DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Vision

- To achieve excellence in the domain of Artificial Intelligence and Data Science and produce globally competent professionals to solve futuristic societal challenges and industrial needs

Mission

- To actively engage in the implementation of innovative intelligent solutions for interdisciplinary Artificial Intelligence based applications with ethical standards
- To promote research, innovation and entrepreneurial skills through industry and academic collaboration

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO I: Exhibit proficiency in their career, higher studies and research with strong foundations in Mathematics, Computing, Artificial Intelligence and Data Science.

PEO II: Apply Artificial Intelligence and Data Science knowledge and skills to develop innovative solutions for multi-disciplinary problems, adhering to ethical standards

PEO III: Engage in constructive research, professional development and life-long learning with skills in emerging technologies

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: 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.
4. **Conduct investigations of complex problems**: 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.
5. **Modern tool usage**: 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.

6. **The engineer and society**: 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.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: 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.
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.
12. **Life-long learning**: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Analyze, design and build sustainable intelligent solutions to solve challenges imposed by industry and society.

PSO 2: Demonstrate data analysis skills to achieve effective insights and decision making to solve real-life problems.

PSO 3: Apply mathematical and statistical models to solve the computational tasks, and model real-world problems using appropriate AI / ML algorithms.

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EX.NO: 1	INSTALLATION, CONFIGURATION, AND RUNNING OF HADOOP AND HDFS
DATE:	

AIM:

To install a single-node Hadoop cluster backed by the Hadoop Distributed File System on Ubuntu.

PROCEDURE:

1. Installing Java

prince@prince-VirtualBox:~$ cd ~

Update the source list

prince@prince-VirtualBox:~$ sudo apt-get update

The OpenJDK project is the default version of Java
that is provided from a supported Ubuntu repository.

prince@prince-VirtualBox:~$ sudo apt-get install default-jdk

prince@prince-VirtualBox:~$ java -version

java version "1.7.0_65"
OpenJDK Runtime Environment (IcedTea 2.5.3) (7u71-2.5.3-0ubuntu0.14.04.1)
OpenJDK 64-Bit Server VM (build 24.65-b04, mixed mode)

2. Adding a dedicated Hadoop user

prince@prince-VirtualBox:~$ sudoaddgrouphadoop

Adding group `hadoop' (GID 1002) ...
Done.

prince@prince-VirtualBox:~$ sudoadduser --ingrouphadoophduser

Adding user `hduser' ...
Adding new user `hduser' (1001) with group `hadoop' ...
Creating home directory `/home/hduser' ...
Copying files from `/etc/skel' ...
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
Changing the user information for hduser
Enter the new value, or press ENTER for the default
Full Name []:
Room Number []:

Work Phone []:
Home Phone []:
Other []:
Is the information correct? [Y/n] Y

3. Installing SSH

ssh has two main components:

1. **ssh** : The command we use to connect to remote machines - the client.
2. **sshd** : The daemon that is running on the server and allows clients to connect to the server.

The **ssh** is pre-enabled on Linux, but in order to start **sshd** daemon, we need to install **ssh** first. Use this command to do that :

prince@prince-VirtualBox:~$ sudo apt-get install ssh

This will install ssh on our machine. If we get something similar to the following, we can think it is setup properly:

prince@prince-VirtualBox:~$ which ssh

/usr/bin/ssh
prince@prince-VirtualBox:~$ which sshd
/usr/sbin/sshd

4. Create and Setup SSH Certificates

Hadoop requires SSH access to manage its nodes, i.e. remote machines plus our local machine. For our single-node setup of Hadoop, we therefore need to configure SSH access to localhost.

So, we need to have SSH up and running on our machine and configured it to allow SSH public key authentication.

Hadoop uses SSH (to access its nodes) which would normally require the user to enter a password. However, this requirement can be eliminated by creating and setting up SSH certificates using the following commands. If asked for a filename just leave it blank and press the enter key to continue.

prince@prince-VirtualBox:~$ suhduser
Password:
prince@prince-VirtualBox:~$ ssh-keygen -t rsa -P ""

Generating public/private rsa key pair.
Enter file in which to save the key (/home/hduser/.ssh/id_rsa):
Created directory '/home/hduser/.ssh'.
Your identification has been saved in /home/hduser/.ssh/id_rsa.
Your public key has been saved in /home/hduser/.ssh/id_rsa.pub.
The key fingerprint is:
50:6b:f3:fc:0f:32:bf:30:79:c2:41:71:26:cc:7d:e3**hduser@prince-VirtualBox**
The key's randomart image is:

```
+--[ RSA 2048]----+
|       .oo.o    |
|      . .o=. o  |
|     . + .  o . |
|      o =    E  |
|       S +      |
|        . +     |
|         O +    |
|          O o   |
|           o..  |
+-----------------+
```

hduser@prince-VirtualBox:/home/k$ cat $HOME/.ssh/id_rsa.pub >> $HOME/.ssh/authorized_keys

The second command adds the newly created key to the list of authorized keys so that Hadoop can use ssh without prompting for a password.

We can check if ssh works:

hduser@prince-VirtualBox:/home/k$ sshlocalhost

The authenticity of host 'localhost (127.0.0.1)' can't be established.
ECDSA key fingerprint is e1:8b:a0:a5:75:ef:f4:b4:5e:a9:ed:be:64:be:5c:2f.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'localhost' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 14.04.1 LTS (GNU/Linux 3.13.0-40-generic x86_64)
...

5. Install Hadoop

hduser@prince-VirtualBox:~$ wget http://mirrors.sonic.net/apache/hadoop/common/hadoop-2.6.0/hadoop-2.6.0.tar.gz
hduser@prince-VirtualBox:~$ tar xvzf hadoop-2.6.0.tar.gz

We want to move the Hadoop installation to the **/usr/local/hadoop** directory using the following command:

hduser@prince-VirtualBox:~/hadoop-2.6.0$ sudo mv * /usr/local/hadoop

[sudo] password for hduser:
hduser is not in the sudoers file. This incident will be reported.

Oops!... We got:

"hduser is not in the sudoers file. This incident will be reported."

This error can be resolved by logging in as a root user, and then add **hduser** to **sudo**:

hduser@prince-VirtualBox:~/hadoop-2.6.0$ su prince
Password:

prince@prince-VirtualBox:/home/hduser$ sudoadduserhdusersudo

[sudo] password for prince:
Adding user `hduser' to group `sudo' ...
Adding user hduser to group sudo
Done.

Now, the **hduser** has root priviledge, we can move the Hadoop installation to the **/usr/local/hadoop** directory without any problem:

prince@prince-VirtualBox:/home/hduser$ sudosuhduser

hduser@prince-VirtualBox:~/hadoop-2.6.0$ sudo mv * /usr/local/hadoop

hduser@prince-VirtualBox:~/hadoop-2.6.0$ sudochown -R hduser:hadoop /usr/local/hadoop

6. Setup Configuration Files

The following files will have to be modified to complete the Hadoop setup:

i.~/.bashrc

ii./usr/local/hadoop/etc/hadoop/hadoop-env.sh

iii./usr/local/hadoop/etc/hadoop/core-site.xml

iv./usr/local/hadoop/etc/hadoop/mapred-site.xml.template

v./usr/local/hadoop/etc/hadoop/hdfs-site.xml

i. ~/.bashrc:

Before editing the **.bashrc** file in our home directory, we need to find the path where Java has been installed to set the **JAVA_HOME** environment variable using the following command:

hduser@prince-VirtualBox:~$ update-alternatives --config java

There is only one alternative in link group java (providing /usr/bin/java): /usr/lib/jvm/java-7-openjdk-amd64/jre/bin/java
Nothing to configure.

Now we can append the following to the end of **~/.bashrc**:

hduser@prince-VirtualBox:~$ nano ~/.bashrc

#HADOOP VARIABLES START
export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-amd64
export HADOOP_INSTALL=/usr/local/hadoop
export PATH=$PATH:$HADOOP_INSTALL/bin
export PATH=$PATH:$HADOOP_INSTALL/sbin

export HADOOP_MAPRED_HOME=$HADOOP_INSTALL
export HADOOP_COMMON_HOME=$HADOOP_INSTALL
export HADOOP_HDFS_HOME=$HADOOP_INSTALL
export YARN_HOME=$HADOOP_INSTALL
export HADOOP_COMMON_LIB_NATIVE_DIR=$HADOOP_INSTALL/lib/native
export HADOOP_OPTS="-Djava.library.path=$HADOOP_INSTALL/lib"
#HADOOP VARIABLES END

hduser@prince-VirtualBox:~$ source ~/.bashrc
note that the JAVA_HOME should be set as the path just before the '.../bin/':

hduser@ubuntu-VirtualBox:~$ javac -version
javac 1.7.0_75

hduser@ubuntu-VirtualBox:~$ which javac
/usr/bin/javac

hduser@ubuntu-VirtualBox:~$ readlink -f /usr/bin/javac
/usr/lib/jvm/java-7-openjdk-amd64/bin/javac

ii. /usr/local/hadoop/etc/hadoop/hadoop-env.sh

We need to set **JAVA_HOME** by modifying **hadoop-env.sh** file.

hduser@prince-VirtualBox:~$ nano /usr/local/hadoop/etc/hadoop/hadoop-env.sh

export JAVA_HOME=/usr/lib/jvm/java-7-openjdk-amd64

Adding the above statement in the **hadoop-env.sh** file ensures that the value of JAVA_HOME variable will be available to Hadoop whenever it is started up.

iii. /usr/local/hadoop/etc/hadoop/core-site.xml:

The **/usr/local/hadoop/etc/hadoop/core-site.xml** file contains configuration properties that Hadoop uses when starting up.
This file can be used to override the default settings that Hadoop starts with.

hduser@prince-VirtualBox:~$ sudomkdir -p /app/hadoop/tmp

hduser@prince-VirtualBox:~$ sudochownhduser:hadoop /app/hadoop/tmp

Open the file and enter the following in between the <configuration></configuration> tag:

hduser@prince-VirtualBox:~$ nano /usr/local/hadoop/etc/hadoop/core-site.xml

<configuration>
<property>
<name>hadoop.tmp.dir</name>
<value>/app/hadoop/tmp</value>
<description>A base for other temporary directories.</description>

</property>

<property>
<name>fs.default.name</name>
<value>hdfs://localhost:54310</value>
<description>The name of the default file system. A URI whose
scheme and authority determine the FileSystem implementation. The
uri's scheme determines the config property (fs.SCHEME.impl) naming
theFileSystem implementation class. The uri's authority is used to
determine the host, port, etc. for a filesystem.</description>
</property>
</configuration>

iv. /usr/local/hadoop/etc/hadoop/mapred-site.xml

By default, the **/usr/local/hadoop/etc/hadoop/** folder contains **/usr/local/hadoop/etc/hadoop/mapred-site.xml.template**
file which has to be renamed/copied with the name **mapred-site.xml**:

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

The **mapred-site.xml** file is used to specify which framework is being used for MapReduce. We need to enter the following content in between the <configuration></configuration> tag:

<configuration>
<property>
<name>mapred.job.tracker</name>
<value>localhost:54311</value>
<description>The host and port that the MapReduce job tracker runs
at. If "local", then jobs are run in-process as a single map
and reduce task.
</description>
</property>
</configuration>

v. /usr/local/hadoop/etc/hadoop/hdfs-site.xml

The **/usr/local/hadoop/etc/hadoop/hdfs-site.xml** file needs to be configured for each host in the cluster that is being used.
It is used to specify the directories which will be used as the **namenode** and the **datanode** on that host.

Before editing this file, we need to create two directories which will contain the namenode and the datanode for this Hadoop installation.
This can be done using the following commands:

hduser@prince-VirtualBox:~$ sudomkdir -p /usr/local/hadoop_store/hdfs/namenode
hduser@prince-VirtualBox:~$ sudomkdir -p /usr/local/hadoop_store/hdfs/datanode
hduser@prince-VirtualBox:~$ sudochown -R hduser:hadoop /usr/local/hadoop_store

Open the file and enter the following content in between the <configuration></configuration> tag:

hduser@prince-VirtualBox:~$ nano /usr/local/hadoop/etc/hadoop/hdfs-site.xml

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

7. Format the NewHadoop File system

Now, the Hadoop file system needs to be formatted so that we can start to use it. The format command should be issued with write permission since it creates **current** directory under **/usr/local/hadoop_store/hdfs/namenode** folder:

hduser@prince-VirtualBox:~$ hadoopnamenode -format

```
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.

15/04/18 14:43:03 INFO namenode.NameNode: STARTUP_MSG:
/************************************************************
STARTUP_MSG: Starting NameNode
STARTUP_MSG:   host = laptop/192.168.1.1
STARTUP_MSG:   args = [-format]
STARTUP_MSG:   version = 2.6.0
STARTUP_MSG:   classpath = /usr/local/hadoop/etc/hadoop
...
STARTUP_MSG:   java = 1.7.0_65
************************************************************/
15/04/18 14:43:03 INFO namenode.NameNode: registered UNIX signal handlers for [TERM, HUP, INT]
15/04/18 14:43:03 INFO namenode.NameNode: createNameNode [-format]
15/04/18 14:43:07 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Formatting using clusterid: CID-e2f515ac-33da-45bc-8466-5b1100a2bf7f
15/04/18 14:43:09 INFO namenode.FSNamesystem: No KeyProvider found.
15/04/18 14:43:09 INFO namenode.FSNamesystem: fsLock is fair:true
```

15/04/18 14:43:10 INFO blockmanagement.DatanodeManager: dfs.block.invalidate.limit=1000
15/04/18 14:43:10 INFO blockmanagement.DatanodeManager: dfs.namenode.datanode.registration.ip-hostname-check=true
15/04/18 14:43:10 INFO blockmanagement.BlockManager: dfs.namenode.startup.delay.block.deletion.sec is set to 000:00:00:00.000
15/04/18 14:43:10 INFO blockmanagement.BlockManager: The block deletion will start around 2015 Apr 18 14:43:10
15/04/18 14:43:10 INFO util.GSet: Computing capacity for map BlocksMap
15/04/18 14:43:10 INFO util.GSet: VM type = 64-bit
15/04/18 14:43:10 INFO util.GSet: 2.0% max memory 889 MB = 17.8 MB
15/04/18 14:43:10 INFO util.GSet: capacity = 2^21 = 2097152 entries
15/04/18 14:43:10 INFO blockmanagement.BlockManager: dfs.block.access.token.enable=false
15/04/18 14:43:10 INFO blockmanagement.BlockManager: defaultReplication = 1
15/04/18 14:43:10 INFO blockmanagement.BlockManager: maxReplication = 512
15/04/18 14:43:10 INFO blockmanagement.BlockManager: minReplication = 1
15/04/18 14:43:10 INFO blockmanagement.BlockManager: maxReplicationStreams = 2
15/04/18 14:43:10 INFO blockmanagement.BlockManager: shouldCheckForEnoughRacks = false
15/04/18 14:43:10 INFO blockmanagement.BlockManager: replicationRecheckInterval = 3000
15/04/18 14:43:10 INFO blockmanagement.BlockManager: encryptDataTransfer = false
15/04/18 14:43:10 INFO blockmanagement.BlockManager: maxNumBlocksToLog = 1000
15/04/18 14:43:10 INFO namenode.FSNamesystem: fsOwner = hduser (auth:SIMPLE)
15/04/18 14:43:10 INFO namenode.FSNamesystem: supergroup = supergroup
15/04/18 14:43:10 INFO namenode.FSNamesystem: isPermissionEnabled = true
15/04/18 14:43:10 INFO namenode.FSNamesystem: HA Enabled: false
15/04/18 14:43:10 INFO namenode.FSNamesystem: Append Enabled: true
15/04/18 14:43:11 INFO util.GSet: Computing capacity for map INodeMap
15/04/18 14:43:11 INFO util.GSet: VM type = 64-bit
15/04/18 14:43:11 INFO util.GSet: 1.0% max memory 889 MB = 8.9 MB
15/04/18 14:43:11 INFO util.GSet: capacity = 2^20 = 1048576 entries
15/04/18 14:43:11 INFO namenode.NameNode: Caching file names occuring more than 10 times
15/04/18 14:43:11 INFO util.GSet: Computing capacity for map cachedBlocks
15/04/18 14:43:11 INFO util.GSet: VM type = 64-bit
15/04/18 14:43:11 INFO util.GSet: 0.25% max memory 889 MB = 2.2 MB
15/04/18 14:43:11 INFO util.GSet: capacity = 2^18 = 262144 entries
15/04/18 14:43:11 INFO namenode.FSNamesystem: dfs.namenode.safemode.threshold-pct = 0.9990000128746033
15/04/18 14:43:11 INFO namenode.FSNamesystem: dfs.namenode.safemode.min.datanodes = 0
15/04/18 14:43:11 INFO namenode.FSNamesystem: dfs.namenode.safemode.extension = 30000
15/04/18 14:43:11 INFO namenode.FSNamesystem: Retry cache on namenode is enabled
15/04/18 14:43:11 INFO namenode.FSNamesystem: Retry cache will use 0.03 of total heap and retry cache entry expiry time is 600000 millis
15/04/18 14:43:11 INFO util.GSet: Computing capacity for map NameNodeRetryCache
15/04/18 14:43:11 INFO util.GSet: VM type = 64-bit
15/04/18 14:43:11 INFO util.GSet: 0.029999999329447746% max memory 889 MB = 273.1 KB
15/04/18 14:43:11 INFO util.GSet: capacity = 2^15 = 32768 entries
15/04/18 14:43:11 INFO namenode.NNConf: ACLs enabled? false
15/04/18 14:43:11 INFO namenode.NNConf: XAttrs enabled? true
15/04/18 14:43:11 INFO namenode.NNConf: Maximum size of anxattr: 16384
15/04/18 14:43:12 INFO namenode.FSImage: Allocated new BlockPoolId: BP-130729900-192.168.1.1-1429393391595

15/04/18 14:43:12 INFO common.Storage: Storage directory /usr/local/hadoop_store/hdfs/namenode has been successfully formatted.
15/04/18 14:43:12 INFO namenode.NNStorageRetentionManager: Going to retain 1 images with txid>= 0
15/04/18 14:43:12 INFO util.ExitUtil: Exiting with status 0
15/04/18 14:43:12 INFO namenode.NameNode: SHUTDOWN_MSG:
/**
SHUTDOWN_MSG: Shutting down NameNode at laptop/192.168.1.1
**/

Note that **hadoopnamenode -format** command should be executed once before we start using Hadoop.
If this command is executed again after Hadoop has been used, it'll destroy all the data on the Hadoop file system.

