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);
}
```

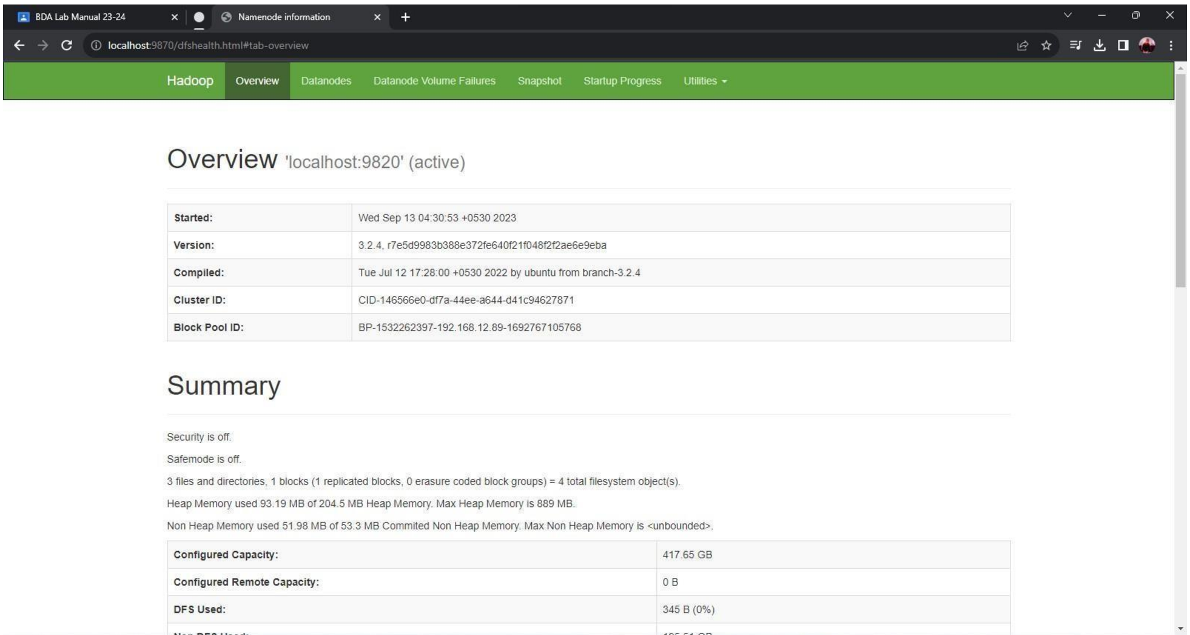
Code:

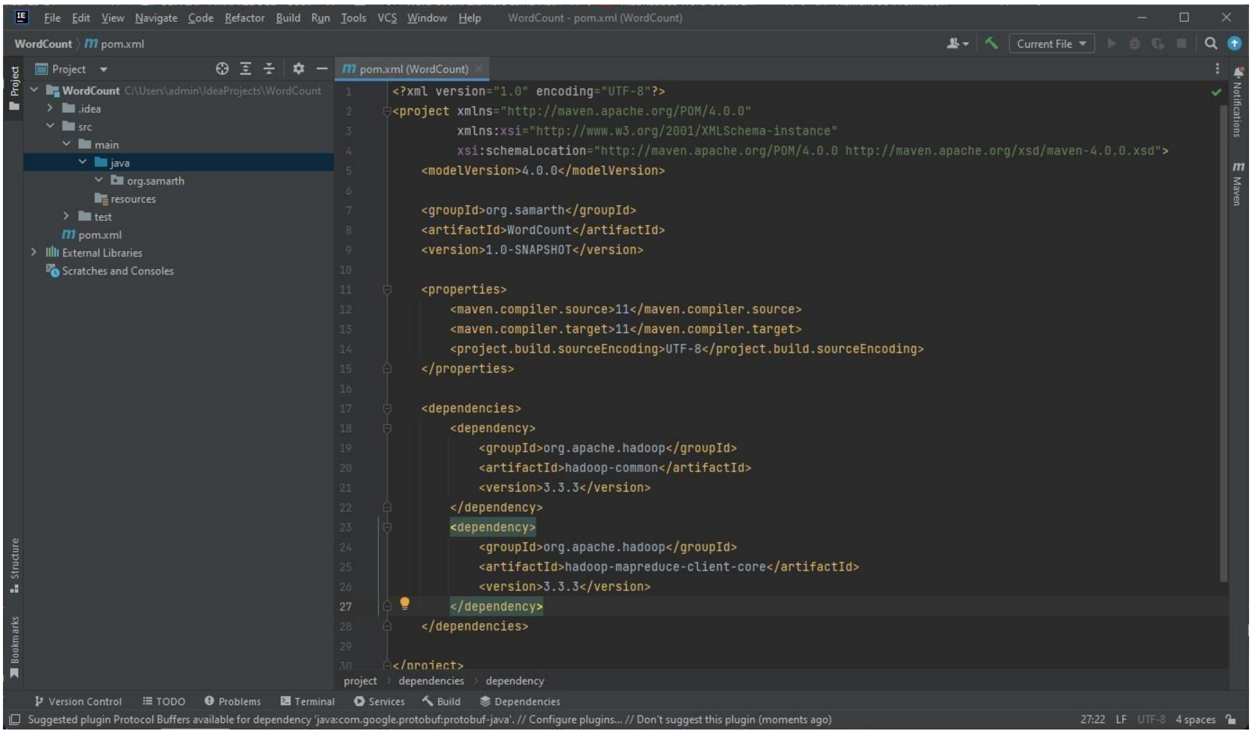
```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
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));
```

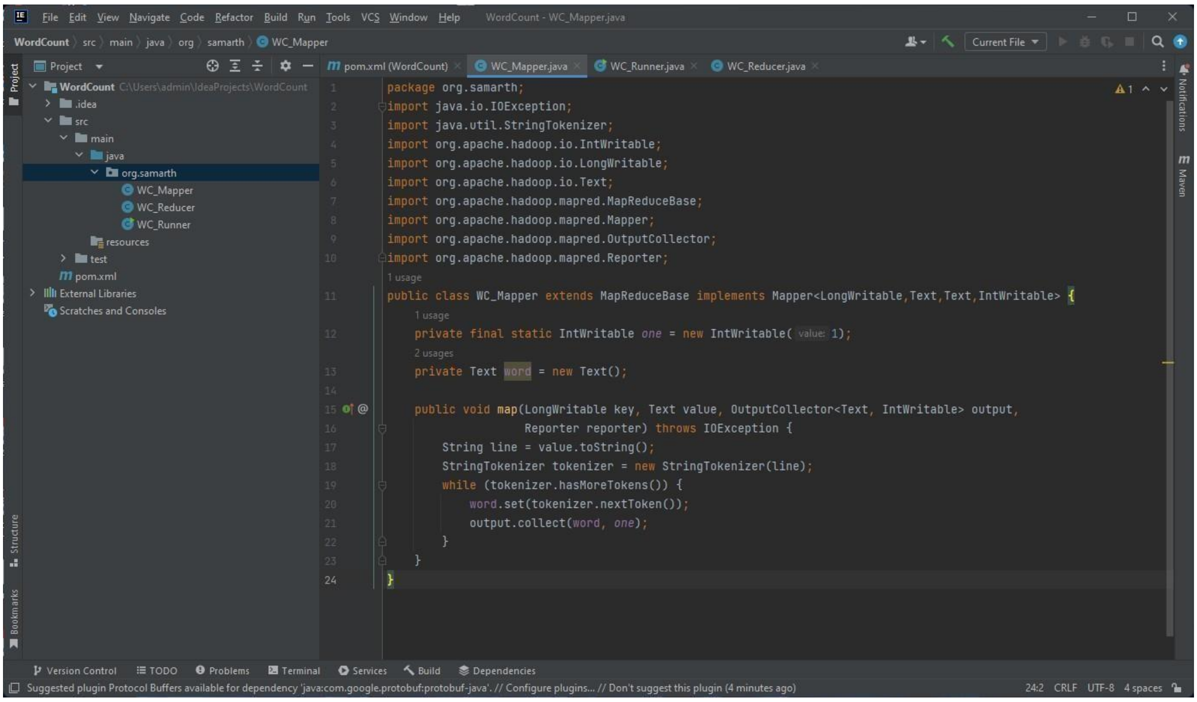
```
}
}
}
public static class Reduce extends Reducer<Text,IntWritable,Text,IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException {
int sum=0;
for(IntWritable x: values)
{
sum+=x.get();
}
context.write(key, new IntWritable(sum));
}
}
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.class);
