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

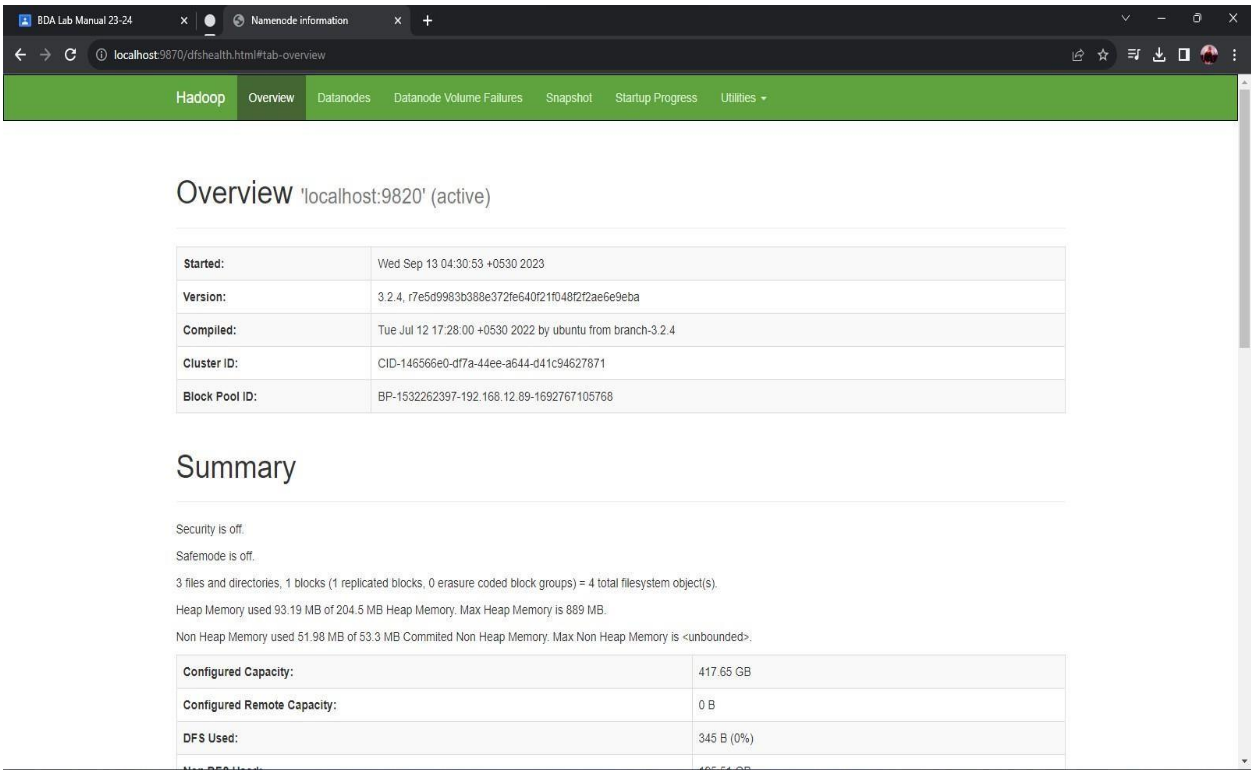
```
void Reduce (keyword, <list of
value>){ for each x in <list of
value>:
sum+=x;

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.

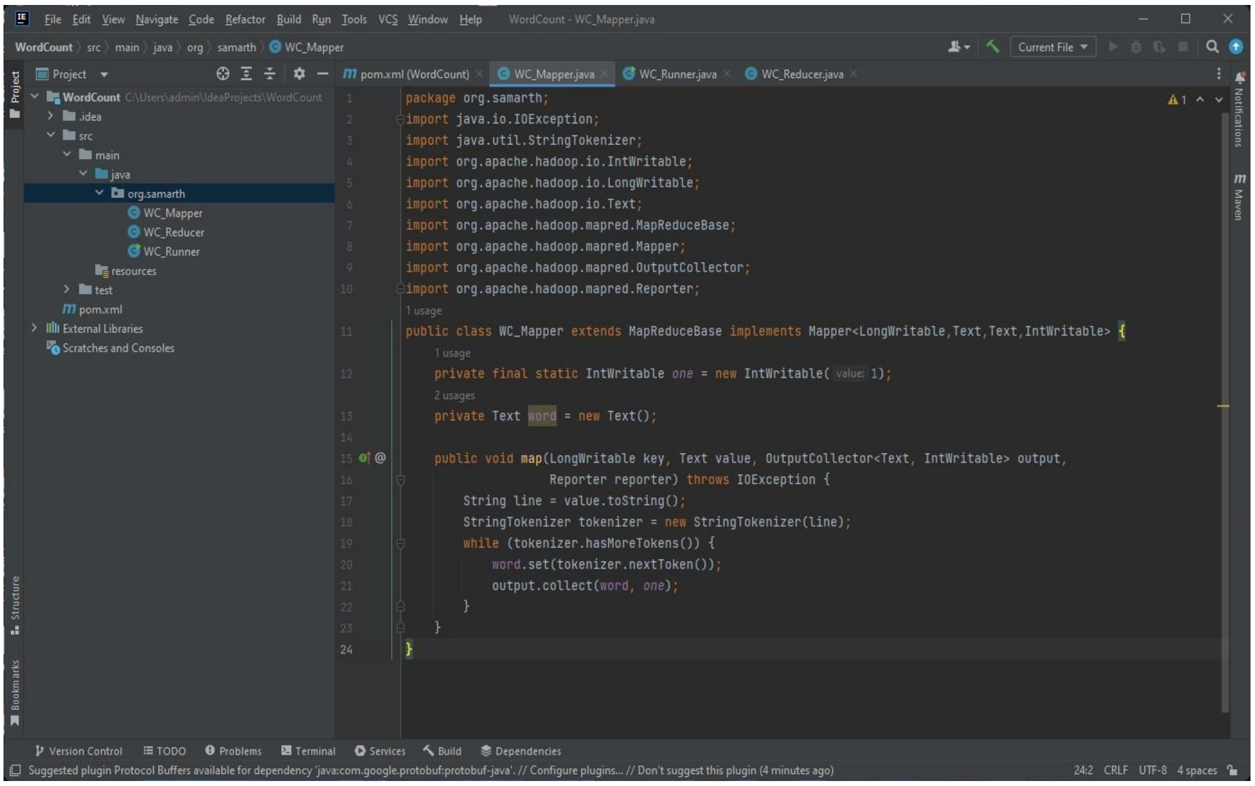
Safemode is off.

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.