8. Starting Hadoop

Now it's time to start the newly installed single node cluster.
We can use **start-all.sh** or (**start-dfs.sh** and **start-yarn.sh**)

prince@prince-VirtualBox:~$ cd /usr/local/hadoop/sbin

prince@prince-VirtualBox:/usr/local/hadoop/sbin$ ls

distribute-exclude.sh start-all.cmd stop-balancer.sh
hadoop-daemon.sh start-all.sh stop-dfs.cmd
hadoop-daemons.sh start-balancer.sh stop-dfs.sh
hdfs-config.cmd start-dfs.cmd stop-secure-dns.sh
hdfs-config.sh start-dfs.sh stop-yarn.cmd
httpfs.sh start-secure-dns.sh stop-yarn.sh
kms.sh start-yarn.cmd yarn-daemon.sh
mr-jobhistory-daemon.sh start-yarn.sh yarn-daemons.sh
refresh-namenodes.sh stop-all.cmd
slaves.sh stop-all.sh

prince@prince-VirtualBox:/usr/local/hadoop/sbin$ sudosuhduser

hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ start-all.sh
hduser@prince-VirtualBox:~$ start-all.sh

This script is Deprecated. Instead use start-dfs.sh and start-yarn.sh
15/04/18 16:43:13 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Starting namenodes on [localhost]
localhost: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser-namenode-laptop.out
localhost: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-laptop.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-hduser-secondarynamenode-laptop.out

15/04/18 16:43:58 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
starting yarn daemons
startingresourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resourcemanager-laptop.out
localhost: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-laptop.out

We can check if it's really up and running:

hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ jps

9026 NodeManager
7348 NameNode
9766 Jps
8887 ResourceManager
7507 DataNode

The output means that we now have a functional instance of Hadoop running on our VPS (Virtual private server).

Another way to check is using **netstat**:

hduser@prince-VirtualBox:~$ netstat -plten | grep java

(Not all processes could be identified, non-owned process info
will not be shown, you would have to be root to see it all.)

tcp	0	0	0.0.0.0:50020	0.0.0.0:*	LISTEN	1001	1843372	10605/java
tcp	0	0	127.0.0.1:54310	0.0.0.0:*	LISTEN	1001	1841277	10447/java
tcp	0	0	0.0.0.0:50090	0.0.0.0:*	LISTEN	1001	1841130	10895/java
tcp	0	0	0.0.0.0:50070	0.0.0.0:*	LISTEN	1001	1840196	10447/java
tcp	0	0	0.0.0.0:50010	0.0.0.0:*	LISTEN	1001	1841320	10605/java
tcp	0	0	0.0.0.0:50075	0.0.0.0:*	LISTEN	1001	1841646	10605/java
tcp6	0	0	:::8040	:::*	LISTEN	1001	1845543	11383/java
tcp6	0	0	:::8042	:::*	LISTEN	1001	1845551	11383/java
tcp6	0	0	:::8088	:::*	LISTEN	1001	1842110	11252/java
tcp6	0	0	:::49630	:::*	LISTEN	1001	1845534	11383/java
tcp6	0	0	:::8030	:::*	LISTEN	1001	1842036	11252/java
tcp6	0	0	:::8031	:::*	LISTEN	1001	1842005	11252/java
tcp6	0	0	:::8032	:::*	LISTEN	1001	1842100	11252/java
tcp6	0	0	:::8033	:::*	LISTEN	1001	1842162	11252/java

9. Stopping Hadoop

$ pwd
/usr/local/hadoop/sbin
$ ls
distribute-exclude.sh httpfs.sh start-all.sh start-yarn.cmd stop-dfs.cmd yarn-daemon.sh
hadoop-daemon.sh mr-jobhistory-daemon.sh start-balancer.sh start-yarn.sh stop-dfs.sh yarn-daemons.sh
hadoop-daemons.sh refresh-namenodes.sh start-dfs.cmd stop-all.cmd stop-secure-dns.sh

hdfs-config.cmd slaves.sh start-dfs.sh stop-all.sh stop-yarn.cmd
hdfs-config.sh start-all.cmd start-secure-dns.sh stop-balancer.sh stop-yarn.sh

We run **stop-all.sh** or (**stop-dfs.sh** and **stop-yarn.sh**) to stop all the daemons running on our machine:
hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ pwd

/usr/local/hadoop/sbin

hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ ls

distribute-exclude.sh httpfs.sh start-all.cmd start-secure-dns.sh stop-balancer.sh stop-yarn.sh
hadoop-daemon.sh kms.sh start-all.sh start-yarn.cmd stop-dfs.cmd yarn-daemon.sh
hadoop-daemons.sh mr-jobhistory-daemon.sh start-balancer.sh start-yarn.sh stop-dfs.sh yarn-daemons.sh
hdfs-config.cmd refresh-namenodes.sh start-dfs.cmd stop-all.cmd stop-secure-dns.sh
hdfs-config.sh slaves.sh start-dfs.sh stop-all.sh stop-yarn.cmd

hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ stop-all.sh

This script is Deprecated. Instead use stop-dfs.sh and stop-yarn.sh
15/04/18 15:46:31 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Stopping namenodes on [localhost]
localhost: stopping namenode
localhost: stopping datanode
Stopping secondary namenodes [0.0.0.0]
0.0.0.0: no secondarynamenode to stop
15/04/18 15:46:59 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
stopping yarn daemons
stoppingresourcemanager
localhost: stopping nodemanager
noproxyserver to stop

10.Hadoop Web Interfaces

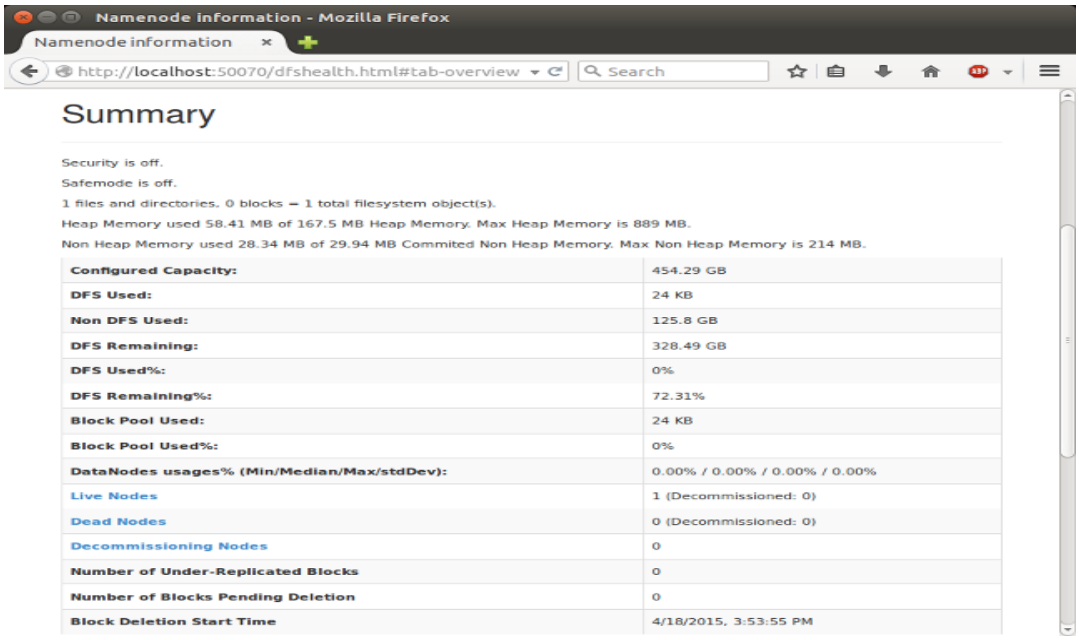
Let's start the Hadoop again and see its Web UI:

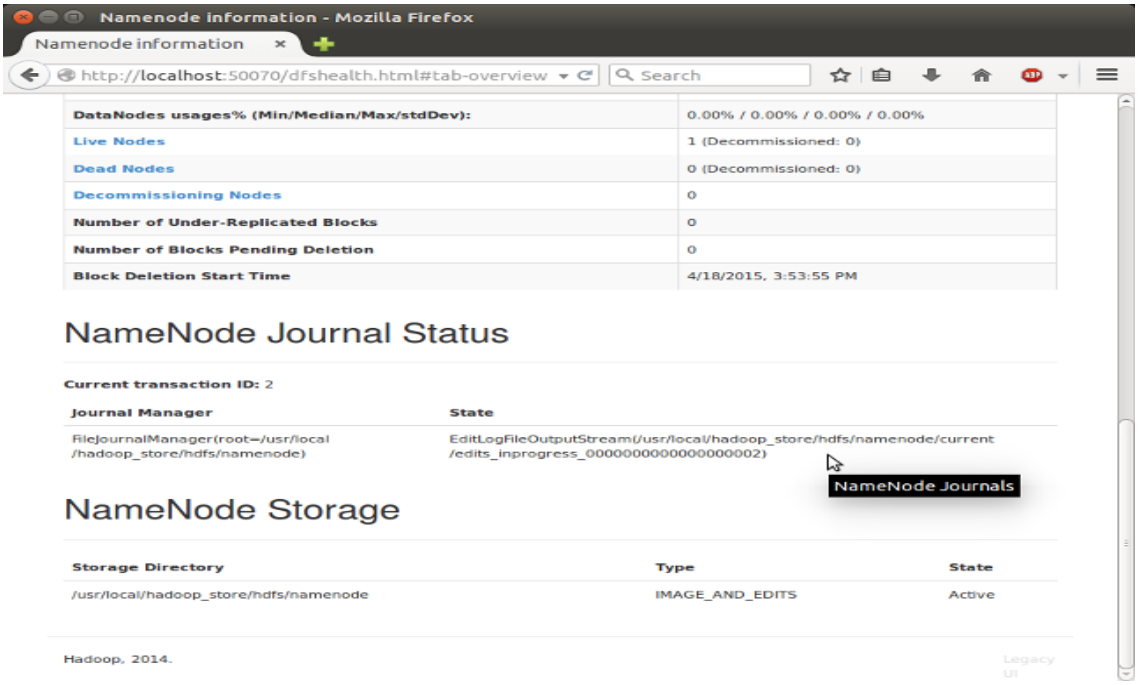
hduser@prince-VirtualBox:/usr/local/hadoop/sbin$ start-all.sh

http://localhost:50070/ - web UI of the NameNode daemon

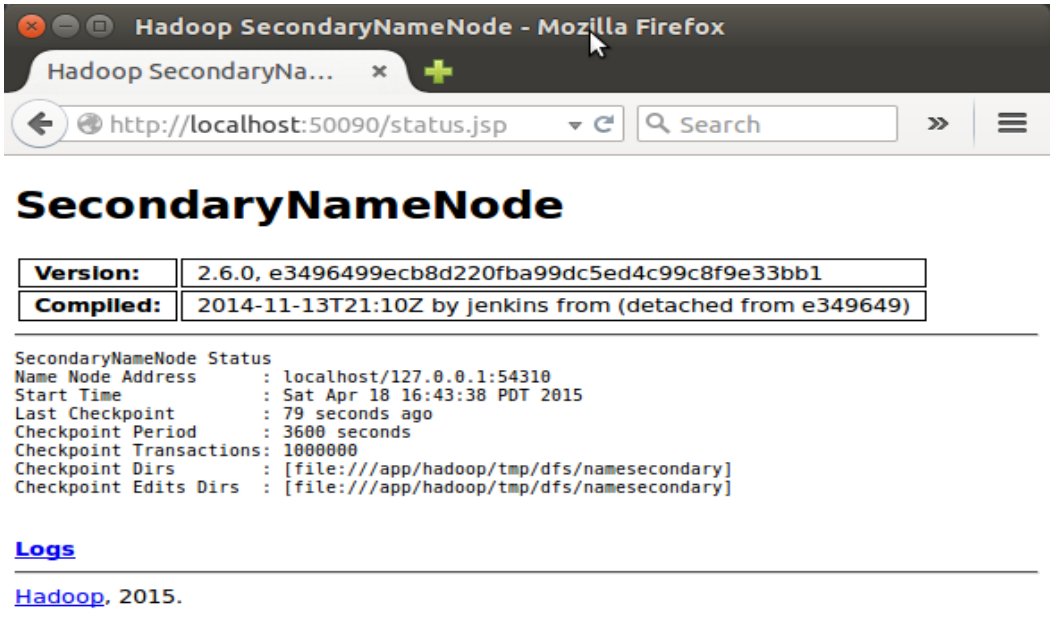
OUTPUT:


Namenode information - Mozilla Firefox
Namenode information
http://localhost:50070/dfshealth.html#tab-overview
Search
Hadoop
Overview
Datanodes
Snapshot
Startup Progress
Utilities
Overview 'localhost:54310' (active)
Started: Sat Apr 18 15:53:55 PDT 2015
Version: 2.6.0, re3496499ecb8d220fba99dc5ed4c99c8f9e33bb1
Compiled: 2014-11-13T21:10Z by jenkins from (detached from e349649)
Cluster ID: CID-e2f515ac-33da-45bc-8466-5b1100a2bf7f
Block Pool ID: BP-130729900-192.168.1.1-1429393391595
Summary
Security is off.
Safemode is off.
1 files and directories, 0 blocks = 1 total filesystem object(s).
Heap Memory used 58.41 MB of 167.5 MB Heap Memory. Max Heap Memory is 889 MB.
Non Heap Memory used 28.34 MB of 29.94 MB Commited Non Heap Memory. Max Non Heap Memory is 214 MB.
http://localhost:50070/dfshealth.html#tab-startup-progress

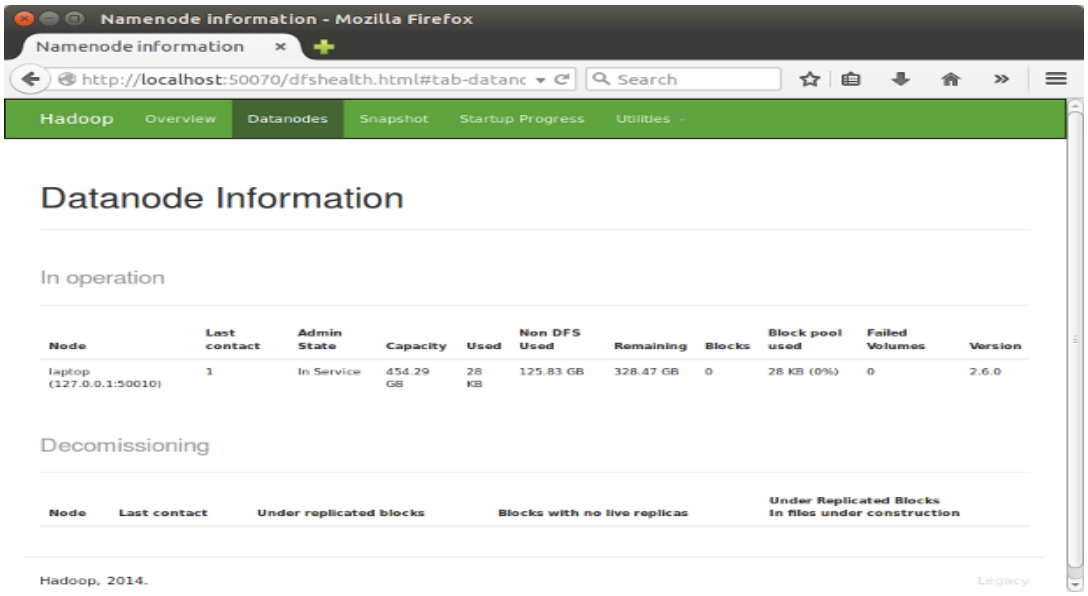

Namenode information - Mozilla Firefox
Namenode information
http://localhost:50070/dfshealth.html#tab-overview
Search
Summary
Security is off.
Safemode is off.
1 files and directories, 0 blocks = 1 total filesystem object(s).
Heap Memory used 58.41 MB of 167.5 MB Heap Memory. Max Heap Memory is 889 MB.
Non Heap Memory used 28.34 MB of 29.94 MB Commited Non Heap Memory. Max Non Heap Memory is 214 MB.
Configured Capacity: 454.29 GB
DFS Used: 24 KB
Non DFS Used: 125.8 GB
DFS Remaining: 328.49 GB
DFS Used%: 0%
DFS Remaining%: 72.31%
Block Pool Used: 24 KB
Block Pool Used%: 0%
DataNodes usages% (Min/Median/Max/stdDev): 0.00% / 0.00% / 0.00% / 0.00%
Live Nodes 1 (Decommissioned: 0)
Dead Nodes 0 (Decommissioned: 0)
Decommissioning Nodes 0
Number of Under-Replicated Blocks 0
Number of Blocks Pending Deletion 0
Block Deletion Start Time 4/18/2015, 3:53:55 PM

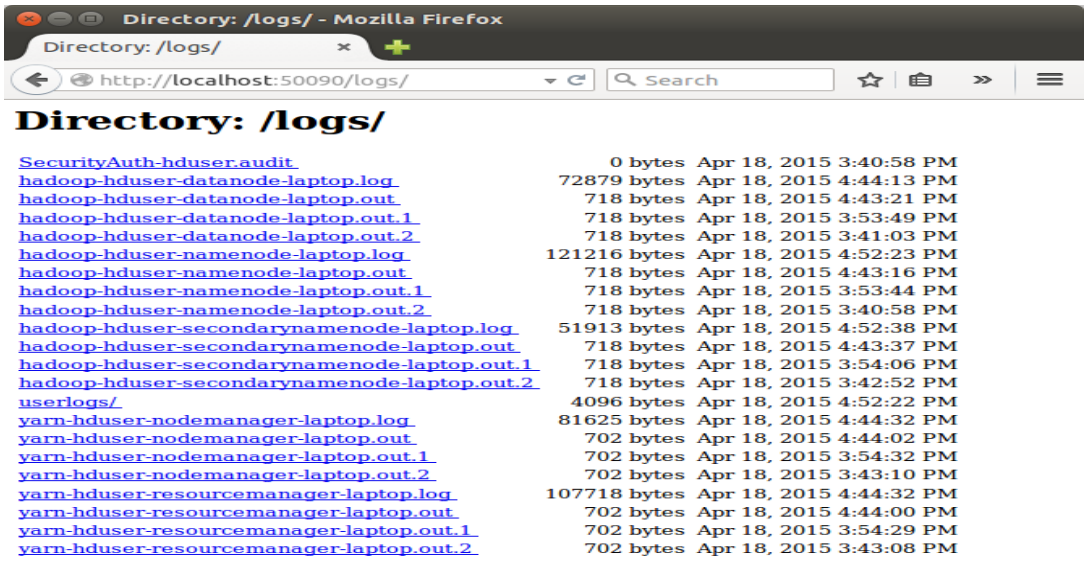


Secondary Name Node



Data Node





RESULT:

Thus, the single-node Hadoop cluster backed by the Hadoop Distributed File System on Ubuntu is installed successfully.