job.setInputFormatClass(TextInputFormat.class);
job.setOutputFormatClass(TextOutputFormat.class);
Path outputPath = new Path(args[1]);
//Configuring the input/output path from the filesystem into the job
FileInputFormat.addInputPath(job, new Path(args[0]));
```

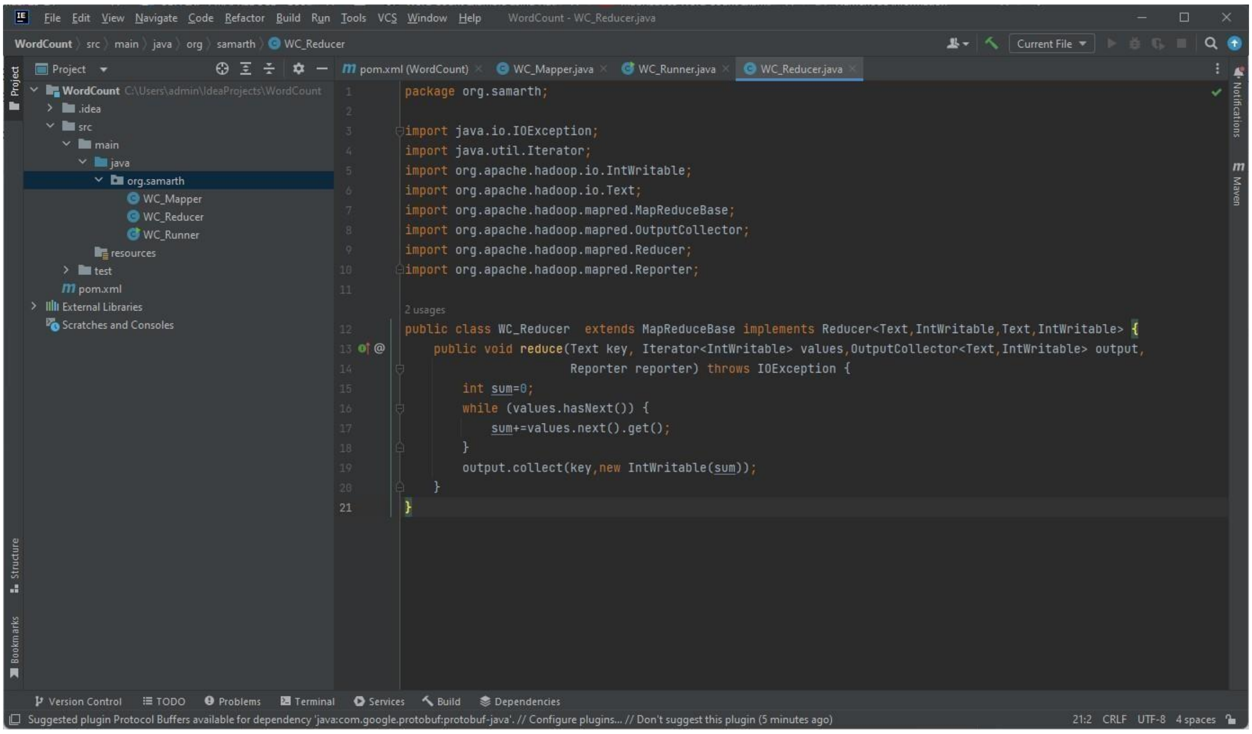
```
FileOutputFormat.setOutputPath(job, new Path(args[1]));
//deleting the output path automatically from hdfs so that we don't have to
delete it explicitly
outputPath.getFileSystem(conf).delete(outputPath);
//exiting the job only if the flag value becomes false
