| |
|---|
| Experiment No.4 |
| Experiment on Hadoop Map-Reduce |
| Date of Performance: 07/08/23 |
| Date of Submission: 14/08/23 |

**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

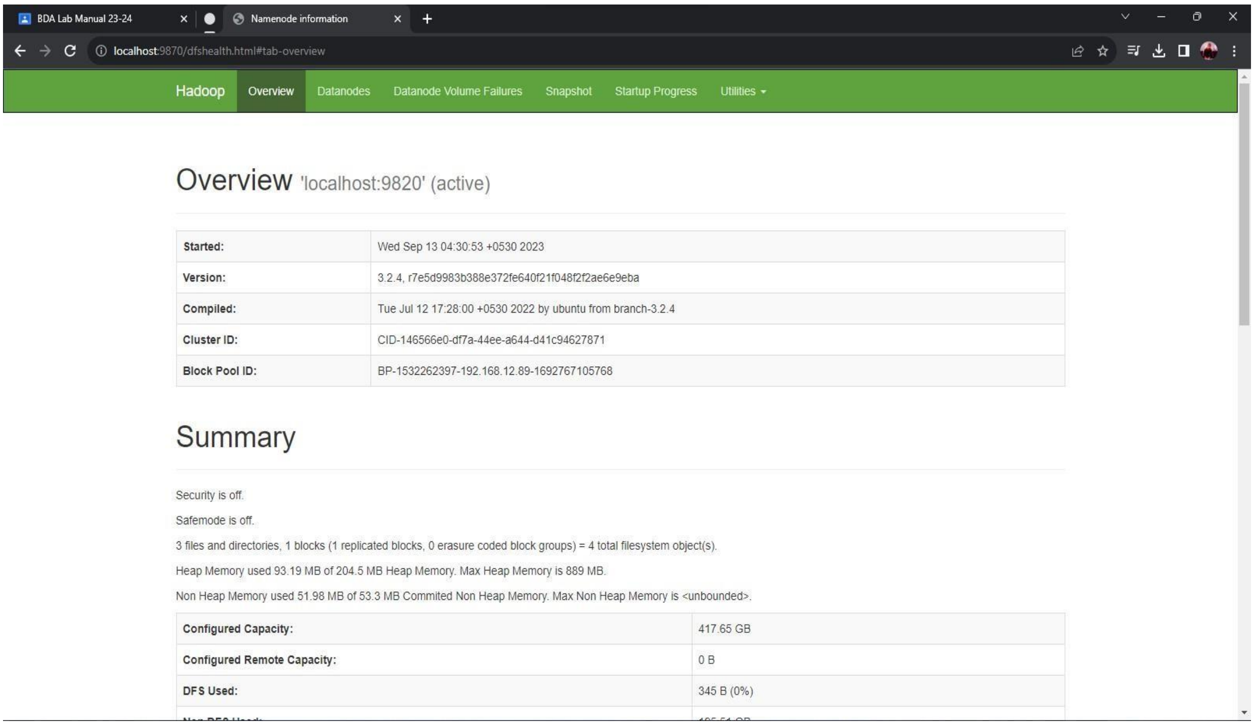
```
void Reduce (keyword, <list of value>){ for each
x in <list of value>:
sum+=x;
final_output.collect(keyword, sum);
}
```

