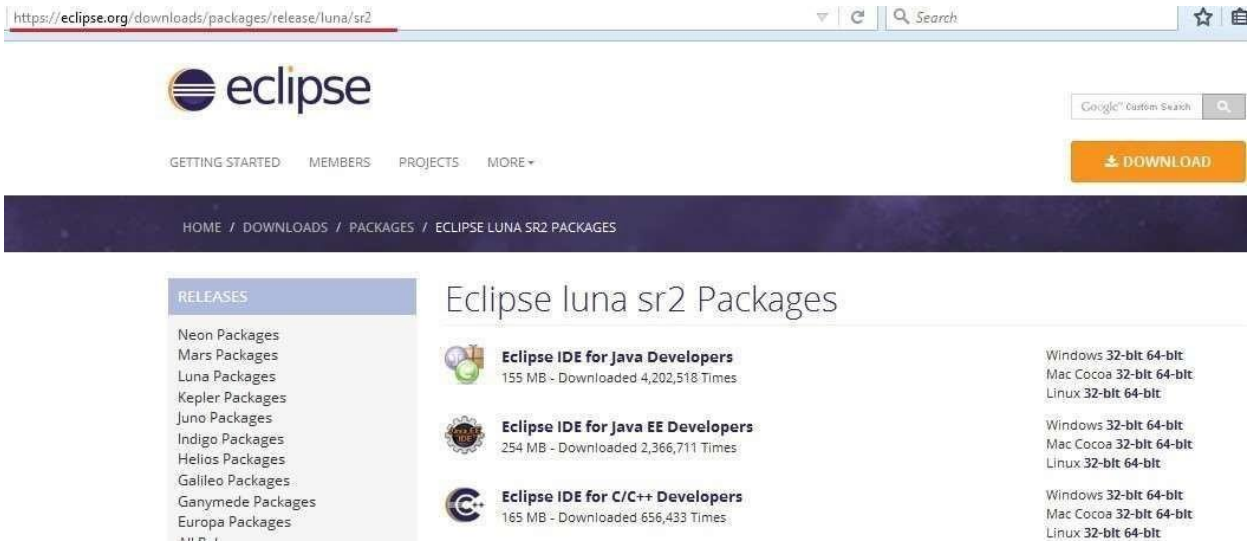
# Practical 5

## AIM: Implementing simple algorithms in Map-Reduce.

1) Configuration Wordcount Program with Eclipse IDE and Run Program in Hadoop2.x

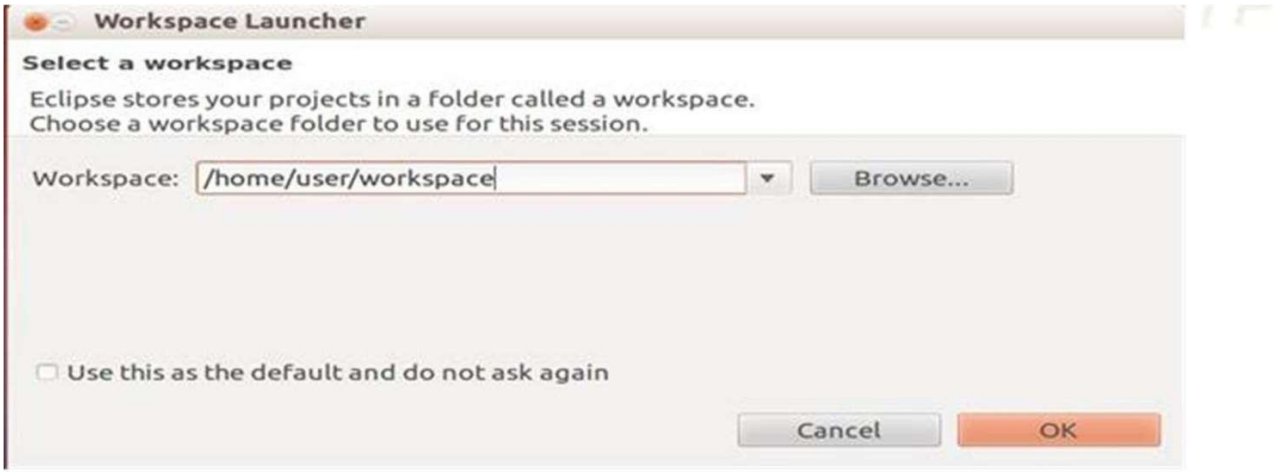
Steps to configure and Run Wordcount
Program Step: Download Eclipse according to
32 bit or 64 bit.