System.exit(job.waitForCompletion(true)  ? 0 : 1);
}
}
```

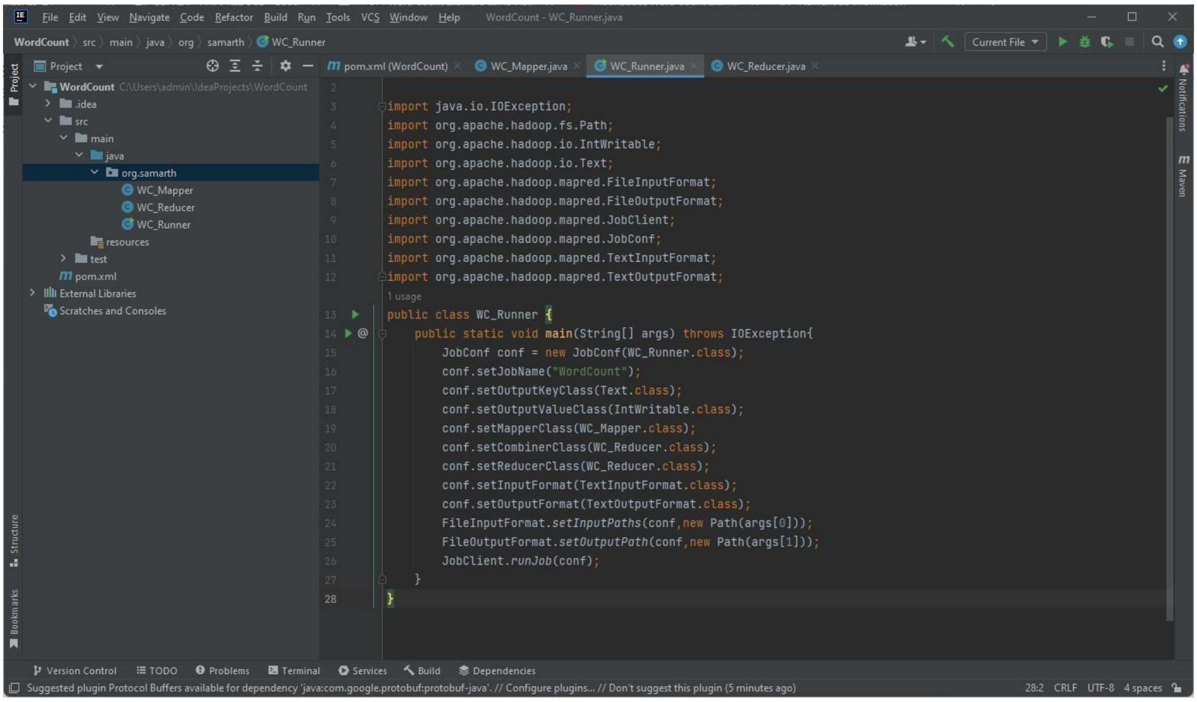
OUTPUT:

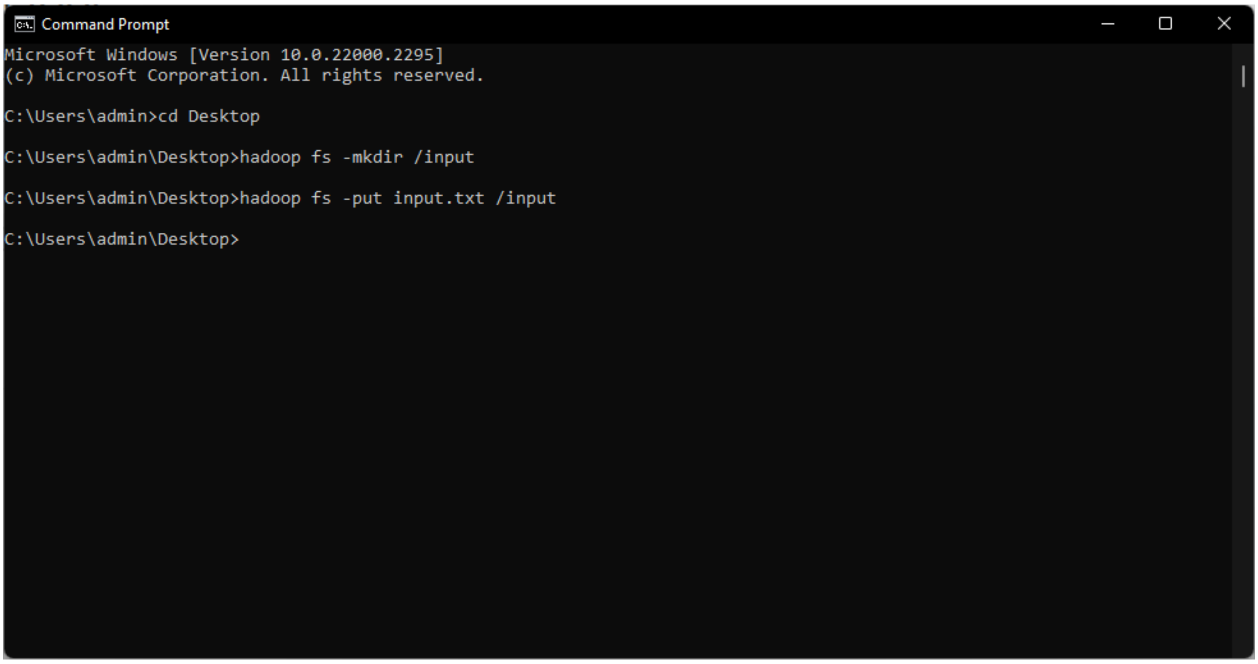


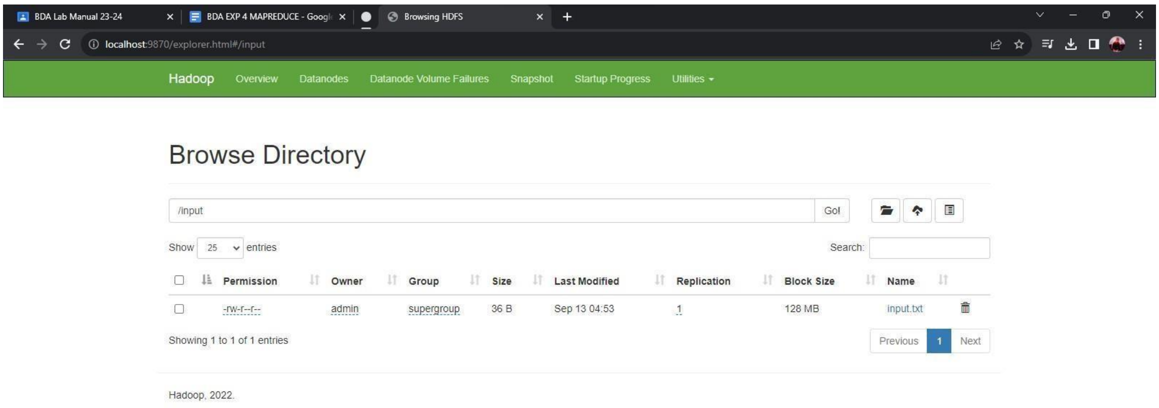

WordCount - pom.xml (WordCount)
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
<modelVersion>4.0.0</modelVersion>
<groupId>org.samarth</groupId>
<artifactId>WordCount</artifactId>
<version>1.0-SNAPSHOT</version>
<properties>
<maven.compiler.source>11</maven.compiler.source>
<maven.compiler.target>11</maven.compiler.target>
<project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
</properties>