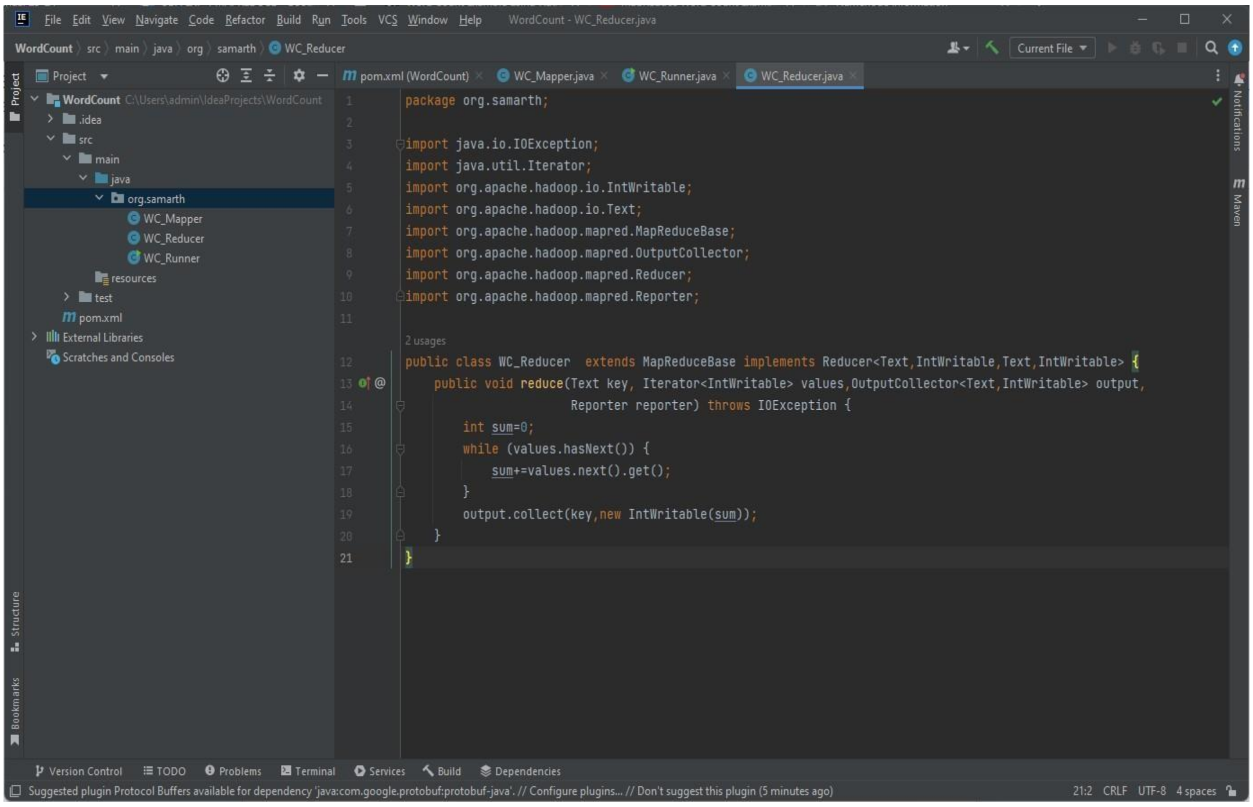
Non Heap Memory used 51.98 MB of 53.3 MB Commited Non Heap Memory. Max Non Heap Memory is <unbounded>.

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



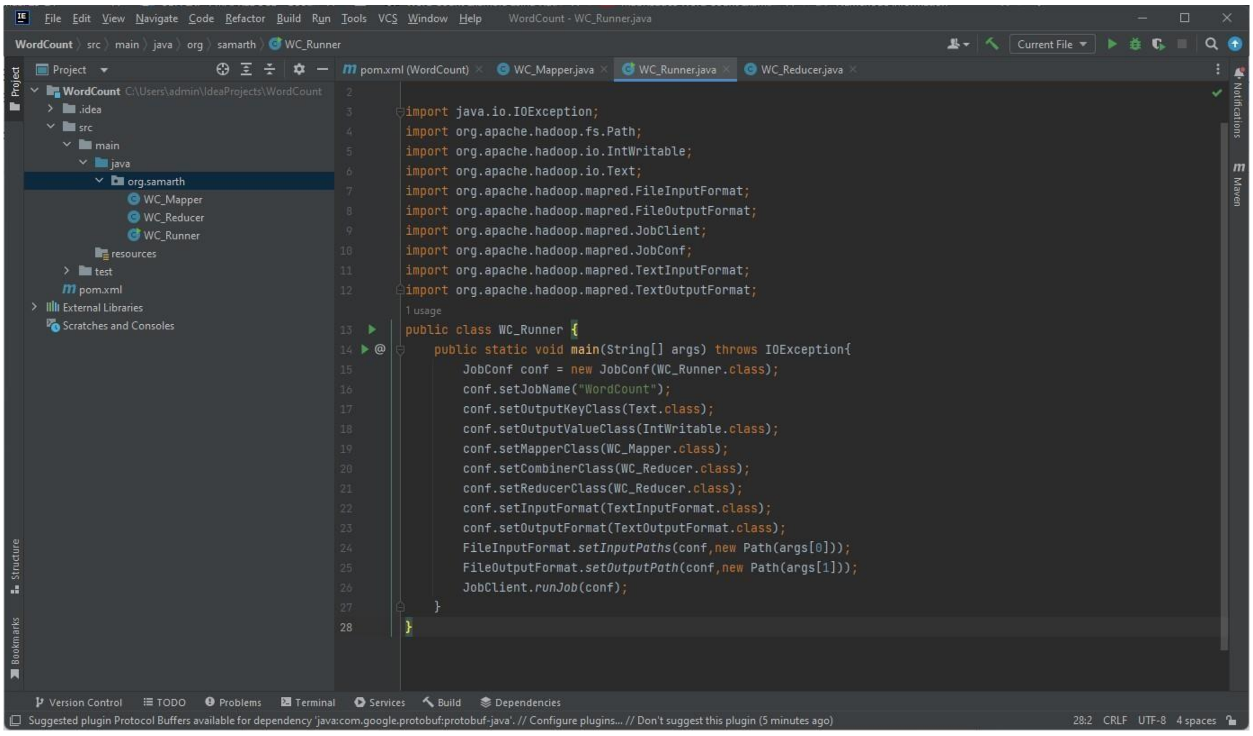
```
package org.samarth;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reporter;
1 usage
public class WC_Mapper extends MapReduceBase implements Mapper<LongWritable,Text,Text,IntWritable> {
    1 usage
    private final static IntWritable one = new IntWritable( value: 1);
    2 usages
    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)   24:2 CRLF UTF-8 4 spaces