https://eclipse.org/downloads/packages/release/luna/sr2

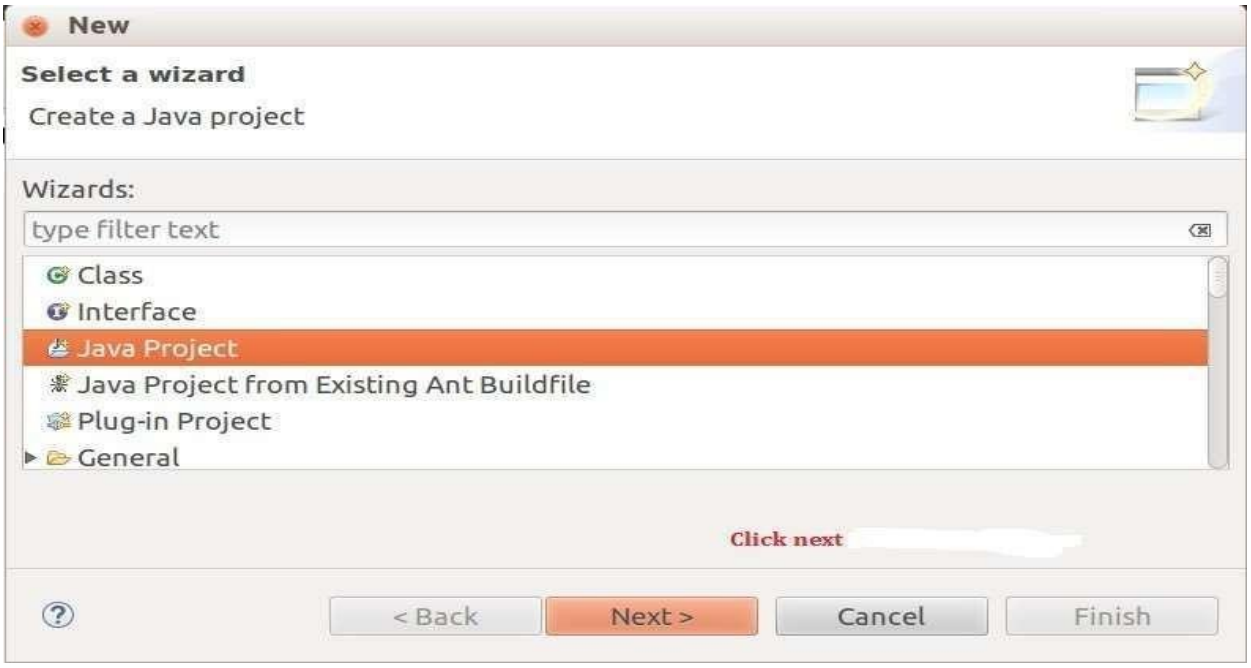



### Step 1: Extract Eclipse and Click on eclipse icon

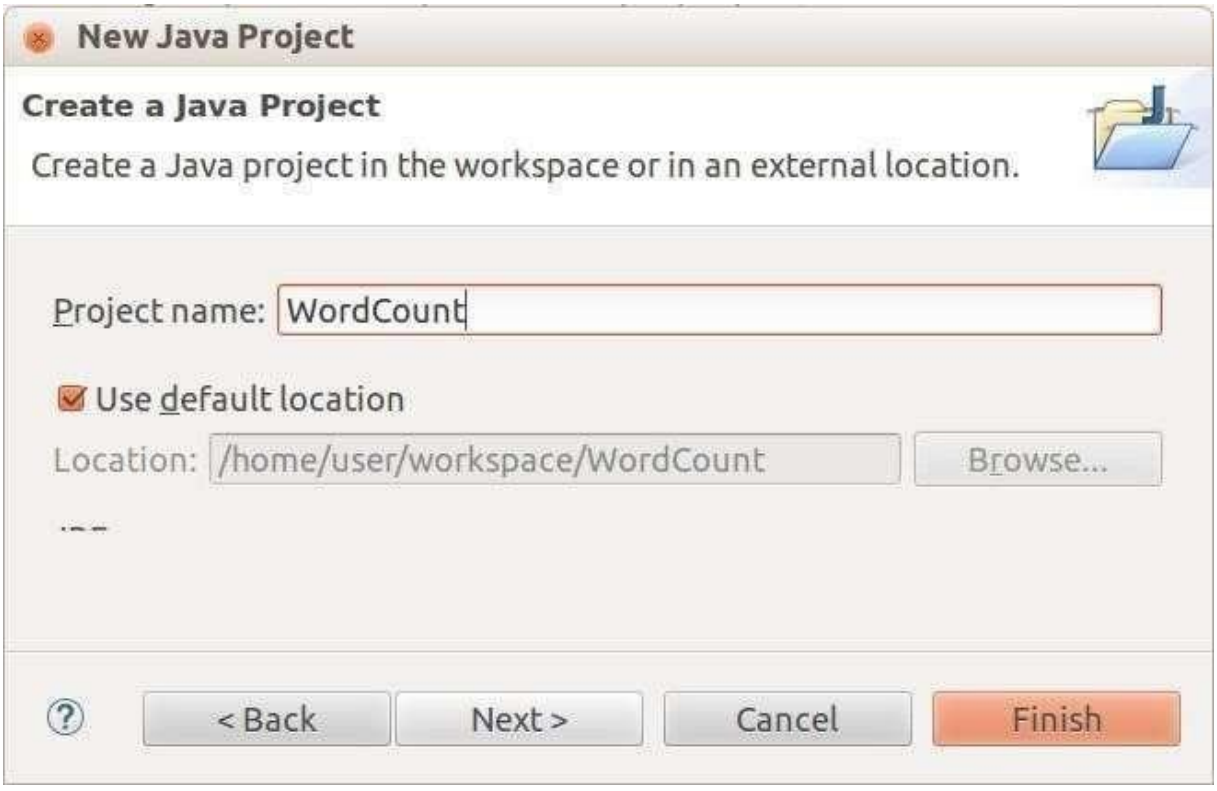

**Step 2: Create workspace in /home/use/workspace if want to change then give location or browse.**



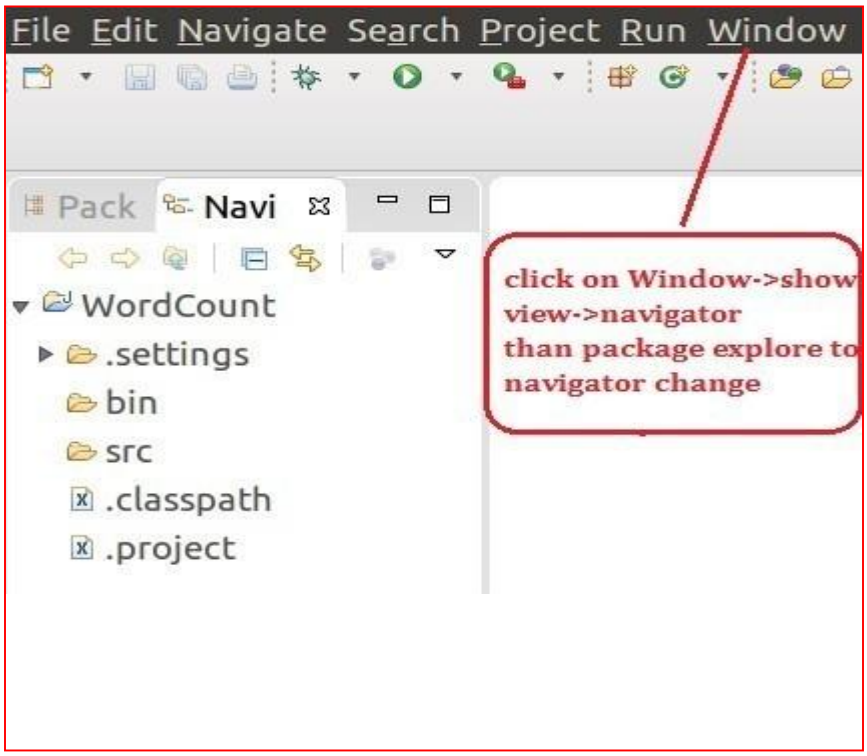
**Step 3: Create project file->new->other->java->javaproject**




**Step 4: Give Project name WordCount**

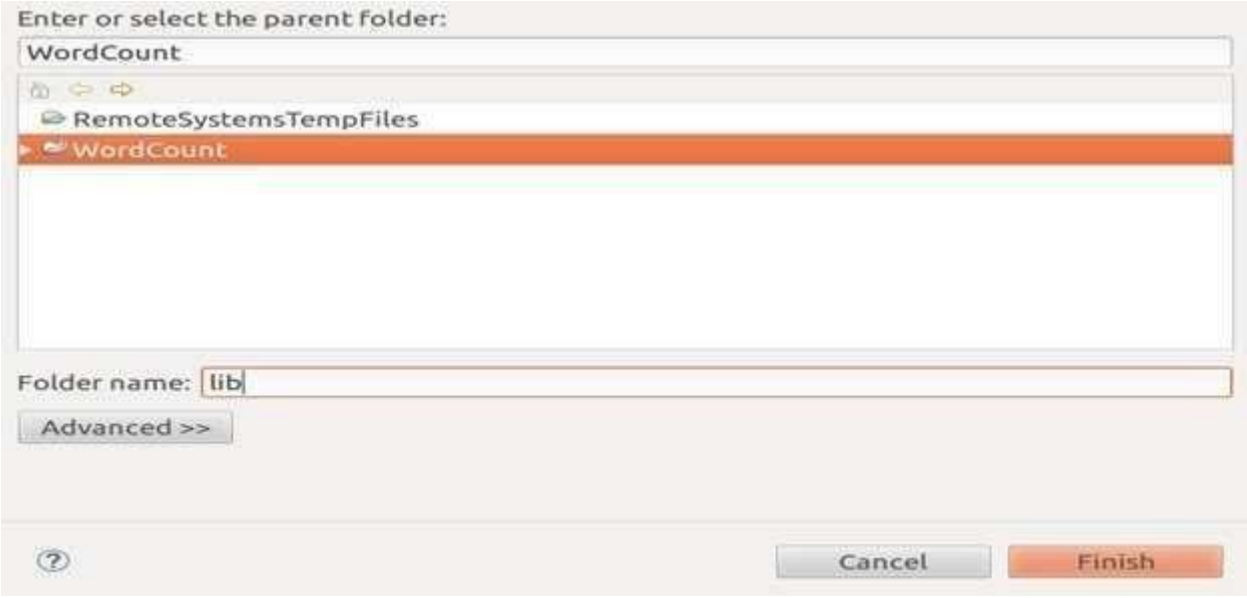


**Step 5: change the default view (Project Explore to**




**Navigator) Window->show view->navigator)**

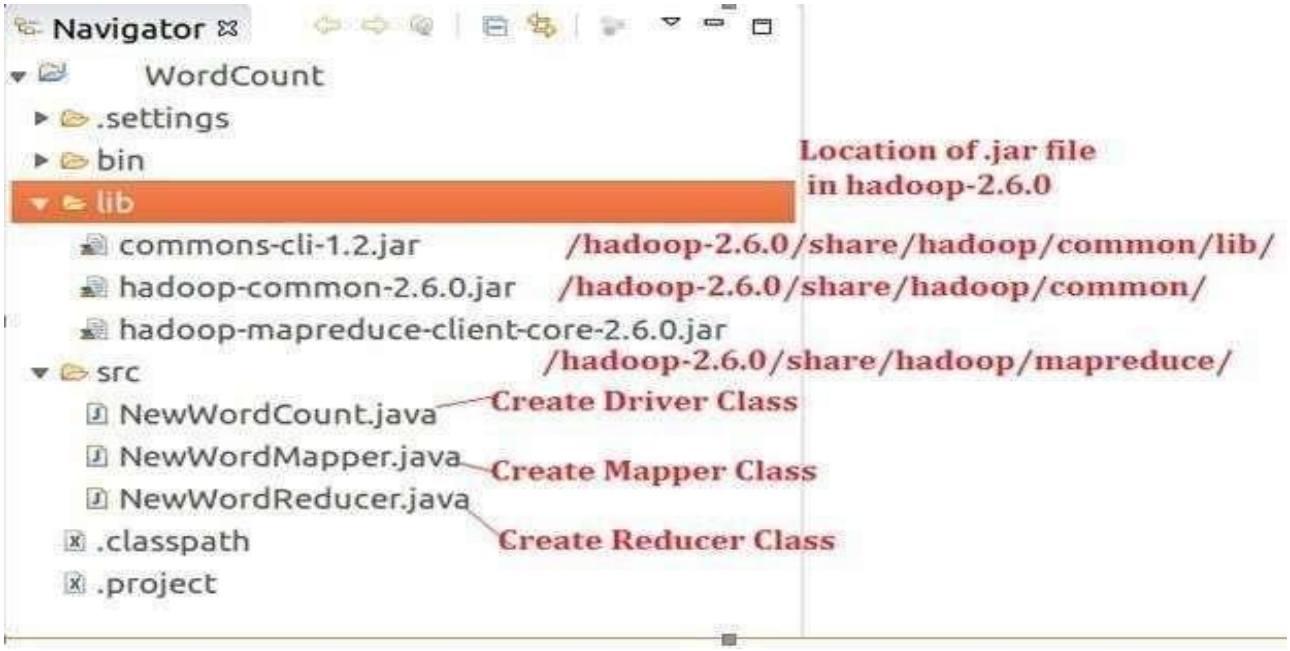
**Step 6: create lib folder inside Wordcount project. Right click on Wordcount->New>Folder**



**Step 7: Copy the Three jar file in lib folder and Create Three java class.Jar file name and location.**

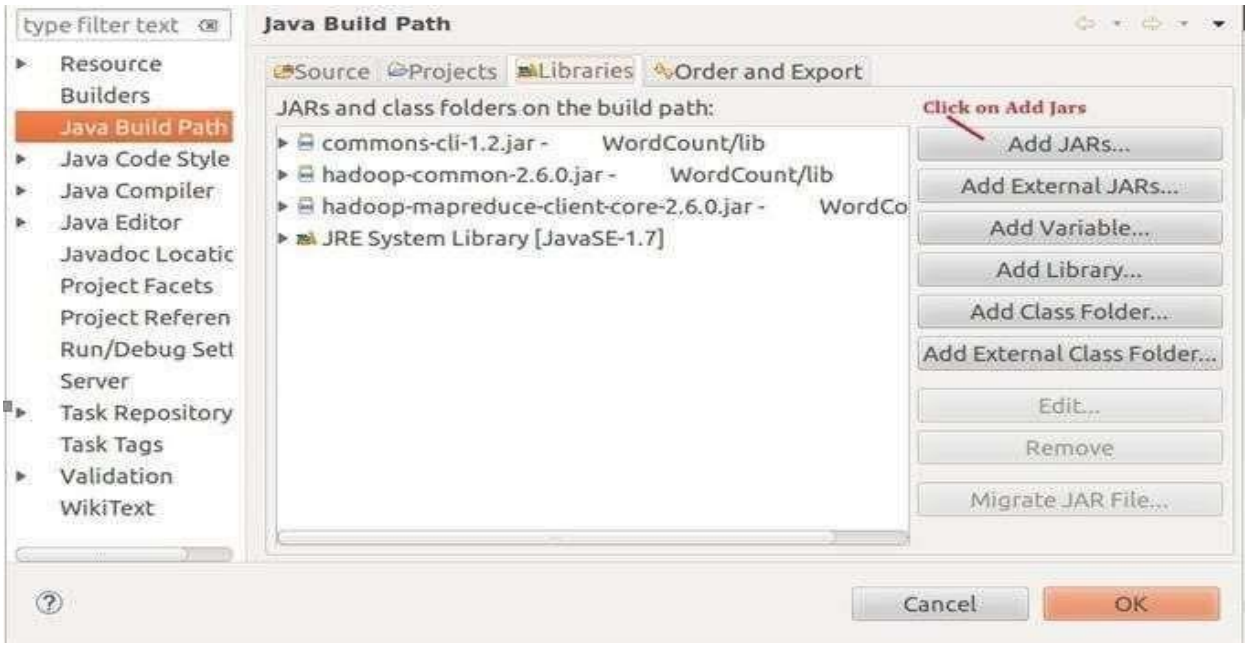
a. /hadoop-2.6.0/share/hadoop/common/lib : commons-cli-1.2.jar
b. /hadoop-2.6.0/share/hadoop/common : hadoop-common-2.6.0.jar
c. /hadoop-2.6.0/share/hadoop/mapreduce/ : hadoop-mapredure-client-core-2.6.0.jar

