Experiment No.4
Experiment on Hadoop Map-Reduce
Date of Performance:7/8/2023
Date of Submission:14/8/2023

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);
}
```

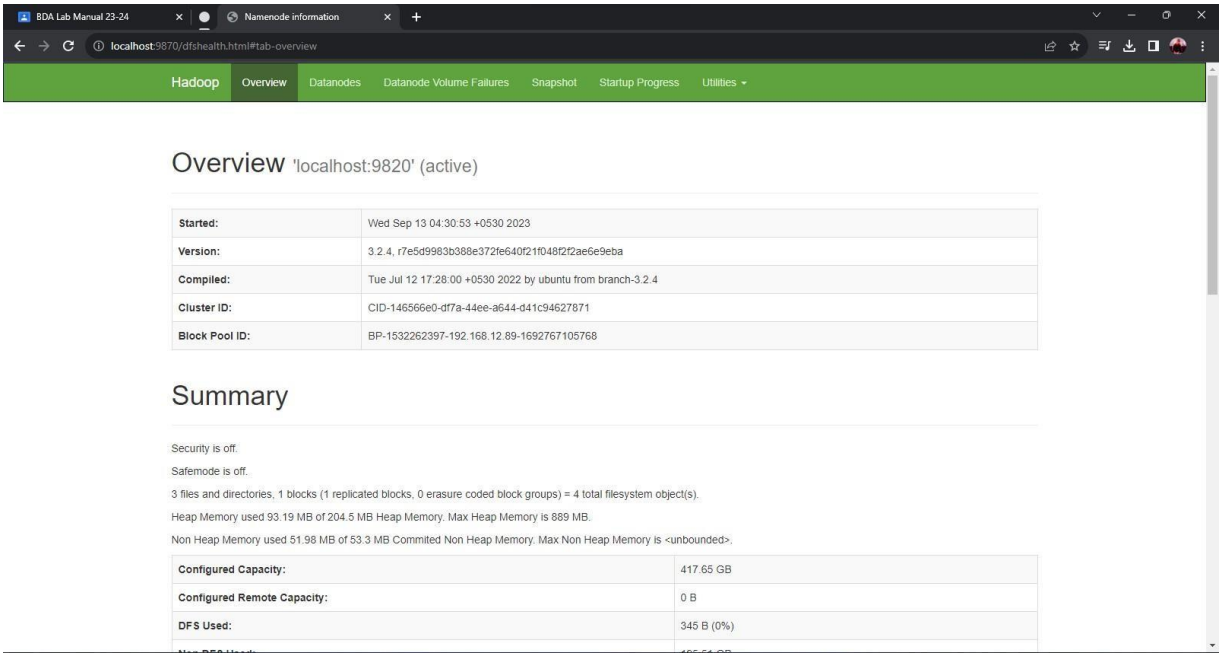
Code:

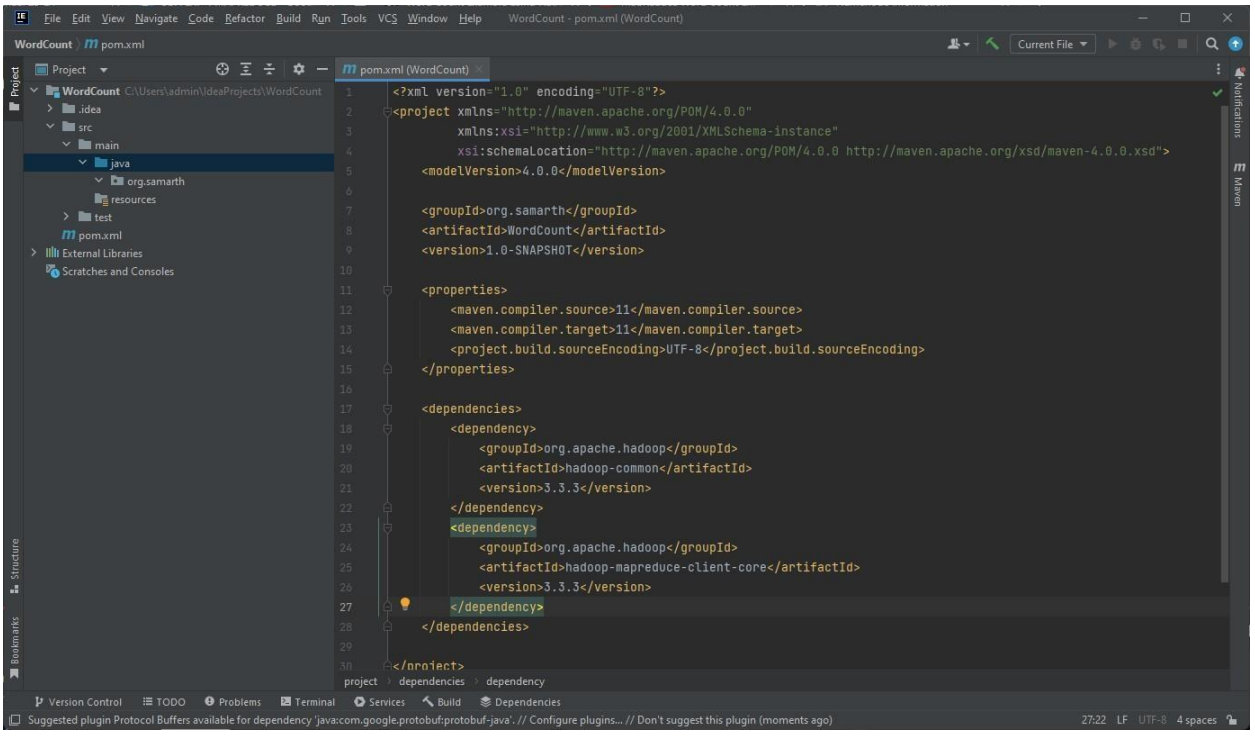
```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.conf.Configuration;
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));
```

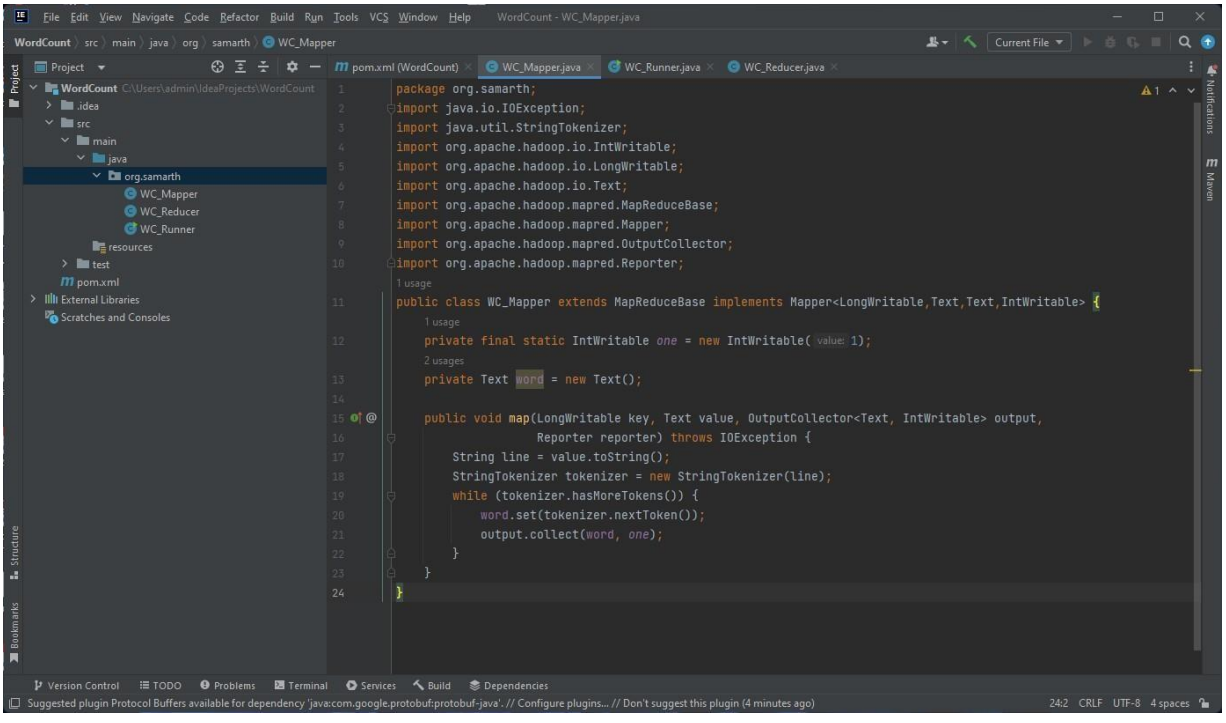
```
}
}
}
public static class Reduce extends Reducer<Text,IntWritable,Text,IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException {
int sum=0;