EX.NO:2	IMPLEMENTATION OF WORD COUNT / FREQUENCY PROGRAMS USING MAPREDUCE
DATE:	

AIM:

To write a java program for counting the number of occurrences of each word in a text file using the MapReduce concepts.

PROCEDURE:

1. Install hadoop.
2. Start all services using the command.

```
hduser@prince-VirtualBox:/usr/local/hadoop/bin$ jps
3242 Jps

hduser@prince-VirtualBox:/usr/local/hadoop/bin$ start-all.sh
This script is Deprecated. Instead use start-dfs.sh and start-yarn.sh
16/09/15 15:38:49 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your
platform... using builtin-java classes where applicable
Starting namenodes on [localhost]
localhost: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser-namenode-prince-
VirtualBox.out
localhost: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-prince-
VirtualBox.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-hduser-
secondarynamenode-prince-VirtualBox.out
16/09/15 15:39:26 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your
platform... using builtin-java classes where applicable
starting yarn daemons
startingresourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resourcemanager-prince-
VirtualBox.out
localhost: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-
prince-VirtualBox.out

hduser@prince-VirtualBox:/usr/local/hadoop/bin$ jps
16098 NameNode
16214 DataNode
16761 NodeManager
16636 ResourceManager
16429 SecondaryNameNode
19231 Jps
```

PROGRAM CODING:

hduser@prince-VirtualBox:/usr/local/hadoop/bin$ **nano wordcount7.java**

```
importjava.io.IOException;
importjava.util.StringTokenizer;
importorg.apache.hadoop.conf.Configuration;
importorg.apache.hadoop.fs.Path;
importorg.apache.hadoop.io.IntWritable;
importorg.apache.hadoop.io.Text;
importorg.apache.hadoop.mapreduce.Job;
importorg.apache.hadoop.mapreduce.Mapper;
importorg.apache.hadoop.mapreduce.Reducer;
importorg.apache.hadoop.mapreduce.lib.input.FileInputFormat;
importorg.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
public class wordcount7 {
public static class TokenizerMapper
extends Mapper<Object, Text, Text, IntWritable>{
private final static IntWritable one = new IntWritable(1);
private Text word = new Text();
public void map(Object key, Text value, Context context)
throws IOException, InterruptedException {
StringTokenizeritr = new StringTokenizer(value.toString());
while (itr.hasMoreTokens()) {
word.set(itr.nextToken());
context.write(word, one);
}
}
}
public static class IntSumReducer
extends Reducer<Text,IntWritable,Text,IntWritable> {
privateIntWritable result = new IntWritable();
public void reduce(Text key, Iterable<IntWritable> values,
Context context
) throws IOException, InterruptedException {
int sum = 0;
for (IntWritableval : values) {
sum += val.get();
}
result.set(sum);
context.write(key, result);
}
}

public static void main(String[] args) throws Exception {
Configuration conf = new Configuration();
Job job = Job.getInstance(conf, "word count");
job.setJarByClass(wordcount7.class);
job.setMapperClass(TokenizerMapper.class);
job.setCombinerClass(IntSumReducer.class);
job.setReducerClass(IntSumReducer.class);
job.setOutputKeyClass(Text.class);
```

```
job.setOutputValueClass(IntWritable.class);
FileInputFormat.addInputPath(job, new Path(args[0]));
FileOutputFormat.setOutputPath(job, new Path(args[1]));
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
}
```

TO COMPILE:

hduser@prince-VirtualBox:/usr/local/hadoop/bin$ **hadoopcom.sun.tools.javac.Main wordcount7.java**

TO CREATE A JAR FILE:

hduser@prince-VirtualBox:/usr/local/hadoop/bin$ **jar cf wc2.jar wordcount7*.java**

TO CREATE A DIRECTORY IN HDFS:

hduser@prince-VirtualBox:/usr/local/hadoop/bin$**hadoopdfs -mkdir /deepika**

TO LOAD INPUT FILE:

hduser@prince-VirtualBox:/usr/local/hadoop/bin$**hdfs -put /home/prince/Downloads/wc.txt /deepika/wc1**

TO EXECUTE:

@prince-VirtualBox:/usr/local/hadoop/bin$ **hadoop jar wc2.jar wordcount7 /deepika/wc1.txt /deepika/out2**

```
16/09/16 14:34:16 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
16/09/16 14:34:17 INFO Configuration.deprecation: session.id is deprecated. Instead, use dfs.metrics.session-id
16/09/16 14:34:17 INFO jvm.JvmMetrics: Initializing JVM Metrics with processName=JobTracker, sessionId=
16/09/16 14:34:17 WARN mapreduce.JobSubmitter: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
16/09/16 14:34:17 INFO input.FileInputFormat: Total input paths to process : 1
16/09/16 14:34:17 INFO mapreduce.JobSubmitter: number of splits:1
16/09/16 14:34:18 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_local364071501_0001
16/09/16 14:34:18 INFO mapreduce.Job: The url to track the job: http://localhost:8080/
16/09/16 14:34:18 INFO mapreduce.Job: Running job: job_local364071501_0001
16/09/16 14:34:18 INFO mapred.LocalJobRunner: OutputCommitter set in config null
16/09/16 14:34:19 INFO mapred.LocalJobRunner: OutputCommitter is org.apache.hadoop.mapreduce.lib.output.FileOutputCommitter
16/09/16 14:34:19 INFO mapred.LocalJobRunner: Waiting for map tasks
16/09/16 14:34:19 INFO mapred.LocalJobRunner: Starting task: attempt_local364071501_0001_m_000000_0
16/09/16 14:34:19 INFO mapred.Task: Using ResourceCalculatorProcessTree : [ ]
16/09/16 14:34:19 INFO mapred.MapTask: Processing split: hdfs://localhost:54310/deepika/wc1:0+712
16/09/16 14:34:19 INFO mapreduce.Job: Job job_local364071501_0001 running in ubermode : false
```

16/09/16 14:34:23 INFO mapreduce.Job: map 0% reduce 0%
16/09/16 14:34:24 INFO mapred.MapTask: (EQUATOR) 0 kvi 26214396(104857584)
16/09/16 14:34:24 INFO mapred.MapTask: mapreduce.task.io.sort.mb: 100
16/09/16 14:34:24 INFO mapred.MapTask: soft limit at 83886080
16/09/16 14:34:24 INFO mapred.MapTask: bufstart = 0; bufvoid = 104857600
16/09/16 14:34:24 INFO mapred.MapTask: kvstart = 26214396; length = 6553600
16/09/16 14:34:24 INFO mapred.MapTask: Map output collector class = org.apache.hadoop.mapred.MapTask$MapOutputBuffer
16/09/16 14:34:26 INFO mapred.LocalJobRunner:
16/09/16 14:34:26 INFO mapred.MapTask: Starting flush of map output
16/09/16 14:34:26 INFO mapred.MapTask: Spilling map output
16/09/16 14:34:26 INFO mapred.MapTask: bufstart = 0; bufend = 1079; bufvoid = 104857600
16/09/16 14:34:26 INFO mapred.MapTask: kvstart = 26214396(104857584); kvend = 26214032(104856128); length = 365/6553600
16/09/16 14:34:26 INFO mapred.MapTask: Finished spill 0
16/09/16 14:34:26 INFO mapred.Task: Task:attempt_local364071501_0001_m_000000_0 is done. And is in the process of committing
16/09/16 14:34:26 INFO mapred.LocalJobRunner: map
16/09/16 14:34:26 INFO mapred.Task: Task 'attempt_local364071501_0001_m_000000_0' done.
16/09/16 14:34:26 INFO mapred.LocalJobRunner: Finishing task: attempt_local364071501_0001_m_000000_0
16/09/16 14:34:26 INFO mapred.LocalJobRunner: map task executor complete.
16/09/16 14:34:26 INFO mapred.LocalJobRunner: Waiting for reduce tasks
16/09/16 14:34:26 INFO mapred.LocalJobRunner: Starting task: attempt_local364071501_0001_r_000000_0
16/09/16 14:34:26 INFO mapred.Task: Using ResourceCalculatorProcessTree : [ ]
16/09/16 14:34:26 INFO mapred.ReduceTask: Using ShuffleConsumerPlugin: org.apache.hadoop.mapreduce.task.reduce.Shuffle@2ee9ab75
16/09/16 14:34:26 INFO mapreduce.Job: map 100% reduce 0%
16/09/16 14:34:26 INFO reduce.MergeManagerImpl: MergerManager: memoryLimit=363285696, maxSingleShuffleLimit=90821424, mergeThreshold=239768576, ioSortFactor=10, memToMemMergeOutputsThreshold=10
16/09/16 14:34:26 INFO reduce.EventFetcher: attempt_local364071501_0001_r_000000_0 Thread started: EventFetcher for fetching Map Completion Events
16/09/16 14:34:26 INFO reduce.LocalFetcher: localfetcher#1 about to shuffle output of map attempt_local364071501_0001_m_000000_0 decomp: 1014 len: 1018 to MEMORY
16/09/16 14:34:27 INFO reduce.InMemoryMapOutput: Read 1014 bytes from map-output for attempt_local364071501_0001_m_000000_0
16/09/16 14:34:27 INFO reduce.MergeManagerImpl: closeInMemoryFile -> map-output of size: 1014, inMemoryMapOutputs.size() -> 1, commitMemory -> 0, usedMemory ->1014
16/09/16 14:34:27 INFO reduce.EventFetcher: EventFetcher is interrupted.. Returning
16/09/16 14:34:27 INFO mapred.LocalJobRunner: 1 / 1 copied.
16/09/16 14:34:27 INFO reduce.MergeManagerImpl: finalMerge called with 1 in-memory map-outputs and 0 on-disk map-outputs
16/09/16 14:34:27 INFO mapred.Merger: Merging 1 sorted segments
16/09/16 14:34:27 INFO mapred.Merger: Down to the last merge-pass, with 1 segments left of total size: 991 bytes
16/09/16 14:34:27 INFO reduce.MergeManagerImpl: Merged 1 segments, 1014 bytes to disk to satisfy reduce memory limit
16/09/16 14:34:27 INFO reduce.MergeManagerImpl: Merging 1 files, 1018 bytes from disk

16/09/16 14:34:27 INFO reduce.MergeManagerImpl: Merging 0 segments, 0 bytes from memory into reduce
16/09/16 14:34:27 INFO mapred.Merger: Merging 1 sorted segments
16/09/16 14:34:27 INFO mapred.Merger: Down to the last merge-pass, with 1 segments left of total size: 991 bytes
16/09/16 14:34:27 INFO mapred.LocalJobRunner: 1 / 1 copied.
16/09/16 14:34:27 INFO Configuration.deprecation: mapred.skip.on is deprecated. Instead, use mapreduce.job.skiprecords
16/09/16 14:34:30 INFO mapred.Task: Task:attempt_local364071501_0001_r_000000_0 is done. And is in the process of committing
16/09/16 14:34:30 INFO mapred.LocalJobRunner: 1 / 1 copied.
16/09/16 14:34:30 INFO mapred.Task: Task attempt_local364071501_0001_r_000000_0 is allowed to commit now
16/09/16 14:34:30 INFO output.FileOutputCommitter: Saved output of task 'attempt_local364071501_0001_r_000000_0' to hdfs://localhost:54310/deepika/out2/_temporary/0/task_local364071501_0001_r_000000
16/09/16 14:34:30 INFO mapred.LocalJobRunner: reduce > reduce
16/09/16 14:34:30 INFO mapred.Task: Task 'attempt_local364071501_0001_r_000000_0' done.
16/09/16 14:34:30 INFO mapred.LocalJobRunner: Finishing task: attempt_local364071501_0001_r_000000_0
16/09/16 14:34:30 INFO mapred.LocalJobRunner: reduce task executor complete.
16/09/16 14:34:30 INFO mapreduce.Job: map 100% reduce 100%
16/09/16 14:34:31 INFO mapreduce.Job: Job job_local364071501_0001 completed successfully
16/09/16 14:34:31 INFO mapreduce.Job: Counters: 38
File System Counters
FILE: Number of bytes read=8552
FILE: Number of bytes written=507858
FILE: Number of read operations=0
FILE: Number of large read operations=0
FILE: Number of write operations=0
HDFS: Number of bytes read=1424
HDFS: Number of bytes written=724
HDFS: Number of read operations=13
HDFS: Number of large read operations=0
HDFS: Number of write operations=4
Map-Reduce Framework
Map input records=10
Map output records=92
Map output bytes=1079
Map output materialized bytes=1018
Input split bytes=99
Combine input records=92
Combine output records=72
Reduce input groups=72
Reduce shuffle bytes=1018
Reduce input records=72
Reduce output records=72
Spilled Records=144
Shuffled Maps =1
Failed Shuffles=0
Merged Map outputs=1

GC time elapsed (ms)=111
CPU time spent (ms)=0
Physical memory (bytes) snapshot=0
Virtual memory (bytes) snapshot=0
Total committed heap usage (bytes)=242360320
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=712
File Output Format Counters
Bytes Written=724

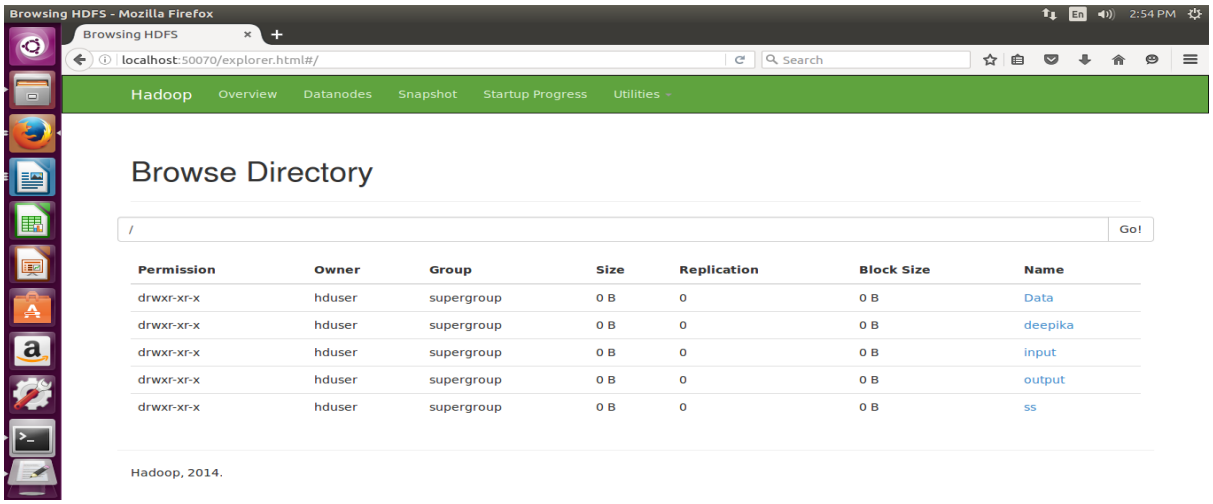
INPUT FILE:

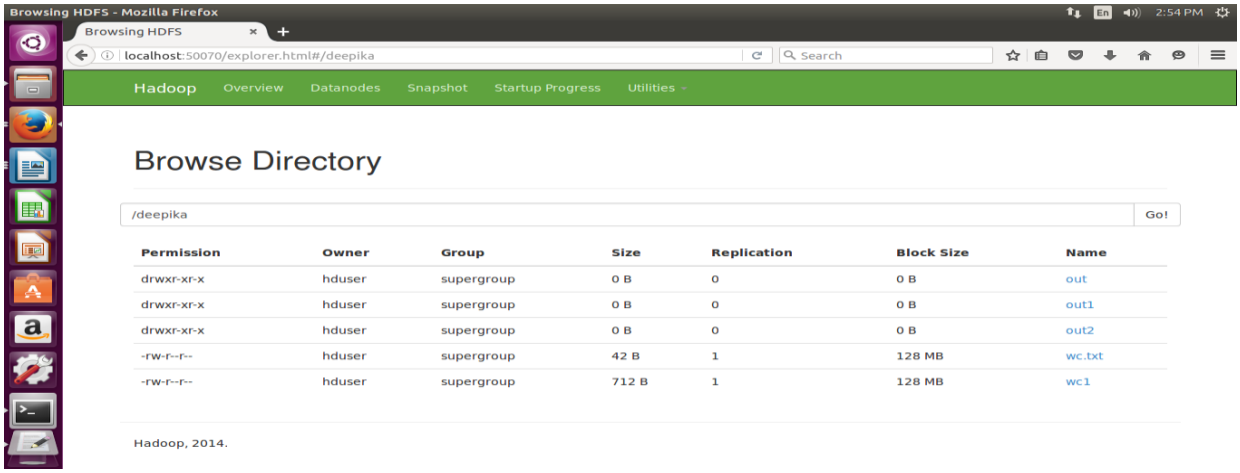
wc1.txt

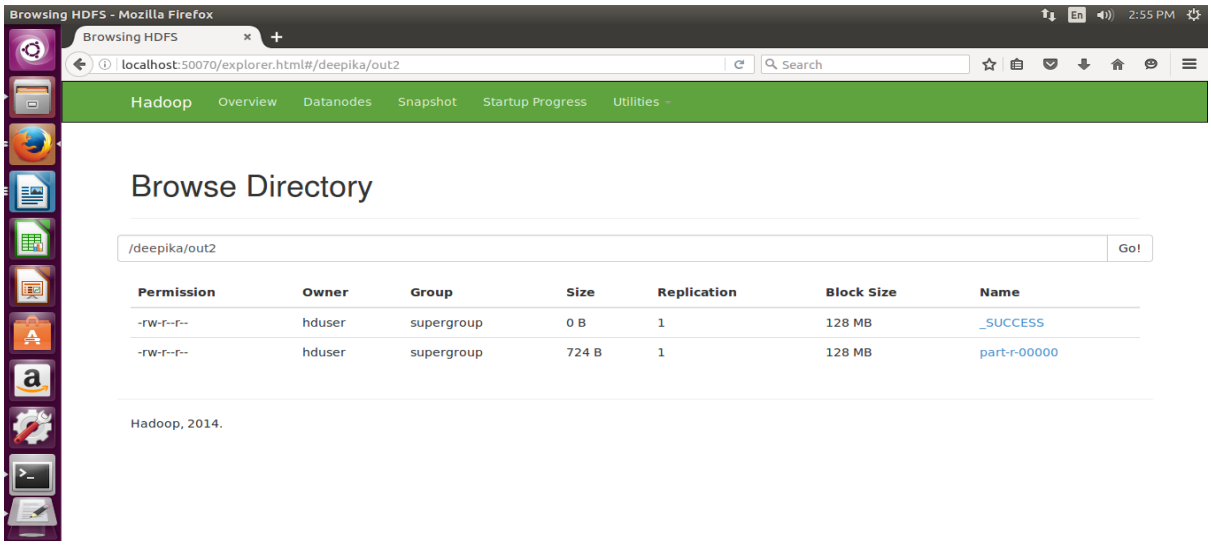
STEPS:

