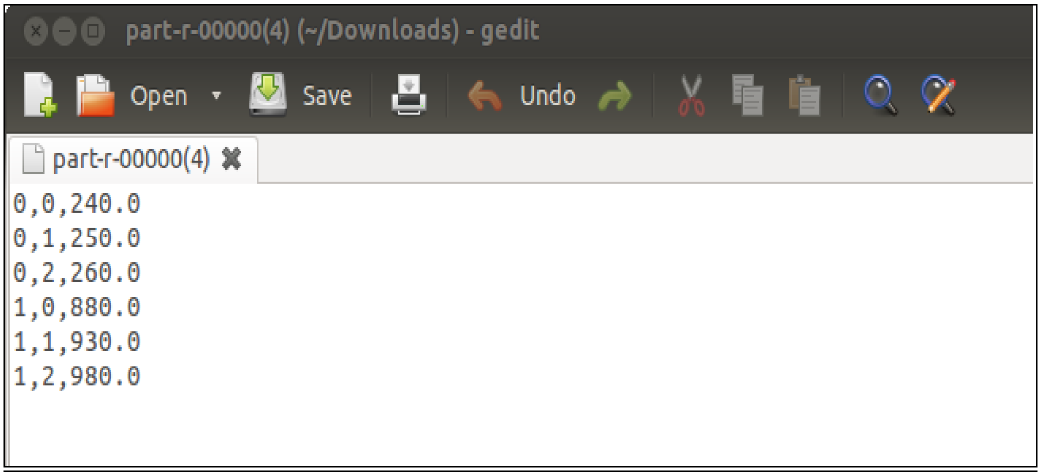
17. if key is (ib, kb, jb, 0)
18. // Save the A block.
19. sib = ib
20. skb = kb
21. Zero matrix A
22. for each value = (i, k, v) in valueList A(i,k) = v
23. if key is (ib, kb, jb, 1)
24. if ib != sib or kb != skb return // A[ib,kb] must be zero!
25. // Build the B block.
26. Zero matrix B
27. for each value = (k, j, v) in valueList B(k,j) = v
28. // Multiply the blocks and emit the result.
29. ibase = ib*IB
30. jbase = jb*JB
31. for 0 <= i < row dimension of A
32. for 0 <= j < column dimension of B
33. sum = 0
34. for 0 <= k < column dimension of A = row dimension of B
a. sum += A(i,k)*B(k,j)
35. if sum != 0 emit (ibase+i, jbase+j), sum

Set of Data sets over different Clusters are taken as Rows and Columns

## 7.4 INPUT/OUTPUT:



```
lendi@ubuntu:~/Desktop$ hadoop jar MatrixMultiplication.jar  /matrix_data/ /matrix_output_new
```



```
0,0,240.0
0,1,250.0
0,2,260.0
1,0,880.0
1,1,930.0
1,2,980.0
```

## 7.5 PRE-LAB VIVA QUESTIONS:

1. Explain what is “map” and what is “reducer” in Hadoop?
2. Mention what daemons run on a master node and slave nodes?
3. Mention what is the use of Context Object?

## 7.6 LAB ASSIGNMENT:

1. Implement matrix addition with Hadoop Map Reduce.

## 7.7 POST-LAB VIVA QUESTIONS:

1. What is partitioner in Hadoop?
2. Explain of RecordReader in Hadoop?

## WEEK-8

## PIG LATIN LANGUAGE - PIG

### 8.1 OBJECTIVE:

1. Installation of PIG.

### 8.2 RESOURCES:

VMWare, Web browser, 4 GB RAM, Hard Disk 80 GB.

### 8.3 PROGRAM LOGIC:

**STEPS FOR INSTALLING APACHE PIG**

1) Extract the pig-0.15.0.tar.gz and move to home directory

2) Set the environment of PIG in bashrc file.

3) Pig can run in two modes

Local Mode and Hadoop Mode

Pig –x local and pig

4) Grunt Shell

Grunt >

5) LOADING Data into Grunt Shell

DATA = LOAD <CLASSPATH> USING PigStorage(DELIMITER) as (ATTRIBUTE : DataType1, ATTRIBUTE : DataType2…..)