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:**



## 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.

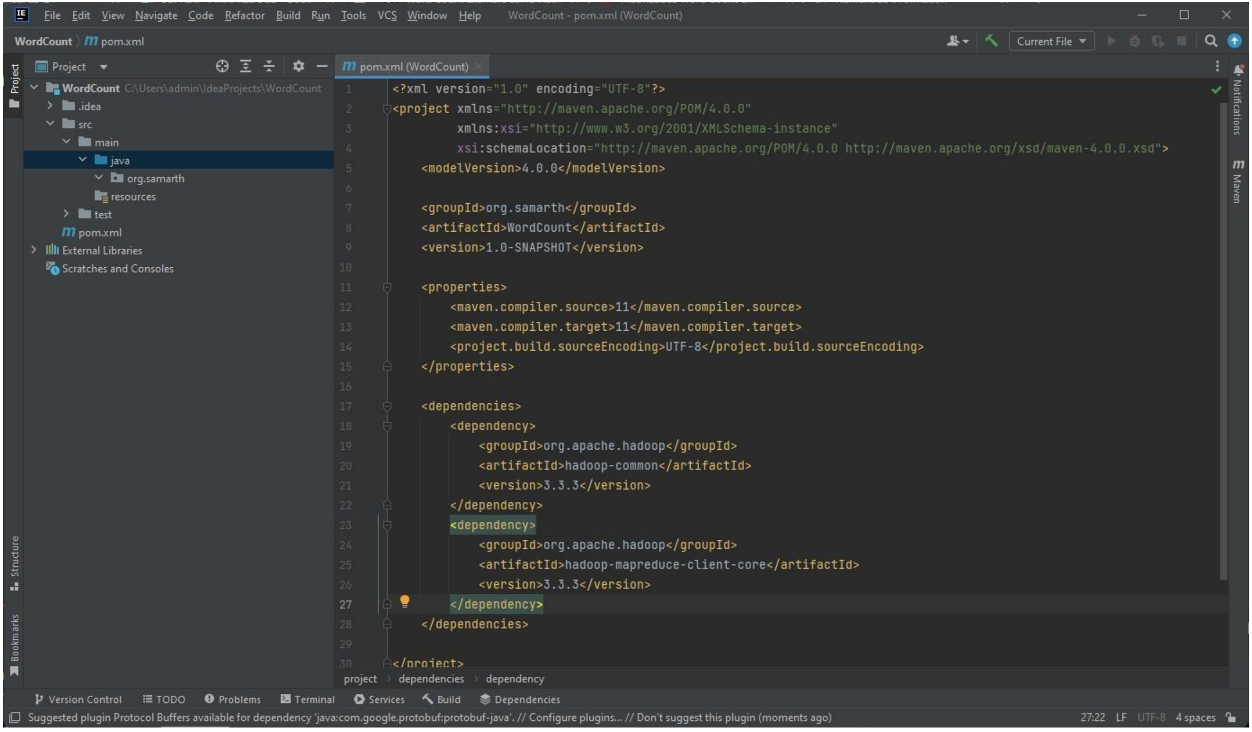
Safemode is off.

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.