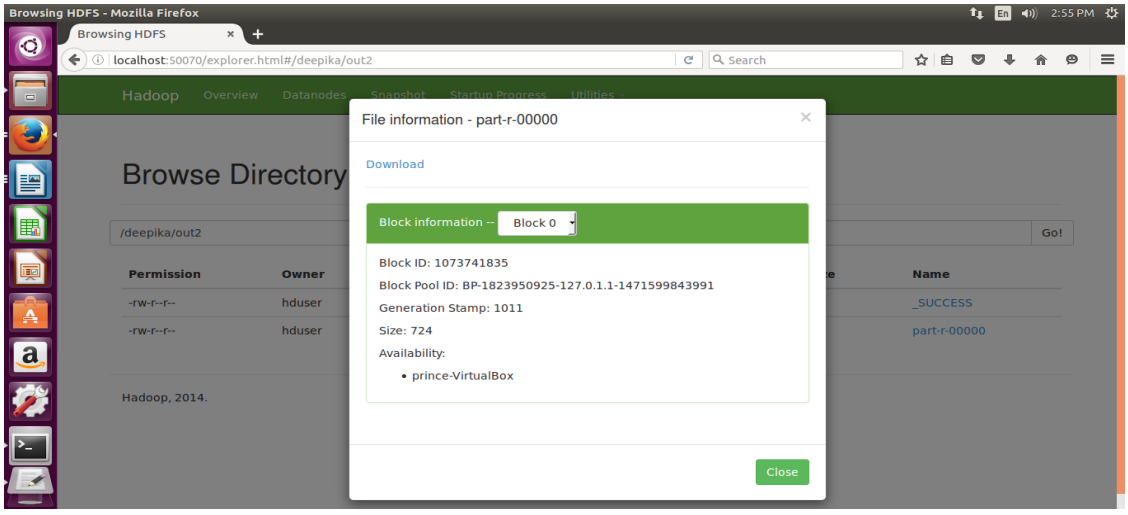
1. Open an editor and type WordCount program and save as WordCount.java
2. Set the path as export HADOOP_CLASSPATH=${JAVA_HOME}/lib/tools.jar
3. To compile the program, bin/hadoopcom.sun.tools.javac.Main WordCount.java
4. Create a jar file, jar cf wc.jar WordCount*.class
5. Create input files input.txt,input1.txt and input2.txt and create a directory in hdfs, /mit/wordcount/input
6. Move these i/p files to hdfs system, bin/hadoopfs –put /opt/hadoop-2.7.0/input.txt /mit/wordcount/input/input.txt repeat this step for other two i/p files.
7. To execute, bin/hadoop jar wc.jar WordCount /mit/wordcount/input /mit/wordcount/output.
8. The mapreduce result will be available in the output directory.

OUTPUT:









/mit/wordcount/input 2
/mit/wordcount/input/input.txt 1
/mit/wordcount/output. 1
/opt/hadoop-2.7.0/input.txt 1
1. 1
2. 1
3. 1

4. 1
5. 1
6. 1
7. 1
8. 1
Create 2
HADOOP_CLASSPATH=${JAVA_HOME}/lib/tools.jar 1
Move 1
Open 1
STEPS: 1
Set 1
The 1
To 2
WordCount 2
WordCount*.class 1
WordCount.java 2
a 2
an 1
and 4
as 2
available 1
be 1
bin/hadoop 3
cf 1
com.sun.tools.javac.Main 1
compile 1
create 1
directory 1
directory. 1
editor 1
execute, 1
export 1
file, 1
files 2
files. 1
for 1
fs 1
hdfs 1
hdfs, 1
i/p 2
in 2
input 1
input.txt,input1.txt 1
input2.txt 1
jar 3
mapreduce 1
other 1
output 1
path 1
program 1
program, 1

repeat 1
result 1
save 1
step 1
system, 1
the 3
these 1
this 1
to 1
two 1
type 1
wc.jar 2
will 1
–put 1

RESULT:

Thus, the java program for counting the number of occurrences of each word in a text file using the MapReduce concepts is executed successfully.

EX.NO:3	IMPLEMENTATION OF AN MR PROGRAM THAT PROCESSES A WEATHER DATASET
DATE:	

AIM:

To implement an MR program that processes a weather dataset.

PROGRAM:

AverageMapper.java

```
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import java.io.IOException;

public class AverageMapper extends Mapper <LongWritable, Text, Text, IntWritable>
{
public static final int MISSING = 9999;
public void map(LongWritable key, Text value, Context context)
throwsIOException,  InterruptedException
        {
                String line = value.toString();
                String year =
                line.substring(15,19);int
                temperature;
                if (line.charAt(87)=='+')
                        temperature = Integer.parseInt(line.substring(88, 92));
                else
                        temperature = Integer.parseInt(line.substring(87, 92));
                String quality = line.substring(92, 93);
                if(temperature != MISSING && quality.matches("[01459]"))
                context.write(new Text(year),new IntWritable(temperature));
        }
}
```

AverageReducer.java

```
import org.apache.hadoop.mapreduce.*;
import java.io.IOException;

public class AverageReducer extends Reducer <Text, IntWritable,Text, IntWritable >
 {
public void reduce(Text key,  Iterable<IntWritable> values, Context context) throws IOException,
InterruptedException
        {
        int max_temp =
        0;int count = 0;
        for (IntWritable value : values)
                {
                        max_temp +=
                        value.get();count+=1;
                }
        context.write(key, new IntWritable(max_temp/count));
        }                               }
```

AverageDriver.java

```
import org.apache.hadoop.io.*;
import org.apache.hadoop.fs.*;
import org.apache.hadoop.mapreduce.*;
import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class AverageDriver
{
      public static void main (String[] args) throws Exception
      {
              if (args.length != 2)
              {
                   System.err.println("Please Enter the input and output parameters");
```

```
            System.exit(-1);
        }

        Job job = new Job(); job.setJarByClass(AverageDriver.class);
        job.setJobName("Max temperature");

        FileInputFormat.addInputPath(job,new Path(args[0]));
        FileOutputFormat.setOutputPath(job,new Path (args[1]));

        job.setMapperClass(AverageMapper.class);
        job.setReducerClass(AverageReducer.class);

        job.setOutputKeyClass(Text.class);
        job.setOutputValueClass(IntWritable.class);

        System.exit(job.waitForCompletion(true)?0:1);
    }
}
```

RESULT:

Thus, the MR program that processes a weather dataset is implemented and executed successfully.

EX.NO:4a	IMPLEMENTATION OF LINEAR REGRESSION
DATE:	

AIM:

To implement the linear regression using R Language.

PROCEDURE:

1. Linear regression is used to predict a quantitative outcome variable (y) on the basis of one or multiple predictor variables (x).

2. The goal is to build a mathematical formula that defines y as a function of the x variable.

3. When you build a regression model, you need to assess the performance of the predictive model.

4. Two important metrics are commonly used to assess the performance of the predictive regression model:

5. Root Mean Squared Error, which measures the model prediction error. It corresponds to the average difference between the observed known values of the outcome and the predicted value by the model. RMSE is computed as RMSE = mean((observeds - predicteds)^2) %>% sqrt(). The lower the RMSE, the better the model.

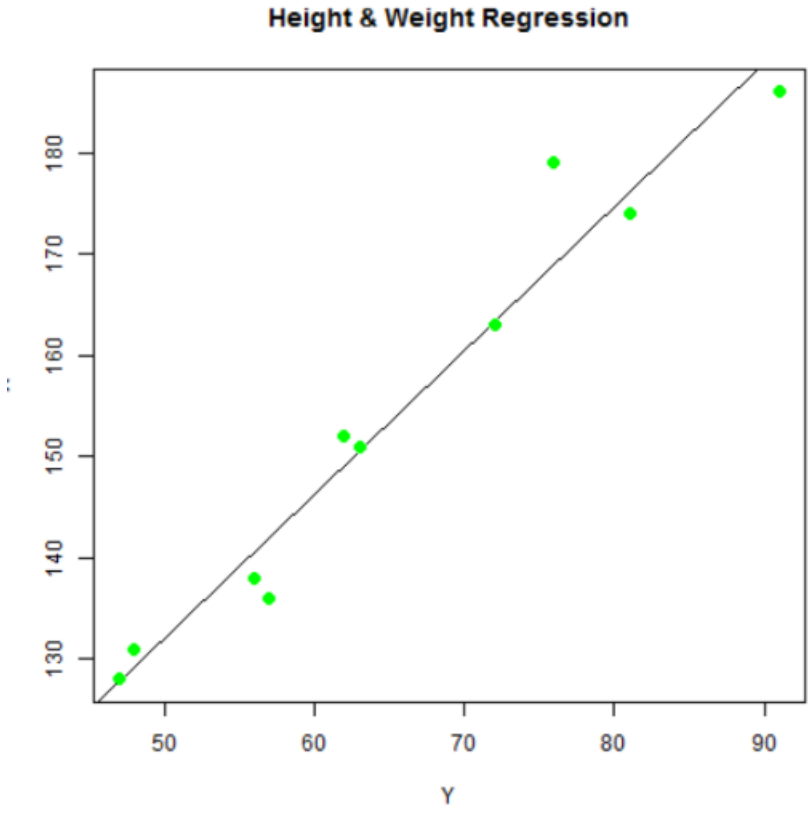
6. R-square, representing the squared correlation between the observed known outcome values and the predicted values by the model. The higher the R2, the better the model.

PROGRAM:

```
X=c(151,174,138,186,128,136,179,163,152,131)
Y=c(63,81,56,91,47,57,76,72,62,48)
plot(X,Y)
relation=lm(Y~X)
print(relation)
print(summary(relation))
a=data.frame(X=170)
result=predict(relation,a)
print(result)
png(file="linearregression.png")
plot(Y,X,col="green",main="Height & Weight Regression",abline(lm(X~Y)),
cex=1.3,pch=16,Xlab="Weight in kg",Ylab="Height in cm")
dev.off()
```

OUTPUT:

```
  > a=data.frame(X=170)
>result=predict(relation,a)
>print(result)
1
76.22869
>png(file="linearregression.png")
>plot(Y,X,col="green",main="Height & Weight Regression",abline(lm(X~Y)),
cex=1.3,pch=16,Xlab="Weight in kg",Ylab="Height in cm")
>dev.off()
RStudioGD
```



RESULT:

Thus, the implementation of linear regression was executed and verified successfully.

EX.NO:4b	IMPLEMENTATION OF LOGISTIC REGRESSION
DATE:	

AIM:

To implement the logistic regression using R programming language.

PROCEDURE:

1. Logistic regression is used to predict the class of individuals based on one or multiple predictor variables (x).
2. It is used to model a binary outcome, that is a variable, which can have only two possible values: 0 or 1, yes or no, diseased or non-diseased.
3. Logistic regression belongs to a family, named Generalized Linear Model (GLM), developed for extending the linear regression model to other situations.
4. Other synonyms are binary logistic regression, binomial logistic regression and logit model.
5. Logistic regression does not return directly the class of observations. It allows us to estimate the probability (p) of class membership. The probability will range between 0 and 1.

PROGRAM:

```
input=mtcars[,c("am","cyl","hp","wt")]
am.data=glm(formula=am~cyl+hp+wt,data=input,family = binomial)
print(summary(am.data))
```

OUTPUT:

Call:

glm(formula = am ~ cyl + hp + wt, family = binomial, data = input)

Deviance Residuals:

Min 1Q Median 3Q Max

-2.17272 -0.14907 -0.01464 0.14116 1.27641

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 19.70288 8.11637 2.428 0.0152 *

cyl 0.48760 1.07162 0.455 0.6491

hp 0.03259 0.01886 1.728 0.0840 .

wt -9.14947 4.15332 -2.203 0.0276 *

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 43.2297 on 31 degrees of freedom

Residual deviance: 9.8415 on 28 degrees of freedom

AIC: 17.841

Number of Fisher Scoring iterations: 8

RESULT:

Thus, the implementation of logistic regression was executed and verified successfully.

EX.NO:5a	IMPLEMENTATION OF SVM CLASSIFICATION TECHNIQUE
DATE:	

AIM:

To implement SVM Classification using R Language.

PROCEDURE:

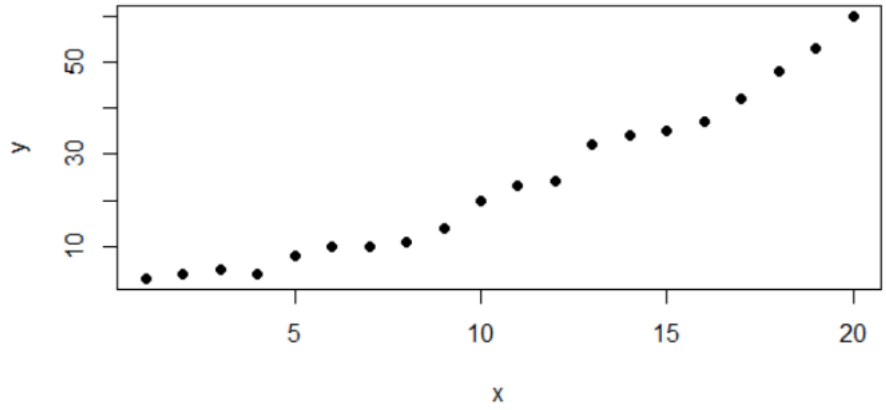
1. To use SVM in R, we have a package e1071.
2. The package is not preinstalled, hence one needs to run the line "install.packages("e1071") to install the package.
3. Then import the package contents using the library command--library(e1071)

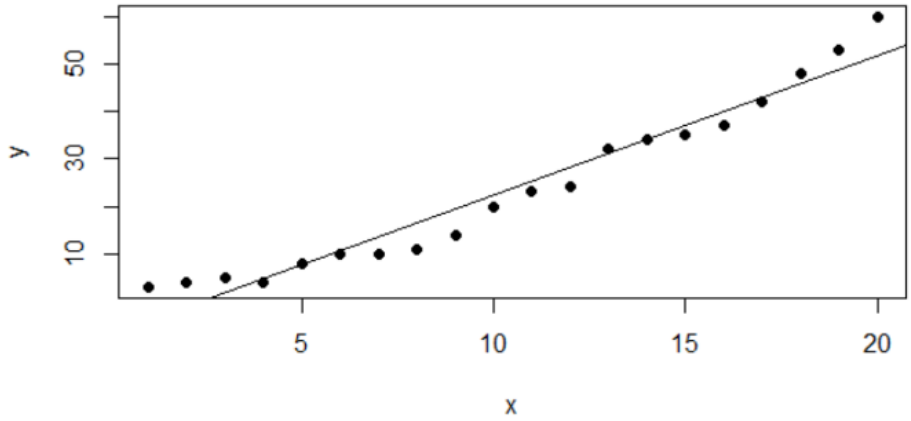
PROGRAM:

```
x=c(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20)
y=c(3,4,5,4,8,10,10,11,14,20,23,24,32,34,35,37,42,48,53,60)
#Create a data frame of the data
train=data.frame(x,y)
#Plot the dataset
plot(train,pch=16)
#Linear regression
model<- lm(y ~ x, train)
#Plot the model using abline
abline(model)
#SVM
library(e1071)
#Fit a model. The function syntax is very similar to lm function
model_svm<- svm(y ~ x , train)
#Use the predictions on the data
pred<- predict(model_svm, train)
#Plot the predictions and the plot to see our model fit
points(train$x, pred, col = "blue", pch=4)

error<- model$residuals
lm_error<- sqrt(mean(error^2)) # 3.832974
predictions (pred)
error_2 <- train$y - pred
svm_error<- sqrt(mean(error_2^2)) # 2.696281
svm_tune<- tune(svm, y ~ x, data = train,
ranges = list(epsilon = seq(0,1,0.01), cost = 2^(2:9)))
print(svm_tune)
best_mod<- svm_tune$best.model
best_mod_pred<- predict(best_mod, train)
error_best_mod<- train$y - best_mod_pred
# this value can be different on your computer
# because the tune method randomly shuffles the data
```

```
best_mod_RMSE<- sqrt(mean(error_best_mod^2)) # 1.290738
plot(svm_tune)
plot(train,pch=16)
points(train$x, best_mod_pred, col = "blue", pch=4)
```

OUTPUT:





RESULT:

Thus, the implementation of SVM was executed and verified successfully.

EX.NO:5b	IMPLEMENTATION OF DECISSION TREE CLASSIFICATION TECHNIQUE
DATE:	

AIM:

To implement decision tree classification using R Language.