Three java file for Drivercode,Mapper code,Reducer code.
NewWordCount.java : main class
NewWordMapper.j
ava
NewWordReducer.j
ava




**Step 8: set java build path (class path) by Right Click on**

->WordCountProject-> Properties->JavaBuildPath->Libaries->Click on Add jar and find three jar file in lib folder of WordCount project.




**NewWordCount.java**

```
import org.apache.hadoop.fs.Path;
import
org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.conf.Configuration;
import
org.apache.hadoop.mapreduce.Job;
import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputForm
at; import
org.apache.hadoop.mapreduce.lib.output.TextOutputForm
at; public class NewWordCount
{
public static void main(String[] args) throws Exception
{
//Creating an object of Configuration class, which loads the
configuration parameters Configuration conf = new Configuration();
```

```
//Creating the object of Job class and passing the conf object and Job name as
arguments. The Job class allows the user to configure the job, submit it and control
its execution.
Job job = new Job(conf, "wordcount");
//Setting the jar by finding where a given class came from
job.setJarByClass(NewWordCount.class); //Setting the key class for
job output data job.setOutputKeyClass(Text.class);
//Setting the value class for job output data job.setOutputValueClass(IntWritable.class);
//Setting the mapper for the job job.setMapperClass(NewWordMapper.class);
//Setting the reducer for the job job.setReducerClass(NewWordReducer.class);
//Setting the Input Format for the job
job.setInputFormatClass(TextInputFormat.class); //Setting the Output Format for the job
job.setOutputFormatClass(TextOutputFormat.class);
//Adding a path which will act as a input for MR job. args[0] means it will use the
first argument written on terminal as input path
FileInputFormat.addInputPath(job, new Path(args[0])); //Setting the path to a
directory where MR job will dump the output. args[1] means it will use the second
argument written on terminal as output path
FileOutputFormat.setOutputPath(job,new Path(args[1])); //Submitting
the job to the cluster and waiting for its completion
job.waitForCompletion(true);
}}
```

**NewWordMapper.java**

```
import java.io.IOException;
import
java.util.StringTokenizer;
import
org.apache.hadoop.io.IntWritable;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.mapreduce.Mapp
er;
public class NewWordMapper 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
```

```
IOException, InterruptedException
{
String line = value.toString();
StringTokenizer tokenizer = new
StringTokenizer(line);
while(tokenizer.hasMoreTokens())
{
word.set(tokenizer.nextToken()); context.write(word,one);
}}}
```

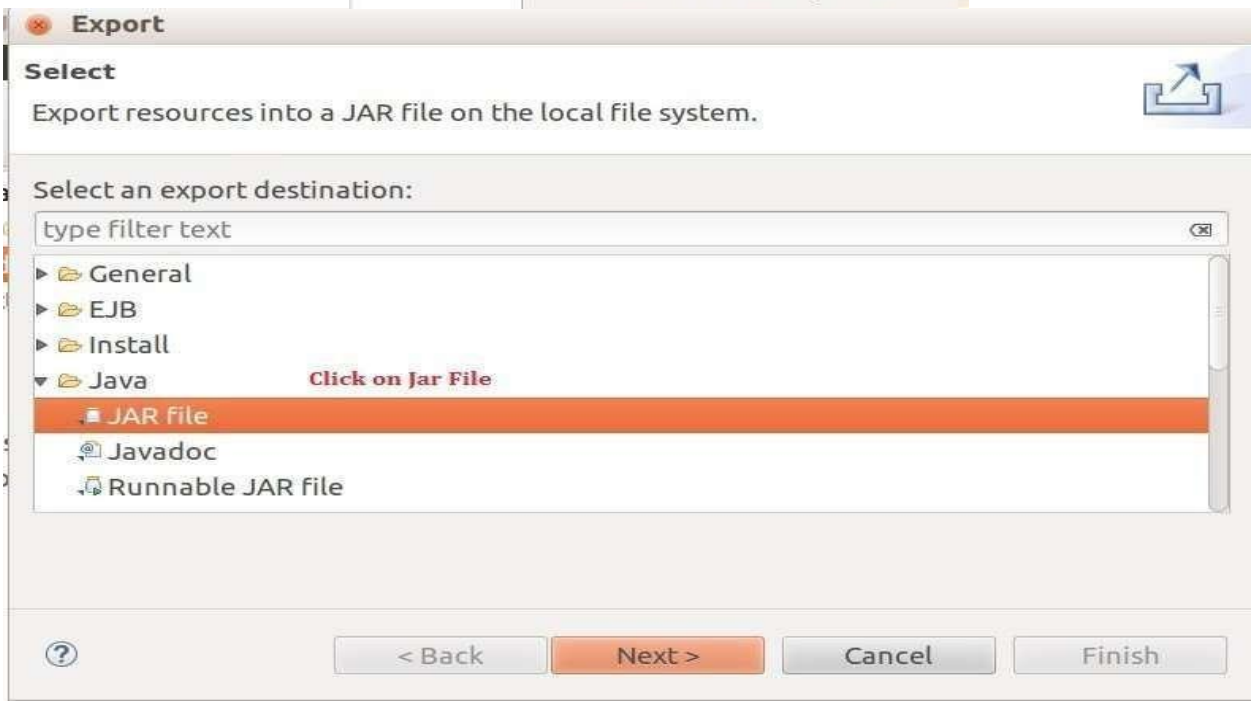
**NewWordReducer.java**

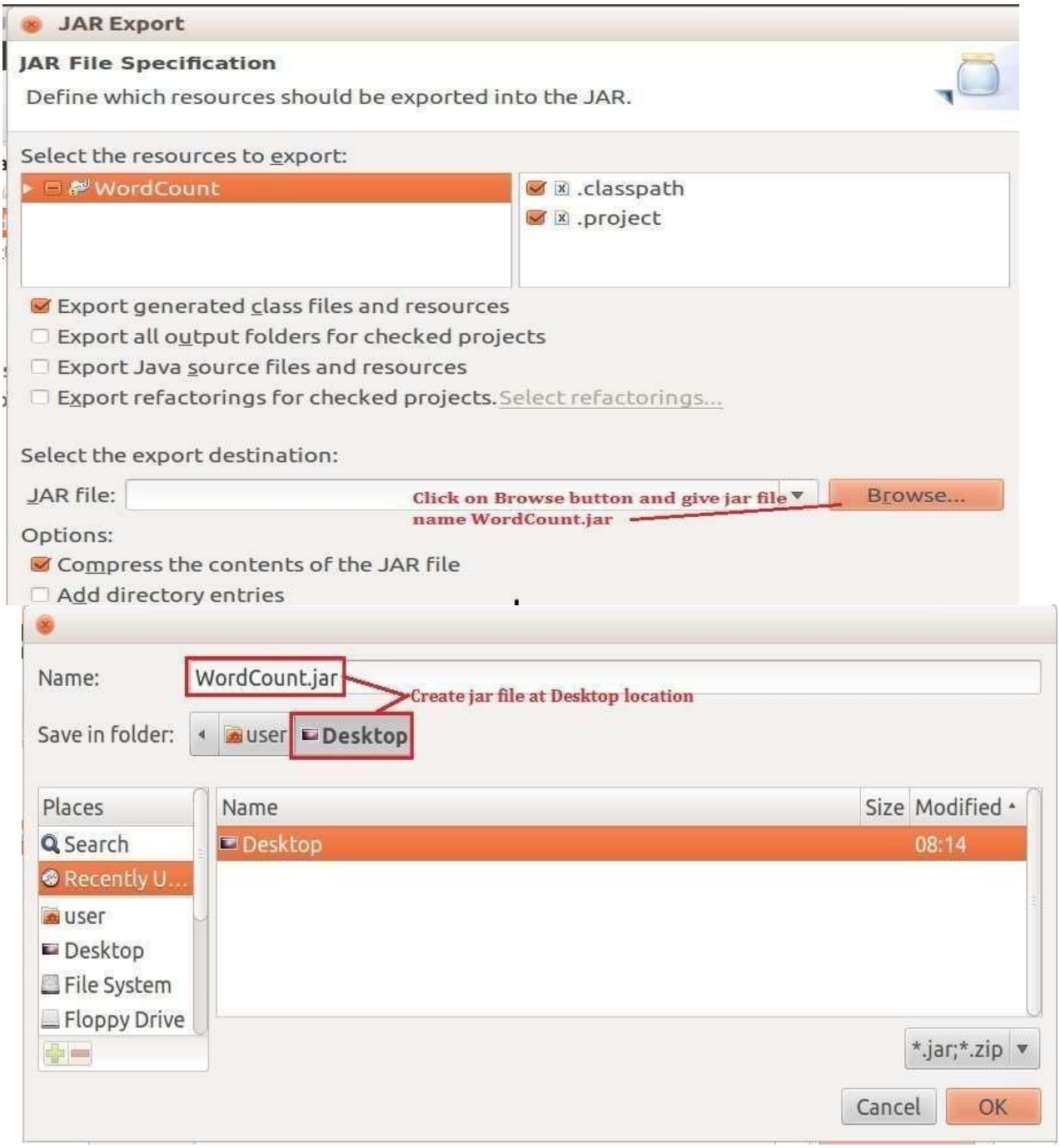
```
import java.io.IOException;
import
org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
public class NewWordReducer extends Reducer<Text, IntWritable, Text, IntWritable>
{
public void reduce(Text key, Iterable<IntWritable>values,
Contextcontext) throws IOException, InterruptedException
{
int count = 0;
for(IntWritable val :
values)
{
count += val.get();
}
context.write(key, new IntWritable(count));
}}
```

**Step 9: Create Jar file Right click on**

WordCountProject->Export->java->jar file>Browse->give jar WordCount.jar filename ->OK->finish.