6) Describe Data

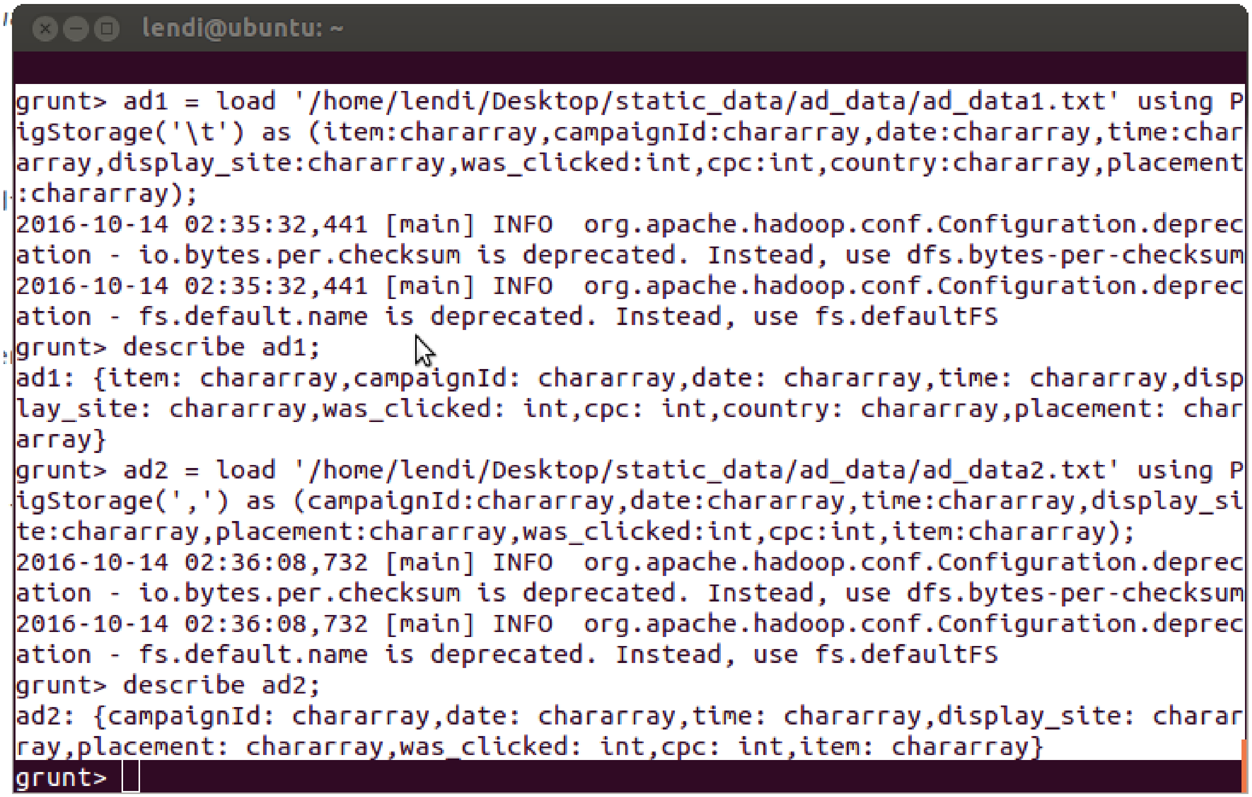
Describe DATA;

7) DUMP Data

Dump DATA;

### 8.4 INPUT/OUTPUT:

Input as Website Click Count Data



```
grunt> ad1 = load '/home/lendi/Desktop/static_data/ad_data/ad_data1.txt' using P
igStorage('\t') as (item:chararray,campaignId:chararray,date:chararray,time:char
array,display_site:chararray,was_clicked:int,cpc:int,country:chararray,placement
:chararray);
2016-10-14 02:35:32,441 [main] INFO  org.apache.hadoop.conf.Configuration.deprec
ation - io.bytes.per.checksum is deprecated. Instead, use dfs.bytes-per-checksum
2016-10-14 02:35:32,441 [main] INFO  org.apache.hadoop.conf.Configuration.deprec
ation - fs.default.name is deprecated. Instead, use fs.defaultFS
grunt> describe ad1;
ad1: {item: chararray,campaignId: chararray,date: chararray,time: chararray,disp
lay_site: chararray,was_clicked: int,cpc: int,country: chararray,placement: char
array}
grunt> ad2 = load '/home/lendi/Desktop/static_data/ad_data/ad_data2.txt' using P
igStorage(',') as (campaignId:chararray,date:chararray,time:chararray,display_si
te:chararray,placement:chararray,was_clicked:int,cpc:int,item:chararray);
2016-10-14 02:36:08,732 [main] INFO  org.apache.hadoop.conf.Configuration.deprec
ation - io.bytes.per.checksum is deprecated. Instead, use dfs.bytes-per-checksum
2016-10-14 02:36:08,732 [main] INFO  org.apache.hadoop.conf.Configuration.deprec
ation - fs.default.name is deprecated. Instead, use fs.defaultFS
grunt> describe ad2;
ad2: {campaignId: chararray,date: chararray,time: chararray,display_site: charar
ray,placement: chararray,was_clicked: int,cpc: int,item: chararray}
grunt> 
```

