Experiment No.4
Experiment on Hadoop Map-Reduce
Date of Performance: 07/08/2023
Date of Submission: 14/08/2023

Aim:- To write a program to implement a word count program using MapReduce.

Theory:

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

1. Mapper

2. Reducer

3. Driver

Step-1:- Write a Mapper

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

Input value of the WordCount Map task will be a line of text from the input data file and the key would be the line number <line_number, line_of_text> . Map task outputs <word, one> for each word in the line of text. Pseudo-code void Map (key, value){ for each word x in value:

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

}
```

Step-2:- Write a Reducer

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

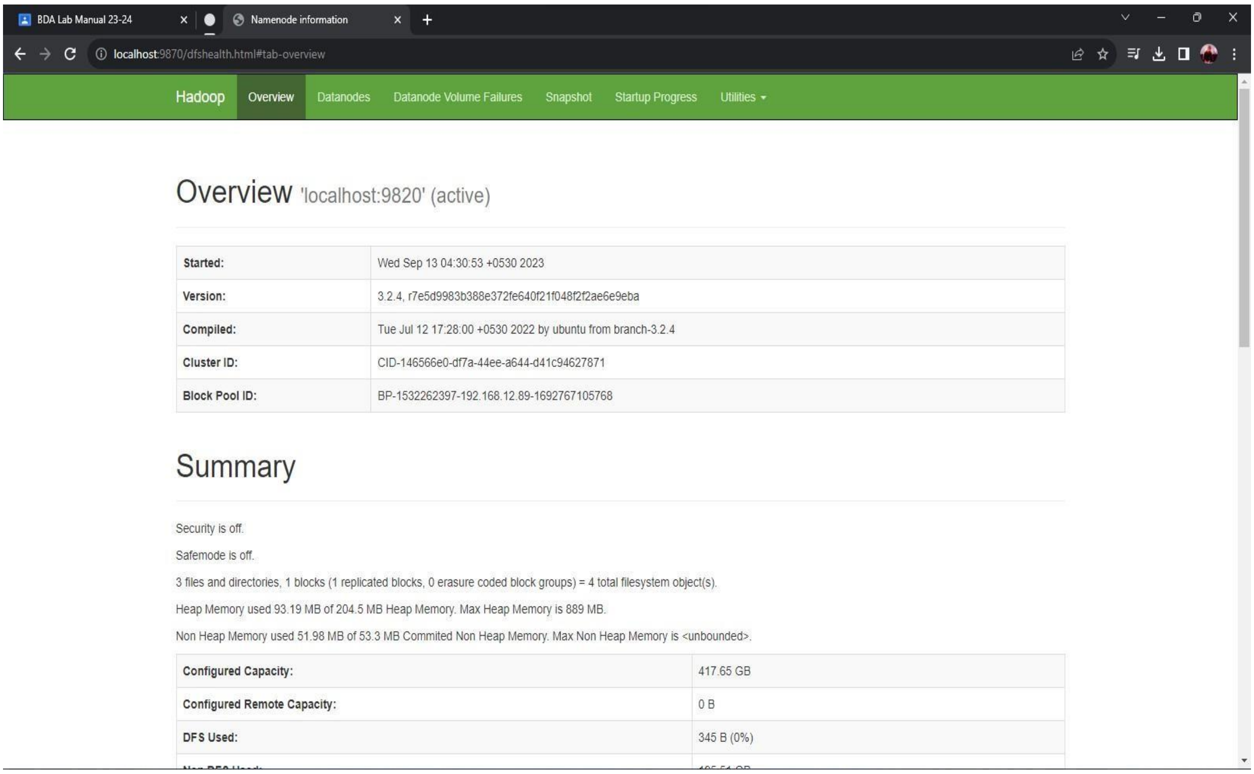
```
void Reduce (keyword, <list of
value>){ for each x in <list of
value>:
sum+=x;

final_output.collect(keyword, sum);

}
```

Code:

```
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.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.mapreduce.Job;
importorg.apache.hadoop.mapreduce.lib.input.TextIn
putFormat;
importrg.apache.hadoop.mapreduce.lib.output.TextO
utputFormat;
importorg.apache.hadoop.mapreduce.lib.input.FileIn
putFormat;
importorg.apache.hadoop.mapreduce.lib.output.File
OutputFormat;
import org.apache.hadoop.fs.Path;
public class WordCount
{ public static class Map extends Mapper<LongWritable,Text,Text,IntWritable>
{ public void map(LongWritable key, Text value,Context context) throws

IOException,InterruptedException{
```

```
String line = value.toString();

StringTokenizer tokenizer = new
StringTokenizer(line); while
(tokenizer.hasMoreTokens()) {
value.set(tokenizer.nextToken());
context.write(value, new
IntWritable(1));