File Edit
Navigator
WordCo
.setting
bin
lib
src
New
Go Into
Open in New Window
Copy
Paste
Delete
Move...
Rename...
Import...
Export..
Click on Export
Refresh
Close Project
Close Unrelated Projects


Export
Select
Export resources into a JAR file on the local file system.
Select an export destination:
type filter text
General
EJB
Install
Java
Click on Jar File
JAR file
Javadoc
Runnable JAR file
< Back
Next >
Cancel
Finish




**Step 10: Create txt file name is input file**

hi how are you how is your job
how is your family how is your
brother how is your sister what is
the time now what is the strength

of Hadoop

**Step 11: create directory inside hdfs name is /home/user/input**

```
user@ubuntu: ~
user@ubuntu:~$ hadoop fs -mkdir -p /home/user/input
OpenJDK Client VM warning: You have loaded library /home/user/hadoop-2.6.0/lib/n
ative/libhadoop.so.1.0.0 which might have disabled stack guard. The VM will try
to fix the stack guard now.
It's highly recommended that you fix the library with 'execstack -c <libfile>',
or link it with '-z noexecstack'.
16/06/16 13:06:43 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
user@ubuntu:~$
```

**Step 12: move inputfile.txt in hdfs /home/user/input director.**

```
user@ubuntu: ~                    input file location        hdfs dir location
user@ubuntu:~$ hadoop fs -put '/home/user/Desktop/inputfile' /home/user/input
OpenJDK Client VM warning: You have loaded library /home/user/hadoop-2.6.0/lib/n
ative/libhadoop.so.1.0.0 which might have disabled stack guard. The VM will try
to fix the stack guard now.
It's highly recommended that you fix the library with 'execstack -c <libfile>',
or link it with '-z noexecstack'.
16/06/16 13:11:04 WARN util.NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
```

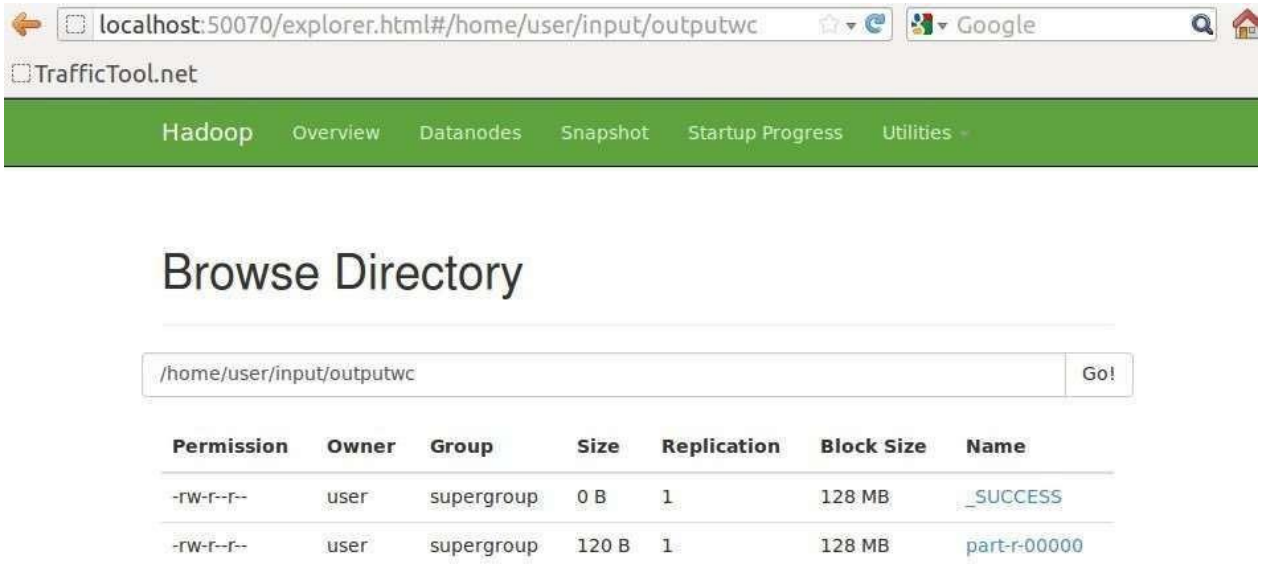
**Step 13: Run WordCount.jar file in HDFS .**

```
user@ubuntu: ~ WordCount.jar file location at localfile system   Main Class name   inputfile locatio in HDFS
user@ubuntu:~$ hadoop jar '/home/user/Desktop/WordCount.jar' NewWordCount /home/user/i
nput/inputfile /home/user/input/outputwc
                                  output directory location where part-r-00000
                                  and -SUCCESS file create
```

**Step 14: Console final output**

```
user@ubuntu: ~
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=477
                CPU time spent (ms)=10180
                Physical memory (bytes) snapshot=231100416
                Virtual memory (bytes) snapshot=806215680
                Total committed heap usage (bytes)=137433088
        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=142
        File Output Format Counters
                Bytes Written=120
```

**Step 15: http://localhost:500070 Browser output.**



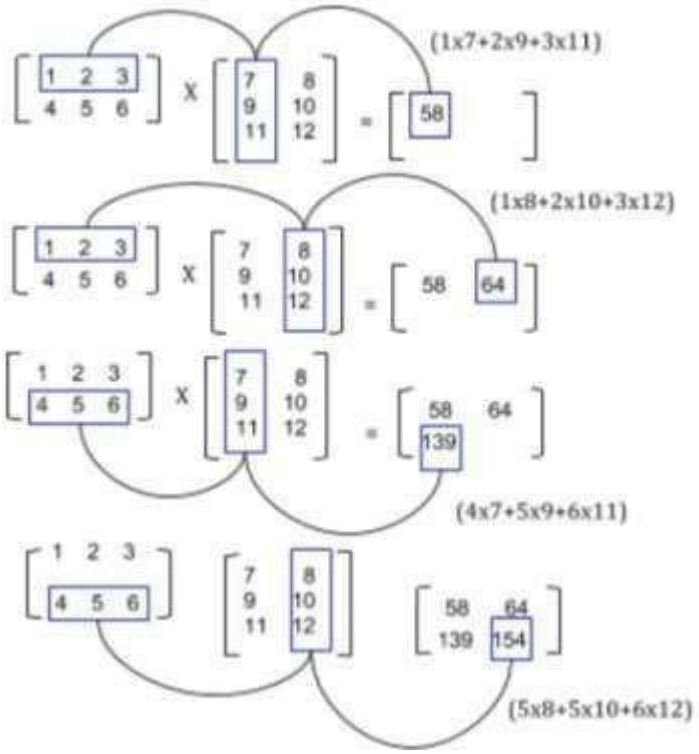

**Step 16: out file part-r-00000**

```
user@ubuntu:~$ hadoop fs -cat /home/user/input/outputwc/part-r-00000
OpenJDK Client VM warning: You have loaded library /home/user/hadoop-2.6.0/lib/native/l
ibhadoop.so.1.0.0 which might have disabled stack guard. The VM will try to fix the sta
ck guard now.
It's highly recommended that you fix the library with 'execstack -c <libfile>', or link
 it with '-z noexecstack'.
16/06/16 13:33:43 WARN util.NativeCodeLoader: Unable to load native-hadoop library for
your platform... using builtin-java classes where applicable
are     1
brother 1
family  1
hadoop  1
hi      1
how     5
is      6
job     1
now     1
of      1
sister  1
strength        1
the     2
time    1
what    2
you     1
your    4
```

## 2) Configuration Matrix Multiplication using MapReduce Programming

In mathematics, matrix multiplication or the matrix product is a binary operation that produces a matrix from two matrices. The definition is motivated by linear equations and linear transformations on vectors, which have numerous applications in applied

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




**Algorithm for Map Function.**

for each element mij of M do produce (key, value) pairs as ((i, k), (M, j, mij), for k=1,2, 3, up to the number of columns of N
for each element njk of N do produce (key, value) pairs as ((i, k), (N, j, Njk), for I = 1,2, 3, Up to the number of rows of M.
return Set of (key, value) pairs that each key (i, k), has list with values (M, j, mij) and (N, j, njk) for all possible values of j.