## 8.5 PRE-LAB VIVA QUESTIONS:

1) What do you mean by a bag in Pig?
2) Differentiate between PigLatin and HiveQL
3) How will you merge the contents of two or more relations and divide a single relation into two or more relations?

## 8.6 LAB ASSIGNMENT:

1. Process baseball data using Apache Pig.

## 8.7 POST-LAB VIVA QUESTIONS:

1. What is the usage of foreach operation in Pig scripts?
2. What does Flatten do in Pig

# WEEK-9

# PIG COMMANDS

## 9.1 OBJECTIVE:

Write Pig Latin scripts sort, group, join, project, and filter your data.

## 9.2 RESOURCES:

VMWare, Web browser, 4 GB RAM, Hard Disk 80 GB.

## 9.3 PROGRAM LOGIC:

**FILTER Data**

FDATA = FILTER DATA by ATTRIBUTE = VALUE;

**GROUP Data**

GDATA = GROUP DATA by ATTRIBUTE;

**Iterating Data**

FOR_DATA = FOREACH DATA GENERATE GROUP AS GROUP_FUN,

ATTRIBUTE = <VALUE>

**Sorting Data**

SORT_DATA = ORDER DATA BY ATTRIBUTE WITH CONDITION;

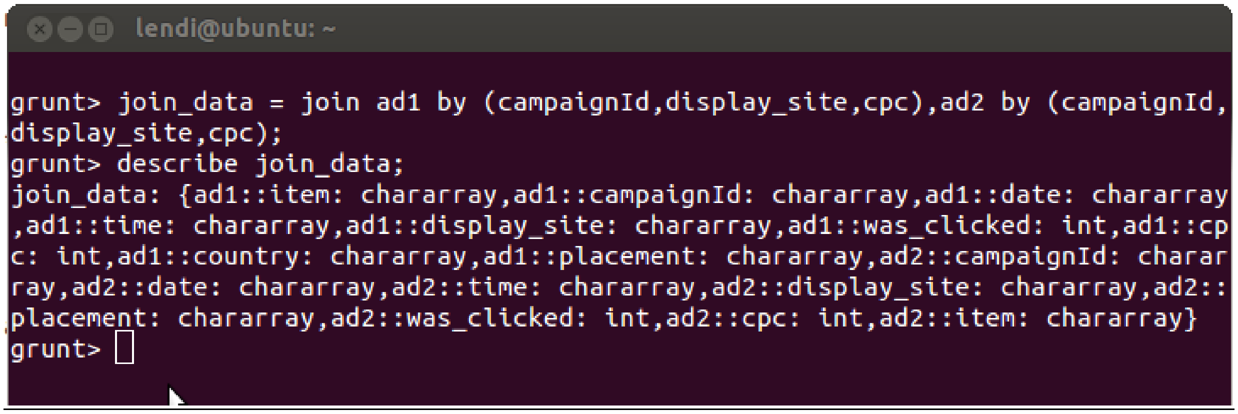
**LIMIT Data**

LIMIT_DATA = LIMIT DATA COUNT;

**JOIN Data**

JOIN DATA1 BY (ATTRIBUTE1,ATTRIBUTE2….) , DATA2 BY (ATTRIBUTE3,ATTRIBUTE….N)

## 9.4 INPUT / OUTPUT :



```
grunt> join_data = join ad1 by (campaignId,display_site,cpc),ad2 by (campaignId,
display_site,cpc);
grunt> describe join_data;
join_data: {ad1::item: chararray,ad1::campaignId: chararray,ad1::date: chararray
,ad1::time: chararray,ad1::display_site: chararray,ad1::was_clicked: int,ad1::cp
c: int,ad1::country: chararray,ad1::placement: chararray,ad2::campaignId: charar
ray,ad2::date: chararray,ad2::time: chararray,ad2::display_site: chararray,ad2::
placement: chararray,ad2::was_clicked: int,ad2::cpc: int,ad2::item: chararray}
grunt> 
```

## 9.5 PRE-LAB VIVA QUESTIONS:

1. How will you merge the contents of two or more relations and divide a single relation into two or more relations?
2. What is the usage of foreach operation in Pig scripts?
3. What does Flatten do in Pig?