}
}
}
public static class Reduce extends
Reducer<Text,IntWritable,Text,IntWritable> { public void
reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException { int sum=0;
for(IntWritable x: values)
}
context.write(key, new IntWritable(sum));

}
}


public static void main(String[] args)
throws Exception {
Configuration conf= new Configuration();
Job job = new Job(conf,"My Word Count
Program");
job.setJarByClass(WordCount.class);
job.setMapperClass(Map.class);
job.setReducerClass(Reduce.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.clas
s);
job.setInputFormatClass(TextInputForma
t.class);
job.setOutputFormatClass(TextOutputFor
mat.class);
Path outputPath = new Path(args[1]);

//Configuring the input/output path from the filesystem into the job

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

//deleting the output path automatically from hdfs so that we don't
have to delete it explicitly
outputPath.getFileSystem(conf).delete(outpu
tPath); //exiting the job only if the flag value
becomes false
System.exit(job.waitForCompletion(true) ? 0 : 1);

}

}
```

Output:



Overview 'localhost:9820' (active)

Started:	Wed Sep 13 04:30:53 +0530 2023
Version:	3.2.4, r7e5d9983b388e372fe640f21f048f2f2ae6e9eba
Compiled:	Tue Jul 12 17:28:00 +0530 2022 by ubuntu from branch-3.2.4
Cluster ID:	CID-146566e0-df7a-44ee-a644-d41c94627871
Block Pool ID:	BP-1532262397-192.168.12.89-1692767105768

Summary

Security is off.

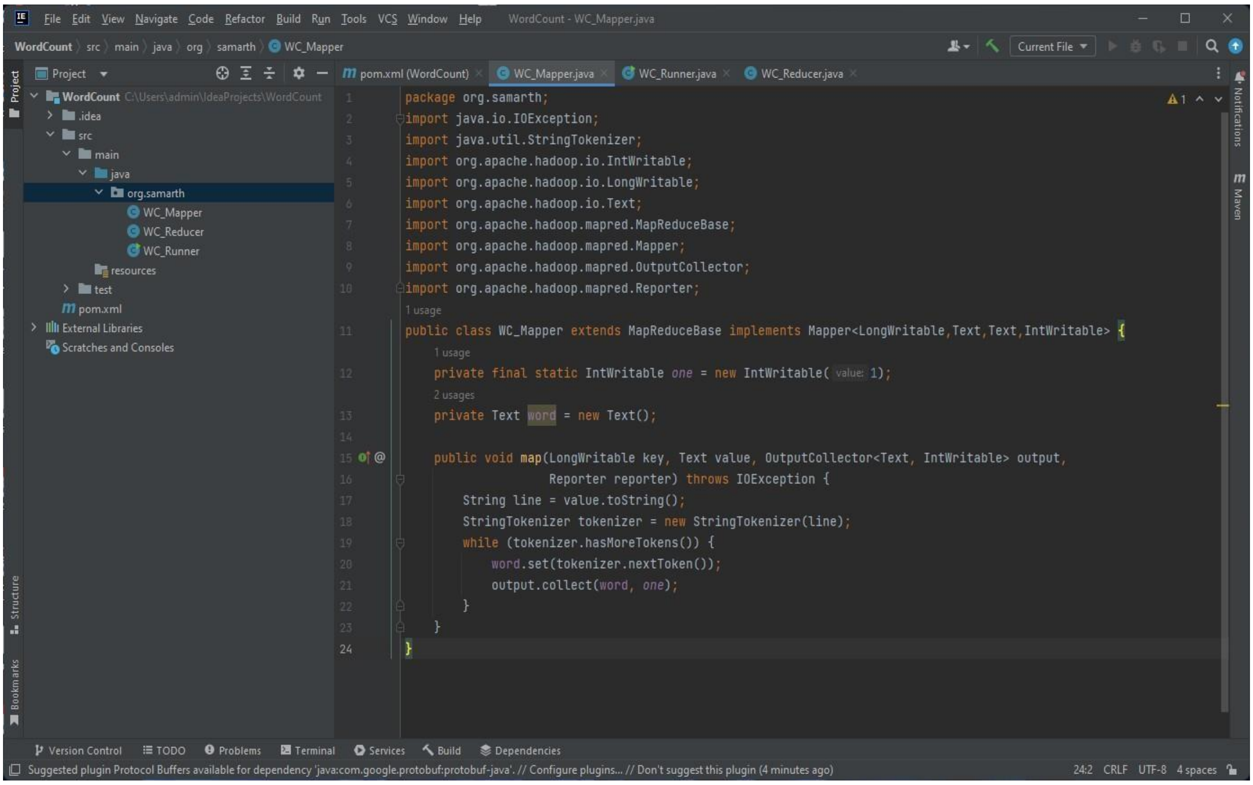
Safemode is off.

3 files and directories, 1 blocks (1 replicated blocks, 0 erasure coded block groups) = 4 total filesystem object(s).

Heap Memory used 93.19 MB of 204.5 MB Heap Memory. Max Heap Memory is 889 MB.

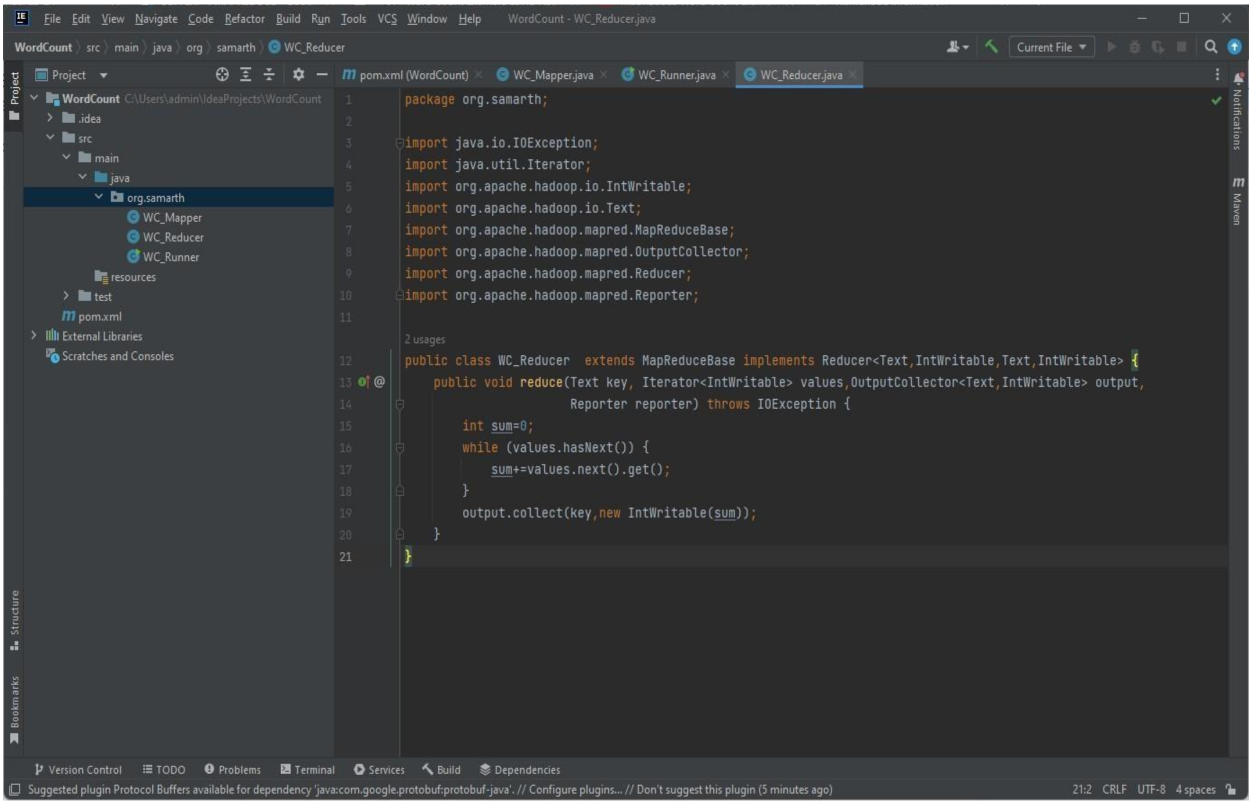
