Project : MapReduce Pi

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ACKNOWLEDGEMENT

One of our master's degree Project for Hadoop MapReduce for PI computation,

Is Interesting, which made me to learn new things, it is useful in designing and applying on Google Cloud

Platform (Hadoop MapReduce) on Google Cloud Platform and Oracle Virtual Machine /

For deploying this project , I would like to thank Dr. Henry Chang for providing all the required input .

Also, for all I would like to always pray to Almighty for giving us wisdom and power to understand things.

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ABSTRACT

The main lesson about this assignment is to study details,

about deploying applications on both Google Cloud Platform and Oracle Virtual Machine to learn about Hadoop MapReduce to apply for Pi calculations with

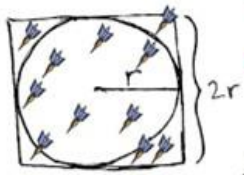
radius and random points for a circle to compute points to find whether points are inside (darts) or outside circle.

https://hc.labnet.sfbu.edu/~henry/npu/classes/mapreduce/pi/slide/mapreduce_pi.html

MapReduce Pi

Overview

- Throw N darts on the board. Each dart lands at a random position (x,y) on the board.
  - Note if each dart landed inside the circle or not
    - Check if $x^2+y^2<r$
  - Take the total number of darts that landed in the circle as S



$$4\left(\frac{S}{N}\right)=\pi$$

Explanation

- If radius is 5, then based on the input values in Map, we can calculate

```
pi = 4 * (5 / N)
   = 4 * (Insde / (Inside + Outside))
   = 4 * (5 / (5 + 7))
   = 4 * (5 / 12)
   = 1.66
```

Note:

- To get more accurate pi value you can
  - increase the value of the radius, and
  - create much much more input values (e.g., a million values)

Inside or Outside the circle

Formula

$(x - center\_x)^2 + (x - center\_x)^2$ compare r^2

- Inside: if compare is <
- Outside: if compare is >
- On the circle: if compare is =

Note

- The center of the circle:

```
(center_x, center_y)
```

- Radius

```
r
```

Job: Pi

Inside or Outside the circle

Formula

$(x - center\_x)^2 + (x - center\_x)^2$ compare r^2

- **Inside:** if compare is <
- **Outside:** if compare is >
- **On the circle:** if compare is =

Note

- **The center of the circle:**

  (center_x, center_y)