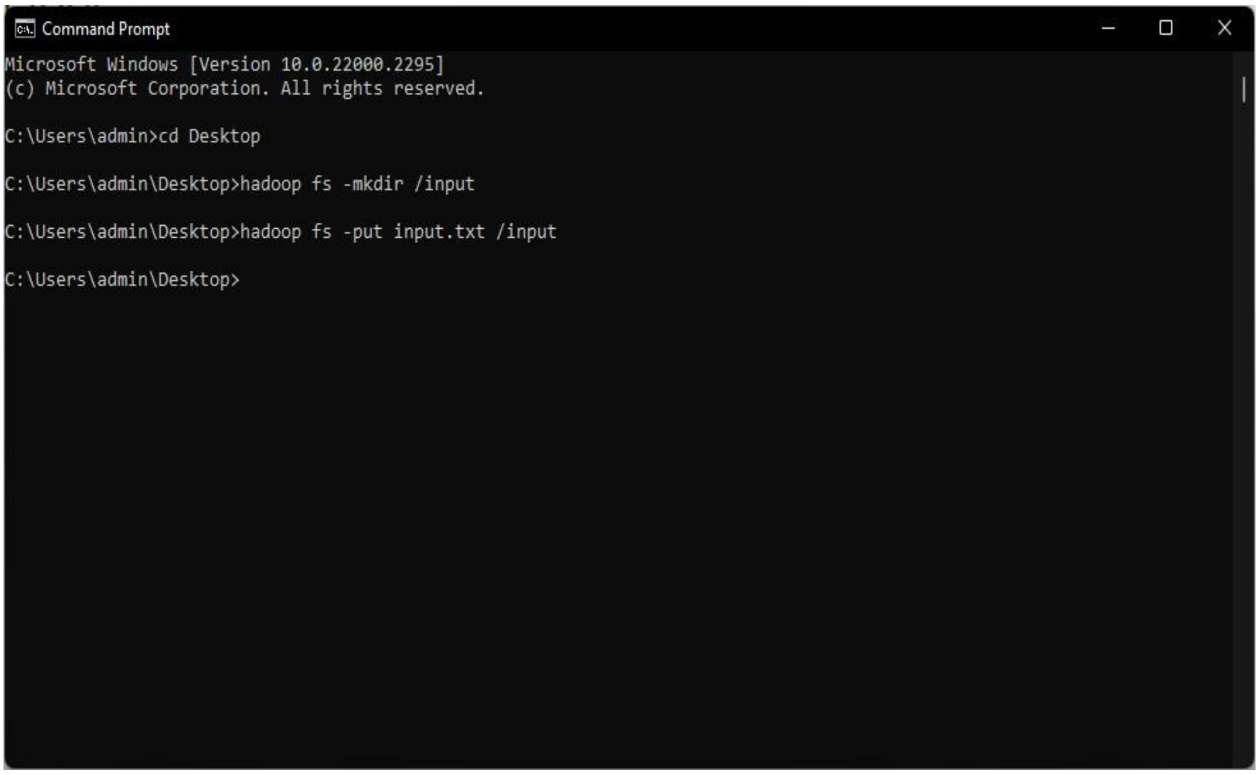
```java
package org.samarth;

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;

2 usages
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)

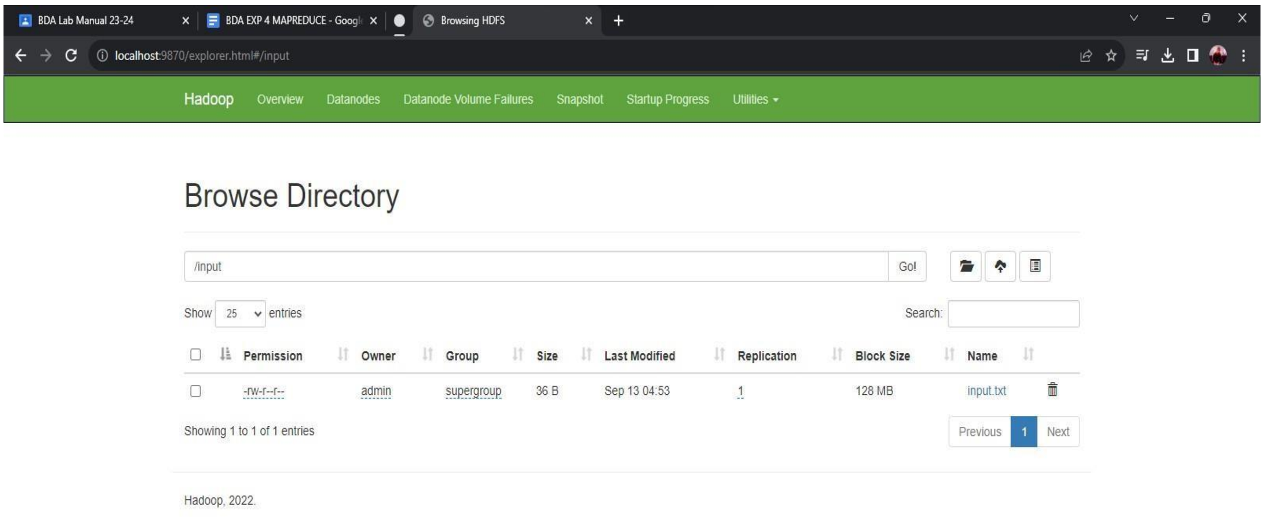