## 9.6 LAB ASSIGNMENT:

1. Using Apache Pig to develop User Defined Functions for student data.

## 9.7 PRE-LAB VIVA QUESTIONS:

1. What do you mean by a bag in Pig?
2. Differentiate between PigLatin and HiveQL

# WEEK-10

## PIG LATIN MODES, PROGRAMS

### 10.1 OBJECTIVE:

a. Run the Pig Latin Scripts to find Word Count.
b. Run the Pig Latin Scripts to find a max temp for each and every year.

### 10.2 RESOURCES:

VMWare, Web Browser, 4 GB RAM, 80 GB Hard Disk.

### 10.3 PROGRAM LOGIC:

Run the Pig Latin Scripts to find Word Count.

```
lines = LOAD '/user/hadoop/HDFS_File.txt' AS (line:chararray);
words = FOREACH lines GENERATE FLATTEN(TOKENIZE(line)) as word;
grouped = GROUP words BY word;
wordcount = FOREACH grouped GENERATE group, COUNT(words);
DUMP wordcount;
```

Run the Pig Latin Scripts to find a max temp for each and every year

```
-- max_temp.pig: Finds the maximum temperature by year
records = LOAD 'input/ncdc/micro-tab/sample.txt'
AS (year:chararray, temperature:int, quality:int);
filtered_records = FILTER records BY temperature != 9999 AND
(quality == 0 OR quality == 1 OR quality == 4 OR quality == 5 OR quality == 9);
grouped_records = GROUP filtered_records BY year;
max_temp = FOREACH grouped_records GENERATE group,
MAX(filtered_records.temperature);
DUMP max_temp;
```

### 10.4 INPUT / OUTPUT:

```
(1950,0,1)
(1950,22,1)
(1950,-11,1)
(1949,111,1)
(1949,78,1)
```

### 10.5 PRE-LAB VIVA QUESTIONS:

1. List out the benefits of Pig?
2. Classify Pig Latin commands  in Pig?

### 10.6 LAB ASSIGNMENT:

1. Analyzing average stock price from the stock data using Apache Pig

### 10.7 POST-LAB VIVA QUESTIONS:

1. Discuss the modes of Pig scripts?
2. Explain the Pig Latin application flow?

# WEEK-11

# HIVE

### 11.1 OBJECTIVE:

Installation of HIVE.

### 11.2 RESOURCES:

VMWare, Web Browser, 1GB RAM, Hard Disk 80 GB.

### 11.3 PROGRAM LOGIC:

Install MySQL-Server

1) Sudo apt-get install mysql-server
2) Configuring MySQL UserName and Password
3) Creating User and granting all Privileges

```
Mysql –uroot –proot
Create user <USER_NAME> identified by <PASSWORD>
```

4) Extract and Configure Apache Hive

```
tar xvfz apache-hive-1.0.1.bin.tar.gz
```

5) Move Apache Hive from Local directory to Home directory
6) Set CLASSPATH in bashrc