- **Radius**

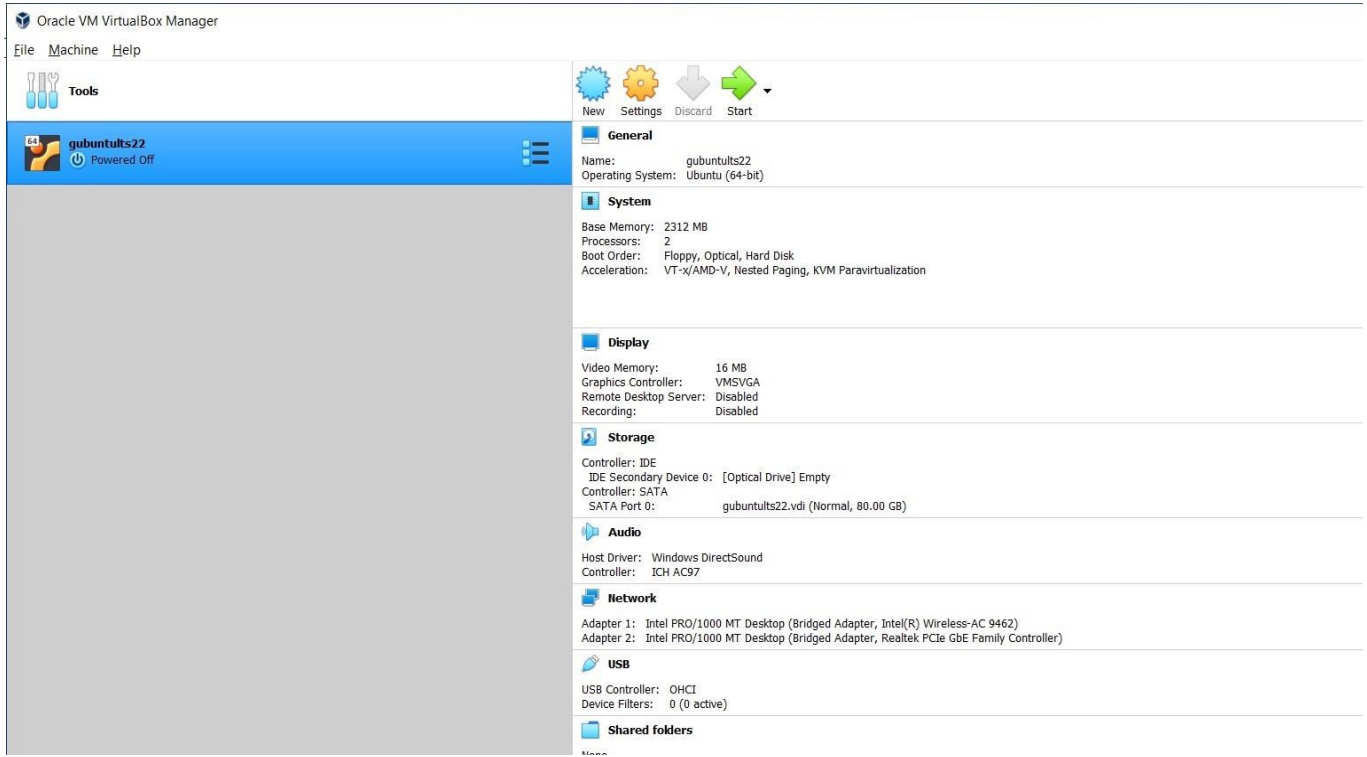
  r

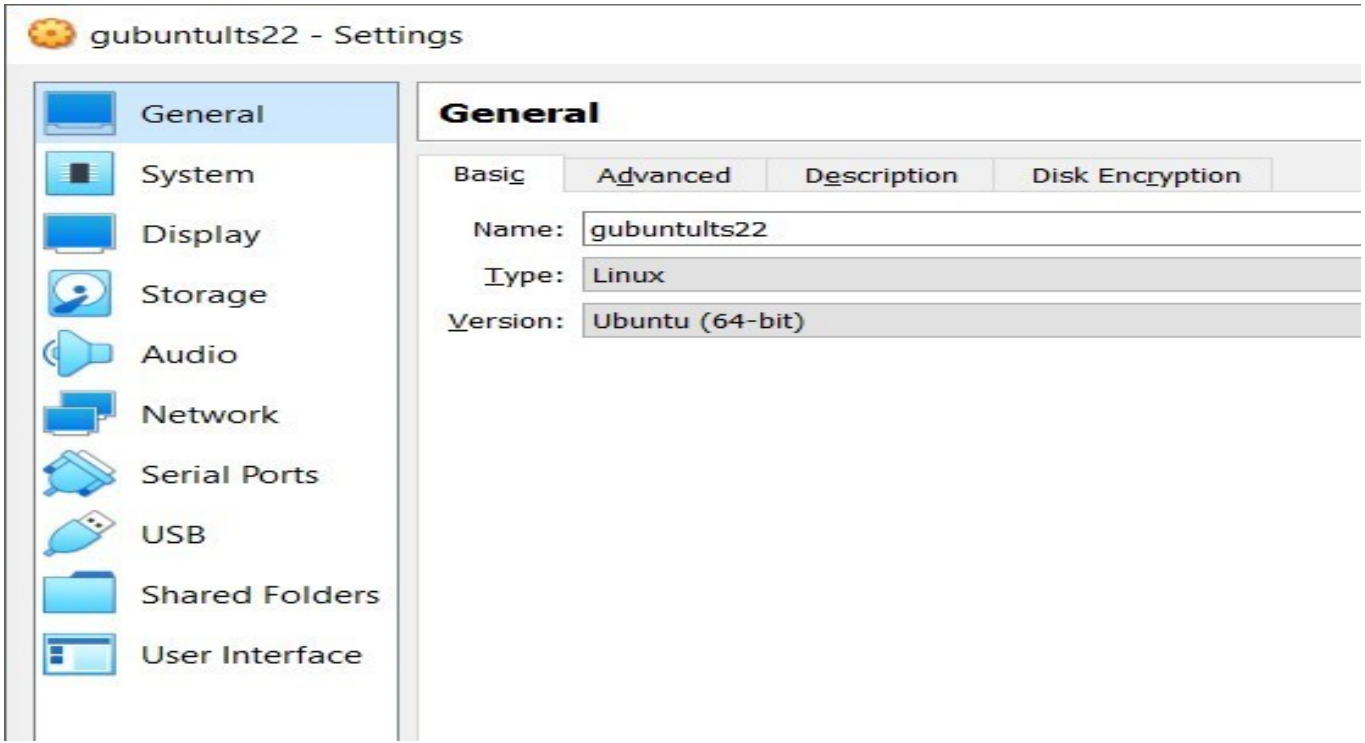
Job: Pi

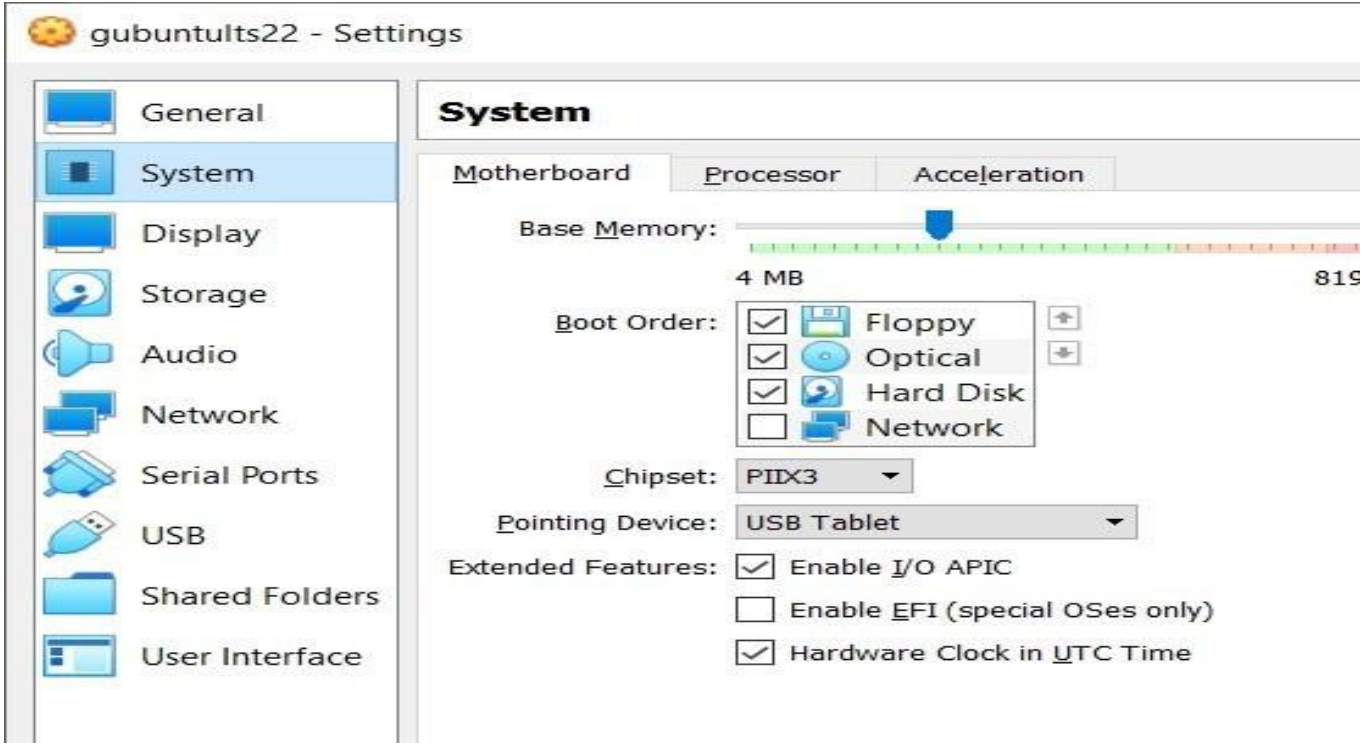
Map Task								Reduce Task		
map()				combine()				reduce()		
Input (Given)		Output (Program)		Input (Given)		Output (Program)		Input (Given)		Output (Program)
Key	Value (radius=2)	Key	Value (radius=2)	Key	Values	Key	Value	Key	Values	
file1	(0, 1)	Outside	1	Inside	[1]	Inside	1	Inside	[1, 3, 1]	Inside 5
	(1, 3)	Inside	1	Outside	[1, 1]	Outside	2	Outside	[2, 1, 4]	Outside 7
	(4, 3)	Outside	1							
file2	(2, 3)	Inside	1	Inside	[1, 1, 1]	Inside	3			
	(1, 3)	Inside	1	Outside	[1]	Outside	1			
	(1, 4)	Outside	1							
	(3, 2)	Inside	1							
file3	(3, 0)	Outside	1	Inside	[1]	Inside	1			
	(3, 3)	Inside	1	Outside	[1, 1, 1, 1]	Outside	4			
	(3, 4)	Outside	1							
	(0, 0)	Outside	1							
	(4, 4)	Outside	1							