for(IntWritable x: values)
{
sum+=x.get();
}
context.write(key, new IntWritable(sum));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

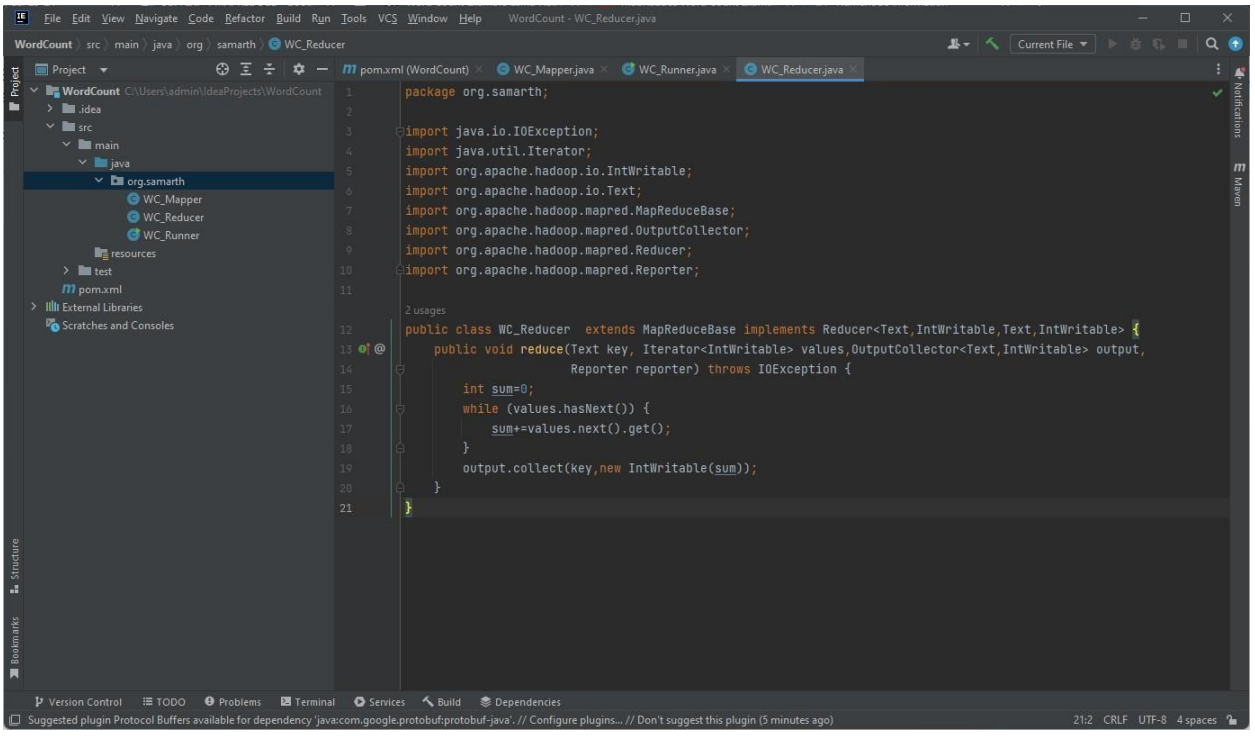
```
FileOutputFormat.setOutputPath(job, new Path(args[1]));
//deleting the output path automatically from hdfs so that we don't have to
delete it explicitly
outputPath.getFileSystem(conf).delete(outputPath);
//exiting the job only if the flag value becomes false
System.exit(job.waitForCompletion(true)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

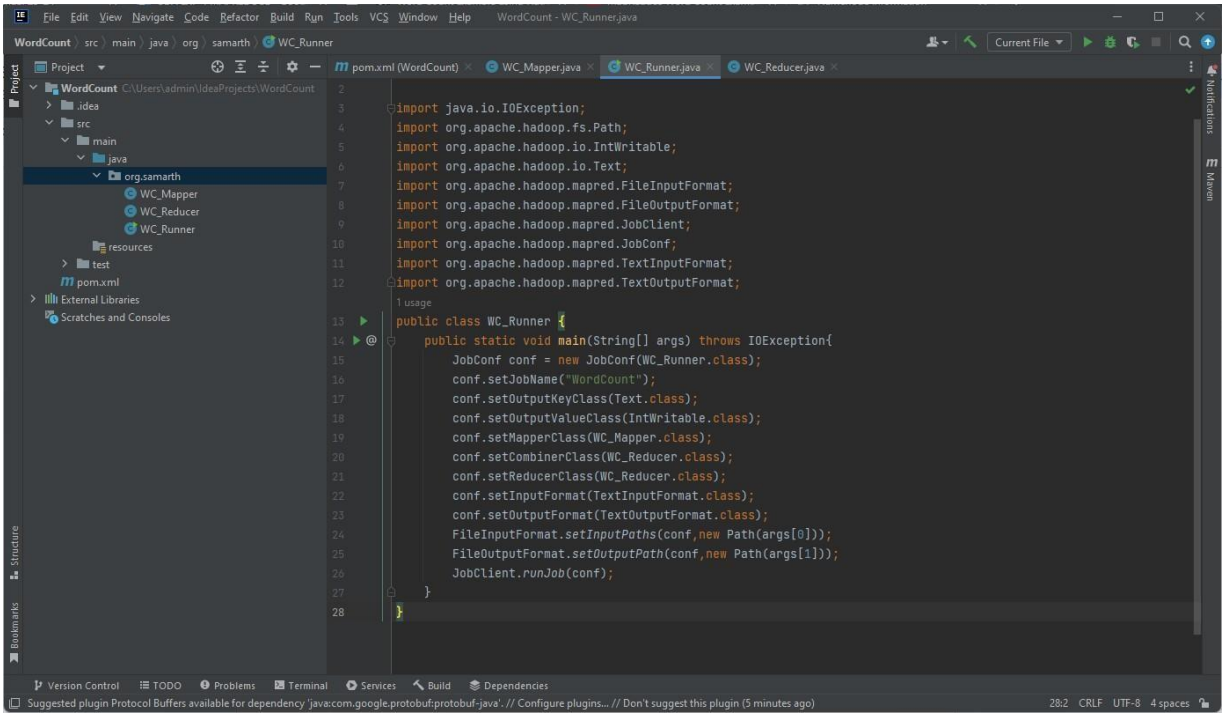
OUTPUT:



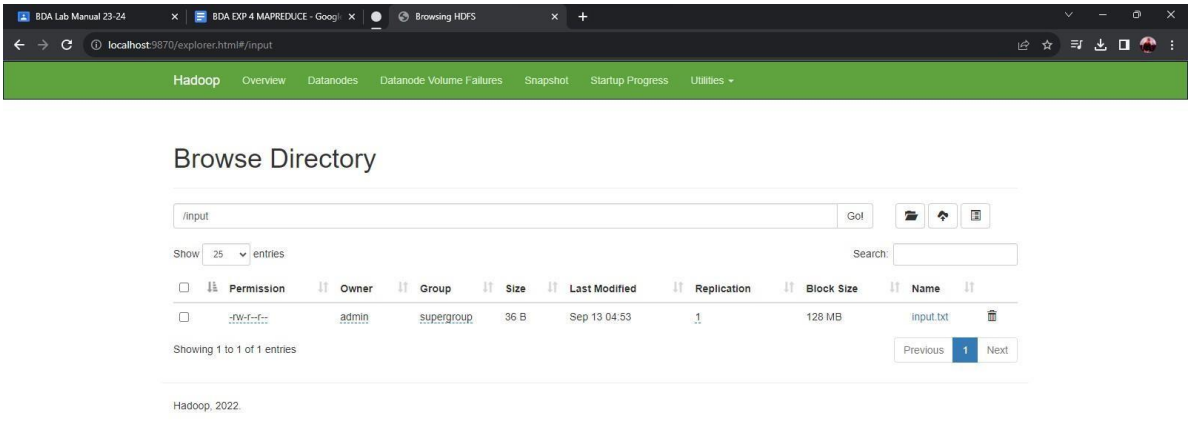