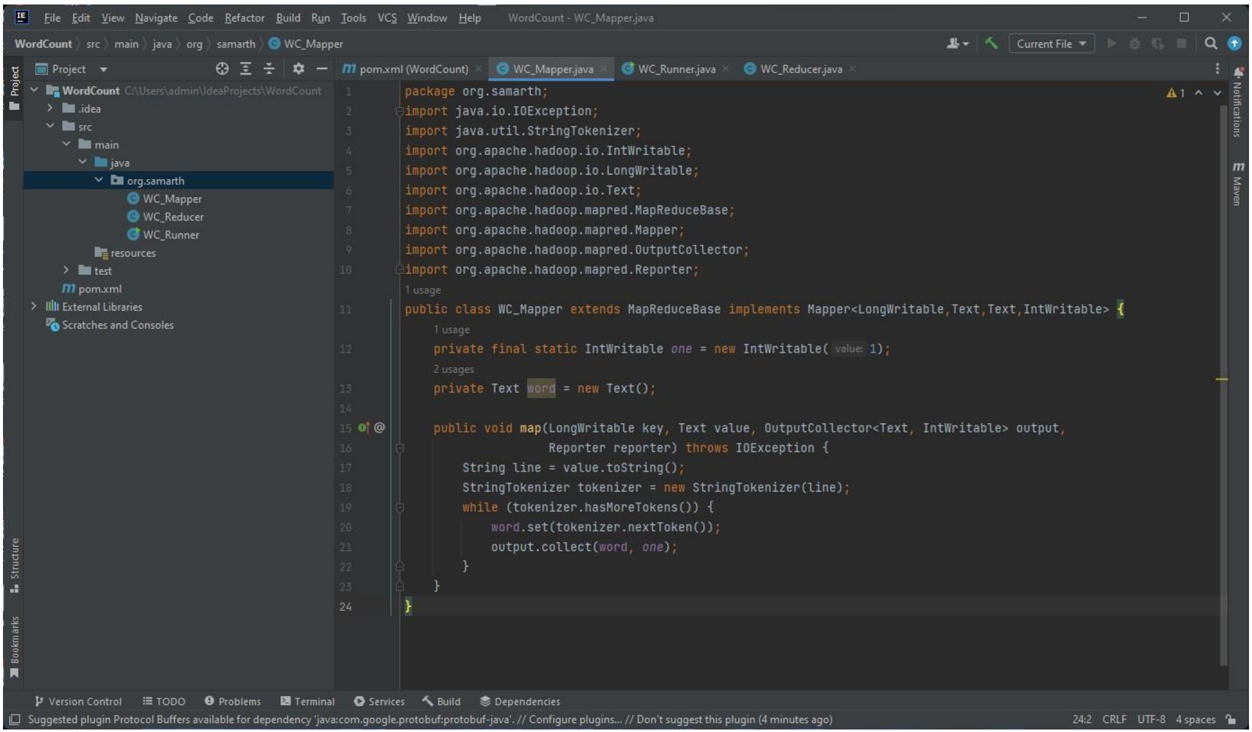
Non Heap Memory used 51.98 MB of 53.3 MB Commited Non Heap Memory. Max Non Heap Memory is <unbounded>.

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



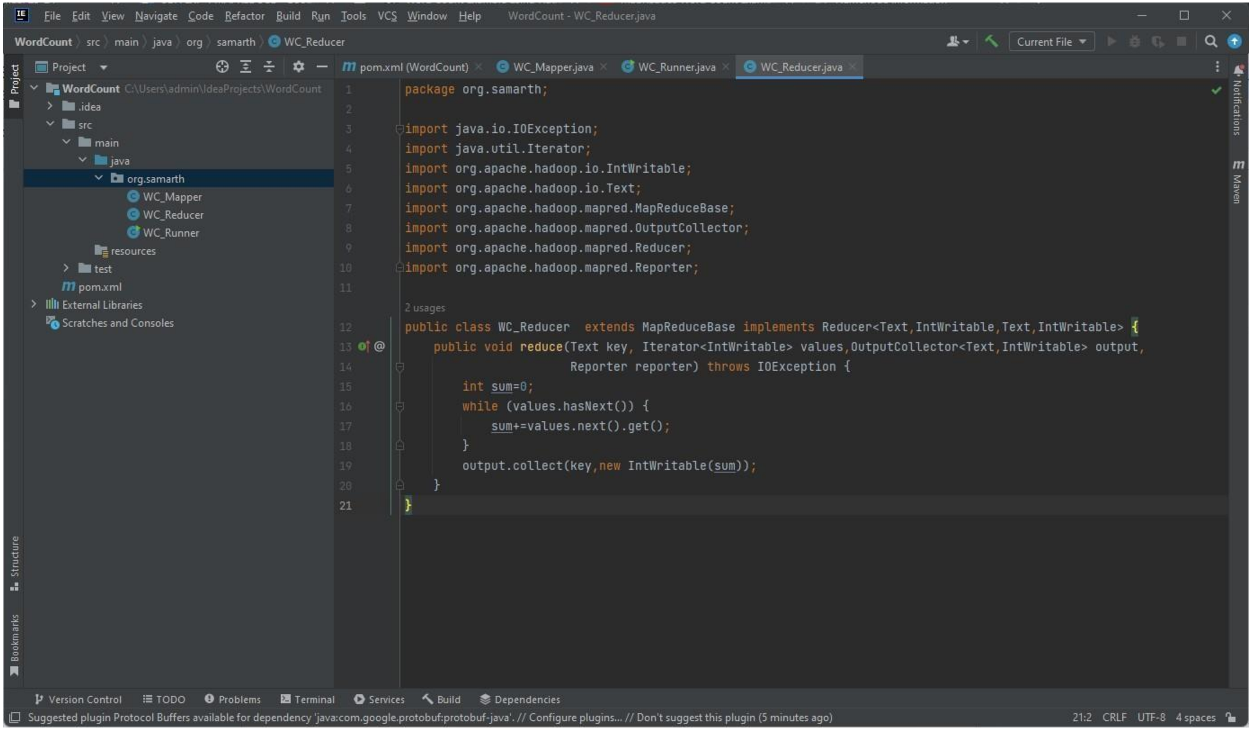
```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <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>
```