**Algorithm for Reduce Function.**

for each key (i, k) do
sort values begin with M by j in listM sort values begin with N by j in listN multiply mij and njk for jth value of each list sum up mij x njk return (i, k), Σj=1 mij x njk

**Step 1. Creating Mapper file for Matrix Multiplication.**

```
package example;
import org.apache.hadoop.conf.*;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.mapreduce.Mapper;
import java.io.IOException;
public class Map
extends org.apache.hadoop.mapreduce.Mapper<LongWritable, Text, Text, Text>
{
@Override
public void map(LongWritable key, Text value, Context context) throws
IOException, InterruptedException
{
Configuration conf =
context.getConfiguration(); int m =
Integer.parseInt(conf.get("m"));
int p =
Integer.parseInt(conf.get("p"));
String line = value.toString();
// (M, i, j, Mij);
String[] indicesAndValue =
line.split(","); Text outputKey =
new Text();
Text outputValue = new Text();
if (indicesAndValue[0].equals("M"))
{
for (int k = 0; k < p; k++)
{
outputKey.set(indicesAndValue[1] + "," + k);
// outputKey.set(i,k);
outputValue.set(indicesAndValue[0] + "," +indicesAndValue[2]+ "," + indicesAndValue[3]);
// outputValue.set(M,j,Mij);
context.write(outputKey,
outputValue);
}}
else
{
// (N, j, k, Njk);
for (int i = 0; i < m; i++)
{
outputKey.set(i + "," + indicesAndValue[2]);
```

```
outputValue.set("N," + indicesAndValue[1] + ","+
 indicesAndValue[3]); context.write(outputKey, outputValue);
}}}}
```

**Step 2. Creating Reducer.java file for Matrix Multiplication.**

```
package example;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.mapreduce.Reducer;
import java.io.IOException;
import
java.util.HashMap;
public class Reduce
extends org.apache.hadoop.mapreduce.Reducer<Text, Text, Text, Text>
{
@Override
public void reduce(Text key, Iterable<Text> values, Context context) throws
IOException, InterruptedException
{
String[] value;
//key=(i,k),
//Values = [(M/N,j,V/W),..]
HashMap<Integer, Float> hashA = new HashMap<Integer,
Float>(); HashMap<Integer, Float> hashB = new
HashMap<Integer, Float>(); for (Text val : values)
{
value = val.toString().split(",");
if (value[0].equals("M"))
{
hashA.put(Integer.parseInt(value[1]),Float.parseFloat(value[2]));
 }
else
{
hashB.put(Integer.parseInt(value[1]),Float.parseFloat(value[2]));
}}
int n =
Integer.parseInt(context.getConfiguration().get("n")
); float result = 0.0f;
float
m_ij;
float
```

```
n_jk;
for (int j = 0; j < n; j++)
{
m_ij = hashA.containsKey(j) ?
hashA.get(j) : 0.0f; n_jk =
hashB.containsKey(j) ? hashB.get(j) : 0.0f;
result += m_ij * n_jk;
}

if (result != 0.0f)
{
context.write(null, new Text(key.toString() + "," +Float.toString(result)));
}}}
```

**Step 3. Creating MatrixMultiply.java file for**

```
package example;
import
org.apache.hadoop.conf.*;
import
org.apache.hadoop.fs.Path;
import
org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputForma
t; import
org.apache.hadoop.mapreduce.lib.output.TextOutputForm
at; public class MatrixMultiply
{
public static void main(String[] args) throws Exception
{
if (args.length != 2){
System.err.println("Usage: MatrixMultiply <in_dir>
<out_dir>"); System.exit(2);
}
Configuration conf = new Configuration();
// M is an m-by-n matrix; N is an n-by-p
matrix. conf.set("m", "1000");
```

```
conf.set("n", "100");
conf.set("p", "1000");
@SuppressWarnings("deprecat
ion")
Job job = new Job(conf, "MatrixMultiply");
job.setJarByClass(MatrixMultiply.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(Text.class);
job.setMapperClass(Map.class);
job.setReducerClass(Reduce.class);
job.setInputFormatClass(TextInputFormat.class);
job.setOutputFormatClass(TextOutputFormat.cla
ss); FileInputFormat.addInputPath(job, new
Path(args[0]));
FileOutputFormat.setOutputPath(job, new
Path(args[1])); job.waitForCompletion(true);
}}
```

**Step 4. Compiling the program in particular folder named as operation**

```
$ javac -cp hadoop-common-2.2.0.jar:hadoop-mapreduce-
client-core- 2.7.1.jar:operation/:. -d operation/ Map.java
$ javac -cp hadoop-common-2.2.0.jar:hadoop-mapreduce-
client-core- 2.7.1.jar:operation/:. -d operation/ Reduce.java
$ javac -cp hadoop-common-2.2.0.jar:hadoop-mapreduce-
client-core 2.7.1.jar:operation/:. -d operation/
MatrixMultiply.java
```

**Step 5. Let's retrieve the directory after compilation.**

```
$ ls -R operation/ operation/:
www operation/www:
ehadoopinfo
operation/www/ehadoopinfo:
com operation/www/ehadoopinfo/com:
Map.class MatrixMultiply.class  Reduce.class
```

**Step 6. Creating Jar file for the Matrix Multiplication.**

```
$ jar -cvf MatrixMultiply.jar -C

operation/ . added manifest
```

adding: www/(in = 0) (out= 0)(stored 0%) adding: www/ehadoopinfo/(in = 0) (out= 0)(stored 0%) adding: www/ehadoopinfo/com/(in = 0) (out= 0)(stored 0%) adding: www/ehadoopinfo/com/Reduce.class(in = 2919) (out= 1271)(deflated 56%) adding: www/ehadoopinfo/com/MatrixMultiply.class(in = 1815) (out= 932)(deflated 48%) adding: www/ehadoopinfo/com/Map.class(in = 2353) (out= 993)(deflated 57%)

**Step 7. Uploading the M, N file which contains the matrix multiplication data to HDFS.**

$ cat
M
M,0,0,
1
M,0,1,2
M,1,0,3
M,1,1,4
$ cat
N
N,0,0,
5
N,0,1,6
N,1,0,7
N,1,1,8
$ hadoop fs -mkdir Matrix/
$ hadoop fs -copyFromLocal M Matrix/
$ hadoop fs -copyFromLocal N Matrix/

**Step 8. Executing the jar file using hadoop command and thus how fetching record from HDFS and storing output in HDFS.**

$ hadoop jar MatrixMultiply.jar MatrixMultiply Matrix/*

result/ WARNING: Use "yarn jar" to launch YARN

applications.
17/10/09 14:31:22 INFO impl.TimelineClientImpl: Timeline service address: http://sandbox.hortonworks.com:8188/ws/v1/timeline/
17/10/09 14:31:23 INFO client.RMProxy: Connecting to ResourceManager at sandbox.hortonworks.com/10.0.2.15:8050
17/10/09 14:31:23 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.

17/10/09 14:31:24 INFO input.FileInputFormat: Total input paths to process : 2 17/10/09 14:31:24 INFO mapreduce.JobSubmitter: number of splits:2 17/10/09 14:31:24 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1507555978175_0006
17/10/09 14:31:25 INFO impl.YarnClientImpl: Submitted application application_1507555978175_0006
17/10/09 14:31:25 INFO mapreduce.Job: The url to track the job: http://sandbox.hortonworks.com:8088/proxy/application_1507555978175_0006/ 17/10/09 14:31:25 INFO mapreduce.Job: Running job: job_1507555978175_0006
17/10/09 14:31:35 INFO mapreduce.Job: Job job_1507555978175_0006 running in uber mode : false
17/10/09 14:31:35 INFO mapreduce.Job: map 0% reduce 0%
17/10/09 14:31:45 INFO mapreduce.Job: map 100% reduce 0%
17/10/09 14:31:53 INFO mapreduce.Job: map 100% reduce 100%
17/10/09 14:31:54 INFO mapreduce.Job: Job job_1507555978175_0006 completed successfully 17/10/09 14:31:55 INFO mapreduce.Job: Counters: 49
File System Counters

FILE: Number of bytes read=198
FILE: Number of bytes written=386063 FILE: Number of read operations=0
FILE: Number of large read operations=0 FILE: Number of write operations=0 HDFS: Number of bytes read=302 HDFS: Number of bytes written=36 HDFS: Number of read operations=9
HDFS: Number of large read operations=0 HDFS: Number of write operations=2
Job Counters
Launched map tasks=2
Launched reduce tasks=1 Data-local map tasks=2
Total time spent by all maps in occupied slots (ms)=15088 Total time spent by all reduces in

occupied slots (ms)=6188 Total time spent by all
map tasks (ms)=15088
Total time spent by all reduce tasks
(ms)=6188 Total vcore-seconds taken by all
map tasks=15088 Total vcore-seconds taken
by all reduce tasks=6188
Total megabyte-seconds taken by all map
tasks=3772000 Total megabyte-seconds taken by
all reduce tasks=1547000 Map-Reduce
Framework
Map input
records=8 Map
output records=16
Map output
bytes=160

Map output materialized
bytes=204 Input split
bytes=238
Combine input
records=0 Combine
output records=0
Reduce input
groups=4 Reduce
shuffle bytes=204
Reduce input
records=16 Reduce
output records=4
Spilled Records=32
Shuffled Maps =2
Failed Shuffles=0
Merged Map
outputs=2
GC time elapsed
(ms)=196 CPU time
spent (ms)=2720
Physical memory (bytes)
snapshot=536309760 Virtual memory
(bytes) snapshot=2506076160 Total
committed heap usage

(bytes)=360185856 Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGT
H=0
WRONG_MAP=0
WRONG_REDUC
E=0
File Input Format
Counters Bytes
Read=64
File Output Format Counters Bytes Written=36

**Step 10. Getting Output from part-r-00000 that was generated after the execution of the hadoop command.**

$ hadoop fs -cat result/part-r-

00000 0,0,19.0

0,1,22.0
1,0,43.0
1,1,50.0

**Implementing simple algorithms in Map-Reduce.**

1) **Join Algorithm**

UsersDetails.csv

This file contains the user related data, where data is present in following format,
<UserID><FirstName><LastName>

```
1,Shyama,Patni
2,Paul,Kam
3,Jayesh,Patel
4,Sid,Dave
5,Prakash,Aarya
6,Jastin,Cohelo
```

AddressDetails.csv

This file contains the User's Address related data, where data is present in following format, <UserID><City><State><Country>

```
1,Kolkata,W.Bengal,India
2,Atlanta,Georgia,USA
3,Rajkot,Gujarat,India
4,Mumbai,Maharashtra,India
6,San Francisco,California,USA
```