File Edit View Navigate Code Refactor Build Run Tools VCS Window Help
WordCount - pom.xml (WordCount)
WordCount > pom.xml
Current File
Project
pom.xml (WordCount)
WordCount C:\Users\admin\IdeaProjects\WordCount
.idea
src
main
java
org.samarth
resources
test
pom.xml
External Libraries
Scratches and Consoles
<?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>
project > dependencies > dependency
Version Control TODO Problems Terminal Services Build Dependencies
Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (moments ago)
27:22 LF UTF-8 4 spaces

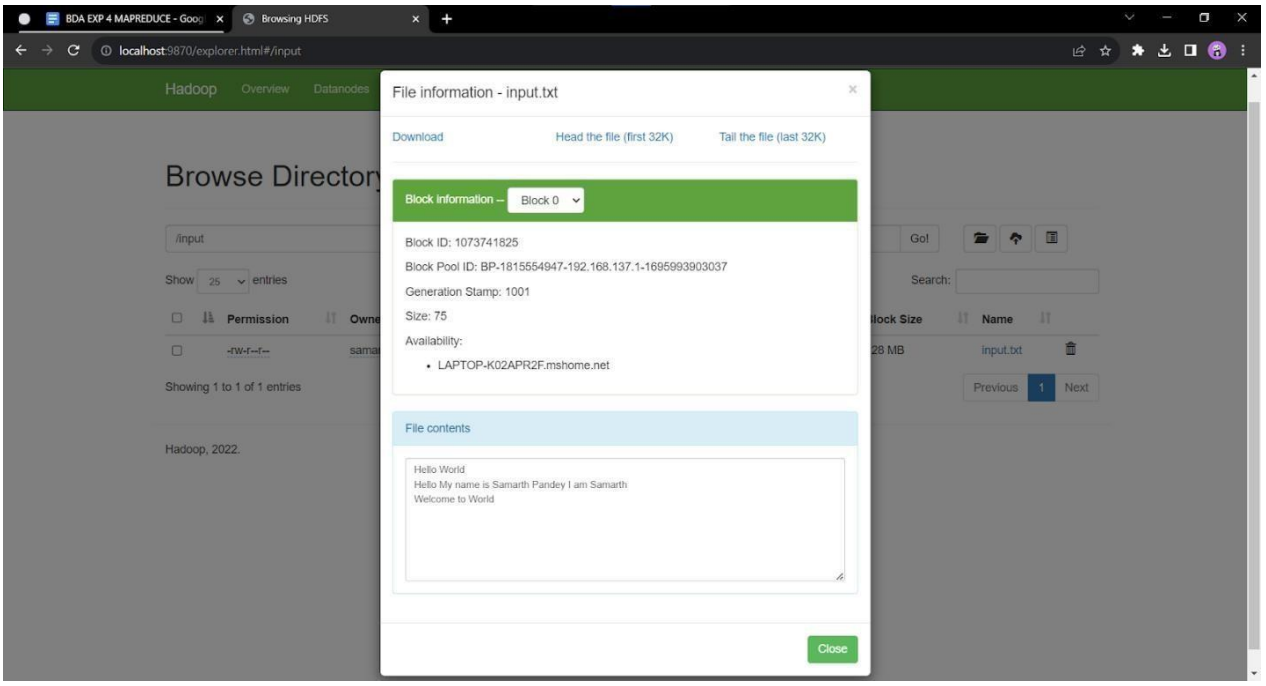