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



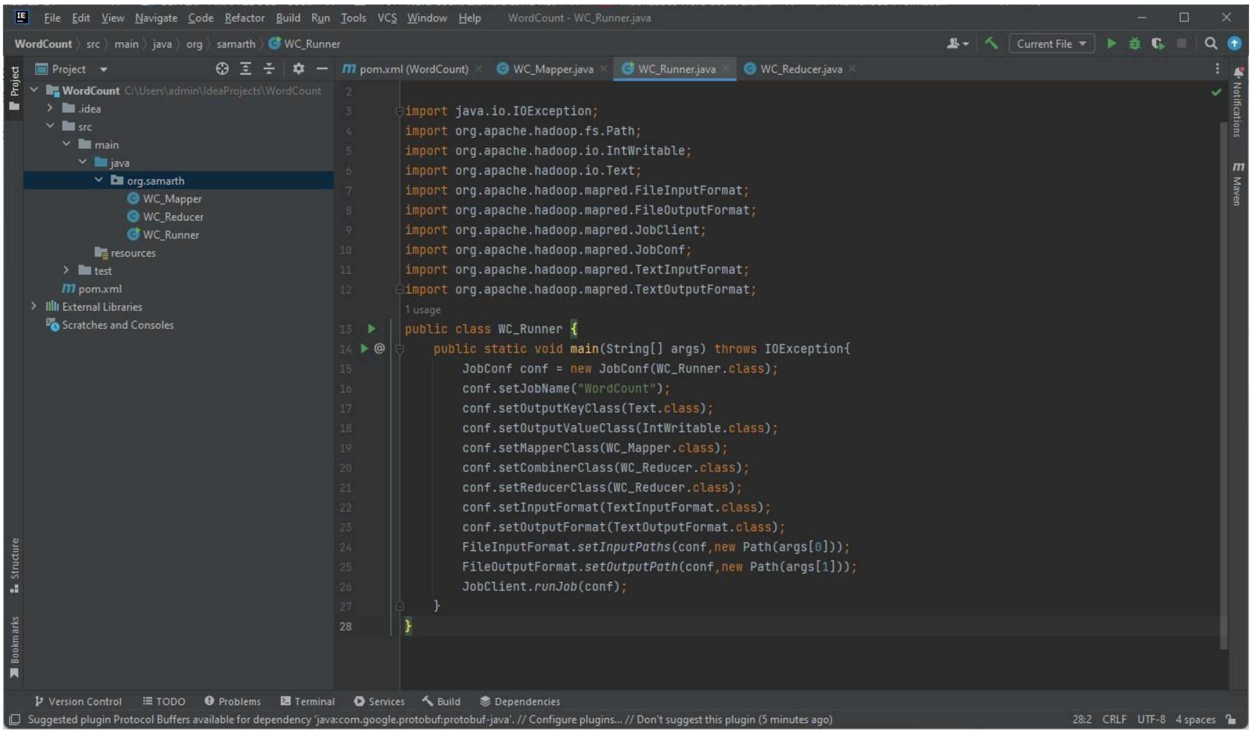
```java
package org.samarth;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import 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));
    }
}
```