We are going to use following 4 Java files for this algorithm,

1) AddressFileMapper.java
2) UserFileMapper.java
3) UserDataReducer.java
4) ReduceSideJoinDriver.java


**AddressFileMapper.java**

```
package
com.javadeveloperzone.hadoop.reducesidejoin;
import java.io.IOException;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class AddressFileMapper extends Mapper<LongWritable, Text, LongWritable, Text>
{
private static final String fileTag = "AD~";
private static final String DATA_SEPARATOR = ",";
```

```
public void map(LongWritable key, Text value, Context context) throws
IOException, InterruptedException
{
String values[] =
value.toString().split(DATA_SEPARATOR);
StringBuilder dataStringBuilder = new
StringBuilder();
for (int index = 0; index < values.length; index++)
{
if (index != 0)
{
dataStringBuilder.append(values[index].toString().trim() + DATA_SEPARATOR);
}
else
{
dataStringBuilder.append(fileTag);
}}
String dataString =
dataStringBuilder.toString();  if
(dataString != null && dataString.length()
> 1)
{
dataString = dataString.substring(0, dataString.length() - 1);

}
dataStringBuilder = null;
context.write(new LongWritable(Long.parseLong(values[0])), new Text(dataString));
}}
```

**UserFileMapper.java**

```
package
com.javadeveloperzone.hadoop.reducesidejoin;
import java.io.IOException;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class UserFileMapper extends Mapper<LongWritable, Text, LongWritable, Text>
{
private static final String fileTag = "UD~";
private static final String DATA_SEPARATOR = ",";
public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException
```

```
{
String values[] =
value.toString().split(DATA_SEPARATOR);
StringBuilder dataStringBuilder = new
StringBuilder();
for (int index = 0; index < values.length; index++)
{
if (index != 0)
{
dataStringBuilder.append(values[index].toString().trim() + DATA_SEPARATOR);
}
else
{
dataStringBuilder.append(fileTag);
}}
String dataString =
dataStringBuilder.toString();  if
(dataString != null && dataString.length()
> 1)
{
dataString = dataString.substring(0, dataString.length() - 1);
}
dataStringBuilder = null;
context.write(new LongWritable(Long.parseLong(values[0])), new Text(dataString));
}}
```

**ReduceSideJoinDriver.java**

```
package
com.javadeveloperzone.hadoop.reducesidejoin;
import org.apache.hadoop.conf.Configuration;
import
org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import
org.apache.hadoop.mapreduce.lib.input.MultipleInputs;
import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputForm
```

```
at; import
org.apache.hadoop.mapreduce.lib.output.TextOutputForm
at; import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;
public class ReduceSideJoinDriver extends Configured implements Tool
{
private static final String
DATA_SEPARATOR = ","; public int
run(String[] args) throws Exception
{
Configuration configuration = new Configuration();
configuration.set("mapreduce.output.textoutputformat.separator",
DATA_SEPARATOR);
Job job = Job.getInstance(configuration);
job.setJobName("Reduce Side Join Mapreduce example
using Java");
job.setJarByClass(ReduceSideJoinDriver.class);
// Map
job.setMapOutputKeyClass(LongWritable
.class);
job.setMapOutputValueClass(Text.class);
// Job
job.setOutputKeyClass(LongWritable.clas
s); job.setOutputValueClass(Text.class);
job.setInputFormatClass(TextInputFormat
.class);
job.setOutputFormatClass(TextOutputForma
t.class);
job.setReducerClass(UserDataReducer.class)
;
MultipleInputs.addInputPath(job, new Path(args[0]), TextInputFormat.class,
UserFileMapper.class); MultipleInputs.addInputPath(job, new Path(args[1]),
TextInputFormat.class, AddressFileMapper.class); FileOutputFormat.setOutputPath(job,
new Path(args[2]));
job.waitForCompletion(t
rue); return 0;
}
public static void main(String[] args) throws Exception
{
if (args.length == 3)
{
int result = ToolRunner.run(new Configuration(), new
```

```
ReduceSideJoinDriver(), args); if (0 == result)
{
System.out.println("Reduce Side Join Mapreduce example using Java Job Completed
Successfully...");
}
else
{
System.out.println("Reduce Side Join Mapreduce example using Java Job Failed...");
}}
else
{
System.out.println("USAGE <InputPath1><InputPath2><OutputPath>");
}}}
```

**UserDataReducer.java**

```
package
com.javadeveloperzone.hadoop.reducesidejoin;
import java.io.IOException;
import
org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
public class UserDataReducer extends Reducer<LongWritable, Text, LongWritable, Text>
{
public static final String TAG_SEPARATOR = "~";
private static final String
DATA_SEPARATOR = ","; @Override
protected void reduce(LongWritable key, Iterable<Text> values,
Reducer<LongWritable, Text, LongWritable, Text>.Context context) throws
IOException, InterruptedException
{
String value;
String[]
spllitedValues;
String tag;
String data = null, userDetails = null,
addressDetails = null; for (Text txtValue : values)
{
value = txtValue.toString();
spllitedValues =
value.split(TAG_SEPARATOR); tag =
spllitedValues[0];
```

```
if (tag.equalsIgnoreCase("UD"))
{
userDetails = splitedValues[1];
}
else if (tag.equalsIgnoreCase("AD"))
{
addressDetails = splitedValues[1];
}}
if (userDetails != null && addressDetails != null)
{
data = userDetails + DATA_SEPARATOR + addressDetails;
}
else if (userDetails == null)
{
data = addressDetails;
}
else if (addressDetails == null)
{
data = userDetails;
}
context.write(key, new Text(data));
}}
```

**Copy files from local file system to HDFS**

hdfs dfs -copyFromLocal 4-UserDetails.csv /input/javadeveloperzone/reducesidejoin/ hdfs dfs -copyFromLocal 4-AddressDetails.csv /input/javadeveloperzone/reducesidejoin/

**Build & Run Application**

hadoop jar HadoopJoins.jar com.javadeveloperzone.hadoop.reducesidejoin.ReduceSideJoinDriver /input/javadeveloperzone/reducesidejoin/4-UserDetails.csv /input/javadeveloperzone/reducesidejoin/4- AddressDetails.csv /output/javadeveloperzone/hadoop/reducesidejoin

**OUTPUT: -**

```
1,Shyama,Patni,Kolkata,W.Bengal,India
2,Paul,Kam,Atlanta,Georgia,USA
3,Jayesh,Patel,Rajkot,Gujarat,India
4,Sid,Dave,Mumbai,Maharashtra,India
5,Prakash,Aarya
6,Jastin,Cohelo,San Francisco,California,USA
```

## 2) Sort Algorithm

**Input (test.txt)**

1,50
2,20
3,30
4,10
5,15
6,25
7,55
8,35
9,70

**Sort.java**

```
package
com.my.cert.example;
import
java.nio.ByteBuffer;
import
org.apache.hadoop.conf.Configuration;
import  org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import
org.apache.hadoop.io.IntWritable.Comparator
; import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.io.WritableComparator;
import org.apache.hadoop.mapreduce.Job;
import
org.apache.hadoop.mapreduce.Mapper;
import
org.apache.hadoop.mapreduce.Reducer;
import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import
org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputForm
at;
import
```

```
org.apache.hadoop.mapreduce.lib.output.TextOutputFor
mat; public class ValueSortExp
{
public static void main(String[] args) throws Exception
{
Path inputPath = new
Path("C:\\hadoop\\test\\test.txt"); Path
outputDir = new
Path("C:\\hadoop\\test\\test1");
// Path inputPath = new Path(args[0]);
// Path outputDir = new Path(args[1]);
// Create configuration
Configuration conf = new Configuration(true);
// Create job
Job job = new Job(conf, "Test HIVE commond");
job.setJarByClass(ValueSortExp.class);
// Setup MapReduce
job.setMapperClass(ValueSortExp.MapTask.cl
ass);
job.setReducerClass(ValueSortExp.ReduceTas
k.class); job.setNumReduceTasks(1);
// Specify key / value
job.setMapOutputKeyClass(IntWritable.cla
ss);
job.setMapOutputValueClass(IntWritable.c
lass);
job.setOutputKeyClass(IntWritable.class);
job.setOutputValueClass(IntWritable.class)
;
job.setSortComparatorClass(IntComparato
r.class);
// Input
FileInputFormat.addInputPath(job,
inputPath);
job.setInputFormatClass(TextInputFormat
.class);
// Output
FileOutputFormat.setOutputPath(job,
outputDir);
job.setOutputFormatClass(TextOutputForma
t.class);
// Execute job
```

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

**MapTask.java**

```
public static class MapTask extends Mapper<LongWritable, Text, IntWritable, IntWritable>
{
public void map(LongWritable key, Text value, Context context)throws
java.io.IOException, InterruptedException
{
String line = value.toString();
String[] tokens = line.split(","); // This is the delimiter
between int keypart = Integer.parseInt(tokens[0]);
int valuePart = Integer.parseInt(tokens[1]);
context.write(new IntWritable(valuePart), new IntWritable(keypart));
}}
```

**ReduceTask.java**

```
public static class ReduceTask extends Reducer<IntWritable, IntWritable, IntWritable,
IntWritable>
{
public void reduce(IntWritable key, Iterable<IntWritable> list,
Context context) throws java.io.IOException, InterruptedException
{
for (IntWritable value : list)
{
context.write(value,key);
}}}
```

**IntComparator.java**

```
public static class IntComparator extends WritableComparator
{
public IntComparator()
{
super(IntWritable.class);
}
@Override
public int compare(byte[] b1, int s1,
int l1, byte[] b2, int s2, int l2)
{
```

```
Integer v1 = ByteBuffer.wrap(b1, s1, l1).getInt(); Integer v2 = ByteBuffer.wrap(b2, s2, l2).getInt();
return v1.compareTo(v2) * (-1);
}}
```