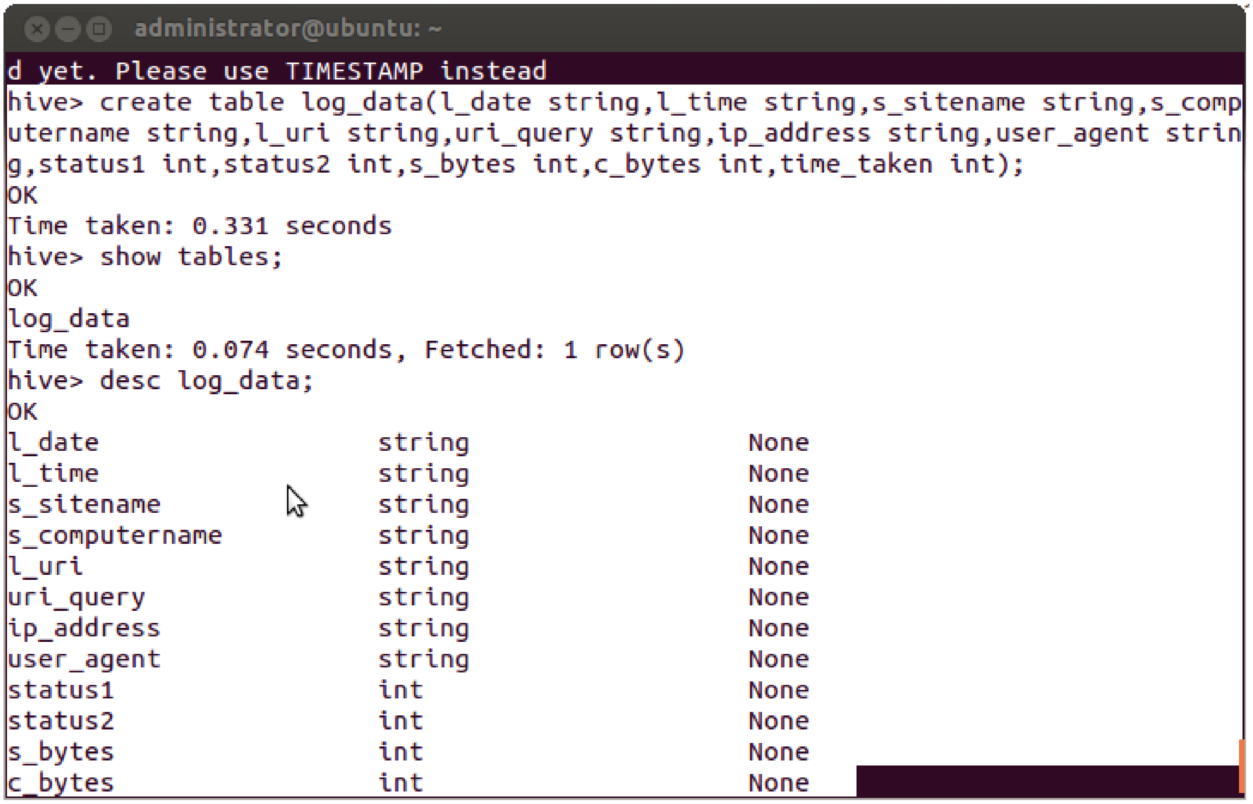
```
Export HIVE_HOME = /home/apache-hive
Export PATH = $PATH:$HIVE_HOME/bin
```

7) Configuring hive-default.xml by adding My SQL Server Credentials

```
<property>
<name>javax.jdo.option.ConnectionURL</name>
<value>
jdbc:mysql://localhost:3306/hive?createDatabaseIfNotExist=true
</value>
</property>
<property>
<name>javax.jdo.option.ConnectionDriverName</name>
<value>com.mysql.jdbc.Driver</value>
</property>
<property>
<name>javax.jdo.option.ConnectionUserName</name>
<value>hadoop</value>
</property>
<property>
<name>javax.jdo.option.ConnectionPassword</name>
<value>hadoop</value>
</property>
```

8) Copying mysql-java-connector.jar to hive/lib directory.

## 11.4 INPUT/OUTPUT:



```
d yet. Please use TIMESTAMP instead
hive> create table log_data(l_date string,l_time string,s_sitename string,s_comp
utername string,l_uri string,uri_query string,ip_address string,user_agent strin
g,status1 int,status2 int,s_bytes int,c_bytes int,time_taken int);
OK
Time taken: 0.331 seconds
hive> show tables;
OK
log_data
Time taken: 0.074 seconds, Fetched: 1 row(s)
hive> desc log_data;
OK
l_date                  string                  None
l_time                  string                  None
s_sitename              string                  None
s_computername          string                  None
l_uri                   string                  None
uri_query               string                  None
ip_address              string                  None
user_agent              string                  None
status1                 int                     None
status2                 int                     None
s_bytes                 int                     None
c_bytes                 int                     None
```

## 11.5 PRE-LAB VIVA QUESTIONS:

1. In Hive, explain the term ‘aggregation’ and its uses?
2. List out the Data types in Hive?

## 11.6 LAB ASSIGNMENT:

1. Analyze twitter data using Apache Hive.

## 11.7 POST-LAB VIVA QUESTIONS:

1. Explain the Built-in Functions in Hive?
2. Describe the various Hive Data types?

# WEEK-12

# HIVE OPERATIONS

## 12.1 OBJECTIVE:

Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

## 12.2 RESOURCES:

VMWare, XAMPP Server, Web Browser, 1GB RAM, Hard Disk 80 GB.