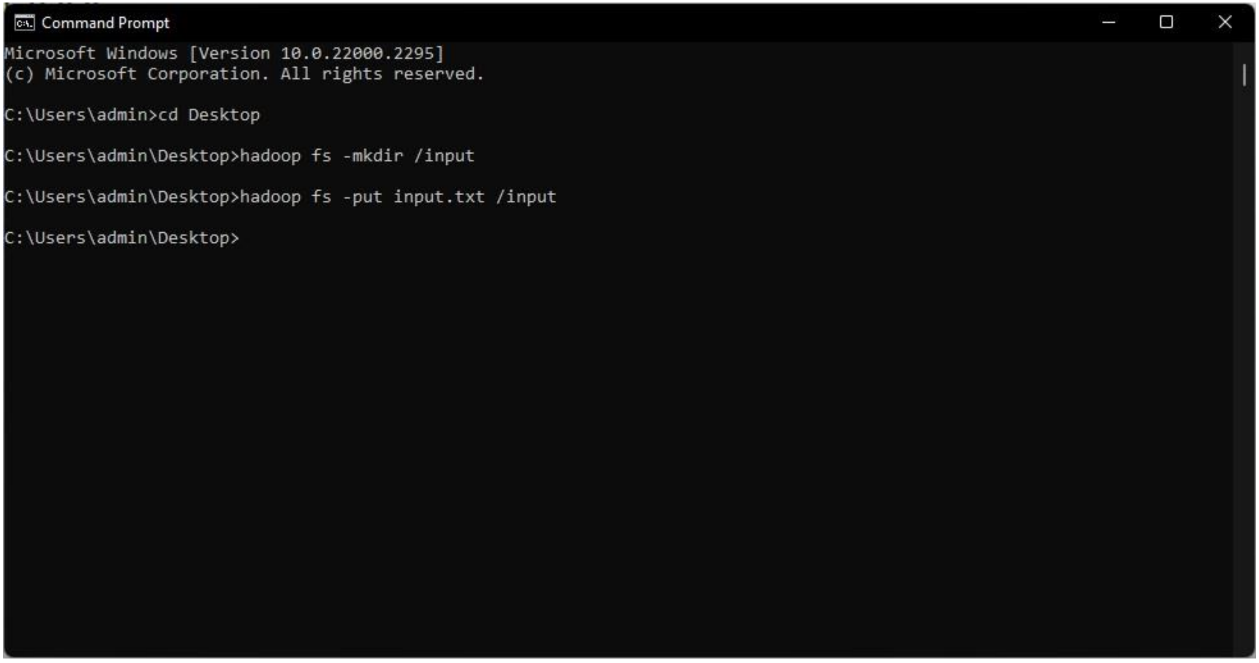
Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (5 minutes ago)



```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;
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);
    }
}
```

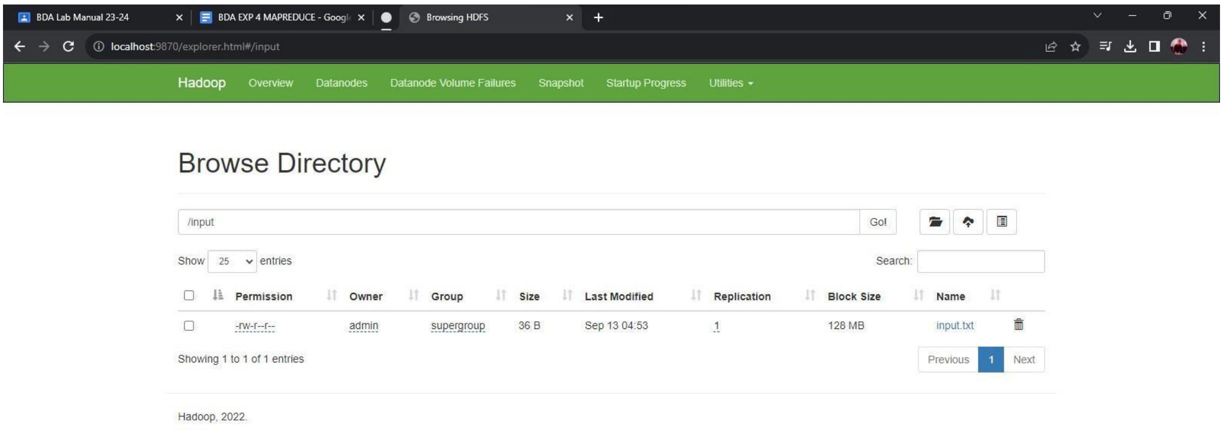
Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (5 minutes ago)