File Edit View Navigate Code Refactor Build Run Tools VCS Window Help
WordCount - WC_Mapper.java
WordCount > src > main > java > org > samarth > WC_Mapper
Current File
pom.xml (WordCount)
WC_Mapper.java
WC_Runner.java
WC_Reducer.java
org.samarth
WC_Mapper
WC_Reducer
WC_Runner
package org.samarth;
import 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);
}
}
}
Version Control TODO Problems Terminal Services Build Dependencies
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

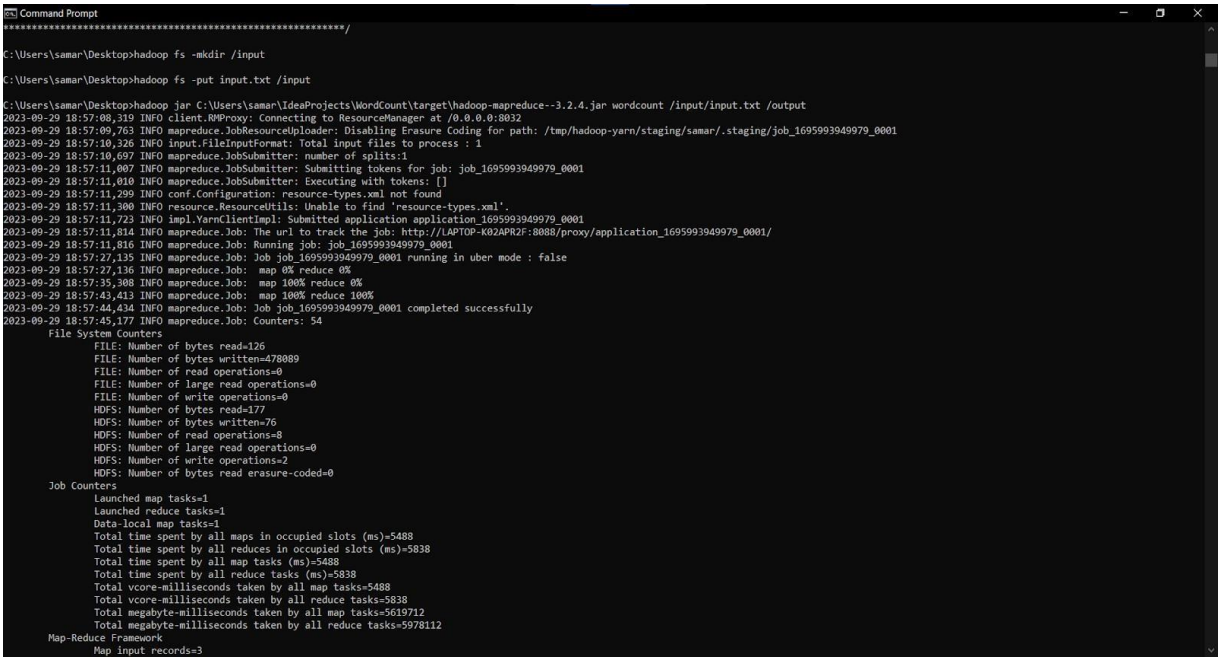

File Edit View Navigate Code Refactor Build Run Tools VCS Window Help WordCount - WC_Reducer.java