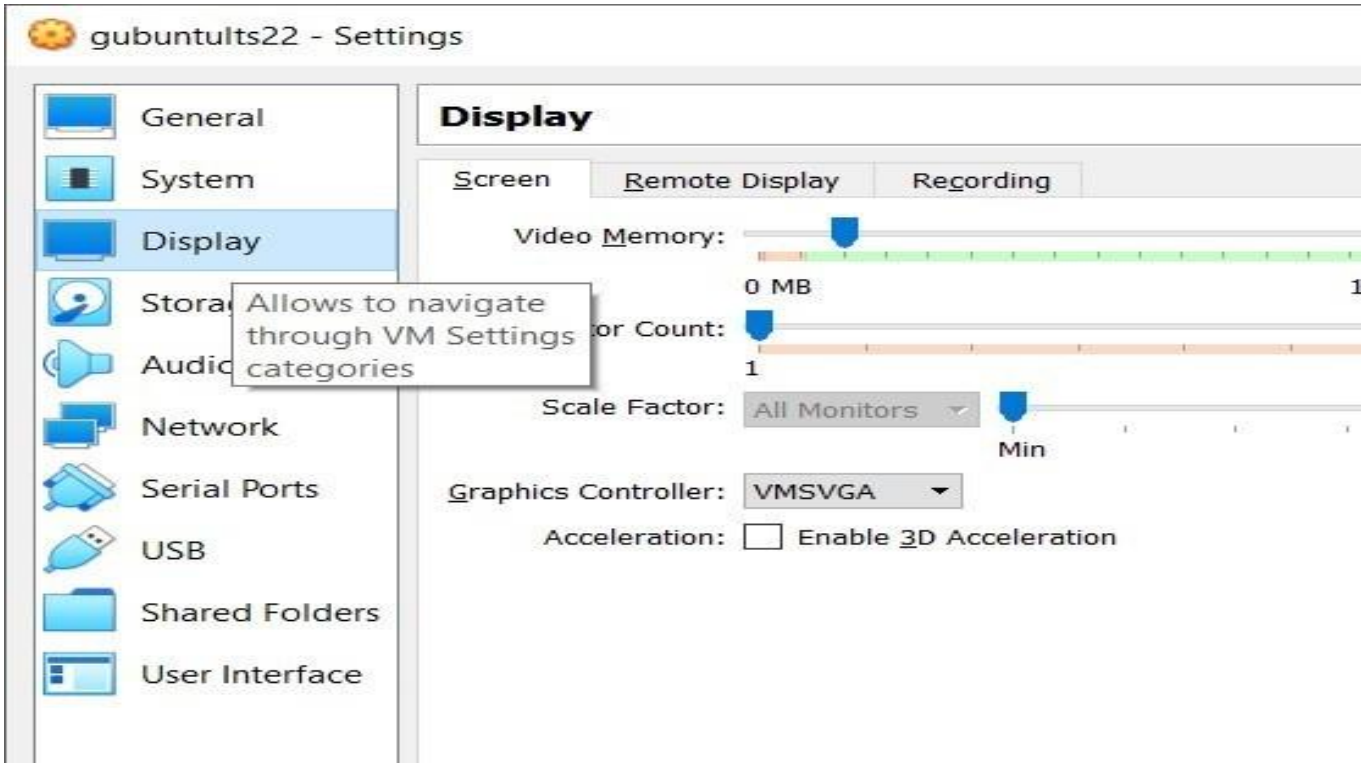
Notes:

MapReduce on Ubuntu on Oracle Virtual Machine local:

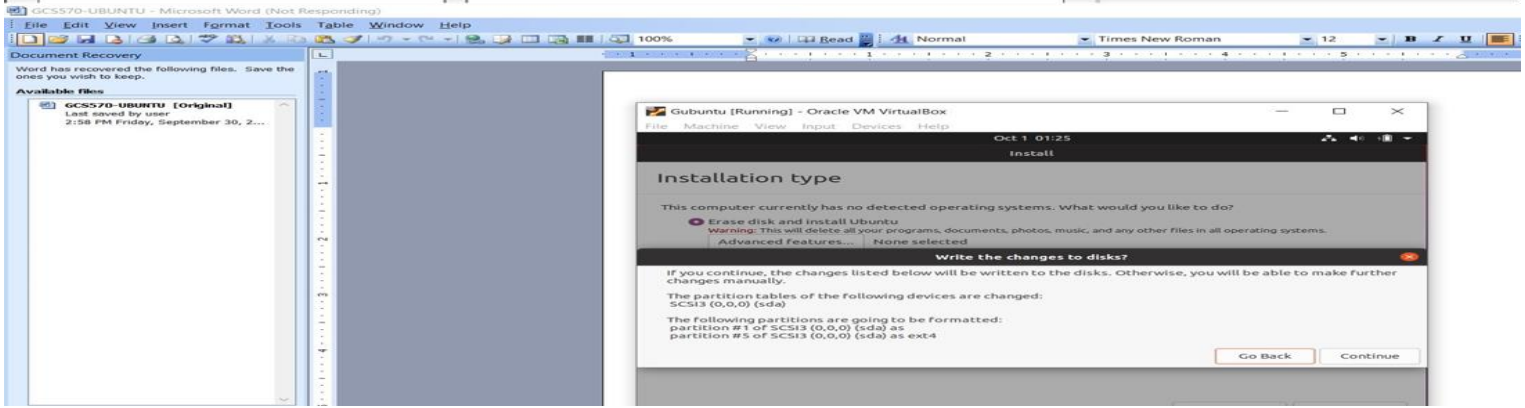


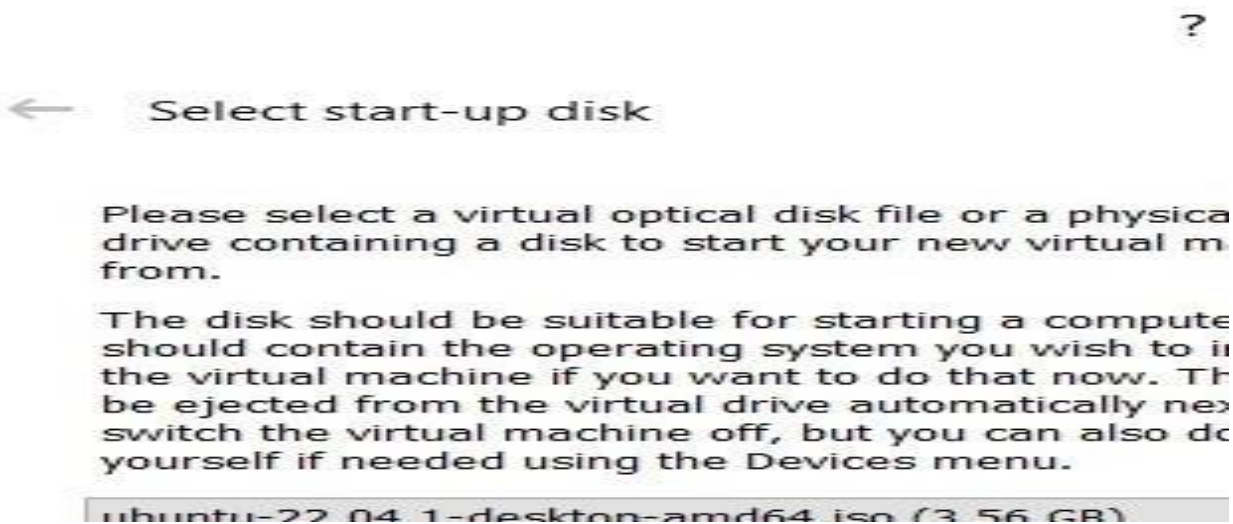

gubuntults22 - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
General
Basic
Advanced
Description
Disk Encryption
Name:
gubuntults22
Type:
Linux
Version:
Ubuntu (64-bit)