**OUTPUT: -**

```
9 70
7 55
1 50
8 35
3 30
6 25
2 20
5 15
4 10
```

# Practical 6

## AIM: Implementing any one Frequent Itemset algorithm using Map- Reduce.

**CODE -**

**Mapper Function**

**Map Phase** input: < k1, v1 >

k1 - Line no v1 - Transaction // get items from each transaction //item count set to 1 for each item k2-item v2 -1 End for

Output(k2, v2)

**Reducer Function**

//Count the occurrences f or each item

// minimum support

**Reduce Phase** input: < k2, List < v2 >> sum

the value for each item occurrence

if (occurrence of an item satisfy minsup)

Em it(Frequent item) k3 - Frequent item v3 - occurrences Output: < k3, v3 >

```
import
java.io.BufferedReader;
import  java.io.*;
import
java.io.IOException;
import java.net.*;
import
java.util.ArrayList;
import java.util.*;
import
model.HashTreeNode;
import model.ItemSet;
import model.Transaction;
import
org.apache.hadoop.conf.Configuration;
import
org.apache.hadoop.conf.Configured;
import
org.apache.hadoop.filecache.DistributedCache
; import org.apache.hadoop.fs.Path;
import
```

```
org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import
org.apache.hadoop.mapreduce.Job;
import
org.apache.hadoop.mapreduce.Mapper;
import
org.apache.hadoop.mapreduce.Reducer;
import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import
org.apache.hadoop.mapreduce.lib.output.FileOutputForm
at; import org.apache.hadoop.util.Tool;
import
org.apache.hadoop.util.ToolRunner;
import utils.AprioriUtils;
import
utils.HashTreeUtils;
import
org.apache.hadoop.fs.*;
/** A parallel hadoop-based Apriori algorithm */
public class MRApriori extends Configured
implements Tool {
 private static String jobPrefix = "MRApriori Algorithm Phase ";
 // TODO : This is bad as I using a global shared
 variable between functions which should
 // ideally be a function parameter. Need to fix this later. These
 parameters are required in
  // reducer logic and have to be dynamica. How can I
  pass some initialisation parameters to
 // reducer ?

 public int run(String[] args) throws
  IOException, InterruptedException,
  ClassNotFoundException { if (args.length
  != 5) {
     System.err.println("Incorrect number of command
      line args. Exiting!!");
      return -1;
     }
```

```
String hdfsInputDir = args[0];
String hdfsOutputDirPrefix = args[1];

int maxPasses = Integer.parseInt(args[2]);
Double MIN_SUPPORT_PERCENT = Double.parseDouble(args[3]);
Integer MAX_NUM_TXNS = Integer.parseInt(args[4]);
System.out.println("InputDir         : " + hdfsInputDir);
System.out.println("OutputDir Prefix : " +
hdfsOutputDirPrefix); System.out.println("Number of Passes
: " + maxPasses); System.out.println("MinSupPercent : " +
MIN_SUPPORT_PERCENT); System.out.println("Max Txns
: " + MAX_NUM_TXNS);
long startTime =
System.currentTimeMillis(); long
endTime =
System.currentTimeMillis();
for (int passNum = 1; passNum <= maxPasses;
 passNum++) { endTime =
 System.currentTimeMillis();
 boolean isPassKMRJobDone = runPassKMRJob(hdfsInputDir,
  hdfsOutputDirPrefix, passNum, MIN_SUPPORT_PERCENT,
 MAX_NUM_TXNS); if (!isPassKMRJobDone) {
  System.err.println("Phase1 MapReduce
   job failed. Exiting!!");
   return -1;
  }
  System.out.println("For pass " + passNum +
   " = " + (System.currentTimeMillis() -
   endTime));
 }
 endTime = System.currentTimeMillis();
 System.out.println("Total time taken = " + (endTime - startTime));


 return 1;
}
private static boolean runPassKMRJob(String hdfsInputDir, String
hdfsOutputDirPrefix, int passNum, Double MIN_SUPPORT_PERCENT,
  Integer MAX_NUM_TXNS)
throws IOException,
```

```
        InterruptedException,
        ClassNotFoundException {
        boolean isMRJobSuccess = false;

         Configuration passKMRConf = new Configuration();
         passKMRConf.setInt("passNum", passNum);
         passKMRConf.set("minSup",
         Double.toString(MIN_SUPPORT_PERCENT));
         passKMRConf.setInt("numTxns",
         MAX_NUM_TXNS); System.out.println("Starting
         AprioriPhase" + passNum + "Job"); if (passNum > 1) {
          DistributedCache.addCacheFile(URI.create("hdfs://127.0.0.1
           :54310" + hdfsOutputDirPrefix +
           (passNum - 1) + "/part-r-00000"), passKMRConf);

          System.out.println("Added to distributed cache the
            output of pass " + (passNum-1));
           }
           */
          Job aprioriPassKMRJob = new Job(passKMRConf,
           jobPrefix + passNum);
          if (passNum == 1) {
           configureAprioriJob(aprioriPassK
           MRJob,
           AprioriPass1Mapper.class);
          } else {
           configureAprioriJob(aprioriPassK
           MRJob,
           AprioriPassKMapper.class);
          }
          FileInputFormat.addInputPath(aprioriPassKMRJob, new Path(hdfsInputDir));
          System.out.println("saurabh " + new Path(hdfsInputDir));
          FileOutputFormat.setOutputPath(aprioriPassKMRJob, new Path(hdfsOutputDirPrefix
          +
passNum));
          isMRJobSuccess =
          (aprioriPassKMRJob.waitForCompletion(true) ? true : false);
          System.out.println("Finished AprioriPhase" + passNum + "Job");

          return isMRJobSuccess;
```

```
}
@SuppressWarnings({ "unchecked", "rawtypes"
})
private static void configureAprioriJob(Job aprioriJob, Class
 mapperClass) { aprioriJob.setJarByClass(MRApriori.class);
 aprioriJob.setMapperClass(mapperClass);
 aprioriJob.setReducerClass(AprioriReducer.class);
 aprioriJob.setOutputKeyClass(Text.class);
 aprioriJob.setOutputValueClass(IntWritable.class);
}
//..... Utility functions .....
// Phase1 - MapReduce
public static class AprioriPass1Mapper extends Mapper <
 Object, Text, Text, IntWritable > {
  private final static IntWritable one = new
  IntWritable(1); private Text item = new Text();
  public void map(Object key, Text txnRecord, Context
  context) throws IOException,
  InterruptedExcepti
   on { Transaction
   txn =
    AprioriUtils.getTransaction(txnRecord.toSt
   ring()); for (Integer itemId: txn.getItems()) {
   item.set(itemId.toString());
   context.write(item, one);
   }
  }
 }
public static class AprioriReducer extends Reducer < Text,
 IntWritable, Text, IntWritable > {
  public void reduce(Text itemset, Iterable < IntWritable > values, Context
context) throws IOException,
  InterruptedExcepti
   on { int
   countItemId = 0;
   for (IntWritable value:
    values) { countItemId +=
    value.get();
   }
```

```
      // TODO : This can be improved. Creating
      too many strings.String itemsetIds =
      itemset.toString(); itemsetIds =
      itemsetIds.replace("[", "");
      itemsetIds                    =
      itemsetIds.replace("]",          "");
      itemsetIds  =  itemsetIds.replace("
      ", ""); Double minSup =
        Double.parseDouble(context.getConfiguration().get("
      minSup")); Integer numTxns =
      context.getConfiguration().getInt("numTxns", 2);
      //System.out.println("dsfsdfsdf: " + MIN_SUPPORT_PERCENT
      +
      " " + MAX_NUM_TXNS);
     // If the item has minSupport, then it is a large itemset.
     if (AprioriUtils.hasMinSupport(minSup, numTxns,
      countItemId)) { context.write(new Text(itemsetIds), new
      IntWritable(countItemId));
     }
    }
}

// Phase2 - MapReduce
public static class AprioriPassKMapper extends Mapper <
  Object, Text, Text, IntWritable > {
    private final static IntWritable one = new
    IntWritable(1); private Text item = new Text();
    private List < ItemSet >
    largeItemsetsPrevPass = new ArrayList <
    ItemSet > ();
    private  List  <  ItemSet  >  candidateItemsets    =              null;private
             HashTreeNode hashTreeRootNode = null;

    @Override
    public void setup(Context context) throws IOException {

      //Path[] uris =
      DistributedCache.getLocalCacheFiles(context.getConfig
      uration()); int passNum =
      context.getConfiguration().getInt("passNum",
        2);
```

```
        String opFileLastPass =
          context.getConfiguration().get("fs.default.name") +
"/user/hduser/mrapriori-out-" + (passNum - 1) + "/part-r-00000";
        //System.out.println("ahsdkjdsgfjhgf"+opFileLastPass);
//System.out.println("Distributed cache file to
        search " + opFileLastPass);

       try {
        Path pt = new Path(opFileLastPass);
        FileSystem fs = FileSystem.get(context.getConfiguration());
        BufferedReader fis = new BufferedReader(new
        InputStreamReader(fs.open(pt))); String currLine = null;

        //System.out.println("aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
        aaaaaaaaaa aaaa ");
        while ((currLine = fis.readLine()) !=
          null) { currLine = currLine.trim();
          String[] words =
          currLine.split("[\\s\\t]+"); if
          (words.length < 2) {
            continue;
          }
          List < Integer > items = new ArrayList <
          Integer > (); for (int k = 0; k < words.length -
          1; k++) {
            String csvItemIds = words[k];
            String[] itemIds =
            csvItemIds.split(","); for (String
            itemId: itemIds) {

              items.add(Integer.parseInt(itemId));
            }
          }
          String finalWord = words[words.length - 1];
          int supportCount = Integer.parseInt(finalWord);
          //System.out.println(items + " --> " +
        supportCount);
        largeItemsetsPrevPass.add(new
        ItemSet(items, supportCount));
       }
      }
     catch (Exception e) {
```

```
      }
      candidateItemsets =
      AprioriUtils.getCandidateItemsets(largeItemsetsPrevPass,
      (passNum - 1)); hashTreeRootNode =
       HashTreeUtils.buildHashTree(candidateItemsets, passNum); // This would be changed
       later
     }
     public void map(Object key, Text txnRecord, Context
     context) throws IOException, InterruptedException {
     Transaction txn =
      AprioriUtils.getTransaction(txnRecord.toStr
      ing()); List < ItemSet >
      candidateItemsetsInTxn =
       HashTreeUtils.findItemsets(hashTreeRootNode
      , txn, 0); for (ItemSet itemset:
      candidateItemsetsInTxn) {
      item.set(itemset.getItems().toString());
      context.write(item, one);
      }
     }
    }
  public static void main(String[] args) throws
   Exception { int exitCode =
   ToolRunner.run(new MRApriori(), args);
   System.exit(exitCode);
  }
}
```