```java
import java.io.IOException;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
import org.apache.hadoop.mapred.JobClient;
import org.apache.hadoop.mapred.JobConf;
import org.apache.hadoop.mapred.TextInputFormat;
import org.apache.hadoop.mapred.TextOutputFormat;
1 usage
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

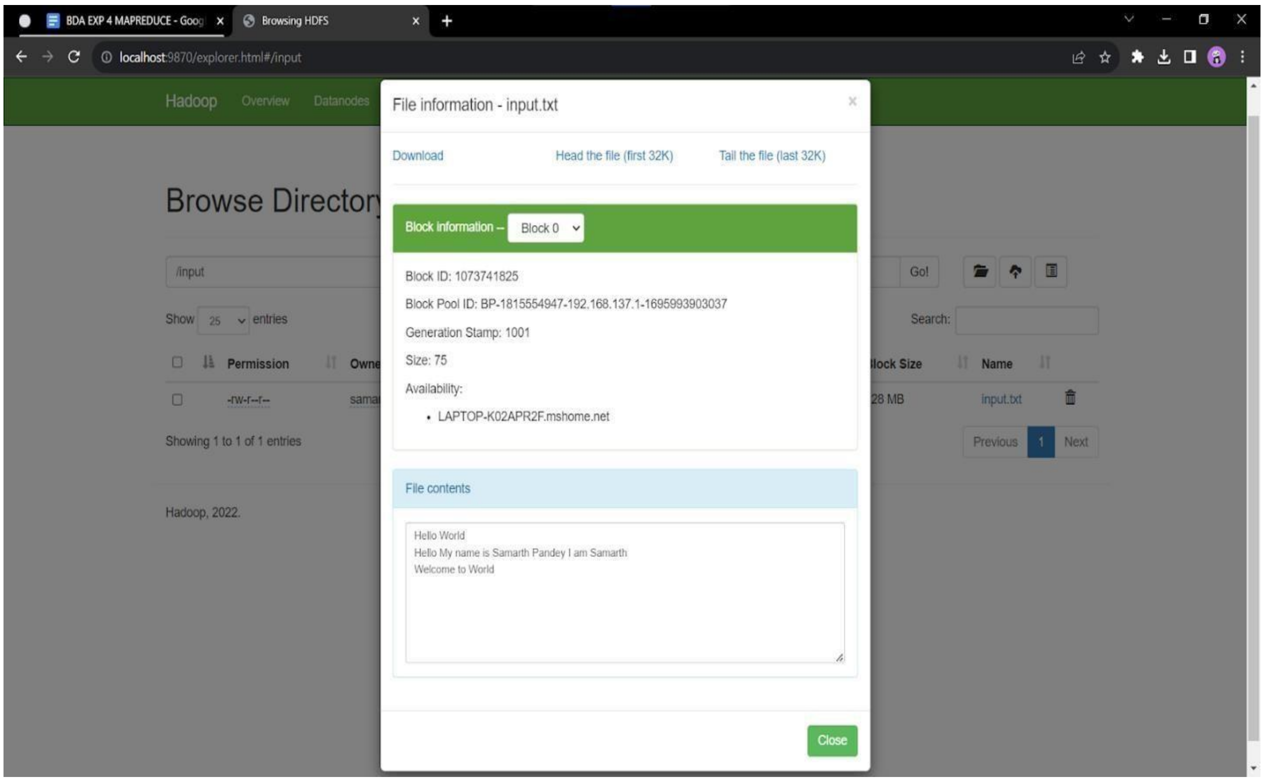
/input

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

Hadoop, 2022.