WordCount src main java org samarth WC_Reducer
Current File
Project
pom.xml (WordCount)
WC_Mapper.java
WC_Runner.java
WC_Reducer.java
WordCount C:\Users\admin\IdeaProjects\WordCount
.idea
src
main
java
org.samarth
WC_Mapper
WC_Reducer
WC_Runner
resources
test
pom.xml
External Libraries
Scratches and Consoles
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));
}
}
Version Control TODO Problems Terminal Services Build Dependencies
Suggested plugin Protocol Buffers available for dependency 'java:com.google.protobuf:protobuf-java'. // Configure plugins... // Don't suggest this plugin (5 minutes ago)
21:2 CRLF UTF-8 4 spaces

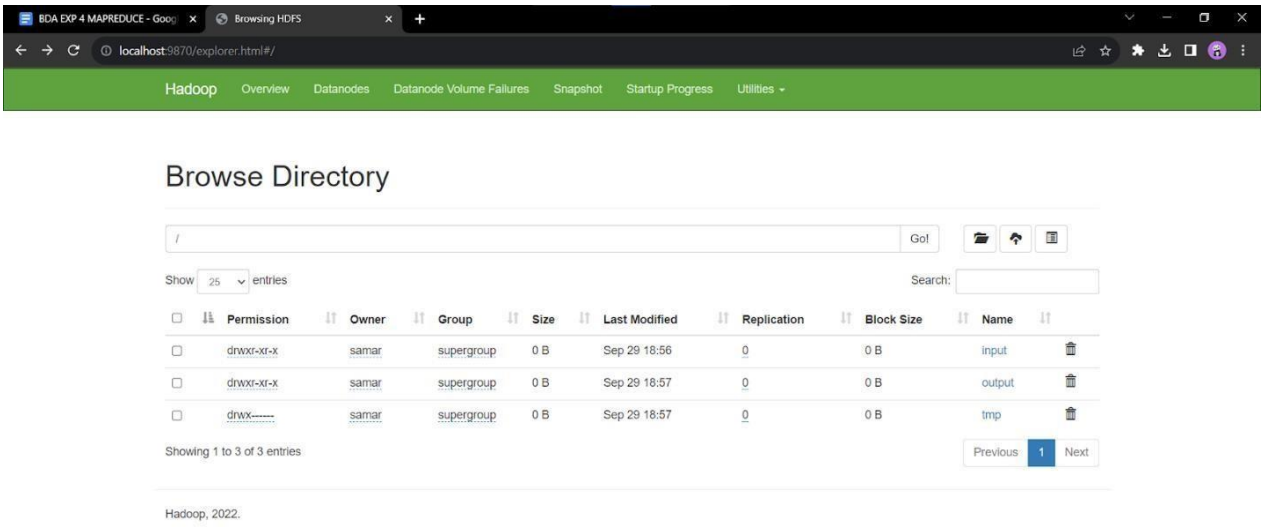

File Edit View Navigate Code Refactor Build Run Tools VCS Window Help WordCount - WC_Runner.java
WordCount src main java org samarth WC_Runner
Current File
Project
pom.xml (WordCount)
WC_Mapper.java
WC_Runner.java
WC_Reducer.java
WordCount C:\Users\admin\IdeaProjects\WordCount
.idea
src
main
java
org.samarth
WC_Mapper
WC_Reducer
WC_Runner
resources
test
pom.xml
External Libraries
Scratches and Consoles
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);
}
}