<dependencies>
<dependency>
<groupId>org.apache.hadoop</groupId>
<artifactId>hadoop-common</artifactId>
<version>3.3.3</version>
</dependency>
<dependency>
<groupId>org.apache.hadoop</groupId>
<artifactId>hadoop-mapreduce-client-core</artifactId>
<version>3.3.3</version>
</dependency>
</dependencies>
</project>

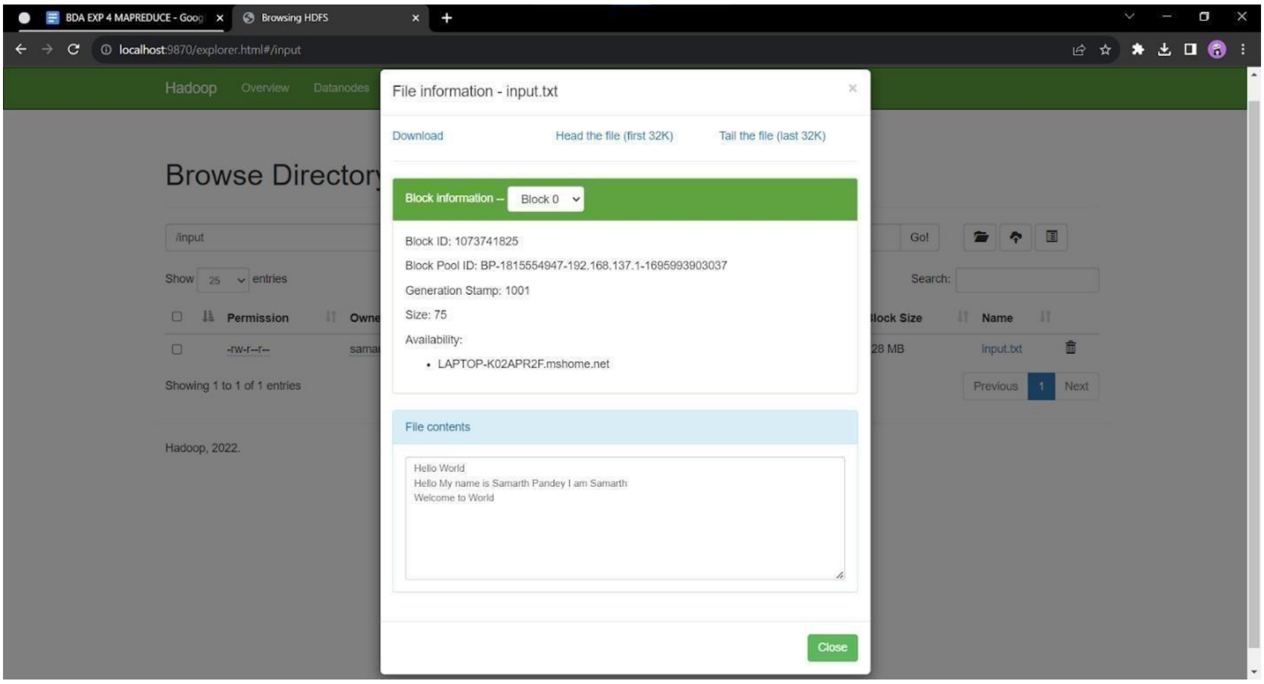

WordCount - WC_Mapper.java
package org.samarth;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
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(value: 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);
}
}
}