localhost:9870/explorer.html#/input

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

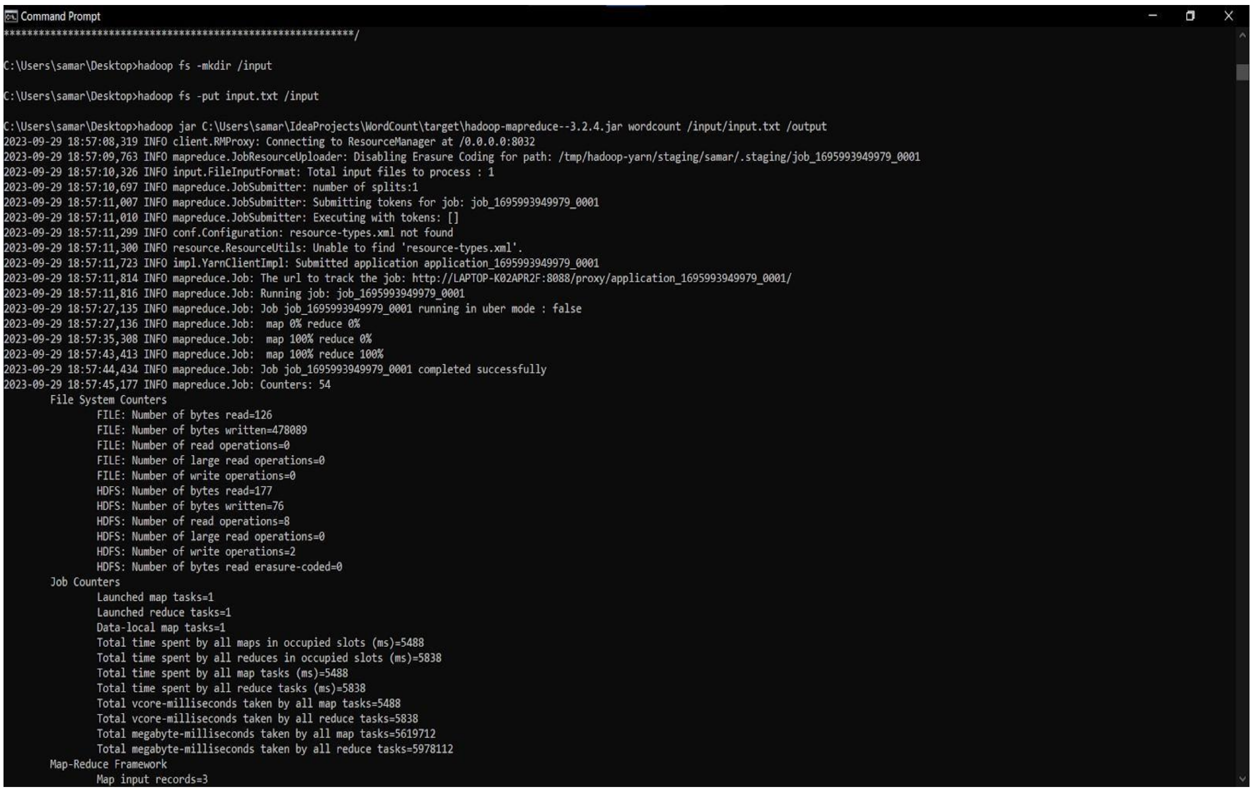
```
Hello World
Hello My name is Samarth Pandey I am Samarth