gubuntults22 - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
System
Motherboard
Processor
Acceleration
Base Memory:
4 MB
Boot Order:
Floppy
Optical
Hard Disk
Network
Chipset:
PIIX3
Pointing Device:
USB Tablet
Extended Features:
Enable I/O APIC
Enable EFI (special OSes only)
Hardware Clock in UTC Time


gubuntults22 - Settings
General
System
Display
Stora
Audic
Network
Serial Ports
USB
Shared Folders
User Interface
Allows to navigate through VM Settings categories
Display
Screen
Remote Display
Recording
Video Memory:
0 MB
or Count:
1
Scale Factor:
All Monitors
Min
Graphics Controller:
VMSVGA
Acceleration:
Enable 3D Acceleration


gubuntults22 - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
Storage
Storage Devices
Controller: IDE
ubuntu-20.04.3-desktop-a...
Controller: SATA
gubuntults22.vdi
Attributes
Optical Drive:
IDE Se
Live
Information
Type: Image
Size: 2.86 G
Location: C:\GUE
Lists all storage controllers for this machine and the virtual images and host drives attached to them.


GCS570-UBUNTU - Microsoft Word (Not Responding)
File Edit View Insert Format Tools Table Window Help
Document Recovery
Word has recovered the following files. Save the ones you wish to keep.
Available files
GCS570-UBUNTU [Original]
Last saved by user
2:58 PM Friday, September 30, 2...
Gubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Oct 1 01:25
Install
Installation type
This computer currently has no detected operating systems. What would you like to do?
Erase disk and install Ubuntu
Warning: This will delete all your programs, documents, photos, music, and any other files in all operating systems.
Advanced features... None selected
Write the changes to disks?
If you continue, the changes listed below will be written to the disks. Otherwise, you will be able to make further changes manually.
The partition tables of the following devices are changed:
SCSI3 (0,0,0) (sda)
The following partitions are going to be formatted:
partition #1 of SCSI3 (0,0,0) (sda) as
partition #5 of SCSI3 (0,0,0) (sda) as ext4
Go Back
Continue



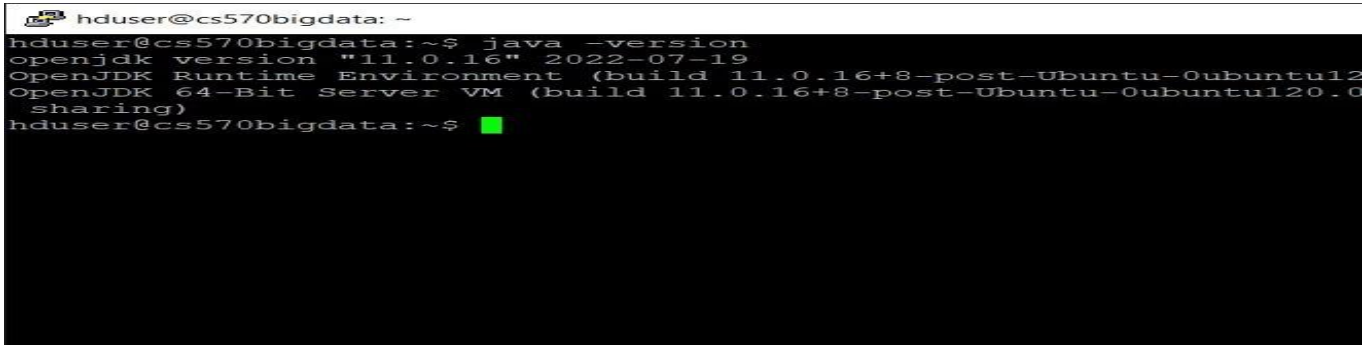
After completion of installation Oracle VM , install Java , Hadoop and the script files Download hadoop

Download Java Extract hadoop

Java installation steps

sudo apt-get install openjdk-11-jre sudo apt-get install

openjdk-11-jdk java - version



Setup hadoop user for Hadoop Installation

sudo addgroup hadoop

sudo adduser --ingroup hadoop hduser sudo su

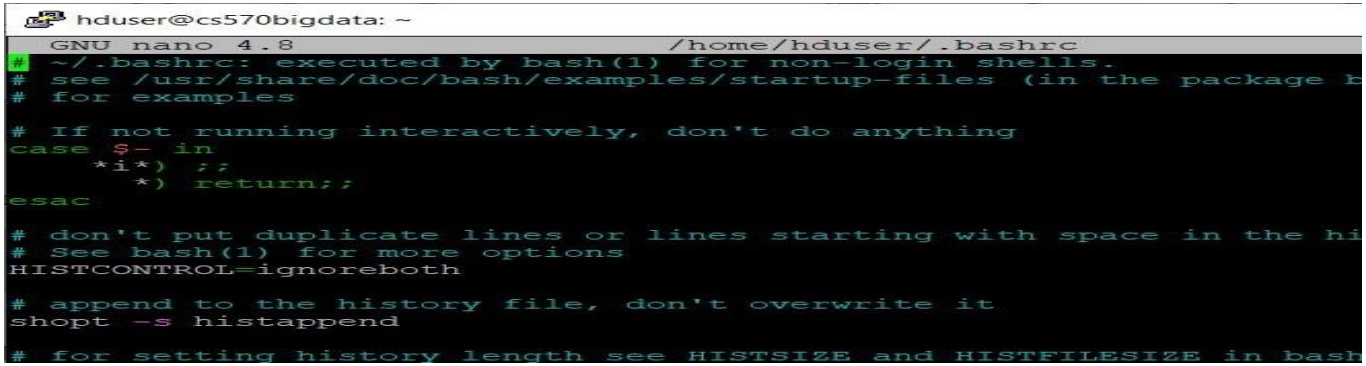
hduser

For this I used hadoop version hadoop-2.10.2.tar.gz Sudo tar

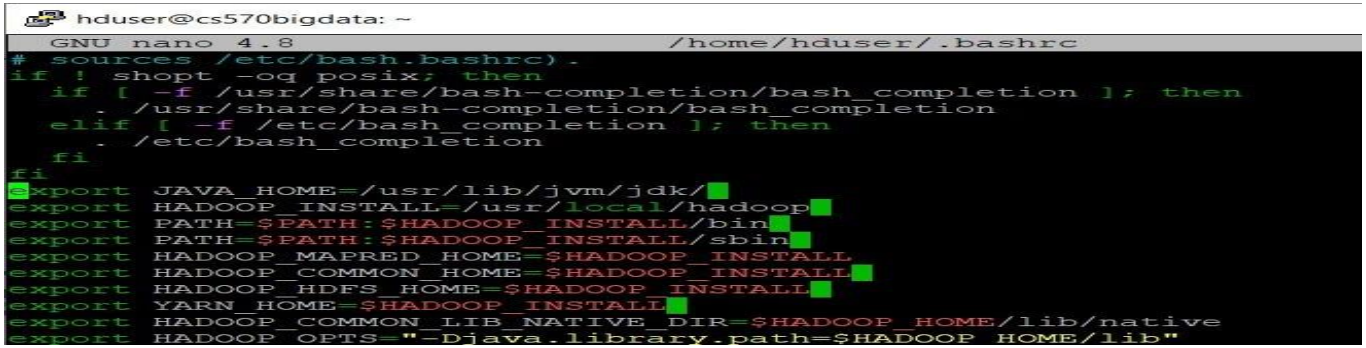
xzf hadoop-2.10.2.tar.gz –C /usr/local Cd / usr/local