PROCEDURE:

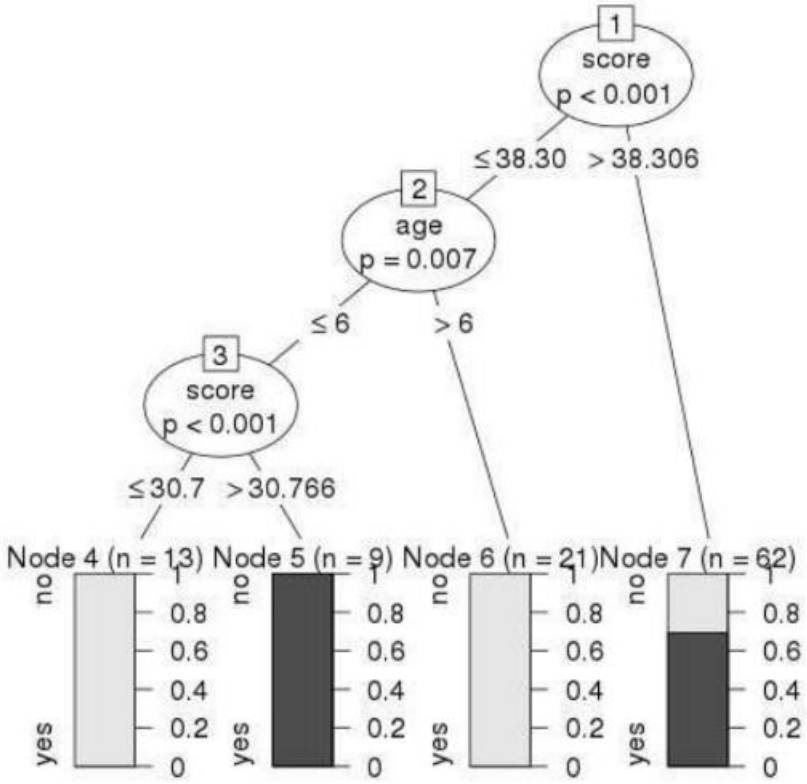
1. Install party packages
a. install.packages("party")
i. it has the ctree function.
2. Create the input data
i. # Create the input data frame.
ii. input.dat <- readingSkills[c(1:105),]
3. Give the chart file a name.
i. png(file = "decision_tree.png")
4. Create the tree.
i. output.tree <- ctree(nativeSpeaker ~ age + shoeSize + score, data = input.dat)
5. Plot the tree.
i. plot(output.tree)
6. Save the file
i. dev.off()

PROGRAM:

```
library(party)
input.dat <- readingSkills[c(1:105),]
png(file = "decision_tree.png")
output.tree <- ctree( nativeSpeaker ~ age + shoeSize + score, data = input.dat)
plot(output.tree)
dev.off()
```

OUTPUT:

```
null device
1
Loading required package: methods
Loading required package: grid
Loading required package: mvtnorm
Loading required package: modeltools
Loading required package: stats4
Loading required package: strucchange
Loading required package: zoo
Attaching package: ‘zoo’
The following objects are masked from ‘package:base’: as.Date, as.Date.numeric
Loading required package: sandwich
```



RESULT:

Thus, the implementation of decision tree classification was executed and verified successfully.

EX.NO:6a	IMPLEMENTATION OF HIERARCHICAL CLUSTERING
DATE:	

AIM:

To implement clustering techniques using hierarchical clustering.

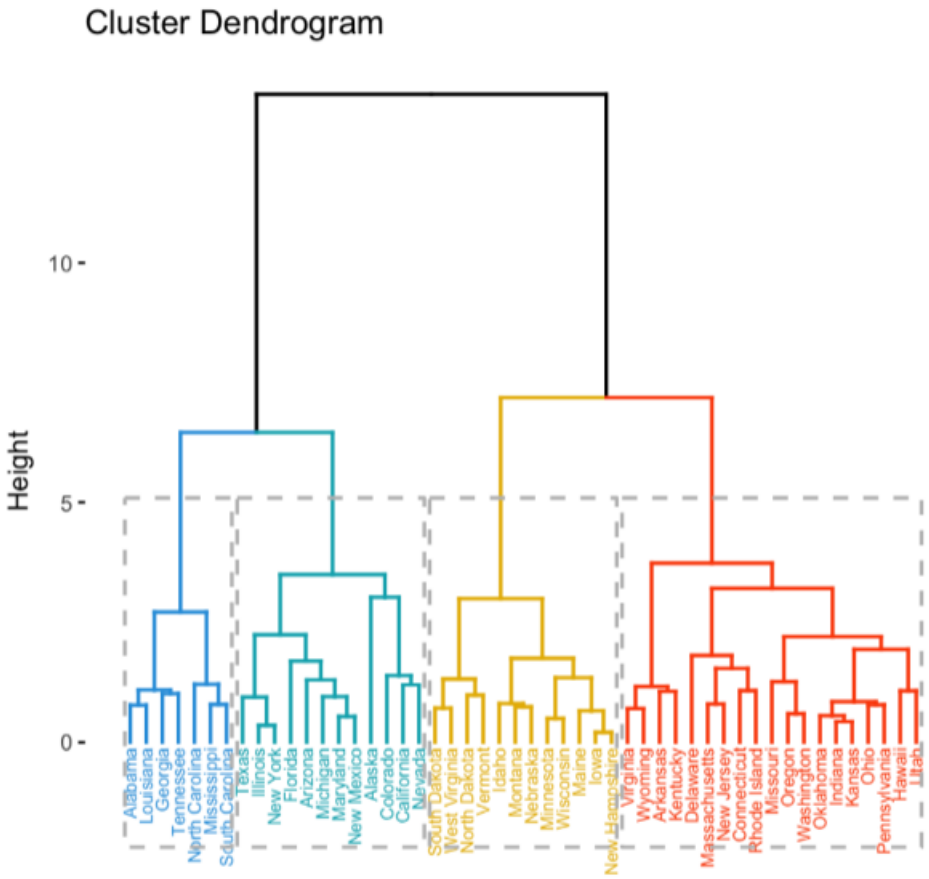
PROCEDURE:

1. Hierarchical clustering is an alternative approach to partitioning clustering for identifying groups in the dataset.
2. It does not require to pre-specify the number of clusters to be generated.
3. The result of hierarchical clustering is a tree-based representation of the objects, which is JYYalso known as dendrogram.
4. Observations can be subdivided into groups by cutting the dendrogram at a desired similarity level.
5. R code to compute and visualize hierarchical clustering.

PROGRAM:

```
install.packages("factoextra")
install.packages("cluster")
install.packages("magrittr")
library("factoextra")
library("cluster")
library("magrittr")
res.hc <- USArrests %>%
scale() %>%
# Scale the data
dist(method = "euclidean") %>% # Compute dissimilarity matrix
hclust(method = "ward.D2") # Compute hierachical clustering
# Visualize using factoextra
# Cut in 4 groups and color by groups
fviz_dend(res.hc, k = 4, # Cut in four groups
cex = 0.5, # label size
k_colors = c("#2E9FDF", "#00AFBB", "#E7B800", "#FC4E07"),
color_labels_by_k = TRUE, # color labels by groups
rect = TRUE # Add rectangle around groups
)
```

OUTPUT:



RESULT:

Thus, the implementation of clustering techniques using hierarchical clustering was executed and verified successfully.

EX.NO:6b	IMPLEMENTATION OF PARTITIONING CLUSTERING
DATE:	

AIM:

To implement the clustering techniques using partitioning clustering.

PROCEDURE:

1. Partitioning algorithms are clustering techniques that subdivide the data sets into a set of k groups, where k is the number of groups pre-specified by the analyst.

2. There are different types of partitioning clustering methods. The most popular is the K-means clustering (MacQueen 1967), in which, each cluster is represented by the center or means of the data points belonging to the cluster. The K-means method is sensitive to outliers.

3. An alternative to k-means clustering is the K-medoids clustering or PAM (Partitioning Around Medoids, Kaufman & Rousseeuw, 1990), which is less sensitive to outliers compared to k-means.

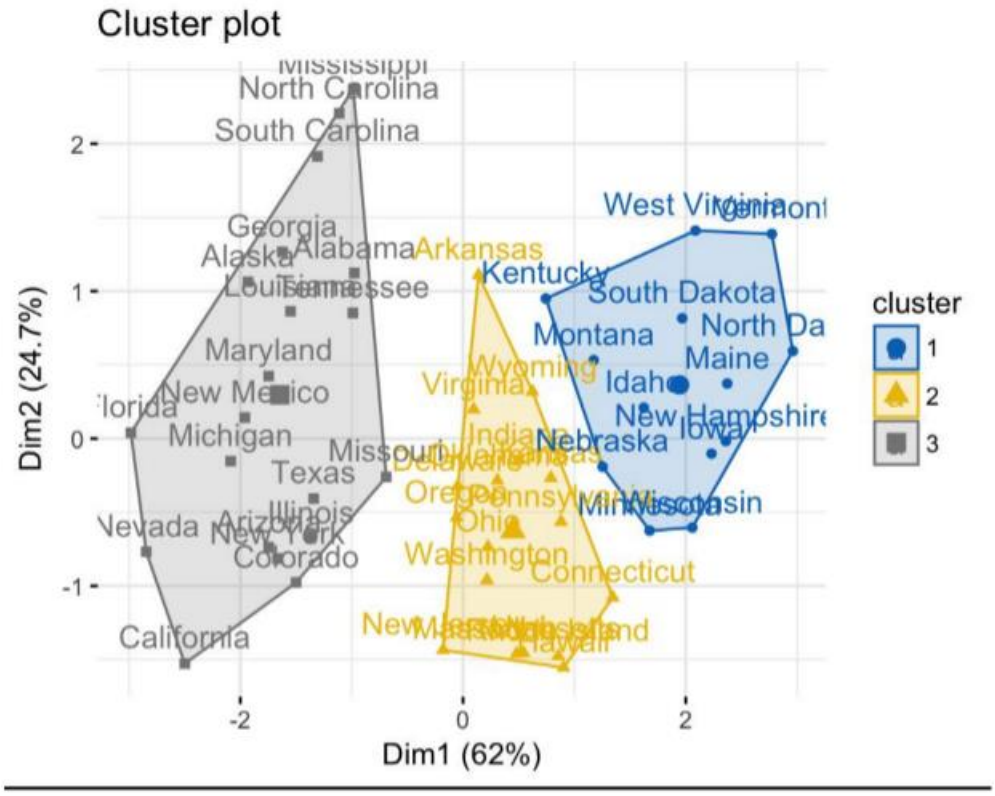
4. Determining the optimal number of clusters: use factoextra::fviz_nbclust()

5. Compute and visualize k-means clustering.

PROGRAM:

```
install.packages("factoextra")
install.packages("magrittr")
install.packages("cluster")
library("factoextra")
library("magrittr")
library("cluster")
set.seed(123)
km.res<-kmeans(my_data, 3, nstart=25)
# Visualize
library("factoextra")
fviz_cluster(km.res, data=my_data,
ellipse.type="convex",
palette="jco",
ggtheme=theme_minimal())
```

OUTPUT:



RESULT:

Thus, the implementation of clustering techniques using partitioning clustering was executed and verified successfully.

EX.NO:6c	IMPLEMENTATION OF FUZZY CLUSTERING
DATE:	

AIM:

To implement the clustering techniques using fuzzy clustering.

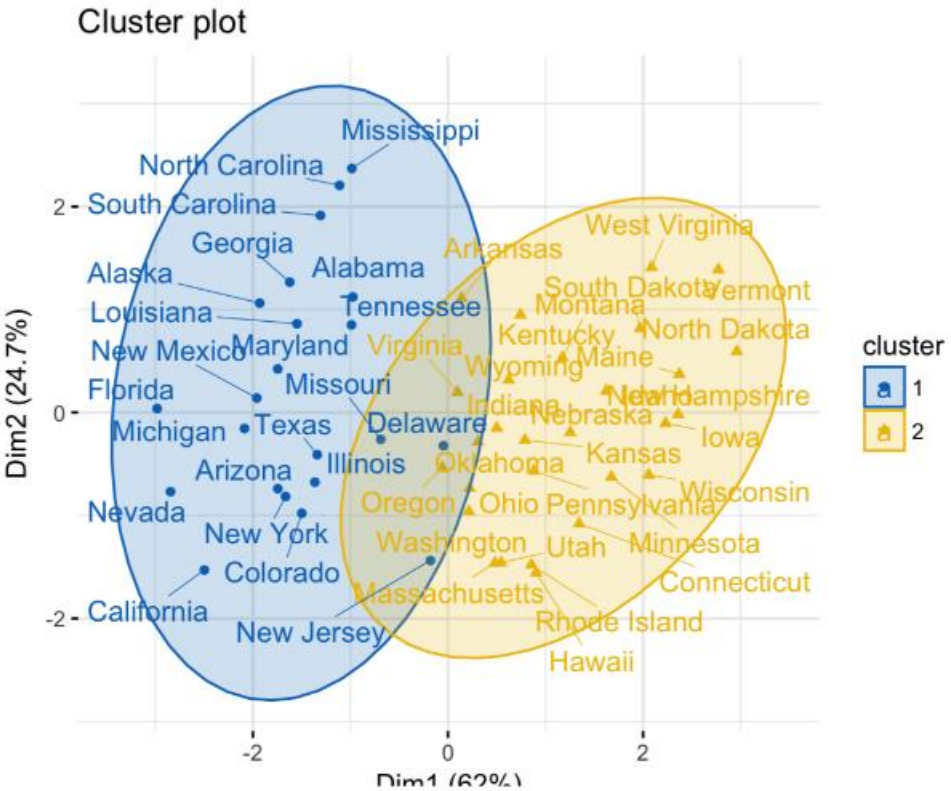
PROCEDURE:

1. Fuzzy clustering is also known as soft method. Standard clustering approaches produce partitions (K-means, PAM), in which each observation belongs to only one cluster. This is known as hard clustering.
2. In Fuzzy clustering, items can be a member of more than one cluster. The Fuzzy c-means method is the most popular fuzzy clustering algorithm.
3. Cluster for computing fuzzy clustering
4. factoextra for visualizing clusters.
5. The function fanny()can be used to compute fuzzy clustering.
6. Compute and visualize fuzzy clustering using the combination of cluster and factoextra R packages.

PROGRAM:

```
install.packages("factoextra")
install.packages("magrittr")
install.packages("cluster")
library("factoextra")
library("magrittr")
library("cluster")
library(cluster)
df<-scale(USArrests)# Standardize the data
res.fanny<-fanny(df, 2)# Compute fuzzy clustering with k = 2
head(res.fanny$membership, 3)# Membership coefficients
res.fanny$coeff# Dunn's partition coefficient
head(res.fanny$clustering)# Observation groups
library(factoextra)
fviz_cluster(res.fanny, ellipse.type="norm", repel=TRUE,
palette="jco", ggtheme=theme_minimal(),
legend="right")
```

OUTPUT:



RESULT:

Thus, the implementation of clustering techniques using fuzzy clustering was executed and verified successfully.

EX.NO:7a	IMPLEMENTATION OF DENSITY BASED CLUSTERING
DATE:	

AIM:

To implement the clustering techniques using density-based clustering.

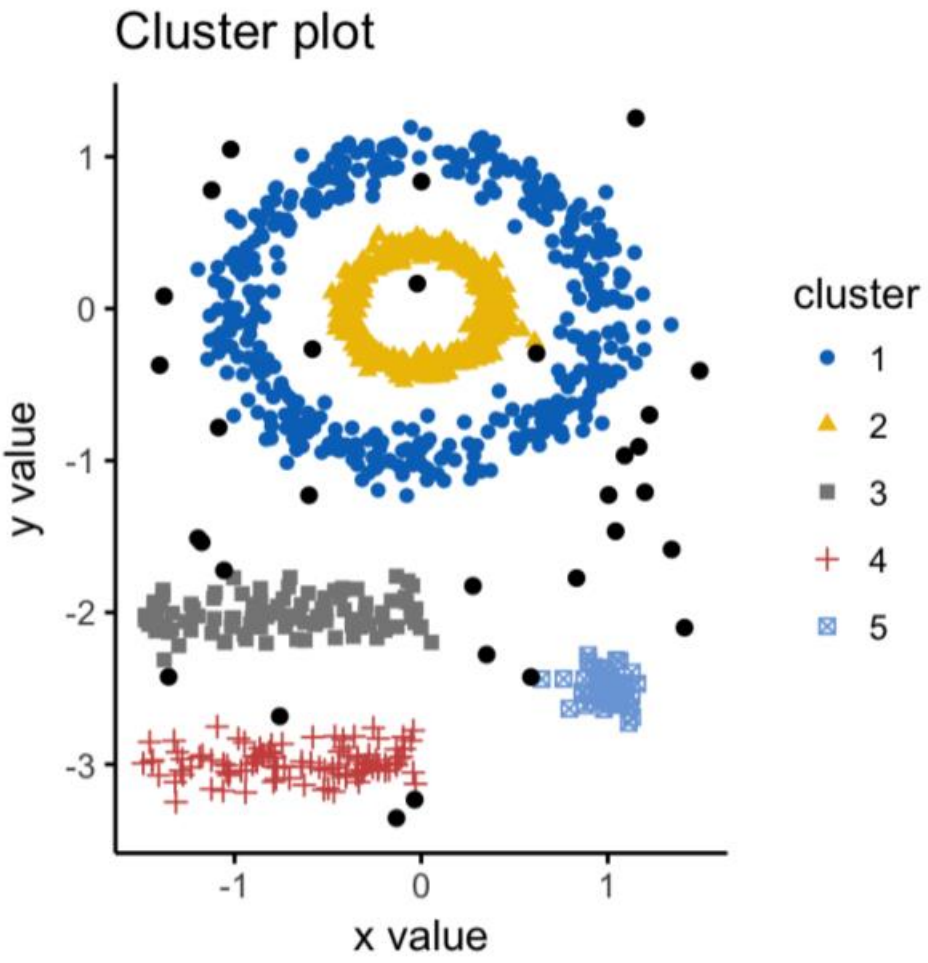
PROCEDURE:

1. It can be used to identify clusters of any shape in a data set containing noise and outliers.
2. Clusters are dense regions in the data space, separated by regions of lower density of points.
3. The simulated data set multishapes is used.
4. The function fviz_cluster() is used to visualize the clusters.
5. First, install factoextra: install.packages("factoextra"); then compute and visualize k-means clustering using the data set multishapes.
6. The goal is to identify dense regions, which can be measured by the number of objects close to a given point.