## 12.3 PROGRAM LOGIC:

**SYNTAX for HIVE Database Operations**

**DATABASE Creation**

CREATE DATABASE|SCHEMA [IF NOT EXISTS] <database name>

**Drop Database Statement**

DROP DATABASE StatementDROP (DATABASE|SCHEMA) [IF EXISTS] database_name [RESTRICT|CASCADE];

**Creating and Dropping Table in HIVE**

CREATE [TEMPORARY] [EXTERNAL] TABLE [IF NOT EXISTS] [db_name.] table_name
[(col_name data_type [COMMENT col_comment], ...)]
[COMMENT table_comment] [ROW FORMAT row_format] [STORED AS file_format]

**Loading Data into table log_data**

**Syntax:**

**LOAD DATA LOCAL INPATH '<path>/u.data' OVERWRITE INTO TABLE u_data;**

**Alter Table in HIVE**

Syntax

ALTER TABLE name RENAME TO new_name
ALTER TABLE name ADD COLUMNS (col_spec[, col_spec ...])
ALTER TABLE name DROP [COLUMN] column_name
ALTER TABLE name CHANGE column_name new_name new_type
ALTER TABLE name REPLACE COLUMNS (col_spec[, col_spec ...])

**Creating and Dropping View**

CREATE VIEW [IF NOT EXISTS] view_name [(column_name [COMMENT column_comment], ...) ] [COMMENT table_comment] AS SELECT ...

**Dropping View**

**Syntax:**

DROP VIEW view_name

**Functions in HIVE**

String Functions:- round(), ceil(), substr(), upper(), reg_exp() etc
Date and Time Functions:- year(), month(), day(), to_date() etc
Aggregate Functions :- sum(), min(), max(), count(), avg() etc

## INDEXES

```
CREATE INDEX index_name ON TABLE base_table_name (col_name, ...)
AS 'index.handler.class.name'
[WITH DEFERRED REBUILD]
[IDXPROPERTIES (property_name=property_value, ...)]
[IN TABLE index_table_name]
[PARTITIONED BY (col_name, ...)]
[
[ ROW FORMAT ...] STORED AS ...
| STORED BY ...
]
[LOCATION hdfs_path]
[TBLPROPERTIES (...)]
```

### Creating Index

```
CREATE INDEX index_ip ON TABLE log_data(ip_address) AS
'org.apache.hadoop.hive.ql.index.compact.CompactIndexHandler' WITH DEFERRED
REBUILD;
```

### Altering and Inserting Index

```
ALTER INDEX index_ip_address ON log_data REBUILD;
```

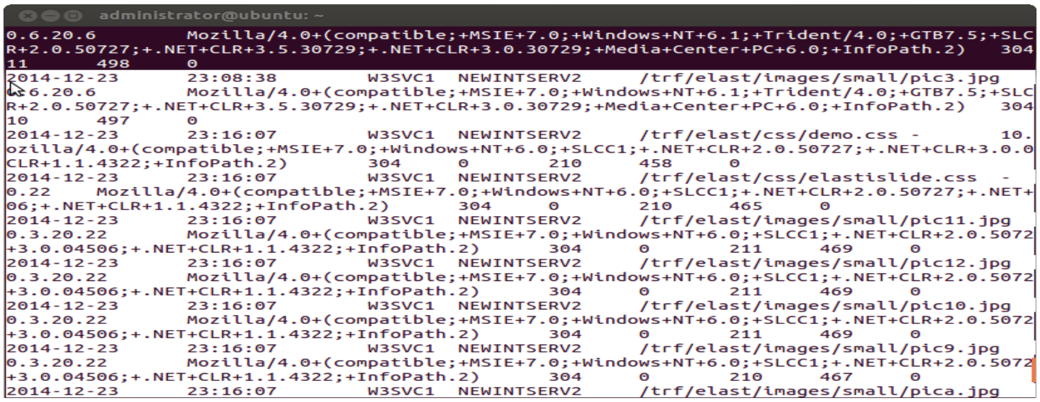
### Storing Index Data in Metastore

```
SET
hive.index.compact.file=/home/administrator/Desktop/big/metastore_db/tmp/index_ipaddress_result;
SET
hive.input.format=org.apache.hadoop.hive.ql.index.compact.HiveCompactIndexInputFormat;
```