Sudo mv hadoop-2.10.2 hadoop

Sudo chown –R hduser:hadoop hadoop



Move to the end and add following lines for hadoop

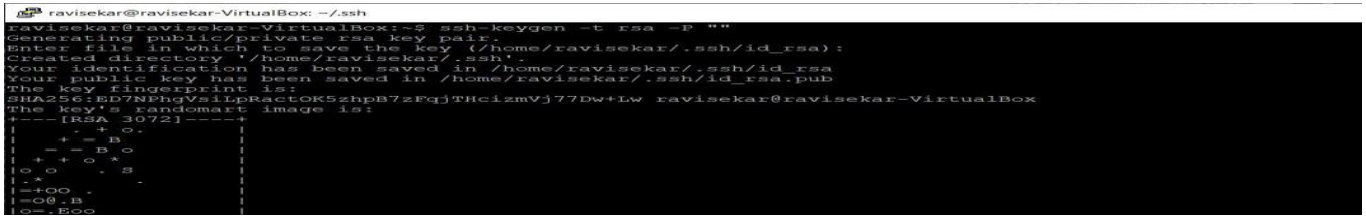


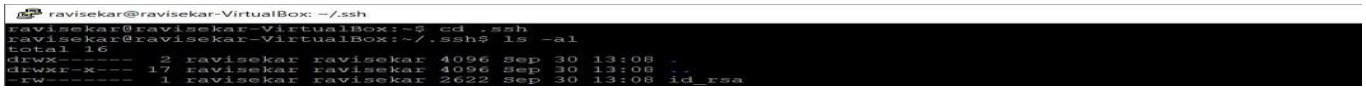
To save use source ~/.bashrc
systemctl reboot –i

Now do the following setting for hduser

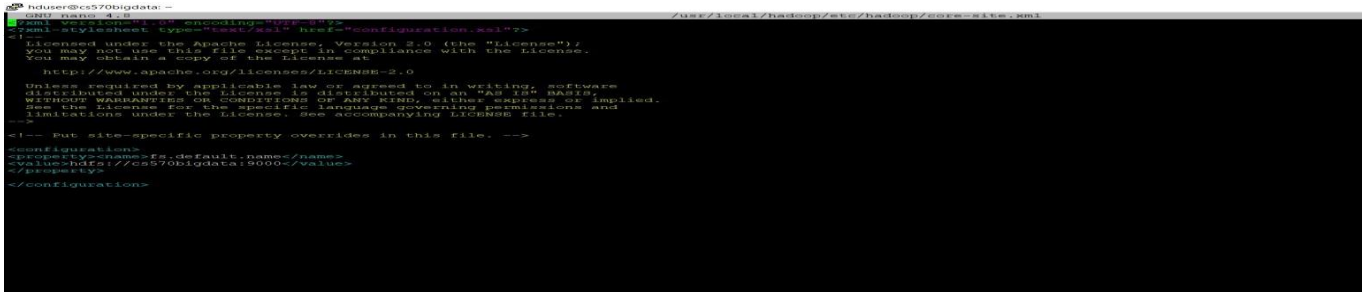
export JAVA_HOME=/usr/lib/jvm/jdk

Ssh generation and creation of authorized keys from public ssh keys

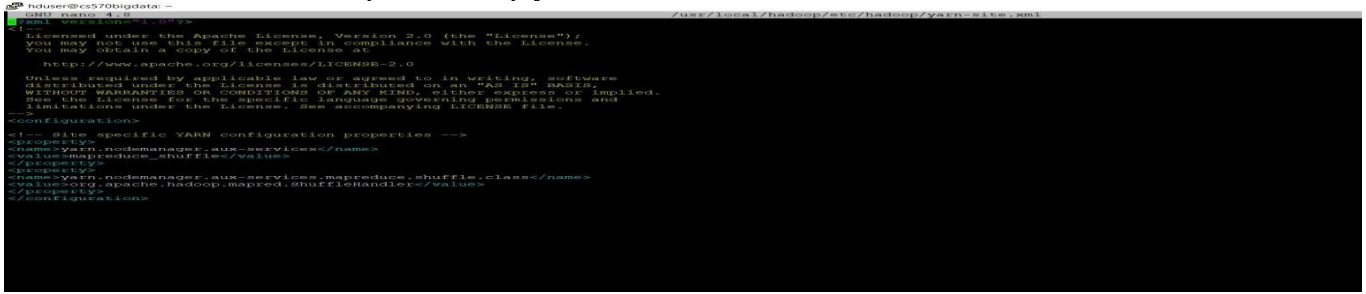




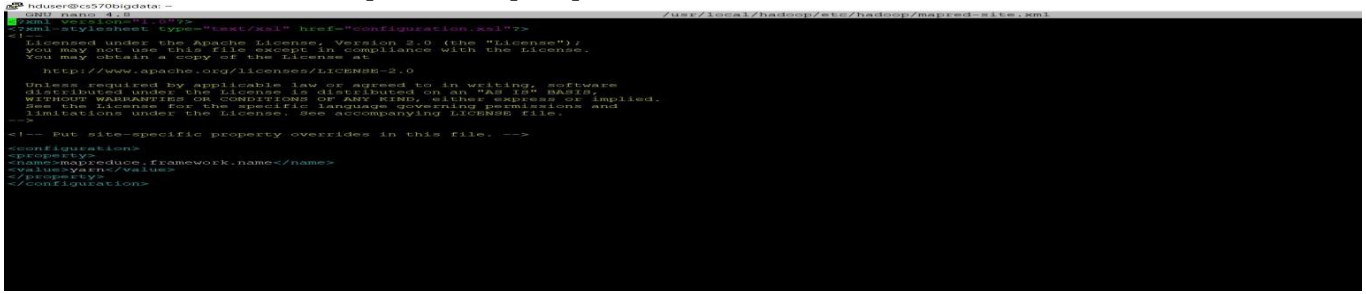
Now we need following files to be set for hadoop :