Non Heap Memory used 51.98 MB of 53.3 MB Commited Non Heap Memory. Max Non Heap Memory is <unbounded>.

Configured Capacity:	417.65 GB
Configured Remote Capacity:	0 B
DFS Used:	345 B (0%)



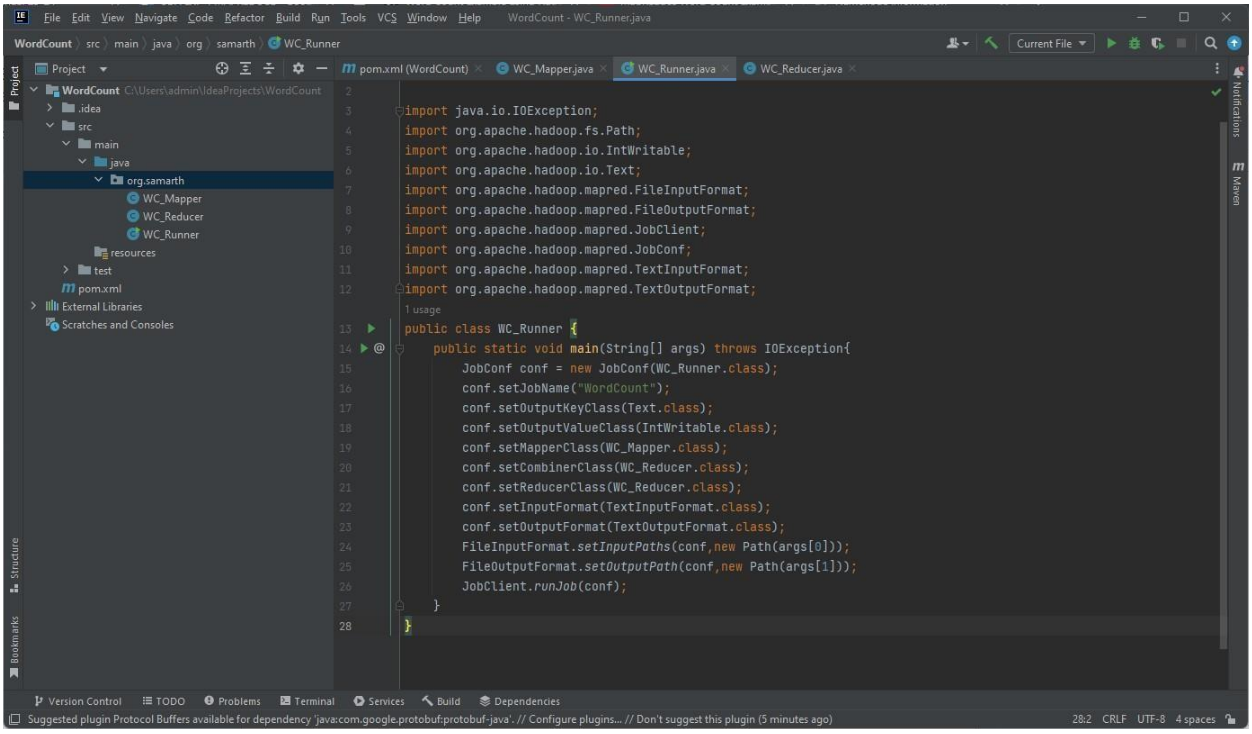
```java
package org.samarth;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reporter;
public class WC_Mapper extends MapReduceBase implements 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, OutputCollector<Text, IntWritable> output,
                    Reporter reporter) throws IOException {
        String line = value.toString();
        StringTokenizer tokenizer = new StringTokenizer(line);
        while (tokenizer.hasMoreTokens()) {
            word.set(tokenizer.nextToken());
            output.collect(word, one);
        }
    }
}
```

Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (4 minutes ago)



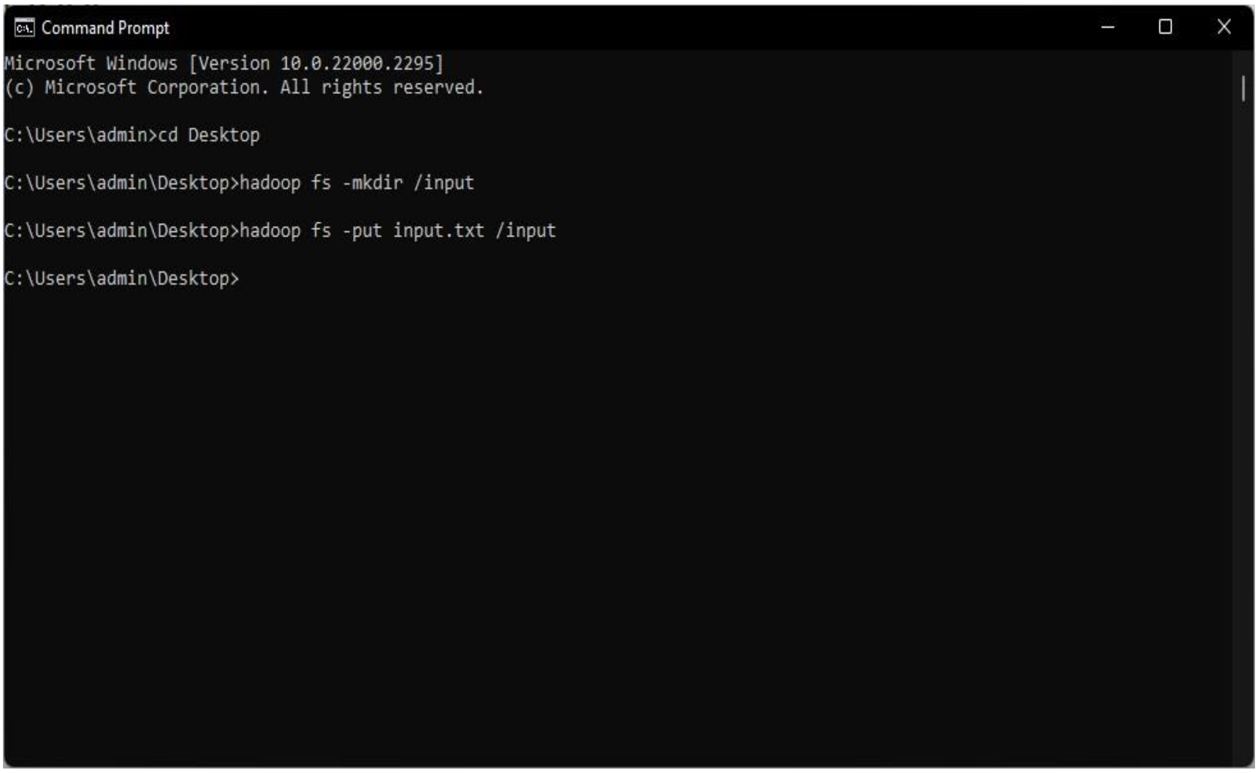
```java
package org.samarth;