Welcome to World
```

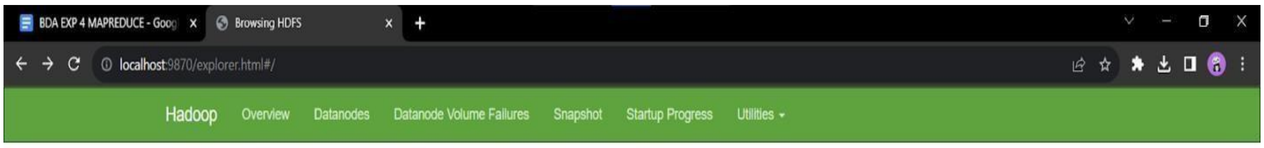
Browse Directory

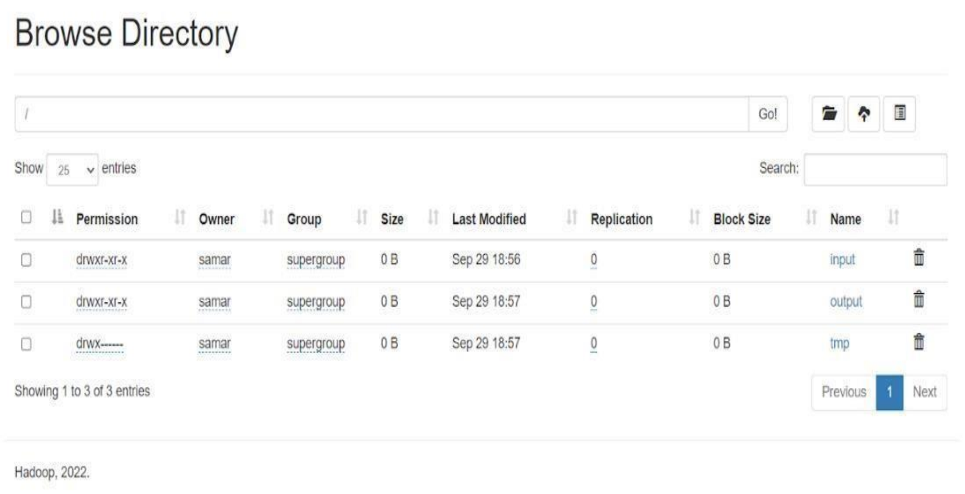
/input

Showing 1 to 1 of 1 entries

Hadoop, 2022.