2. sudo nano /usr/local/hadoop/etc/hadoop/yarn-site.xml

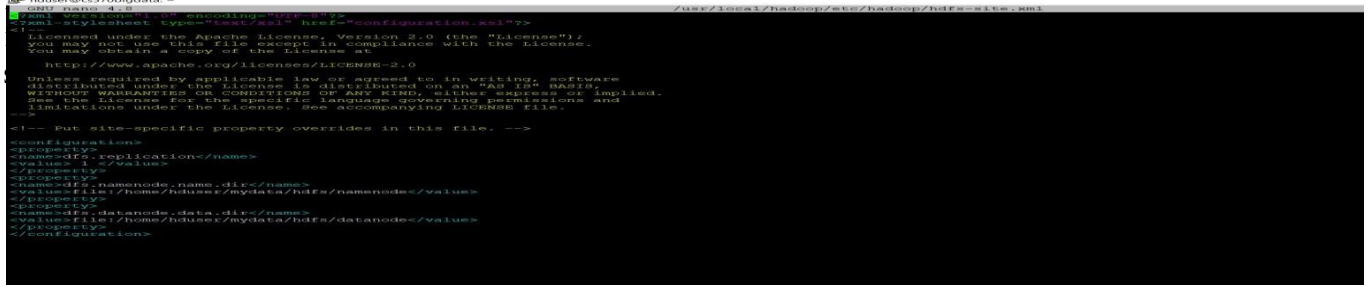


3. sudo nano /usr/local/hadoop/etc/hadoop/mapred-site.xml



4 For doing hdfs.xml

First complete this task's mkdir –p



Create following test data file for hdfs


hduser@cs570bigdata: ~/Desktop/inputdata
hduser@cs570bigdata:~/Desktop/inputdata$ cat test.txt
hello world world hello hello
hduser@cs570bigdata:~/Desktop/inputdata$

Create directory as mentioned

Now copy to file created for input

/usr/local/hadoop/bin/hdfs dfs -put '/home/hduser/Desktop/input data' /user Next final step

for hadoop

hdfs namenode –format

now everything is set we can start hadoop and run the jar for the word count and get the output as shown in below screen

now start hadoop as shown below by running start-dfs.sh start- yarn.sh and jps to check the status as shown in below screens

```
hduser@cs570bigdata: /usr/local/hadoop/sbin
hduser@cs570bigdata:/usr/local/hadoop/sbin$ start-dfs.sh
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.hadoop.security.authentication.util.KerberosUtil (file:/usr/local/hadoop/share/hadoop/common/lib/hadoop-
ity.krb5.Config.getInstance()
WARNING: Please consider reporting this to the maintainers of org.apache.hadoop.security.authentication.util.KerberosUtil
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
Starting namenodes on [cs570bigdata]
cs570bigdata: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser-namenode-cs570bigdata.out
localhost: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-cs570bigdata.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-hduser-secondarynamenode-cs570bigdata.out
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.hadoop.security.authentication.util.KerberosUtil (file:/usr/local/hadoop/share/hadoop/common/lib/hadoop-
ity.krb5.Config.getInstance()
WARNING: Please consider reporting this to the maintainers of org.apache.hadoop.security.authentication.util.KerberosUtil
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
hduser@cs570bigdata:/usr/local/hadoop/sbin$
```

```
hduser@cs570bigdata: /usr/local/hadoop/sbin
hduser@cs570bigdata:/usr/local/hadoop/sbin$ start-yarn.sh
Starting yarn daemons
starting resourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resourcemanager-cs570bigdata.out
localhost: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-cs570bigdata.out
hduser@cs570bigdata:/usr/local/hadoop/sbin$ jps
3347 NodeManager
2998 SecondaryNameNode
3200 ResourceManager
3660 Jps
2638 NameNode
2782 DataNode
hduser@cs570bigdata:/usr/local/hadoop/sbin$
```

Sample program to generate input file for MapReduce Pi:

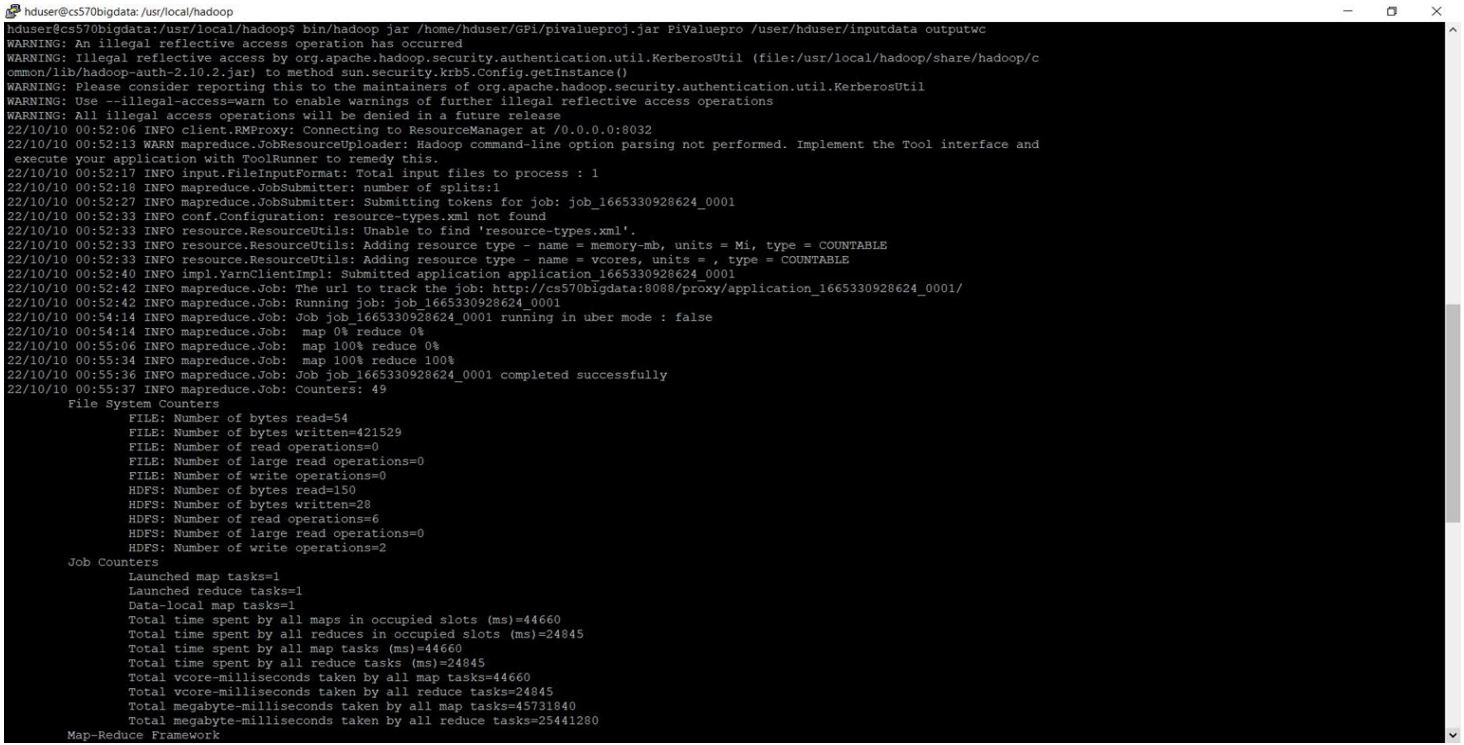
```
import java.io.*;  import
java.util.*;
import java.lang.Object;  import
java.net.URI;

import      org.apache.hadoop.fs.Path;          import
org.apache.hadoop.conf.*;                       import
org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import org.apache.hadoop.mapreduce.Mapper.Context;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;  import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;  import
org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;  import
org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;  import
org.apache.hadoop.fs.*;



public class PiValue {
  public static class Map extends Mapper<LongWritable, Text, Text, IntWritable> {  private final
    static IntWritable one = new IntWritable(1);
    private Text word = new Text();

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