import java.io.IOException;
import java.util.Iterator;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reducer;
import org.apache.hadoop.mapred.Reporter;

public class WC_Reducer  extends MapReduceBase implements Reducer<Text,IntWritable,Text,IntWritable> {
    public void reduce(Text key, Iterator<IntWritable> values,OutputCollector<Text,IntWritable> output,
                       Reporter reporter) throws IOException {
        int sum=0;
        while (values.hasNext()) {
            sum+=values.next().get();
        }
        output.collect(key,new IntWritable(sum));
    }
}
```

Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (5 minutes ago)

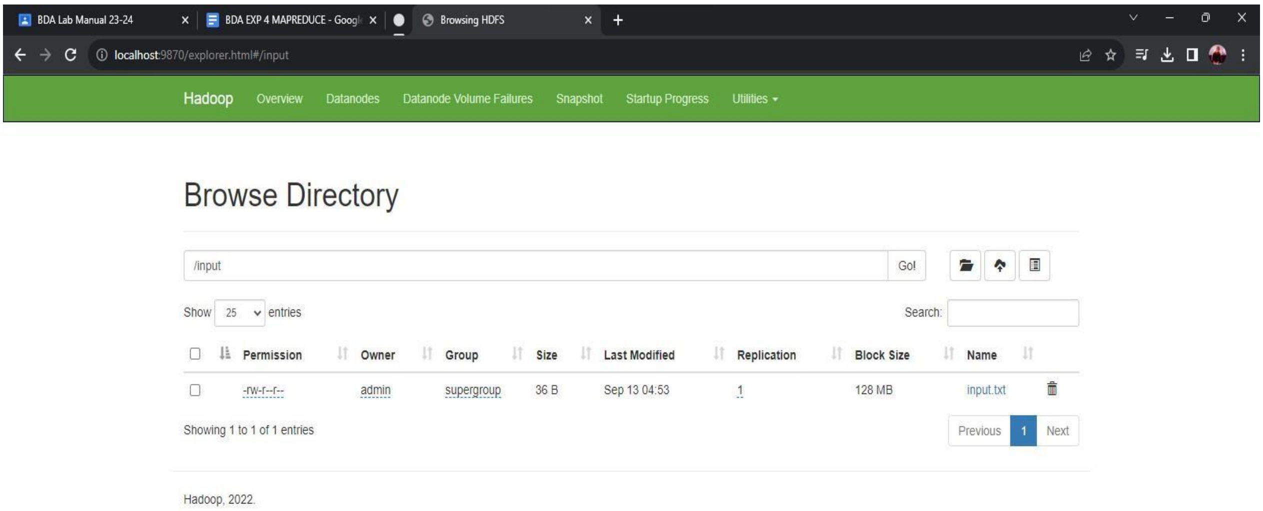


```java
import java.io.IOException;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
import org.apache.hadoop.mapred.JobClient;
import org.apache.hadoop.mapred.JobConf;
import org.apache.hadoop.mapred.TextInputFormat;
import org.apache.hadoop.mapred.TextOutputFormat;
public class WC_Runner {
    public static void main(String[] args) throws IOException{
        JobConf conf = new JobConf(WC_Runner.class);
        conf.setJobName("WordCount");
        conf.setOutputKeyClass(Text.class);
        conf.setOutputValueClass(IntWritable.class);
        conf.setMapperClass(WC_Mapper.class);
        conf.setCombinerClass(WC_Reducer.class);
        conf.setReducerClass(WC_Reducer.class);
        conf.setInputFormat(TextInputFormat.class);
        conf.setOutputFormat(TextOutputFormat.class);
        FileInputFormat.setInputPaths(conf,new Path(args[0]));
        FileOutputFormat.setOutputPath(conf,new Path(args[1]));
        JobClient.runJob(conf);
    }
}
```

Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (5 minutes ago)



```
Microsoft Windows [Version 10.0.22000.2295]
(c) Microsoft Corporation. All rights reserved.