28:2 CRLF UTF-8 4 spaces



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>
```



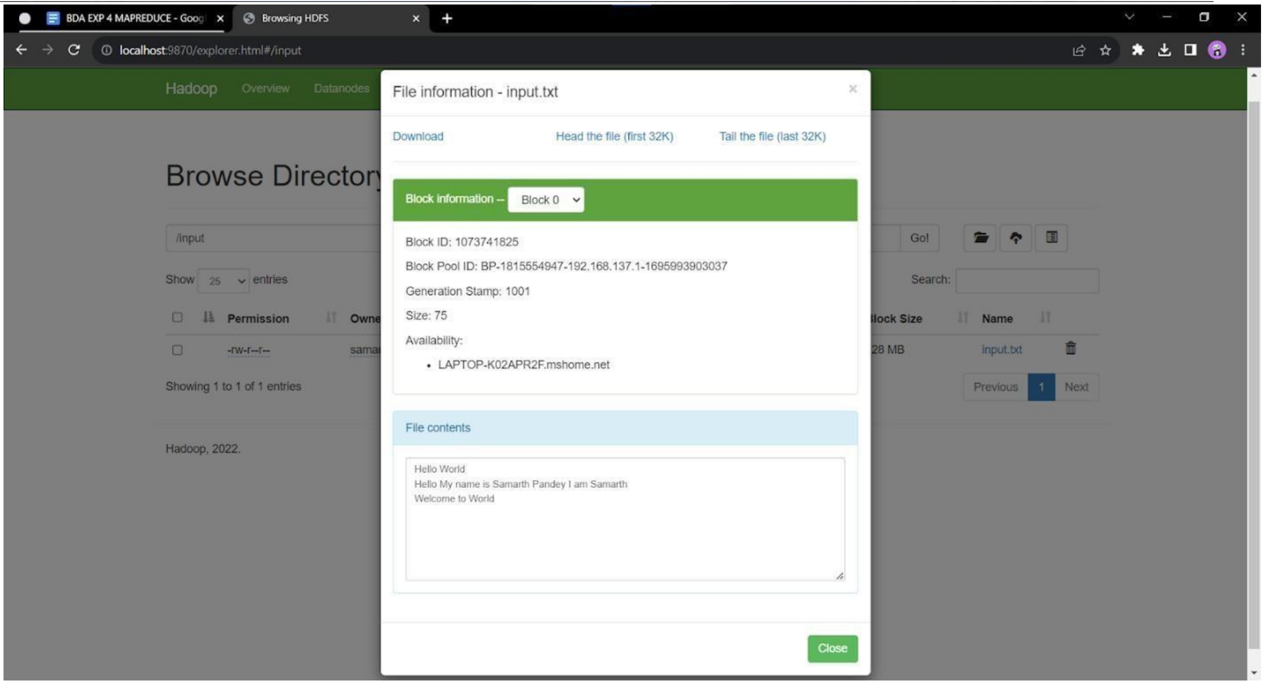
Browse Directory

/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