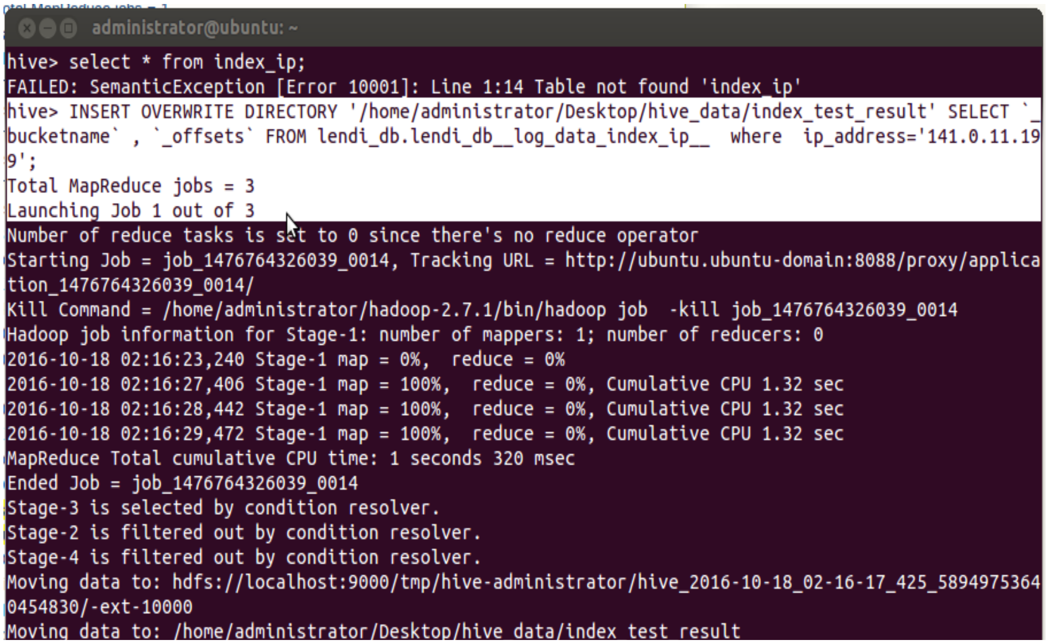
### Dropping Index

```
DROP INDEX INDEX_NAME on TABLE_NAME;
```