C:\Users\admin>cd Desktop

C:\Users\admin\Desktop>hadoop fs -mkdir /input

C:\Users\admin\Desktop>hadoop fs -put input.txt /input

C:\Users\admin\Desktop>
```



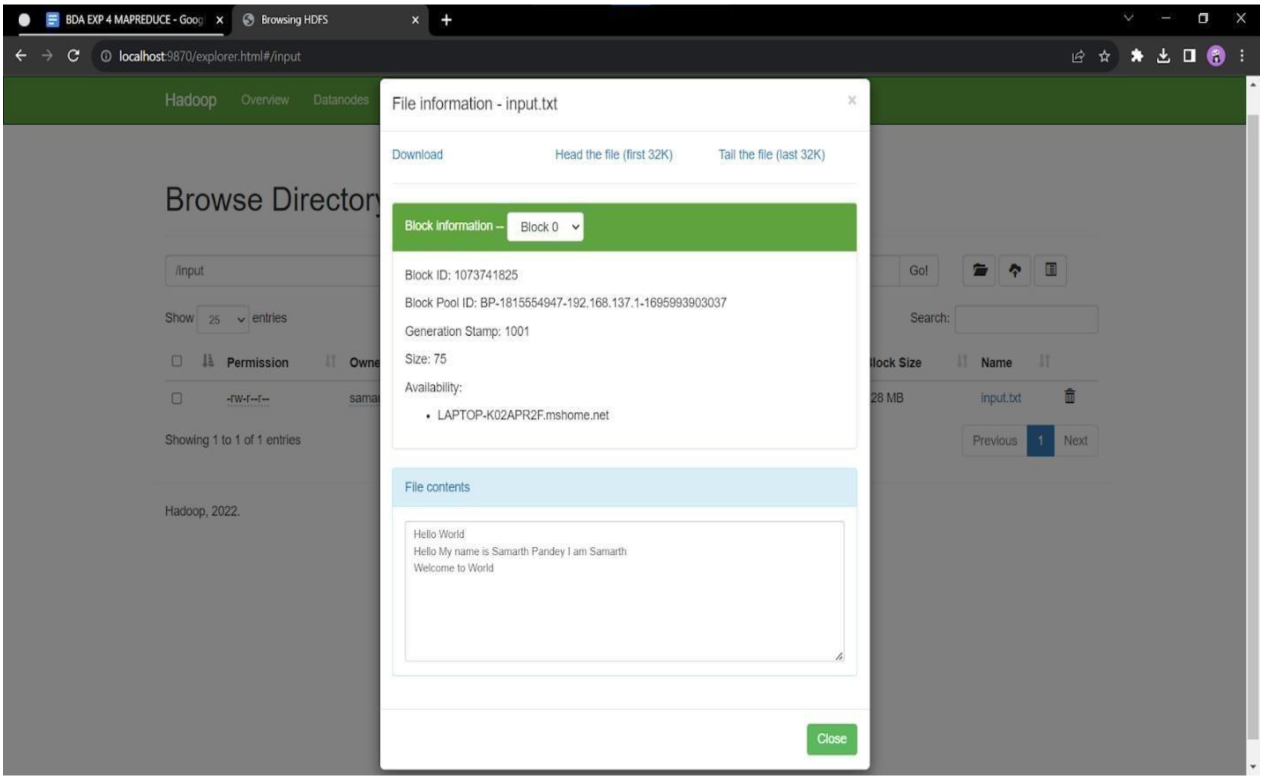
Browse Directory

/input

□	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
□	-rw-r--r--	admin	supergroup	36 B	Sep 13 04:53	1	128 MB	input.txt

Showing 1 to 1 of 1 entries