**OUTPUT:**

1) OUTPUT1)

```
2    3

3    3

5    3
```

# Practical 7

## AIM: Implementing any one Clustering algorithm using Map-Reduce

**Mapper Class:**

```
@Override
protected void map (Cluster Center key, Vector value,
  Context context) throws IO Exception, Interrupted
  Exception {
 Cluster Center nearest = null;
 double nearestDistance =
 Double.MAX_VALUE; for (Cluster
 Center c : centers) {
  double dist =
  DistanceMeasurer.measureDistance(c, value); if
  (nearest == null) {
   nearest = c;
   nearestDistance =
   dist;
  } else {
   if (nearestDistance >
    dist) { nearest = c;
    nearestDistance = dist;
   }
  }
```

```
 }
 context.write(nearest, value);
```

**Reducer Class:**

```
@Override
protected void reduce(ClusterCenter key, Iterable<Vector> values, Context context) throws
IOException, InterruptedException { Vector newCenter = new Vector();
 List<Vector> vectorList = new
 LinkedList<Vector>(); int vectorSize =
 key.getCenter().getVector().length;
 newCenter.setVector(new
 double[vectorSize]);
 for (Vector value : values) {
  vectorList.add(new
  Vector(value));
  for (int i = 0; i < value.getVector().length;
   i++) { newCenter.getVector()[i] +=
   value.getVector()[i];
  }
 }
 for (int i = 0; i <
  newCenter.getVector().length; i++) {
  newCenter.getVector()[i] =
  newCenter.getVector()[i]
    / vectorList.size();
 }
```

```
 ClusterCenter center = new
 ClusterCenter(newCenter);
 centers.add(center);
 for (Vector vector :
  vectorList) {
  context.write(center,
  vector);
 }
 if (center.converged(key))
  context.getCounter(Counter.CONVERGED).incre
  ment(1);
}
```

**Vector Class:**

```
public class Vector implements
WritableComparable<Vector> { private double[]
vector;
public
 Vector() {
 super();
}

public Vector(Vector
 v) { super();
 int l = v.vector.length;
 this.vector = new
 double[l];
```

```
 System.arraycopy(v.vector, 0, this.vector, 0, l);
}
public Vector(double x,
 double y) { super();
 this.vector = new double[] { x, y };
}

@Override
public void write(DataOutput out) throws
 IOException { out.writeInt(vector.length);
 for (int i = 0; i < vector.length;
  i++)
  out.writeDouble(vector[i]);
}

@Override
public void readFields(DataInput in) throws
 IOException { int size = in.readInt();
 vector = new
 double[size]; for (int i =
 0; i < size; i++)
 vector[i] =
 in.readDouble();
}
@Override
public int compareTo(Vector o) {
```

```
 boolean equals = true;
 for (int i = 0; i < vector.length;
   i++) { int c = vector[i] -
   o.vector[i];
   if (c !=
   0.0d) {
   return c;
 }
 return 0;
}
}
```

**DistanceMeasurer.java**

```
public static final double measureDistance(ClusterCenter center,
 Vector v) { double sum = 0;
 int length =
 v.getVector().length; for
 (int i = 0; i < length; i++) {
  sum += Math.abs(center.getCenter().getVector()[i]
   - v.getVector()[i]);
 }
 return sum;
}
```

**Output:**

**Input K-Centers:** (1,1);(5,5)

**Input:**

Vector [vector=[16.0, 3.0]]

Vector [vector=[7.0, 6.0]]

Vector [vector=[6.0, 5.0]]

Vector [vector=[25.0, 1.0]]

Vector [vector=[1.0, 2.0]]

Vector [vector=[3.0, 3.0]]

Vector [vector=[2.0, 2.0]]

Vector [vector=[2.0, 3.0]]
Vector [vector=[-1.0, -23.0]]

**Output:**

ClusterCenter [center=Vector [vector=[13.5, 3.75]]] / Vector

[vector=[16.0, 3.0]] ClusterCenter [center=Vector [vector=[13.5,

3.75]]] / Vector [vector=[7.0, 6.0]] ClusterCenter [center=Vector

[vector=[13.5, 3.75]]] / Vector [vector=[6.0, 5.0]] ClusterCenter

[center=Vector [vector=[13.5, 3.75]]] / Vector [vector=[25.0, 1.0]]

ClusterCenter [center=Vector [vector=[1.4, -2.6]]] / Vector

[vector=[1.0, 2.0]] ClusterCenter [center=Vector [vector=[1.4, -2.6]]]

/ Vector [vector=[3.0, 3.0]] ClusterCenter [center=Vector

[vector=[1.4, -2.6]]] / Vector [vector=[2.0, 2.0]] ClusterCenter

[center=Vector [vector=[1.4, -2.6]]] / Vector [vector=[2.0, 3.0]]

ClusterCenter [center=Vector [vector=[1.4, -2.6]]] / Vector

[vector=[-1.0, -23.0]]

# Practical 8

## AIM: Implementing any one data streaming algorithm using Map-Reduce.

**PartitionerExample.java**

```
package partitionerexample;

import java.io.*;
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.*;
import  org.apache.hadoop.conf.*;
import  org.apache.hadoop.conf.*;
import org.apache.hadoop.fs.*;

import org.apache.hadoop.mapreduce.lib.input.*;
import  org.apache.hadoop.mapreduce.lib.output.*;

import org.apache.hadoop.util.*;

public class PartitionerExample extends Configured implements Tool
{
  //Map class

  public static class MapClass extends Mapper<LongWritable,Text,Text,Text>
  {
    public void map(LongWritable key, Text value, Context context)
    {
      try{
        String[] str = value.toString().split("\t", -3);
        String gender=str[3];
        context.write(new Text(gender), new Text(value));
      }
      catch(Exception e)
      {
        System.out.println(e.getMessage());
      }
    }
  }
```

```
  //Reducer class
  public static class ReduceClass extends Reducer<Text,Text,Text,IntWritable>
  {
    public int max = -1;
    public void reduce(Text key, Iterable <Text> values, Context context)
throws IOException, InterruptedException
    {
      max = -1;

      for (Text val : values)
      {
        String [] str = val.toString().split("\t", -3);
        if(Integer.parseInt(str[4])>max)
        max=Integer.parseInt(str[4]);
      }

      context.write(new Text(key), new IntWritable(max));
    }
  }

  //Partitioner class

  public static class CaderPartitioner extends
  Partitioner < Text, Text >
  {
    @Override
    public int getPartition(Text key, Text value, int numReduceTasks)
    {
      String[] str = value.toString().split("\t");
      int age = Integer.parseInt(str[2]);

      if(numReduceTasks == 0)
      {
        return 0;
      }

      if(age<=20)
      {
        return 0;
      }
```

```
    else if(age>20 && age<=30)
    {
      return 1 % numReduceTasks;
    }
    else
    {
      return 2 % numReduceTasks;
    }
  }
}

@Override
public int run(String[] arg) throws Exception
{
  Configuration conf = getConf();

  Job job = new Job(conf, "topsal");
  job.setJarByClass(PartitionerExample.class);

  FileInputFormat.setInputPaths(job, new Path(arg[0]));
  FileOutputFormat.setOutputPath(job,new Path(arg[1]));

  job.setMapperClass(MapClass.class);

  job.setMapOutputKeyClass(Text.class);
  job.setMapOutputValueClass(Text.class);

  //set partitioner statement

  job.setPartitionerClass(CaderPartitioner.class);
  job.setReducerClass(ReduceClass.class);
  job.setNumReduceTasks(3);
  job.setInputFormatClass(TextInputFormat.class);

  job.setOutputFormatClass(TextOutputFormat.class);
  job.setOutputKeyClass(Text.class);
  job.setOutputValueClass(Text.class);

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

```
  public static void main(String ar[]) throws Exception
  {
    int res = ToolRunner.run(new Configuration(), new
PartitionerExample(),ar);
    System.exit(0);
  }
}
```

**input.txt**

| | | | | |
|---|---|---|---|---|
| 1201 | Gopal | 45 | Male | 50000 |
| 1202 | Manisha | 40 | Female | 51000 |
| 1203 | Khaleel | 34 | Male | 30000 |
| 1204 | Prasanth | 30 | Male | 31000 |
| 1205 | Kiran | 20 | Male | 40000 |
| 1206 | Laxmi | 25 | Female | 35000 |
| 1207 | Bhavya | 20 | Female | 15000 |
| 1208 | Reshma | 19 | Female | 14000 |
| 1209 | kantha | 22 | Male | 22000 |
| 1210 | Satish | 24 | Male | 25000 |
| 1211 | Krishna | 25 | Male | 26000 |

| | | | | |
|---|---|---|---|---|
| 1212 | Arshad | 28 | Male | 20000 |
| 1213 | Lavanya | 18 | Female | 8000 |

**Output:**

$HADOOP_HOME/bin/hadoop fs -cat output_dir/part-00000

**Output in Part-00000**

Female 15000
Male 40000

$HADOOP_HOME/bin/hadoop fs -cat output_dir/part-00001

**Output in Part-00001**

Female 35000
Male 31000

$HADOOP_HOME/bin/hadoop fs -cat output_dir/part-00002

**Output in Part-00002**

Female 51000
Male 50000