PROGRAM:

```
install.packages("factoextra")
install.packages("magrittr")
install.packages("cluster")
library("factoextra")
library("magrittr")
library("cluster")
install.packages("fpc")
install.packages("dbscan")
install.packages("factoextra")
# Load the data
data("multishapes", package="factoextra")
df<-multishapes[, 1:2]
# Compute DBSCAN using fpc package
library("fpc")
set.seed(123)
db<-fpc::dbscan(df, eps=0.15, MinPts=5)
# Plot DBSCAN results
library("factoextra")
fviz_cluster(db, data=df, stand=FALSE,
ellipse=FALSE,
show.clust.cent=FALSE,
geom="point",palette="jco", ggtheme=theme_classic())
```

OUTPUT:



RESULT:

Thus, the implementation of clustering techniques using density-based clustering was executed and verified successfully.

EX.NO:7b	IMPLEMENTATION OF MODEL BASED CLUSTERING
DATE:	

AIM:

To implement the clustering techniques using model-based clustering.

PROCEDURE:

1. In model-based clustering, the data are viewed as coming from a distribution that is mixture of two ore more clusters.
2. It finds best fit of models to data and estimates the number of clusters.
3. Install the mclust package as follow: install.packages("mclust").
4. Model-based clustering results can be drawn using the base function plot.Mclust() .
5. fviz_mclust() uses a principal component analysis to reduce the dimensionnality of the data.

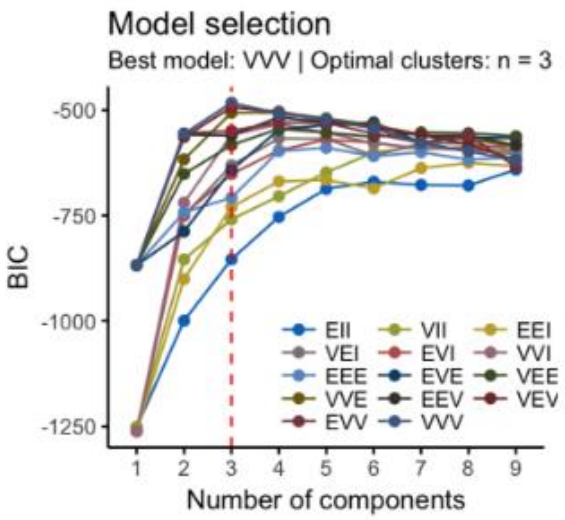
PROGRAM:

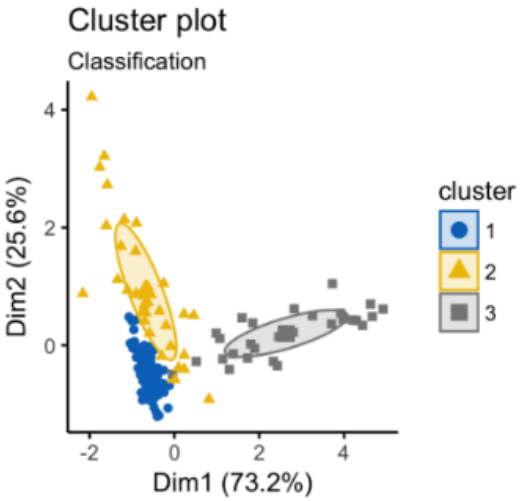
```
install.packages("factoextra")
install.packages("cluster")
install.packages("magrittr")
library("cluster")
library("factoextra")
library("magrittr")
library("mclust")
data("diabetes")
head(diabetes, 3)
library(factoextra)
# BIC values used for choosing the number of clusters
fviz_mclust(mc, "BIC", palette="jco")
# Classification: plot showing the clustering
fviz_mclust(mc, "classification", geom="point",
pointsize=1.5, palette="jco")
# Classification uncertainty
fviz_mclust(mc, "uncertainty", palette="jco")
```

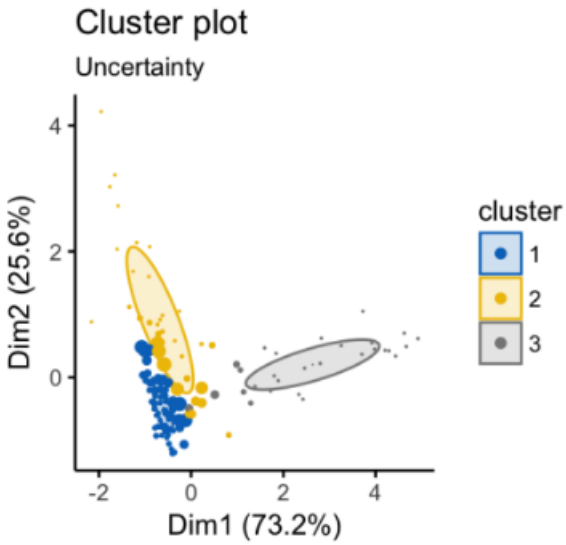
OUTPUT:

```
## ----------------------------------------------------
## Gaussian finite mixture model fitted by EM algorithm
## ----------------------------------------------------
##
## Mclust VVV (ellipsoidal, varying volume, shape, and
```

orientation) model with 3 components:
##
log.likelihood n df BIC ICL
-169 145 29 -483 -501
##
Clustering table:
1 2 3
81 36 28







RESULT:

Thus, the implementation of clustering techniques using model-based clustering was executed and verified successfully.

EX.NO:8a	DATA VISUALIZATION USING PIE CHART PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using pie chart using plotty framework.

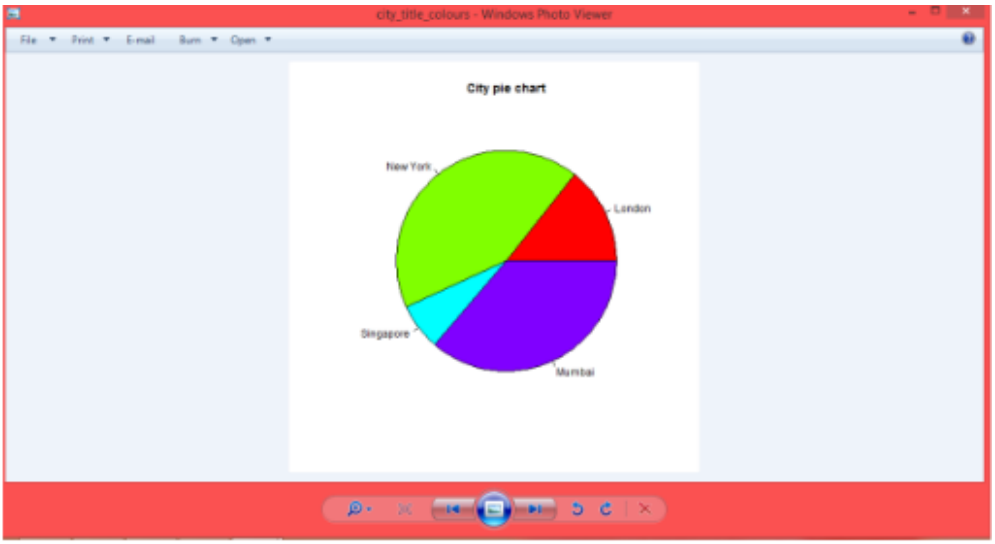
PROCEDURE:

1. In R the pie chart is created using the pie() function which takes positive numbers as a vector input.
2. The additional parameters are used to control labels, color, title etc.
3. The basic syntax for creating a pie-chart using the R is −
    i. pie(x, labels, radius, main, col, clockwise)
4. Following is the description of the parameters used −
    a. 4.a x is a vector containing the numeric values used in the pie chart.
    b. 4.b labels is used to give description to the slices.
    c. 4.c radius indicates the radius of the circle of the pie chart.(value between −1 and +1).
    d. 4.d main indicates the title of the chart.
    e. 4.e col indicates the color palette.
    f. 4.f clockwise is a logical value indicating if the slices are drawn clockwise or anti clockwise.
5. We will use parameter main to add a title to the chart and another parameter is col which will make use of rainbow colour pallet while drawing the chart. The length of the pallet should be same as the number of values we have for the chart. Hence we use length(x).

PROGRAM:

```
# Create data for the graph.
x <- c(21, 62, 10, 53)
labels<- c("London", "New York", "Singapore", "Mumbai")
# Give the chart file a name.
png(file = "city_title_colours.jpg")
# Plot the chart with title and rainbow color pallet.
pie(x, labels, main = "City pie chart", col = rainbow(length(x)))
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using pie chart using the plotty framework.

EX.NO:8b	DATA VISUALIZATION USING BAR PLOT PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using bar plot using plotty framework.

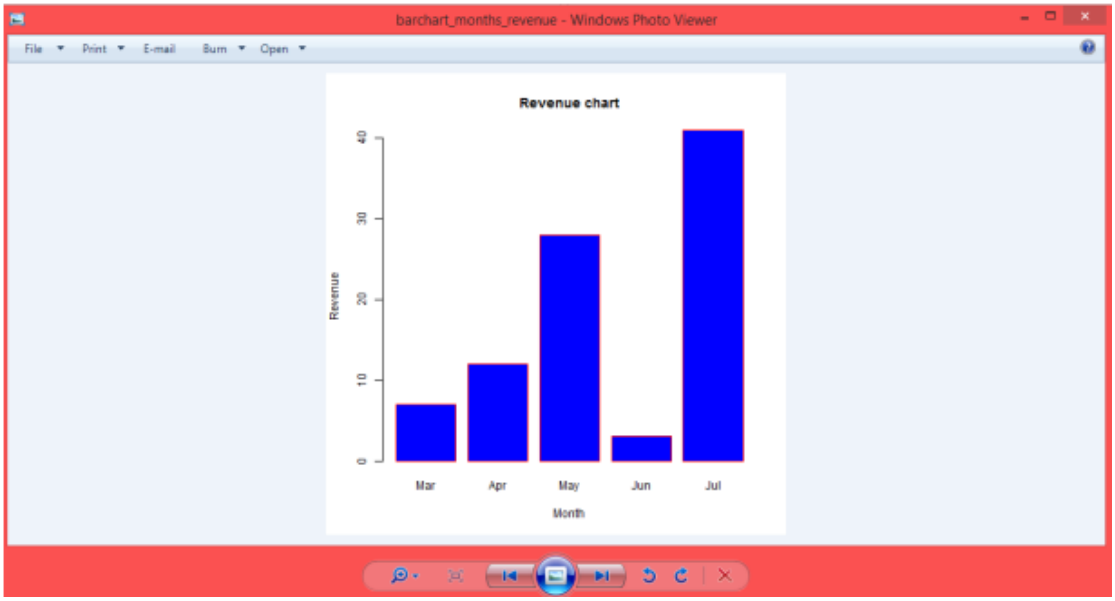
PROCEDURE:

1. R uses the function barplot() to create bar charts. R can draw both vertical and horizontal bars in the bar chart. In bar chart each of the bars can be given different colors.
2. The basic syntax to create a bar-chart in R is −
   i. barplot(H, xlab, ylab, main, names.arg, col)
3. Following is the description of the parameters used −
   a. H is a vector or matrix containing numeric values used in bar chart.
   b. xlab is the label for x axis.
   c. ylab is the label for y axis.
   d. main is the title of the bar chart.
   e. names.arg is a vector of names appearing under each bar.
   f. col is used to give colors to the bars in the graph.
4. The main parameter is used to add title. The col parameter is used to add colors to the bars. The args.name is a vector having same number of values as the input vector to describe the meaning of each bar.

PROGRAM:

```
# Create the data for the chart.
H <- c(7,12,28,3,41)
M <- c("Mar","Apr","May","Jun","Jul")
# Give the chart file a name.
png(file = "barchart_months_revenue.png")
# Plot the bar chart.
barplot(H,names.arg = M,xlab = "Month",ylab = "Revenue",col = "blue",
main = "Revenue chart",border = "red")
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using bar plot using the plotty framework.

EX.NO:9a	DATA VISUALIZATION USING BOX PLOT PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using box plot using plotty framework.

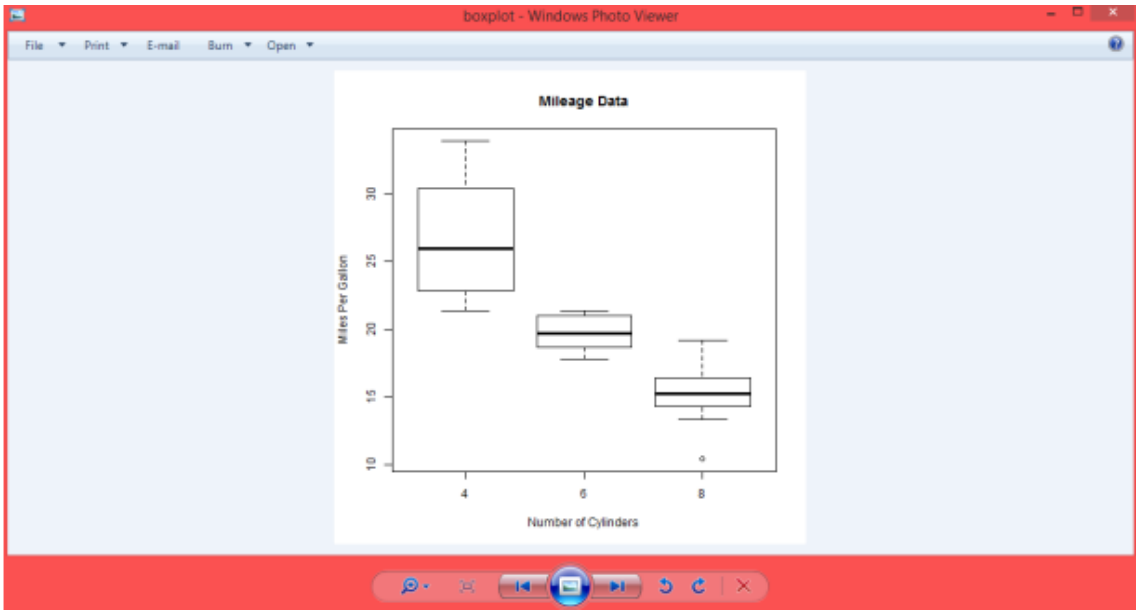
PROCEDURE:

1. Boxplots are created in R by using the boxplot() function.
2. The basic syntax to create a boxplot in R is
   boxplot(x, data, notch, varwidth, names, main)
3. Following is the description of the parameters used
   a. x is a vector or a formula.
   b. data is the data frame.
   c. notch is a logical value. Set as TRUE to draw a notch.
   d. Var width is a logical value. Set as true to draw width of the box proportionate to the sample size.
   e. names are the group labels which will be printed under each boxplot.
   f. main is used to give a title to the graph.

PROGRAM:

```
# Give the chart file a name.
png(file = "boxplot.png")
# Plot the chart.
boxplot(mpg ~ cyl, data = mtcars, xlab = "Number of Cylinders",
ylab = "Miles Per Gallon", main = "Mileage Data")
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using box plot using the plotty framework.

EX.NO:9b	DATA VISUALIZATION USING HISTOGRAM PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using histogram using plotty framework.

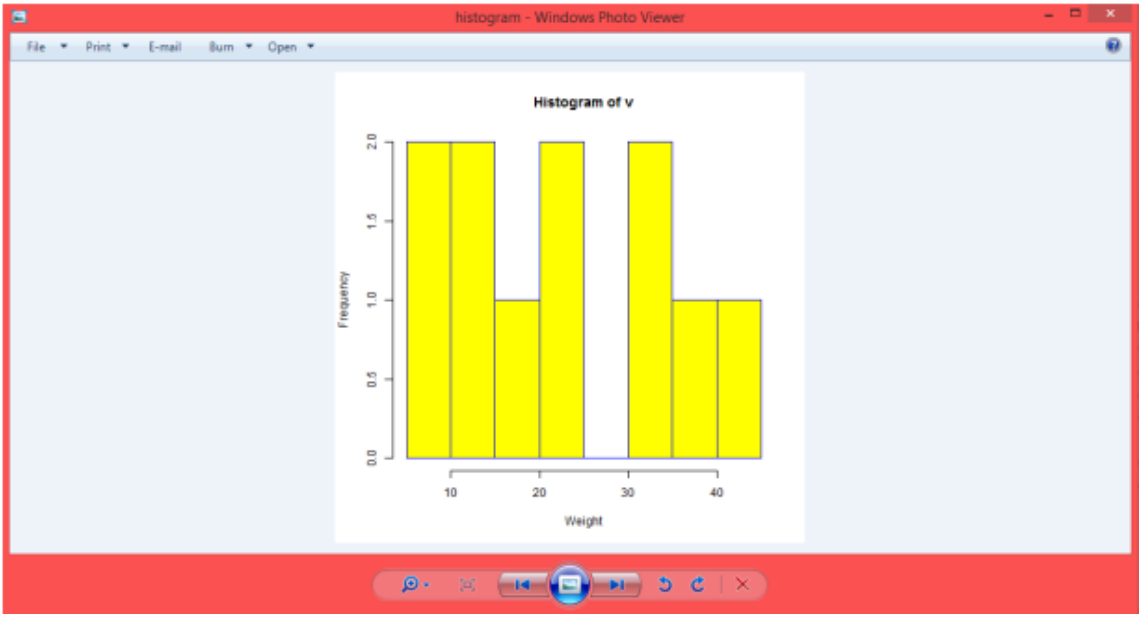
PROCEDURE:

1. R creates histogram using hist() function. This function takes a vector as an input and uses some more parameters to plot histograms.
2. The basic syntax for creating a histogram using R is −
    i. hist(v,main,xlab,xlim,ylim,breaks,col,border)
3. Following is the description of the parameters used −
    a. v is a vector containing numeric values used in histogram.
    b. main indicates title of the chart.
    c. col is used to set color of the bars.
    d. border is used to set border color of each bar.
    e. xlab is used to give description of x-axis.
    f. xlim is used to specify the range of values on the x-axis.
    g. ylim is used to specify the range of values on the y-axis.
    h. breaks is used to mention the width of each bar.

PROGRAM:

```
# Create data for the graph.
v <- c(9,13,21,8,36,22,12,41,31,33,19)
# Give the chart file a name.
png(file = "histogram.png")
# Create the histogram.
hist(v,xlab = "Weight",col = "yellow",border = "blue")
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using histogram using the plotty framework.