Hadoop, 2022.



File information - input.txt

Download   Head the file (first 32K)   Tail the file (last 32K)

Block information -- Block 0

Block ID: 1073741825

Block Pool ID: BP-1815554947-192.168.137.1-1695993903037

Generation Stamp: 1001

Size: 75

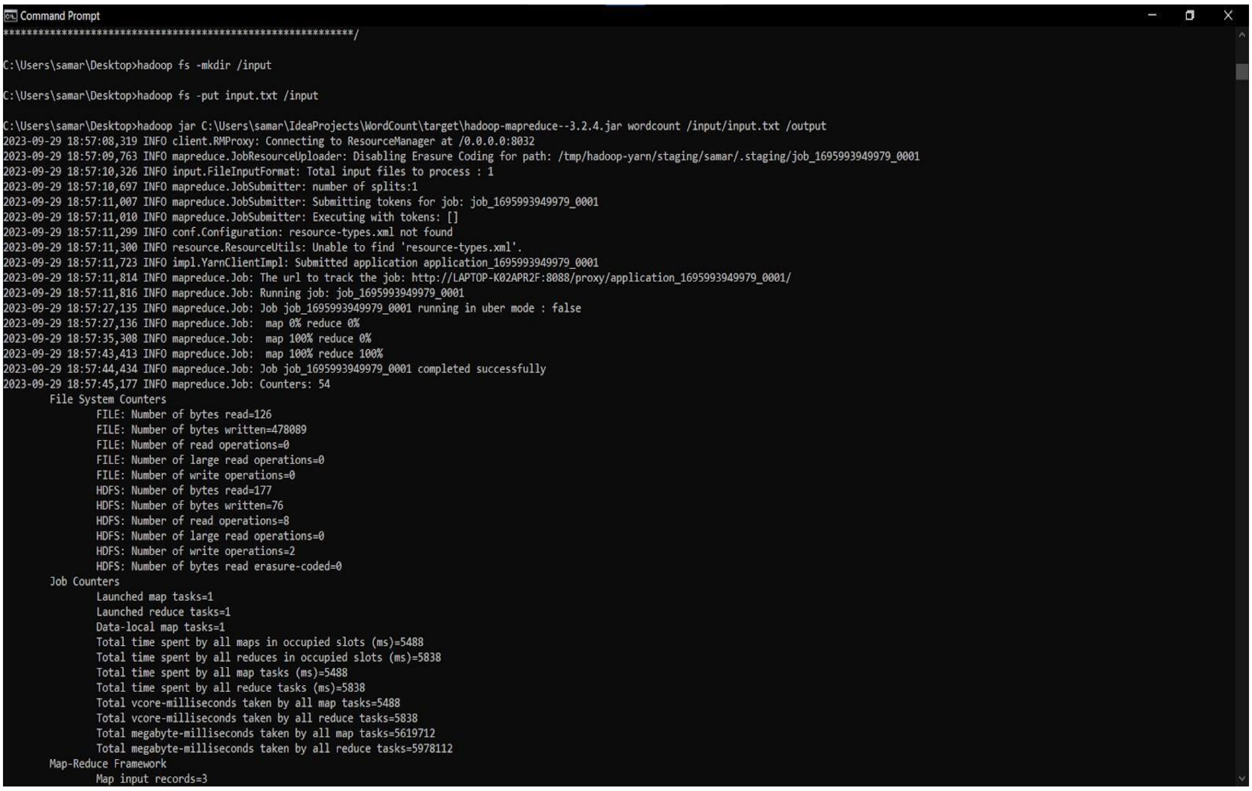
Availability:

- LAPTOP-K02APR2F.mshome.net

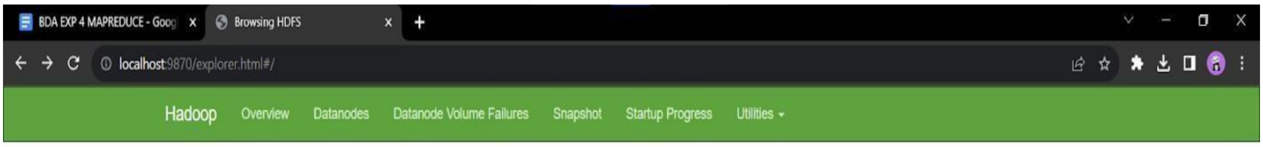
File contents