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

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!

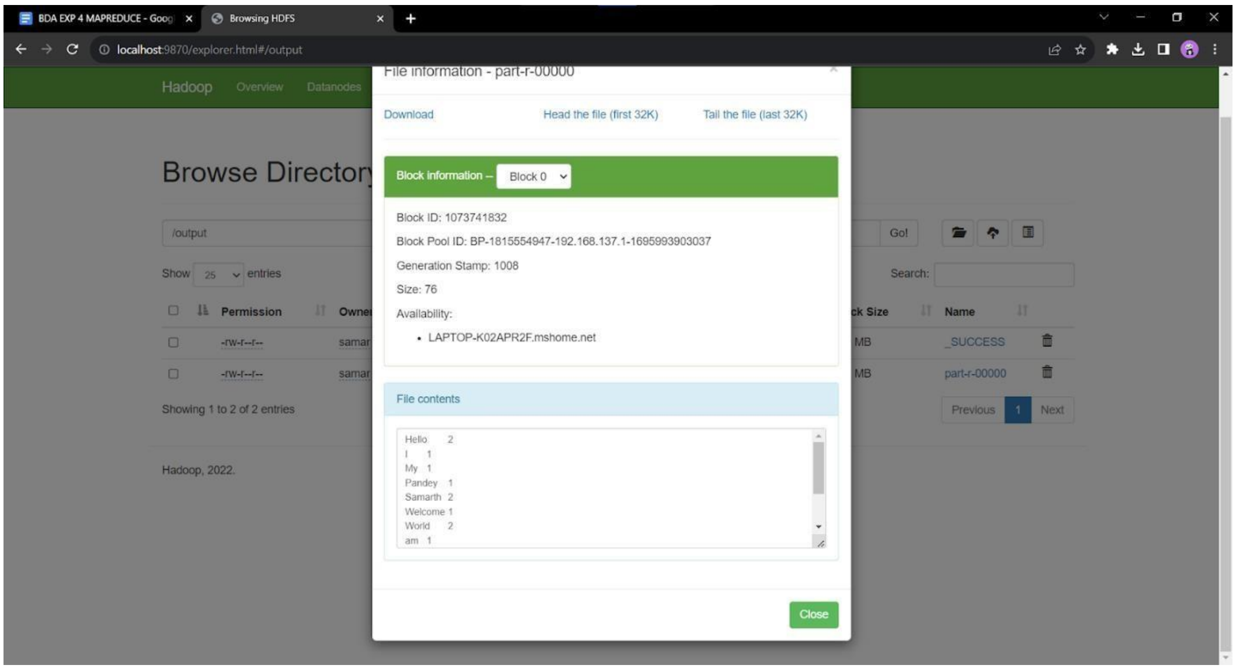
Show 25 entries Search:

	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.


BDA EXP 4 MAPREDUCE - Goog
Browsing HDFS
localhost:9870/explorer.html#/output
Hadoop
Overview
Datanodes

Browse Directory

/output Go!

Show 25 entries Search:

	Permission	Owne	ck Size	Name
☐	-rw-r--r--	samar	MB	_SUCCESS
☐	-rw-r--r--	samar	MB	part-r-00000

Showing 1 to 2 of 2 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:

In a Hadoop cluster, the MapReduce programming paradigm allows for tremendous scalability over hundreds or thousands of computers. It provides a framework for breaking up big datasets into manageable tasks that may be split across several machines in a cluster for processing and analysis. The versatile and dependable MapReduce architecture, which is still a helpful tool for data processing and analysis, has radically changed the way we manage massive data. A straightforward program called WordCount counts how many times each word appears in a given text input data set. In this experiment, we successfully used MapReduce to construct a word count software..