EX.NO:10a	DATA VISUALIZATION USING LINE GRAPH PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using line graph using plotty framework.

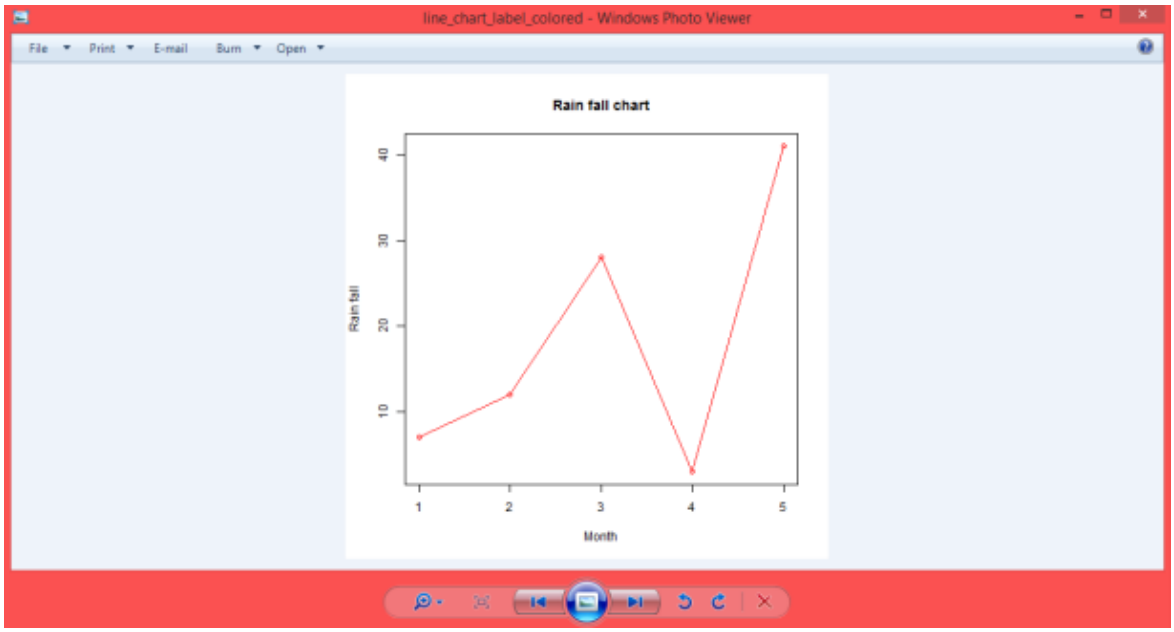
PROCEDURE:

1. The plot() function in R is used to create the line graph.
2. The basic syntax to create a line chart in R is −
    i. plot(v,type,col,xlab,ylab)
3. Following is the description of the parameters used −
    a. v is a vector containing the numeric values.
    b. type takes the value "p" to draw only the points, "l" to draw only the lines and "o" to draw both points and lines.
    c. xlab is the label for x axis.
    d. ylab is the label for y axis.
    e. main is the Title of the chart.
    f. col is used to give colors to both the points and lines.
4. We add color to the points and lines, give a title to the chart and add labels to the axes.

PROGRAM:

```
# Create the data for the chart.
v <- c(7,12,28,3,41)
# Give the chart file a name.
png(file = "line_chart_label_colored.jpg")
# Plot the bar chart.
plot(v,type = "o", col = "red", xlab = "Month", ylab = "Rain fall",main = "Rain fall chart")
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using line graph using the plotty framework

EX.NO:10b	DATA VISUALIZATION USING SCATTER PLOT PLOTTING FRAMEWORK
DATE:	

AIM:

To visualize data using scatter plot using plotty framework.

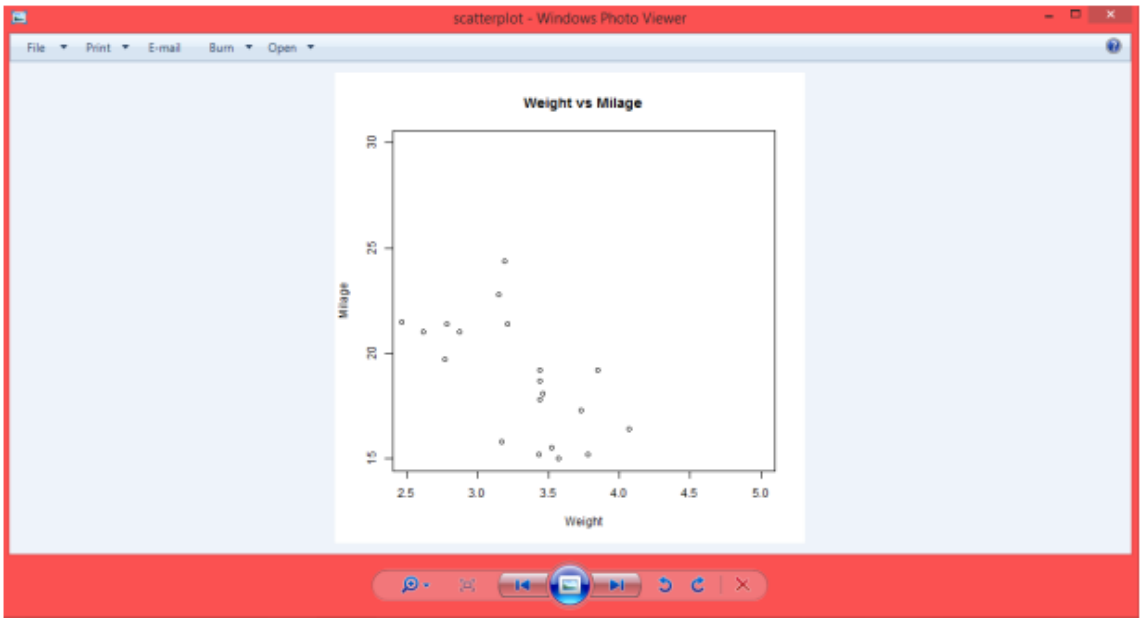
PROCEDURE:

1. The simple scatterplot is created using the plot() function.
2. The basic syntax for creating scatterplot in R is −
    i. plot(x, y, main, xlab, ylab, xlim, ylim, axes)
3. Following is the description of the parameters used −
    a. x is the data set whose values are the horizontal coordinates.
    b. y is the data set whose values are the vertical coordinates.
    c. main is the tile of the graph.
    d. xlab is the label in the horizontal axis.
    e. ylab is the label in the vertical axis.
    f. xlim is the limits of the values of x used for plotting.
    g. ylim is the limits of the values of y used for plotting.
    h. axes indicates whether both axes should be drawn on the plot.

PROGRAM:

```
# Get the input values.
input<- mtcars[,c('wt','mpg')]
# Give the chart file a name.
png(file = "scatterplot.png")
# Plot the chart for cars with weight between 2.5 to 5 and mileage between 15 and 30.
plot(x = input$wt,y = input$mpg,
xlab = "Weight",
ylab = "Milage",
xlim = c(2.5,5),
ylim = c(15,30),
main = "Weight vsMilage")
# Save the file.
dev.off()
```

OUTPUT:



RESULT:

Thus, the data is visualized using scatter plot using the plotty framework.

EX.NO:11a	APPLICATION TO ADJUST THE NUMBER OF BINS IN THE HISTOGRAMUSING R LANGUAGE
DATE:	

AIM:

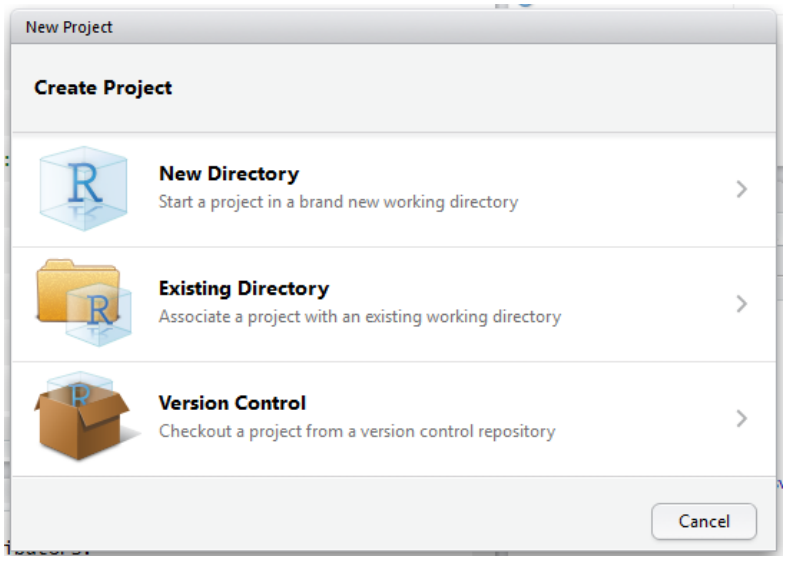
To implement the application to adjust the number of bins in the histogram using r language.

PROCEDURE:

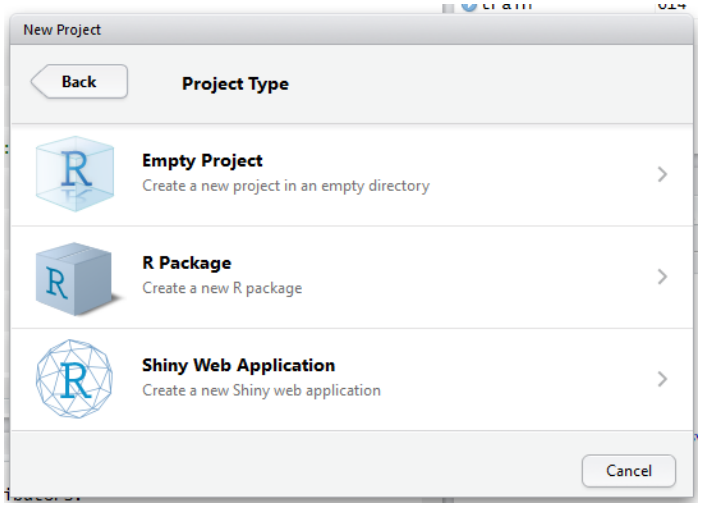
Any shiny app is built using two components:

1. **UI.R:** This file creates the user interface in a shiny application. It provides interactivity tothe shiny app by taking the input from the user and dynamically displaying the generated output on the screen.
2. **Server.R:** This file contains the series of steps to convert the input given by user into thedesired output to be displayed.
    a. Before we proceed further you need to set up Shiny in your system. Follow thesesteps to get started.

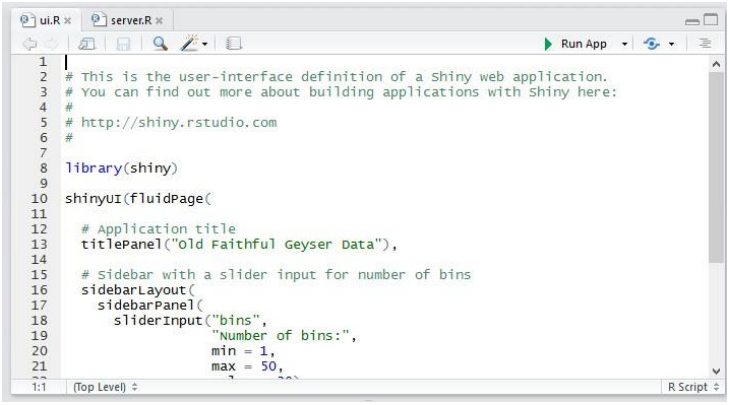
1) Create a new project in R Studio



2) Select type as Shiny web application.



3) It creates two scripts in R Studio named ui.R and server R.

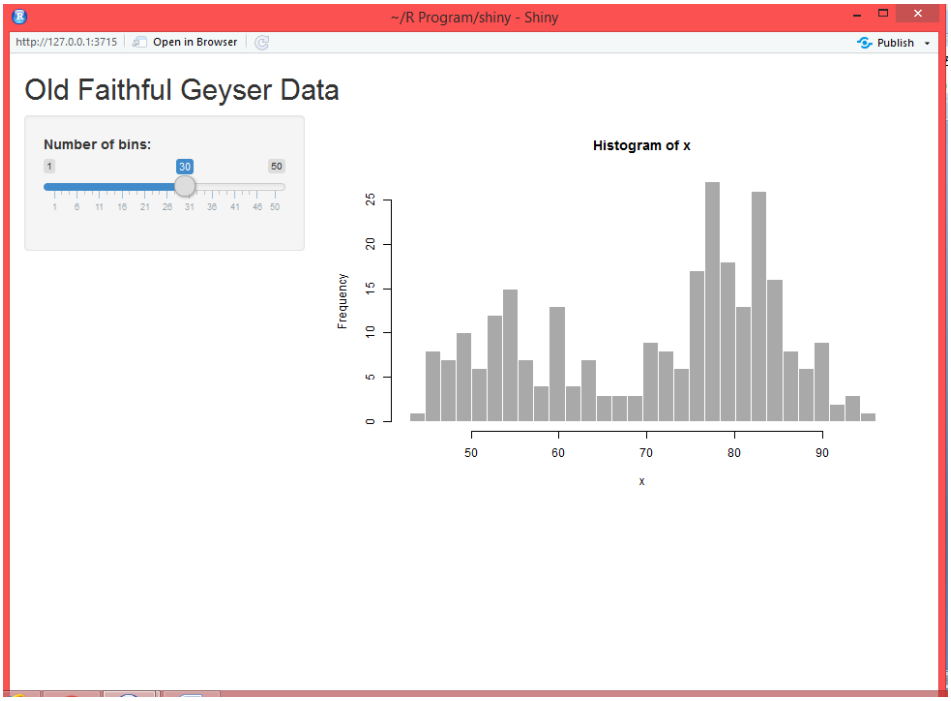


4) Each file needs to be coded separately and the flow of input and output between two is possible.

PROGRAM:

```
# This is a Shiny web application. You can run the application by clicking
# the 'Run App' button above.
#
# Find out more about building applications with Shiny here:
#
#    http://shiny.rstudio.com/

library(shiny)

# Define UI for application that draws a histogram
ui<- fluidPage(

  # Application title
titlePanel("Old Faithful Geyser Data"),

  # Sidebar with a slider input for number of bins
sidebarLayout(
sidebarPanel(
sliderInput("bins",
                  "Number of bins:",
min = 1,
max = 50,
value = 30)
    ),

    # Show a plot of the generated distribution
mainPanel(
plotOutput("distPlot")
    )
  )
)

# Define server logic required to draw a histogram
server<- function(input, output) {

output$distPlot<- renderPlot({
    # generate bins based on input$bins from ui.R
    x    <- faithful[, 2]
bins<- seq(min(x), max(x), length.out = input$bins + 1)

    # draw the histogram with the specified number of bins
hist(x, breaks = bins, col = 'darkgray', border = 'white')
  })}
```

Output



RESULT:

Thus, the application to adjust the number of bins in the histogram using r is implemented.

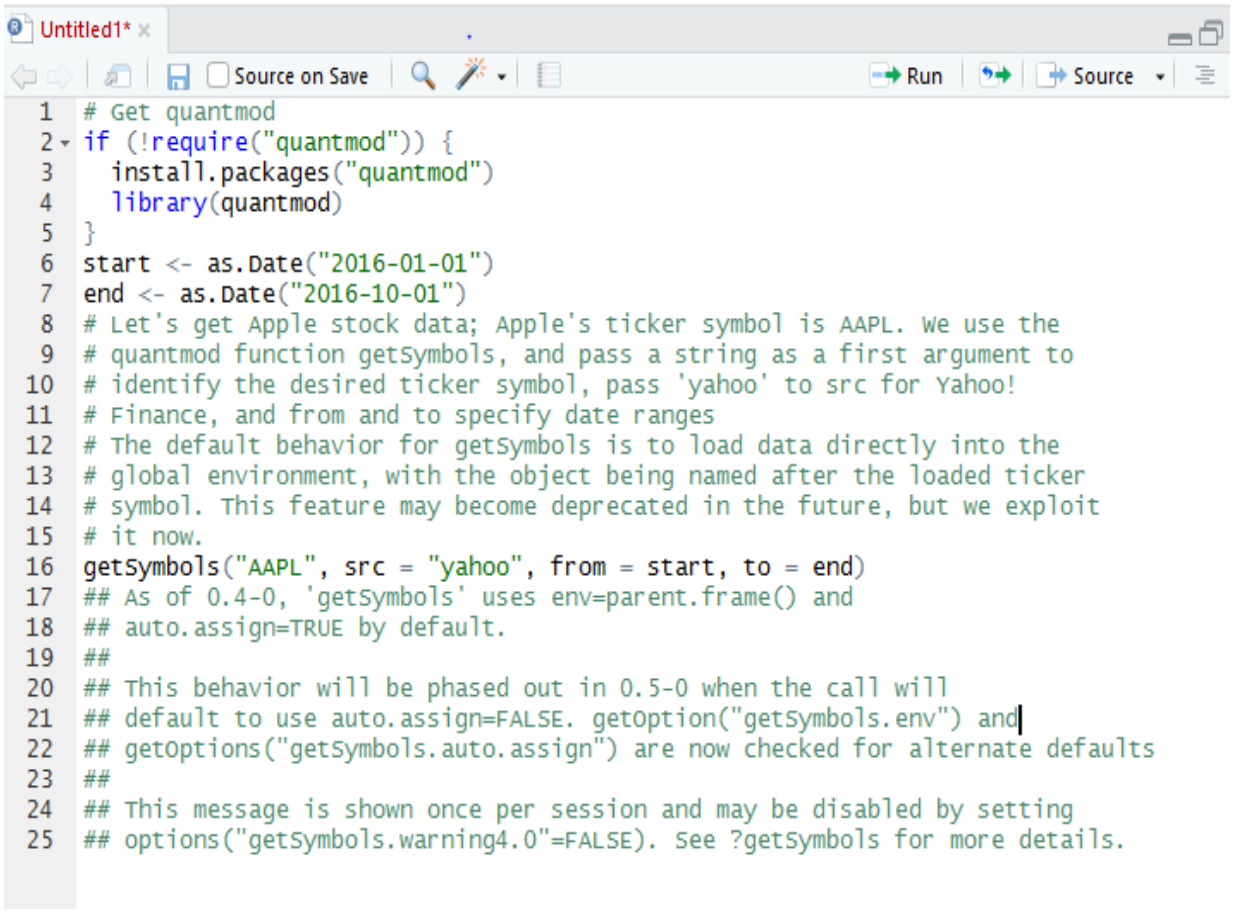
EX.NO:11b	APPLICATION TO ANALYZE STOCK MARKET DATA USING R LANGUAGE
DATE:	

AIM:

To create an application to analyze Stock Market Data using R language.

PROCEDURE:

1a. Toanalyze stock data, Stock data can be obtained from Yahoo! Finance (http://finance.yahoo.com) by using the quantmod package provides easy access to Yahoo! Finance.



1b.getSymbols() can create a object called AAPL in the global environment.