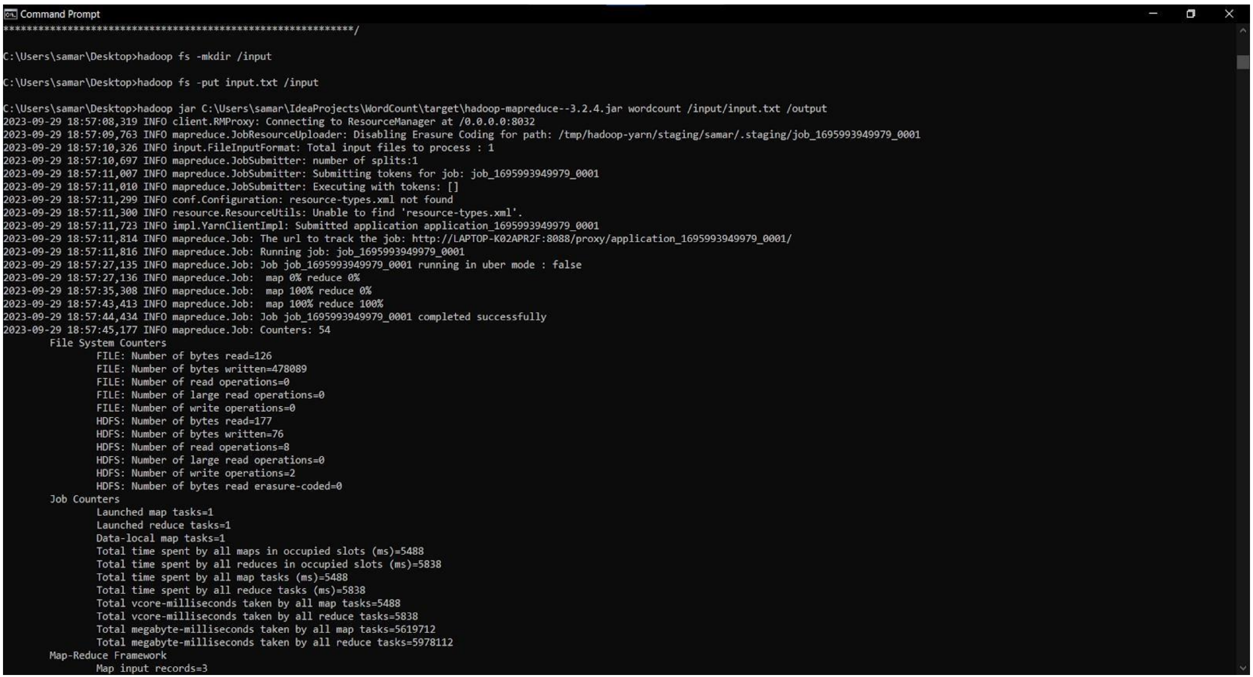
Availability:

- LAPTOP-K02APR2F.mshome.net

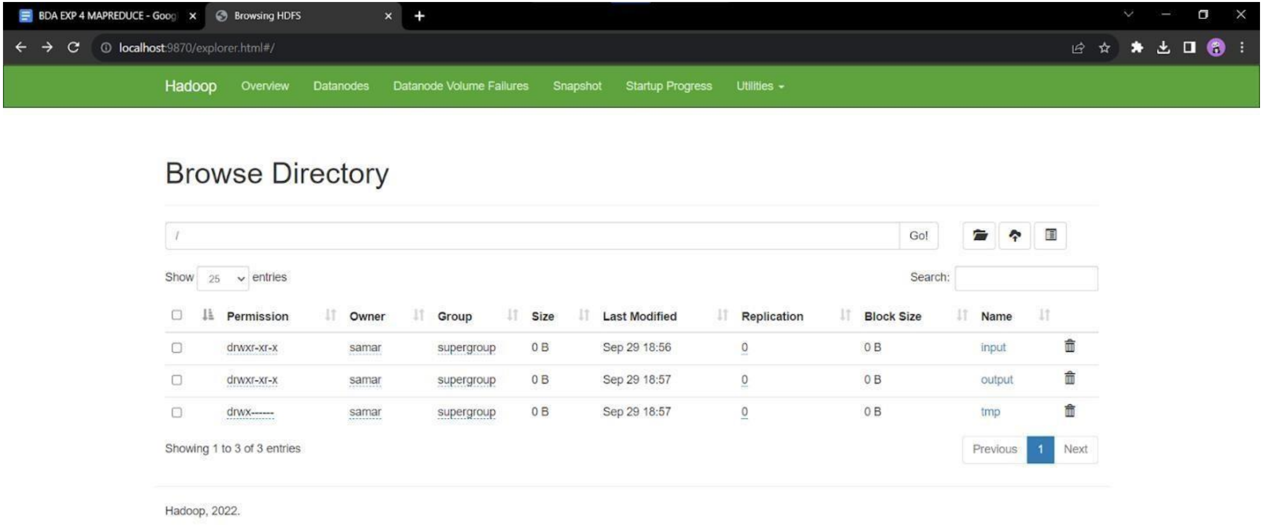
File contents

```
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!