```
        int sum = 0;
                for (IntWritable val : values) {  sum +=
                        val.get();
                }
                context.write(key, new IntWritable(sum));

    }
}

public static void main(String[] args) throws Exception {  Configuration
   conf = new Configuration();
   Job job = new Job(conf, "PiValue");
   job.setJarByClass(PiValue.class);
   job.setOutputKeyClass(Text.class);
   job.setOutputValueClass(IntWritable.class);
   job.setMapperClass(Map.class);
   job.setCombinerClass(Reduce.class);
   job.setReducerClass(Reduce.class);
   job.setInputFormatClass(TextInputFormat.class);
   job.setOutputFormatClass(TextOutputFormat.class);
   job.setNumReduceTasks(1);

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

```
        line2 = line2.replace("outside","").trim();

        System.out.println("Inside:"+line1+", Outside:"+line2);  if (line1 !=

        null && line2 != null) {
          double invalue = Double.valueOf(line1);  double
          outvalue = Double.valueOf(line2);  double pi =4*(
          invalue /(invalue+outvalue));
          System.out.println("PI:"+pi);
        }

        fs.close();
      }
    }
```

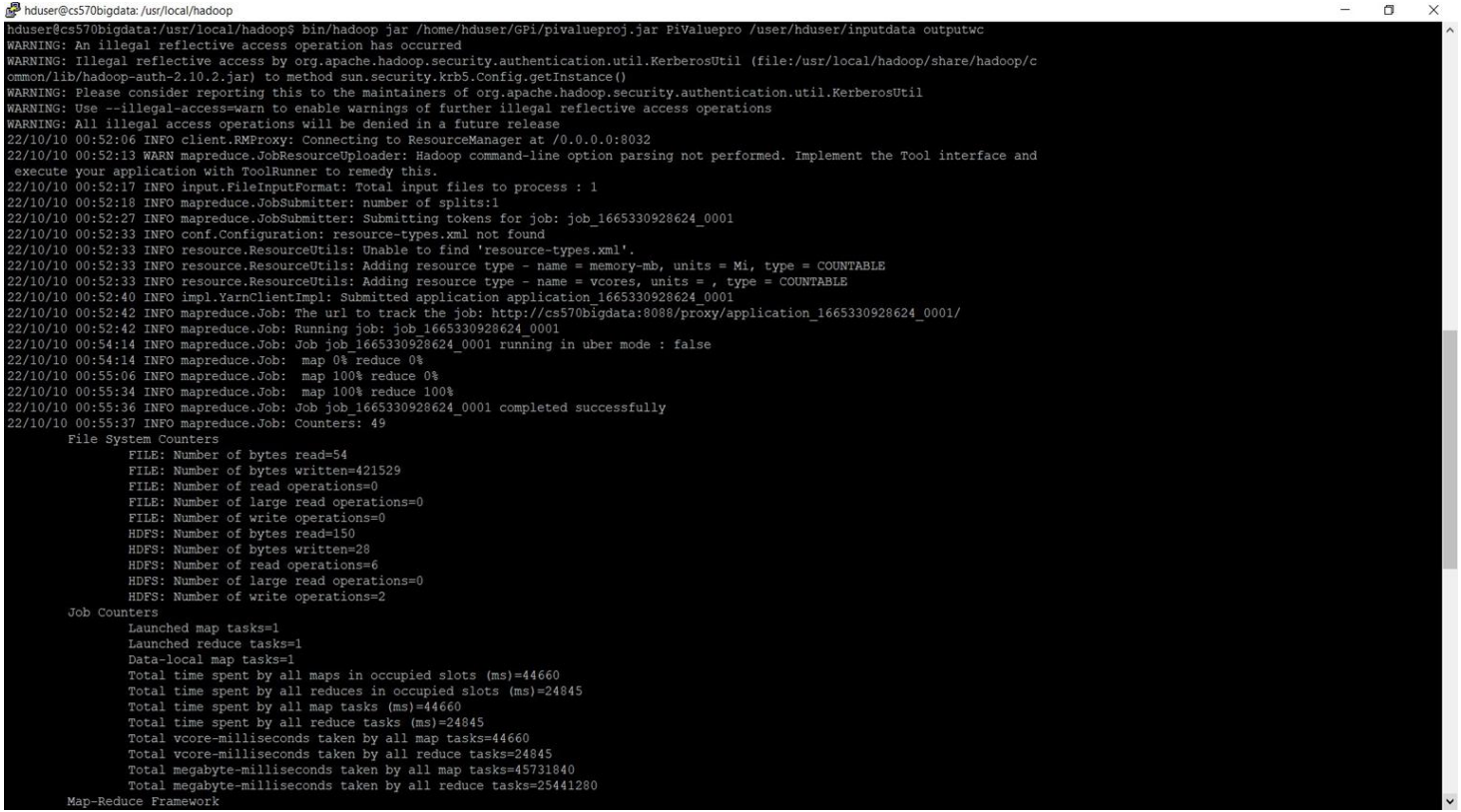
hduser@cs570bigdata:/usr/local/hadoop$ bin/hadoop jar /home/hduser/GPi/pivalueproj.jar PiValuepro /user/hduser/inputdata outputwc

Hadoop running Pi Jar file command:
hduser@cs570bigdata:/usr/local/hadoop$ bin/hadoop jar /home/hduser/GPi/pivalueproj.jar PiValuepro /user/hduser/inputdata outputwc