```
[1] "AAPL"
```

2a.The class of AAPL object can be obtained with the command

```
# What is AAPL?
class(AAPL)
```

2b.AAPL is of the xts class (which is also a zoo-class object). xts objects (provided in the xts package) are seen as improved versions of the ts object for storing time series data.

```
[1] "xts" "zoo"
```

3a. In this stock data's are stored based on time-based indexing and can provide custom attributes, along with allowing multiple (presumably related) time series with the same time index to be stored in the same object.

```
# Let's see the first few rows
head(AAPL)
```

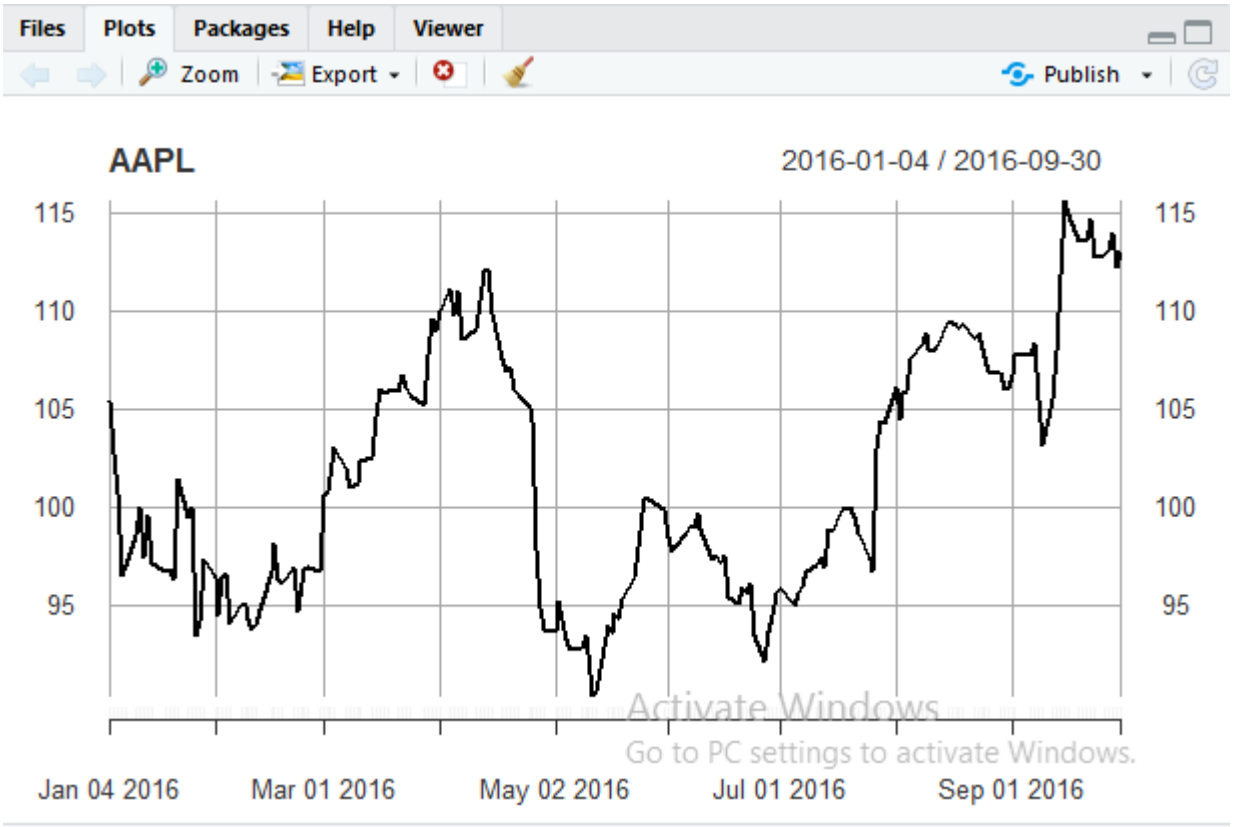
3b.Yahoo! Finance provides six series with each security. Open is the price of the stock at the beginning of the trading day, high is the highest price of the stock on that trading day, low the lowest price of the stock on that trading day, and close the price of the stock at closing time. Volume indicates how many stocks were traded. Adjusted is the closing price of the stock that adjusts the price of the stock for corporate actions.

```
           AAPL.Open AAPL.High AAPL.Low AAPL.Close AAPL.Volume AAPL.Adjusted
2016-01-04    102.61    105.37   102.00     105.35    67649400     101.01419
2016-01-05    105.75    105.85   102.41     102.71    55791000      98.48285
2016-01-06    100.56    102.37    99.87     100.70    68457400      96.55557
2016-01-07     98.68    100.13    96.43      96.45    81094400      92.48048
2016-01-08     98.55     99.11    96.76      96.96    70798000      92.96950
2016-01-11     98.97     99.06    97.34      98.53    49739400      94.47488
```

4a.Stock data series can be visualized using base R plotting with

```
plot(AAPL[, "AAPL.Close"], main = "AAPL")
```

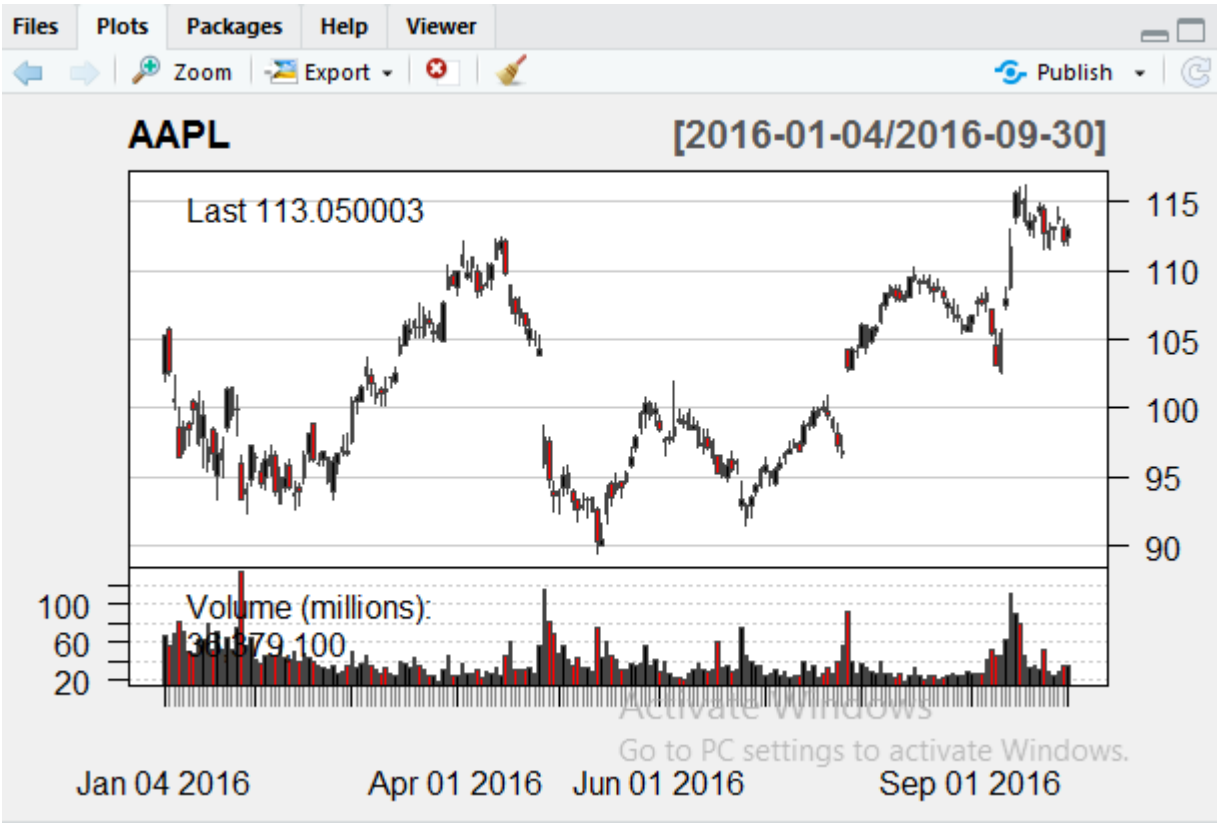
4b.Visualization is obtained as



5a. Financial data is often plotted with the function called candle Chart() from quant mod to create a chart.

```
candleChart(AAPL, up.col = "black", dn.col = "red", theme = "white")
```

5b.With this function, plotting of variables with separate lines as follows



RESULT:

Thus, an application to analyze Stock Market Data using R language is created successfully.

DATE:	APACHE FLINK

Aim:

To demonstrate how to submit a sample Flink job and monitor its execution using the Flink web UI.

Procedure:

1: Download and extract the latest Flink binary release.

2: Start a local cluster using the provided script.

3: Submit a sample Flink job using the CLI tool.

4: Verify the job output and monitor its execution.

5: Access the Flink web UI to view data flow plan and timeline.

Process:

Downloading Flink

Flink runs on all UNIX-like environments, i.e. Linux, Mac OS X, and Cygwin (for Windows).

System need to have **Java 11** installed. To check the Java version installed, type in terminal:

$ java -version

Next, download the latest binary release of Flink, then extract the archive:

$ tar -xzf flink-*.tgz

Browsing the project directory

Navigate to the extracted directory and list the contents by issuing:

$ cd flink-* && ls -l

OUTPUT:

```
total 496
drwxrwxr-x  2 daisy daisy   4096 Mai 25 14:36 bin
drwxrwxr-x  2 daisy daisy   4096 Mai 25 14:36 conf
drwxrwxr-x  7 daisy daisy   4096 Mai 25 14:36 examples
drwxrwxr-x  2 daisy daisy   4096 Mai 25 14:36 lib
-rw-r--r--  1 daisy daisy  11357 Okt 29  2019 LICENSE
drwxrwxr-x  2 daisy daisy   4096 Mai 25 14:37 licenses
drwxr-xr-x  2 daisy daisy   4096 Jan 29 17:03 log
-rw-rw-r--  1 daisy daisy 455180 Mai 25 14:37 NOTICE
drwxrwxr-x  3 daisy daisy   4096 Mai 25 14:36 opt
drwxrwxr-x 10 daisy daisy   4096 Mai 25 14:36 plugins
-rw-r--r--  1 daisy daisy   1309 Jan 29 17:03 README.txt
```

Starting and stopping a local cluster

To start a local cluster, run the bash script that comes with Flink:

$ ./bin/start-cluster.sh

OUTPUT

```
Starting cluster.
Starting standalonesession daemon on host daisy-ThinkPad.
Starting taskexecutor daemon on host daisy-ThinkPad.
```

Flink is now running as a background process. Check its status with the following command:

$ ps aux | grep flink

Able to navigate to the web UI at localhost:8081 to view the Flink dashboard and see that the cluster is up and running.

To quickly stop the cluster and all running components, the provided script:

$ ./bin/stop-cluster.sh

Submitting a Flink job

Flink provides a CLI tool, **bin/flink**, that can run programs packaged as Java ARchives (JAR) and control their execution. Submitting a job means uploading the job's JAR file and related dependencies to the running Flink cluster and executing it.

Flink releases come with example jobs, which you can find in the **examples/** folder.

To deploy the example word count job to the running cluster, issue the following command:

$ ./bin/flink run examples/streaming/WordCount.jar

Verify the output by viewing the logs:

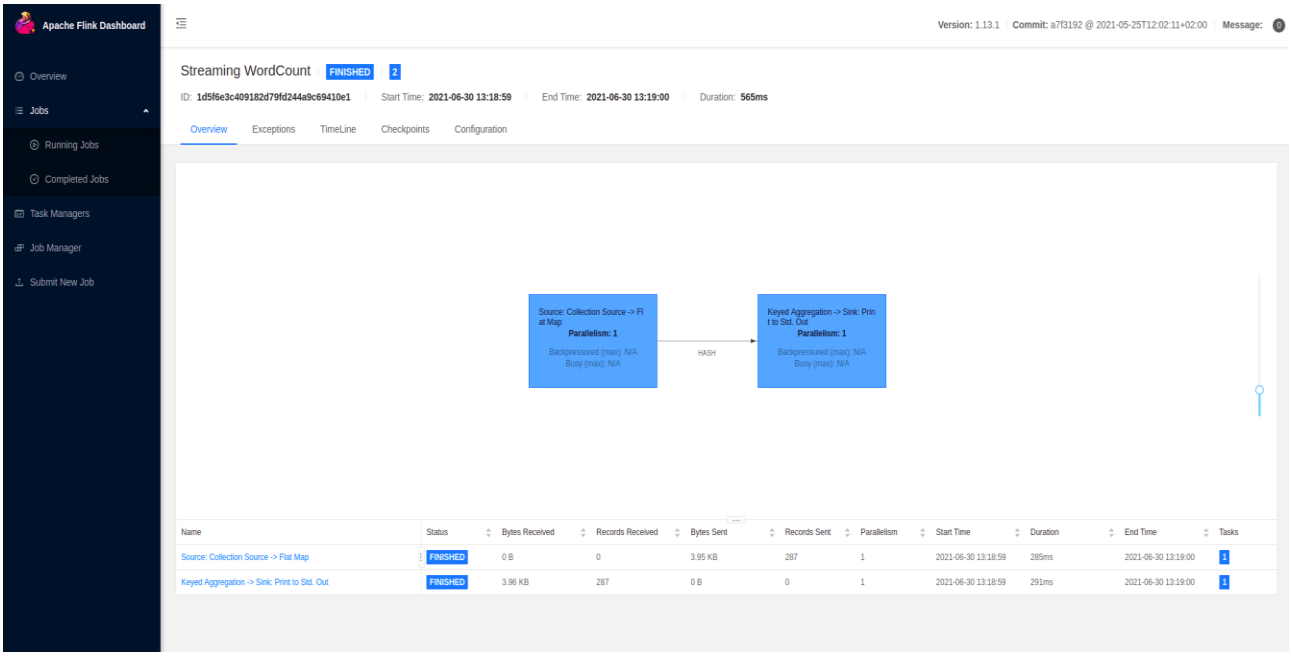
$ tail log/flink-*-taskexecutor-*.out

OUTPUT:

(nymph,1**)**
(in,3**)**
(thy,1**)**
(orisons,1**)**
(be,4**)**
(all,2**)**
(my,1**)**
(sins,1**)**
(remember,1**)**
(d,4**)**

Additionally, we can check Flink's web UI to monitor the status of the cluster and running job.

The data flow plan for the execution:

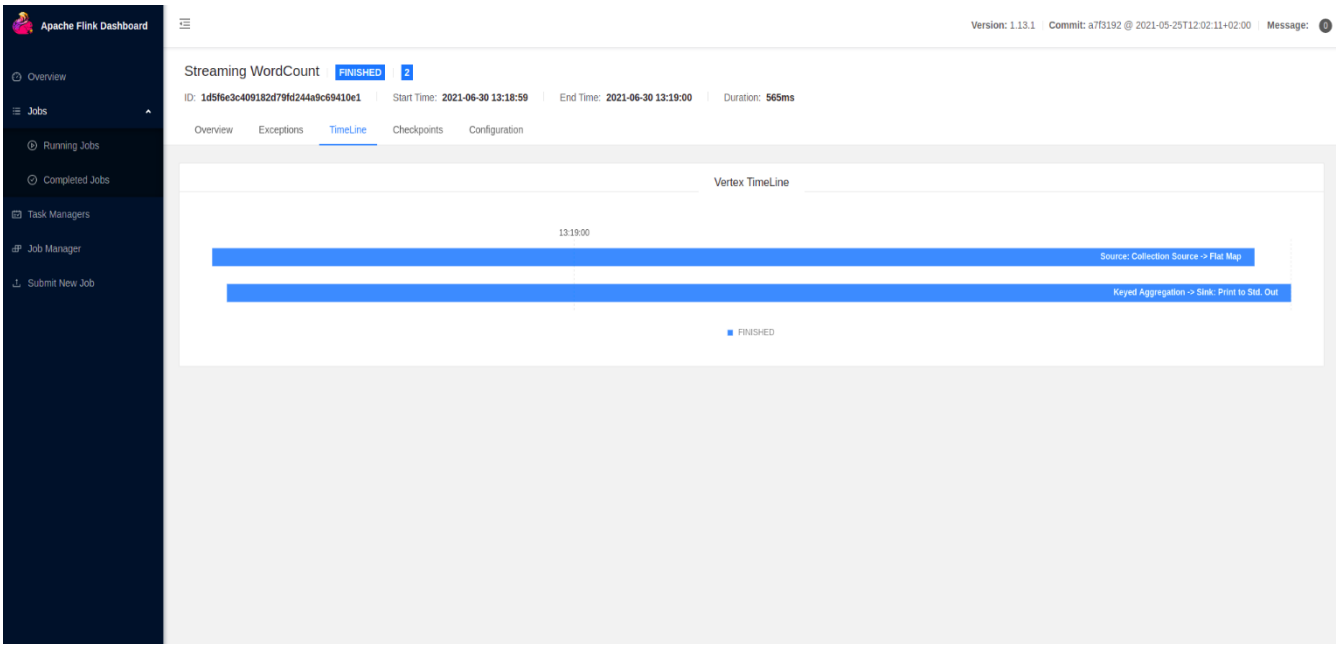


The job execution, Flink has two operators.

- ✓ The first is the source operator which reads data from the collection source.

- ✓ The second operator is the transformation operator which aggregates counts of words

The timeline of the job execution:



Result:

The successful execution of a sample Flink job and its monitoring via the Flink web UI confirms proper functionality and proficiency in Flink application management.