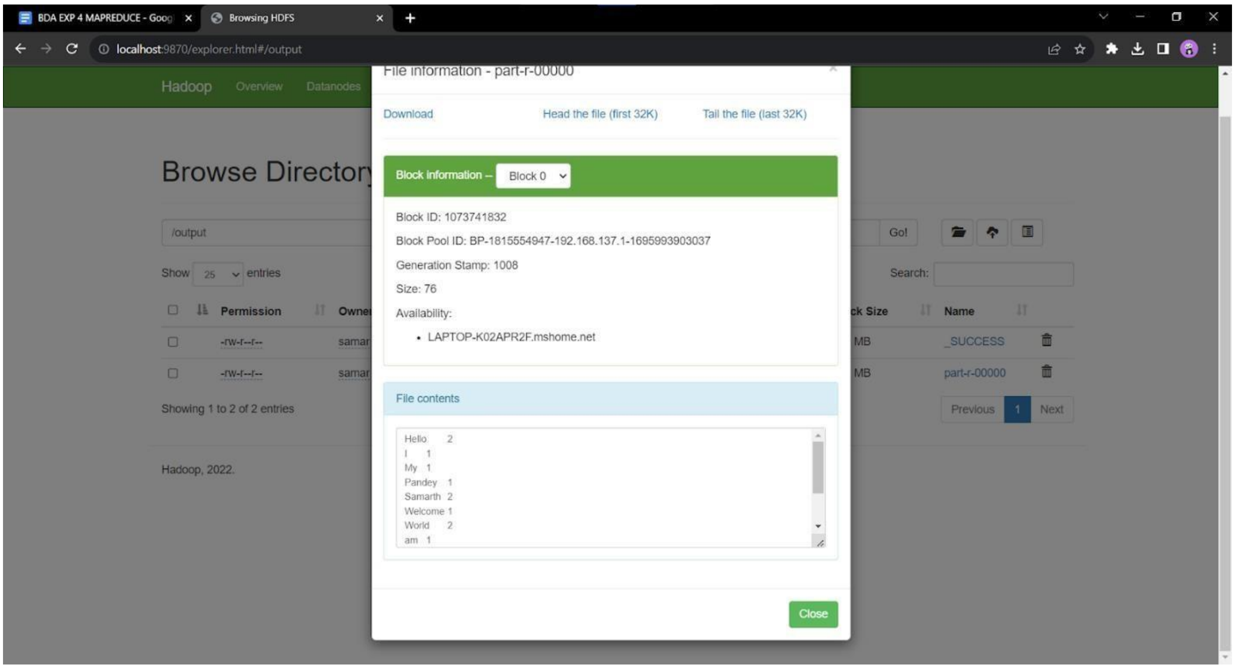
Show 25 entries Search:

| □ | 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

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
```

/output

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

Hadoop, 2022.

## CONCLUSION :

The attempt to use MapReduce to construct a word count programme was a resounding success. When dealing with large datasets, MapReduce clearly showed its scalability and efficiency, assigning tasks to different nodes effectively to enable parallel processing. In particular, it demonstrated how it might ensure the integrity of data processing in dispersed systems. A wide range of developers can use MapReduce thanks to its simple design and simple-to-understand mapper and reducer functionalities. This experiment has real-world applications for more complex data processing tasks like log analysis and machine learning. The program's efficiency can also be increased by incorporating performance optimisation techniques like combiners and partitioners.