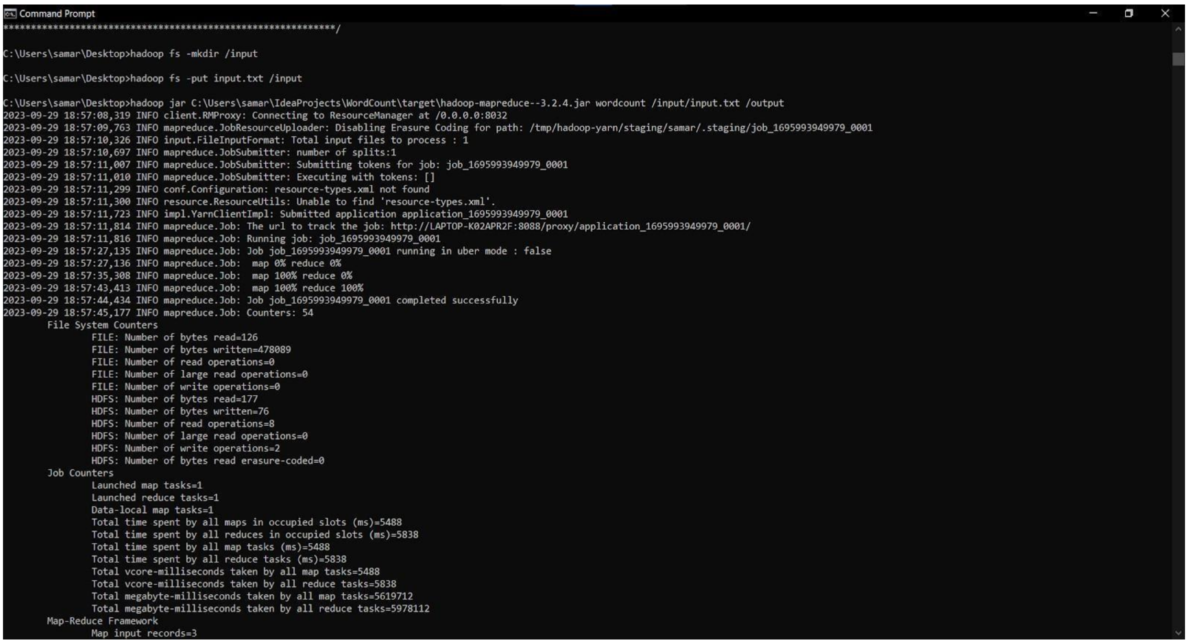

WordCount - WC_Reducer.java
package org.samarth;
import java.io.IOException;
import java.util.Iterator;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reducer;
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));
}
}

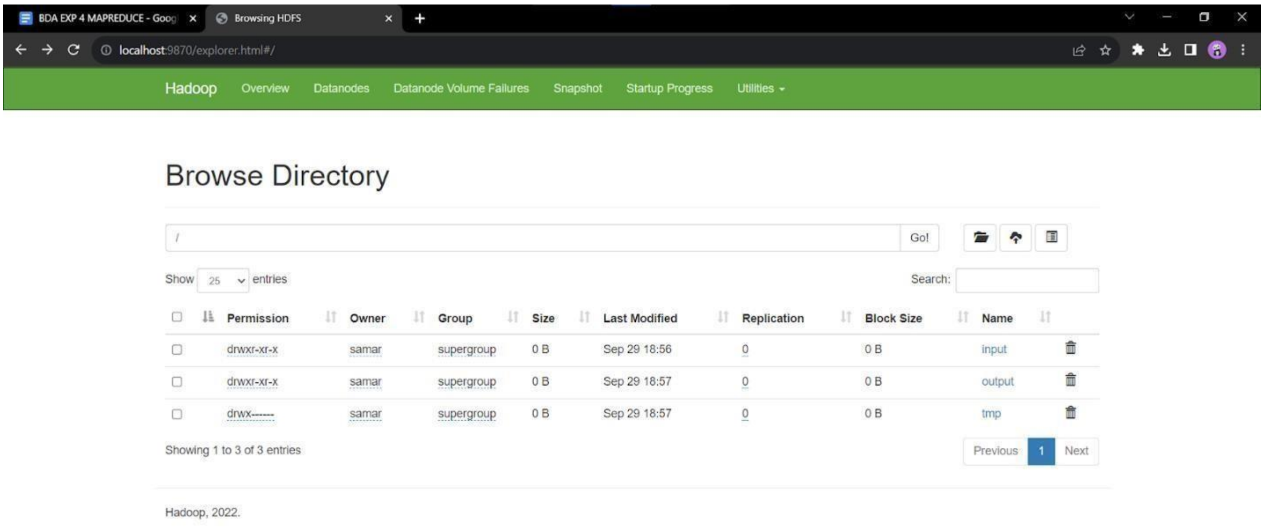

WordCount - WC_Runner.java
import java.io.IOException;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
import org.apache.hadoop.mapred.JobClient;
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);
}
}

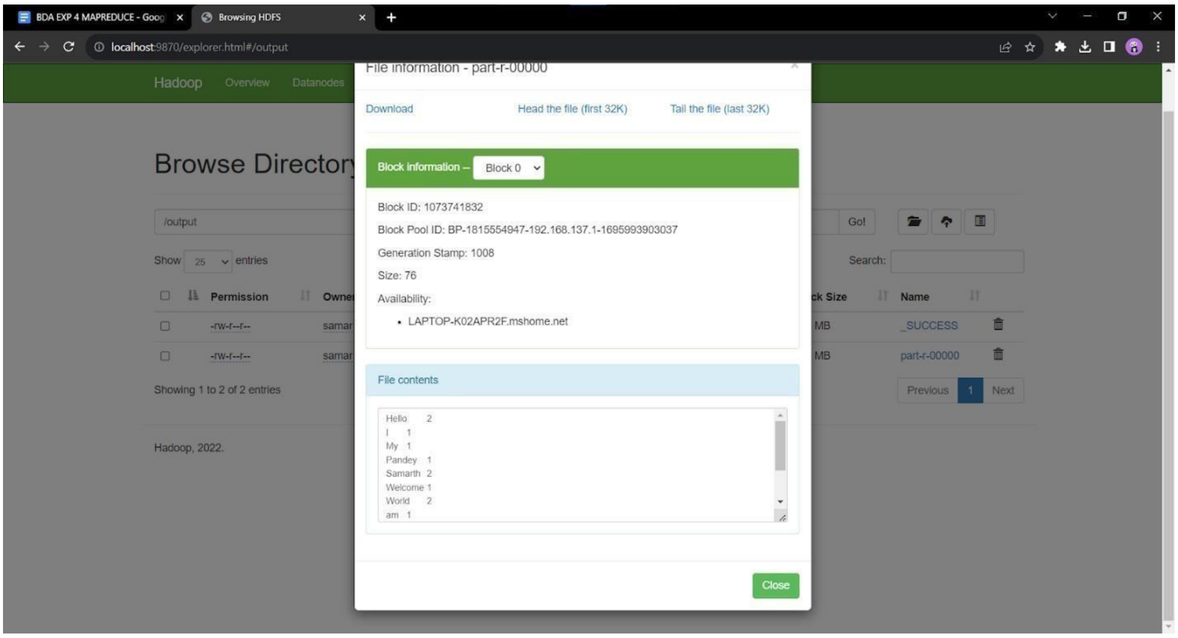

Command Prompt
Microsoft Windows [Version 10.0.22000.2295]