```
Hello World
Hello My name is Samarth Pandey I am Samarth
Welcome to World
```

Close



```
**************************************************************/

C:\Users\samar\Desktop>hadoop fs -mkdir /input

C:\Users\samar\Desktop>hadoop fs -put input.txt /input

C:\Users\samar\Desktop>hadoop jar C:\Users\samar\IdeaProjects\WordCount\target\hadoop-mapreduce--3.2.4.jar wordcount /input/input.txt /output
2023-09-29 18:57:08,319 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
2023-09-29 18:57:09,763 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/samar/.staging/job_1695993949979_0001
2023-09-29 18:57:10,326 INFO input.FileInputFormat: Total input files to process : 1
2023-09-29 18:57:10,697 INFO mapreduce.JobSubmitter: number of splits:1
2023-09-29 18:57:11,007 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1695993949979_0001
2023-09-29 18:57:11,010 INFO mapreduce.JobSubmitter: Executing with tokens: []
2023-09-29 18:57:11,299 INFO conf.Configuration: resource-types.xml not found
2023-09-29 18:57:11,300 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2023-09-29 18:57:11,723 INFO impl.YarnClientImpl: Submitted application application_1695993949979_0001
2023-09-29 18:57:11,814 INFO mapreduce.Job: The url to track the job: http://LAPTOP-K02APR2F:8088/proxy/application_1695993949979_0001/
2023-09-29 18:57:11,816 INFO mapreduce.Job: Running job: job_1695993949979_0001
2023-09-29 18:57:27,135 INFO mapreduce.Job: Job job_1695993949979_0001 running in uber mode : false
2023-09-29 18:57:27,136 INFO mapreduce.Job:  map 0% reduce 0%
2023-09-29 18:57:35,308 INFO mapreduce.Job:  map 100% reduce 0%
2023-09-29 18:57:43,413 INFO mapreduce.Job:  map 100% reduce 100%
2023-09-29 18:57:44,434 INFO mapreduce.Job: Job job_1695993949979_0001 completed successfully
2023-09-29 18:57:45,177 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=126
                FILE: Number of bytes written=478089
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=177
                HDFS: Number of bytes written=76
                HDFS: Number of read operations=8
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
                HDFS: Number of bytes read erasure-coded=0
        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)=5488
                Total time spent by all reduces in occupied slots (ms)=5838
                Total time spent by all map tasks (ms)=5488
                Total time spent by all reduce tasks (ms)=5838
                Total vcore-milliseconds taken by all map tasks=5488
                Total vcore-milliseconds taken by all reduce tasks=5838
                Total megabyte-milliseconds taken by all map tasks=5619712
                Total megabyte-milliseconds taken by all reduce tasks=5978112
        Map-Reduce Framework
                Map input records=3
```



Browse Directory

/ Go!

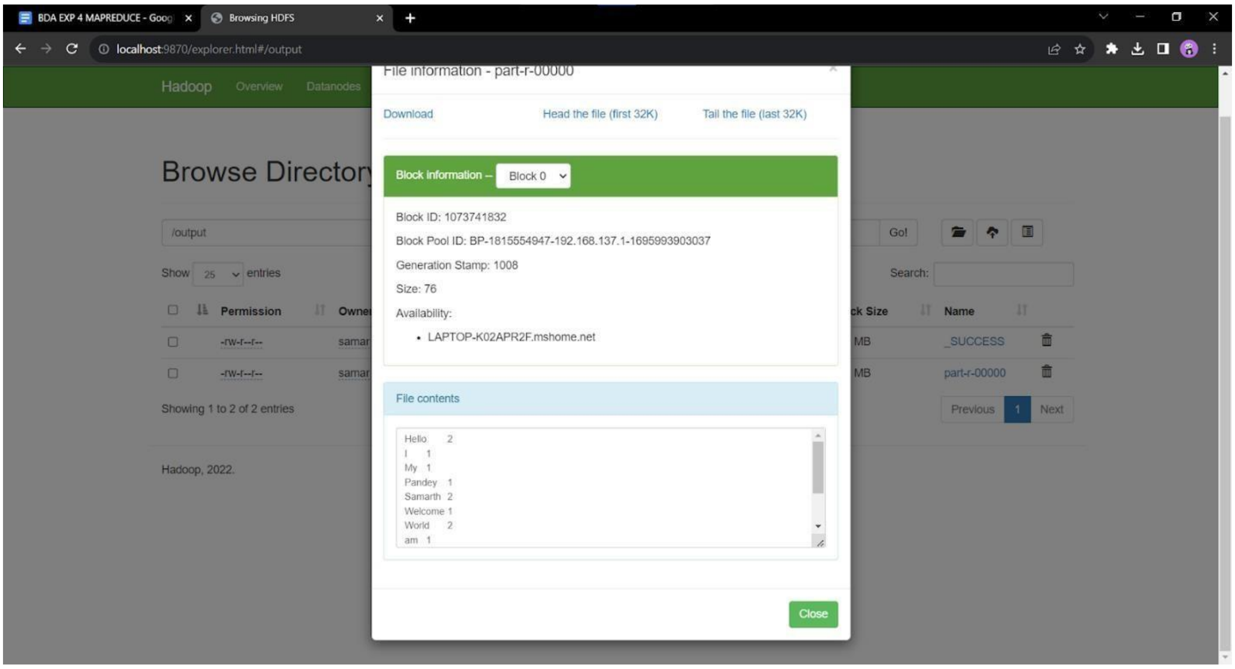
Show 25 entries Search:

□	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
□	drwxr-xr-x	samar	supergroup	0 B	Sep 29 18:56	0	0 B	input
□	drwxr-xr-x	samar	supergroup	0 B	Sep 29 18:57	0	0 B	output
□	drwx------	samar	supergroup	0 B	Sep 29 18:57	0	0 B	tmp

Showing 1 to 3 of 3 entries

Previous 1 Next

Hadoop, 2022.



File information - part-r-00000

Download Head the file (first 32K) Tail the file (last 32K)

Block information -- Block 0

Block ID: 1073741832

Block Pool ID: BP-1815554947-192.168.137.1-1695993903037

Generation Stamp: 1008

Size: 76

Availability:

- LAPTOP-K02APR2F.mshome.net

File contents

```
Hello	2
I	1
My	1
Pandey	1
Samarth	2
Welcome 1
World	2
am	1
```

Close

Conclusion:

MapReduce is a programming paradigm that enables massive scalability across hundreds or thousands of servers in a Hadoop cluster. It framework for processing and analyzing large datasets by dividing them into smaller tasks that can be distributed across a cluster of computers. The way we manage large data has been completely transformed by the flexible and reliable MapReduce framework, which is still a useful tool for data processing and analysis. WordCount is a simple program which counts the number of occurrences of each word in a given text input data set.

In this experiment, we successfully implemented program for word count using MapReduce.