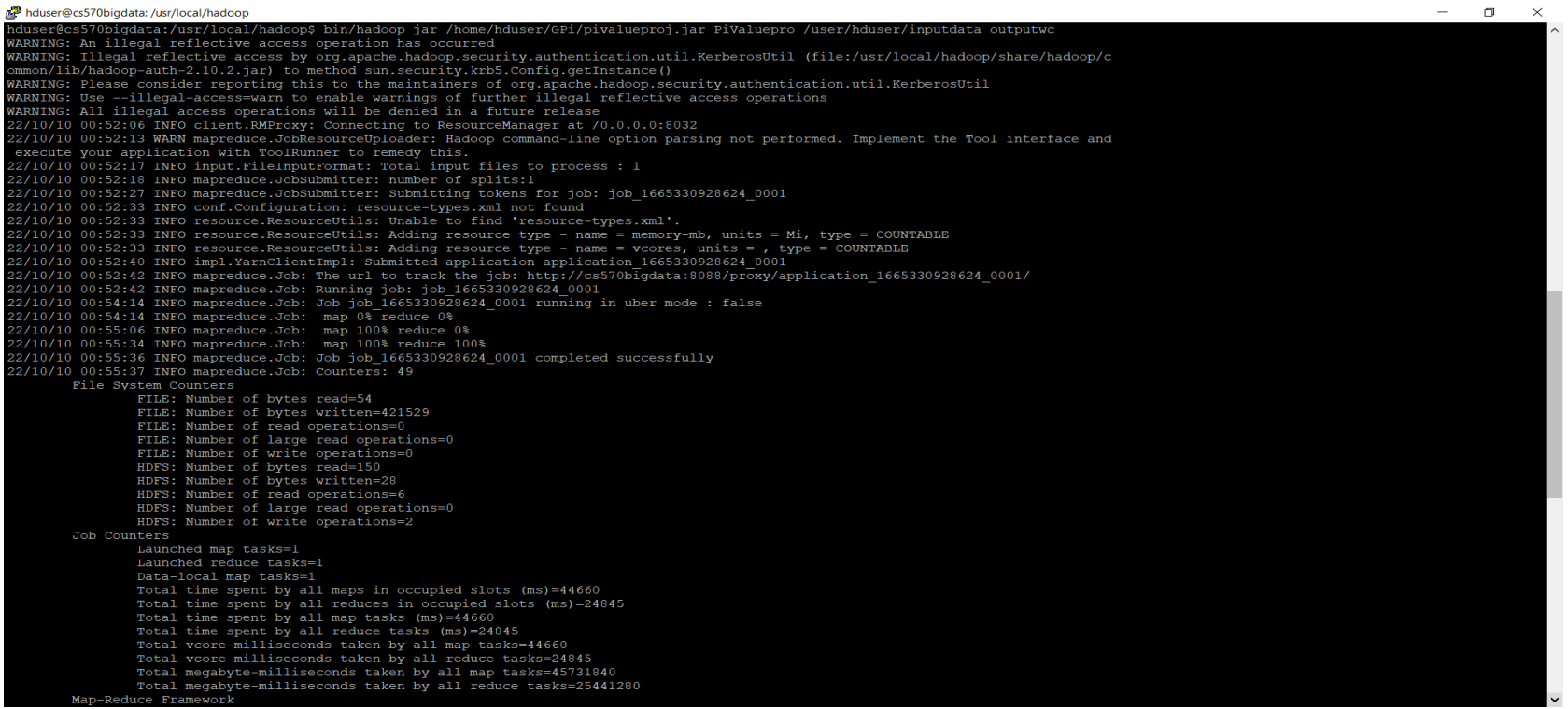


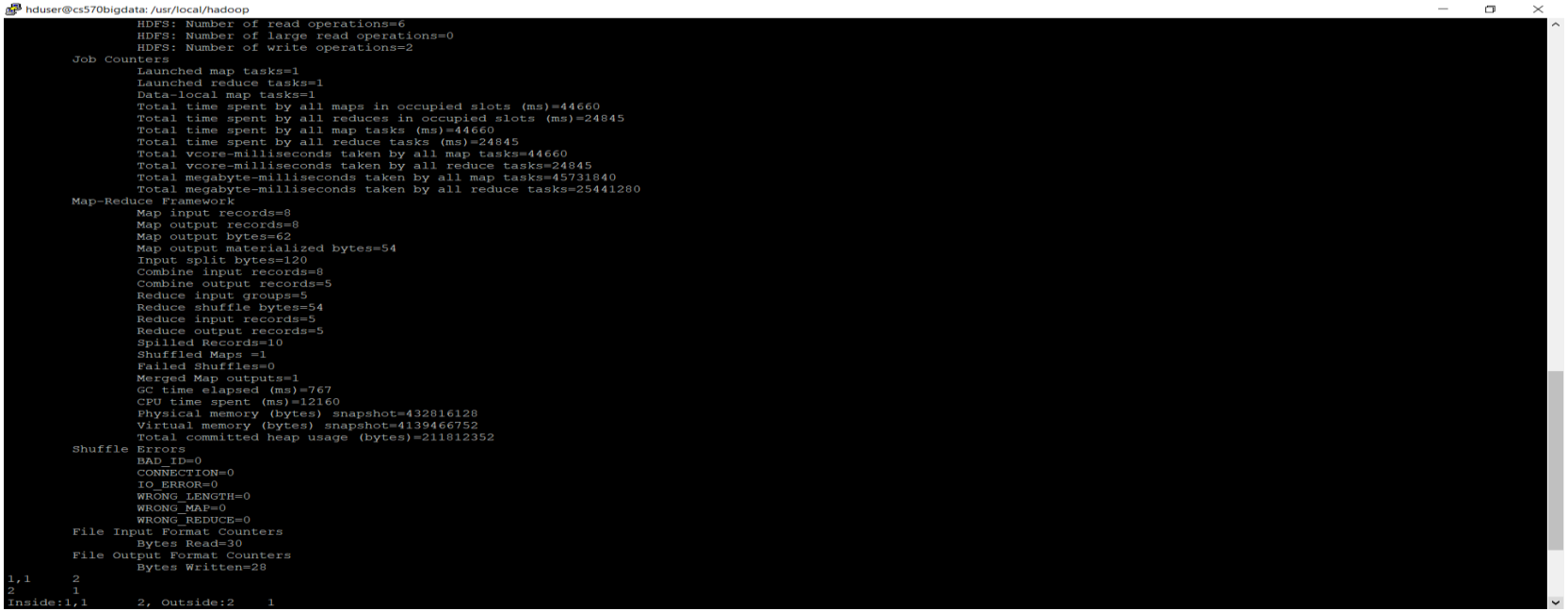
Previous slide output continued :

hduser@cs570bigdata:/usr/local/hadoop$ bin/hadoop jar /home/hduser/GPi/pivalueproj.jar PiValuepro /user/hduser/inputdata outputwc



hduser@cs570bigdata:/usr/local/hadoop$ bin/hadoop jar /home/hduser/GPi/pivalueproj.jar PiValuepro /user/hduser/inputdata outputwc




hduser@cs570bigdata: /usr/local/hadoop
HDFS: Number of read operations=6
HDFS: Number of large read operations=0
HDFS: Number of write operations=2
Job Counters
Launched map tasks=1
Launched reduce tasks=1
Data-local map tasks=1
Total time spent by all maps in occupied slots (ms)=44660
Total time spent by all reduces in occupied slots (ms)=24845
Total time spent by all map tasks (ms)=44660
Total time spent by all reduce tasks (ms)=24845
Total vcore-milliseconds taken by all map tasks=44660
Total vcore-milliseconds taken by all reduce tasks=24845
Total megabyte-milliseconds taken by all map tasks=45731840
Total megabyte-milliseconds taken by all reduce tasks=25441280
Map-Reduce Framework
Map input records=8
Map output records=8
Map output bytes=62
Map output materialized bytes=54
Input split bytes=120
Combine input records=8
Combine output records=5
Reduce input groups=5
Reduce shuffle bytes=54
Reduce input records=5
Reduce output records=5
Spilled Records=10
Shuffled Maps =1
Failed Shuffles=0
Merged Map outputs=1
GC time elapsed (ms)=767
CPU time spent (ms)=12160
Physical memory (bytes) snapshot=432816128
Virtual memory (bytes) snapshot=4139466752
Total committed heap usage (bytes)=211812352
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=30
File Output Format Counters
Bytes Written=28
1,1 2
2 1
Inside:1,1 2, Outside:2 1

Conclusion

Application usage of MapReduce - PI , this lessons learned

Can be applied in many application design for example in study of

Astronomy to find the details of the location of planets , meteors.

Reference :

SFBU course materials