(c) Microsoft Corporation. All rights reserved.
C:\Users\admin>cd Desktop
C:\Users\admin\Desktop>hadoop fs -mkdir /input
C:\Users\admin\Desktop>hadoop fs -put input.txt /input
C:\Users\admin\Desktop>


BDA Lab Manual 23-24
Browsing HDFS
localhost:9870/explorer.html#/input
Hadoop
Overview
Datanodes
Datanode Volume Failures
Snapshot
Startup Progress
Utilities
Browse Directory
/input
Go!
Show 25 entries
Search:
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
Previous 1 Next
Hadoop, 2022.


localhost:9870/explorer.html#/input
Hadoop
Overview
Datanodes
Browse Directory
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
Hadoop, 2022.


Command Prompt
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


BDA EXP 4 MAPREDUCE - Goog
Browsing HDFS
localhost:9870/explorer.html#/
Hadoop
Overview
Datanodes
Datanode Volume Failures
Snapshot
Startup Progress
Utilities
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.


BDA EXP 4 MAPREDUCE - Goog
Browsing HDFS
localhost:9870/explorer.html#/output
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
Browse Directory
/output
Show 25 entries
Search:
-rw-r--r-- samar _SUCCESS
-rw-r--r-- samar part-r-00000
Showing 1 to 2 of 2 entries
Hadoop, 2022.

CONCLUSION:

MapReduce divides the work among numerous computers to process massive datasets fast and efficiently. Additionally, even if a few of the computers malfunction, it can manage problems and continue to function. MapReduce is a versatile tool that is simple to utilise for a number of tasks, including log data analysis and word counts in documents. This experiment demonstrated that MapReduce is a suitable option for distributed systems processing of big datasets. For developers interested in learning about distributed computing, it is also a great option.