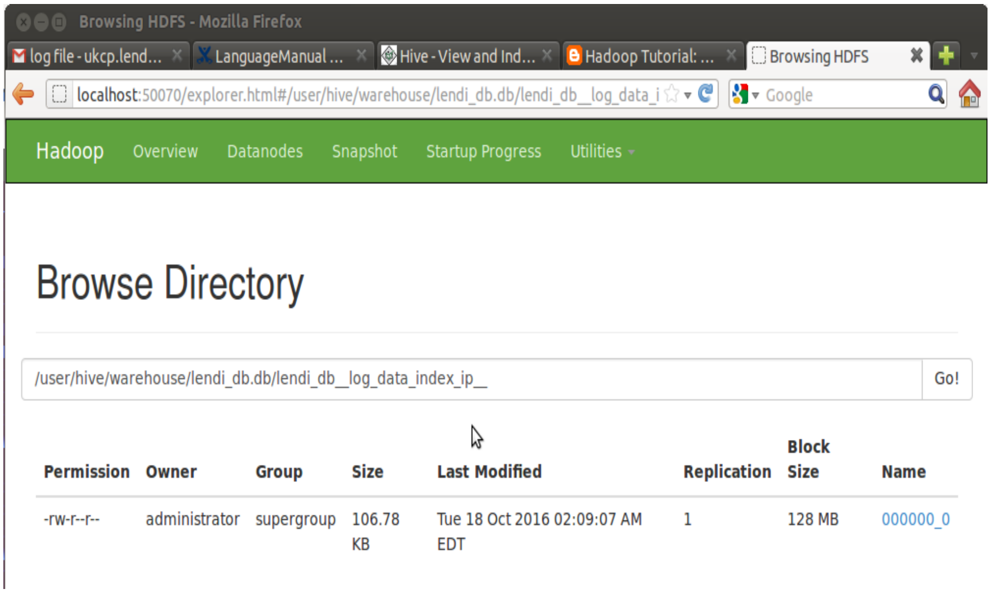
## 12.4 INPUT/OUTPUT:



```
0.6.20.6        Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.1;+Trident/4.0;+GTB7.5;+SLC
R+2.0.50727;+.NET+CLR+3.5.30729;+.NET+CLR+3.0.30729;+Media+Center+PC+6.0;+InfoPath.2)   304
11      498     0
2014-12-23      23:08:38        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pic3.jpg
0.6.20.6        Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.1;+Trident/4.0;+GTB7.5;+SLC
R+2.0.50727;+.NET+CLR+3.5.30729;+.NET+CLR+3.0.30729;+Media+Center+PC+6.0;+InfoPath.2)   304
10      497     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/css/demo.css -       10.
ozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.50727;+.NET+CLR+3.0.0
CLR+1.1.4322;+InfoPath.2)       304     0       210     458     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/css/elastislide.css  -
0.22    Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.50727;+.NET+
06;+.NET+CLR+1.1.4322;+InfoPath.2)      304     0       210     465     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pic11.jpg
0.3.20.22       Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.5072
+3.0.04506;+.NET+CLR+1.1.4322;+InfoPath.2)      304     0       211     469     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pic12.jpg
0.3.20.22       Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.5072
+3.0.04506;+.NET+CLR+1.1.4322;+InfoPath.2)      304     0       211     469     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pic10.jpg
0.3.20.22       Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.5072
+3.0.04506;+.NET+CLR+1.1.4322;+InfoPath.2)      304     0       211     469     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pic9.jpg
0.3.20.22       Mozilla/4.0+(compatible;+MSIE+7.0;+Windows+NT+6.0;+SLCC1;+.NET+CLR+2.0.5072
+3.0.04506;+.NET+CLR+1.1.4322;+InfoPath.2)      304     0       210     467     0
2014-12-23      23:16:07        W3SVC1  NEWINTSERV2     /trf/elast/images/small/pica.jpg
```



```
hive> select * from index_ip;
FAILED: SemanticException [Error 10001]: Line 1:14 Table not found 'index_ip'
hive> INSERT OVERWRITE DIRECTORY '/home/administrator/Desktop/hive_data/index_test_result' SELECT `_
bucketname` , `_offsets` FROM lendi_db.lendi_db__log_data_index_ip__  where  ip_address='141.0.11.19
9';
Total MapReduce jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1476764326039_0014, Tracking URL = http://ubuntu.ubuntu-domain:8088/proxy/applica
tion_1476764326039_0014/
Kill Command = /home/administrator/hadoop-2.7.1/bin/hadoop job  -kill job_1476764326039_0014
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2016-10-18 02:16:23,240 Stage-1 map = 0%,  reduce = 0%
2016-10-18 02:16:27,406 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.32 sec
2016-10-18 02:16:28,442 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.32 sec
2016-10-18 02:16:29,472 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.32 sec
MapReduce Total cumulative CPU time: 1 seconds 320 msec
Ended Job = job_1476764326039_0014
Stage-3 is selected by condition resolver.
Stage-2 is filtered out by condition resolver.
Stage-4 is filtered out by condition resolver.
Moving data to: hdfs://localhost:9000/tmp/hive-administrator/hive_2016-10-18_02-16-17_425_5894975364
0454830/-ext-10000
Moving data to: /home/administrator/Desktop/hive_data/index_test_result
```



Browse Directory

/user/hive/warehouse/lendi_db.db/lendi_db__log_data_index_ip__

| Permission | Owner | Group | Size | Last Modified | Replication | Block Size | Name |
|---|---|---|---|---|---|---|---|
| -rw-r--r-- | administrator | supergroup | 106.78 KB | Tue 18 Oct 2016 02:09:07 AM EDT | 1 | 128 MB | 000000_0 |

## 12.5 PRE-LAB VIVA QUESTIONS:

1. How many types of joins are there in Pig Latin with an examples?
2. Write the Hive command to create a table with four columns: First name, last name, age, and income?

## 12.6 LAB ASSIGNMENT:

1. Analyze stock data using Apache Hive.

## 12.7 POST-LAB VIVA QUESTIONS:

1. Write a shell command in Hive to list all the files in the current directory?
2. List the collection types provided by Hive for the purpose a start-up company want to use Hive for storing its data.