Version Control TODO Problems Terminal Services Build Dependencies
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

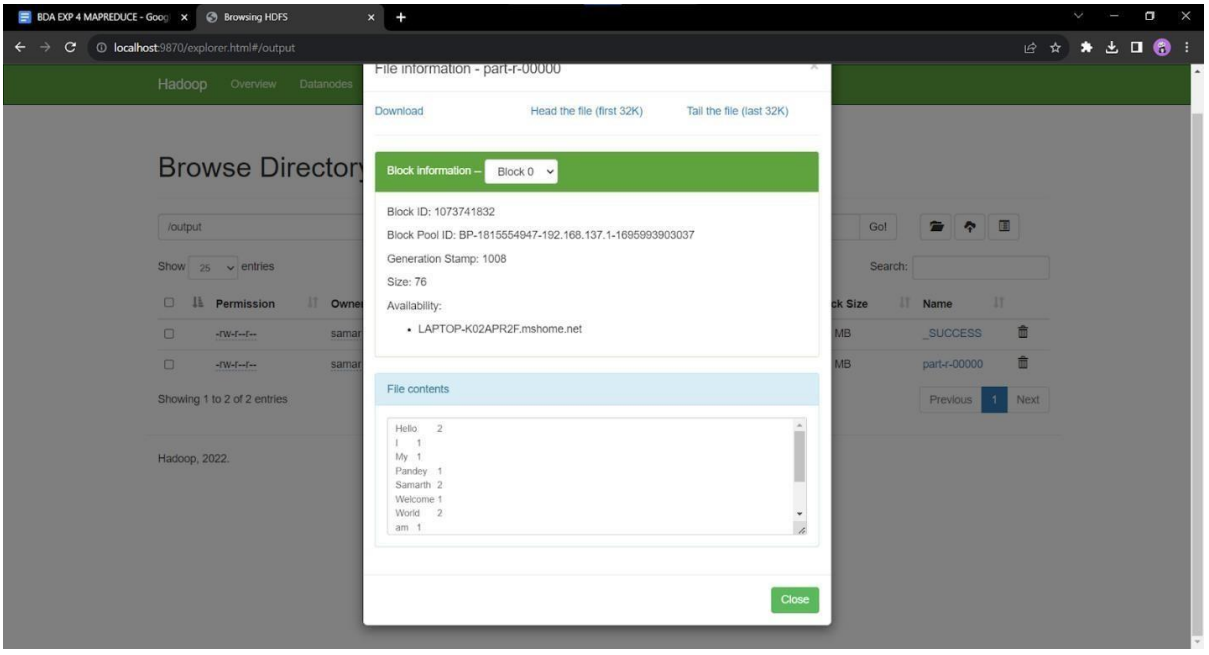

Command Prompt
Microsoft Windows [Version 10.0.22000.2295]
(c) Microsoft Corporation. All rights reserved.
C:\Users\admin>cd Desktop
C:\Users\admin\Desktop>hadoop fs -mkdir /input
C:\Users\admin\Desktop>hadoop fs -put input.txt /input
C:\Users\admin\Desktop>


BDA Lab Manual 23-24
BDA EXP 4 MAPREDUCE - Googl
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.


BDA EXP 4 MAPREDUCE - Goog
Browsing HDFS
localhost:9870/explorer.html#/input
Hadoop
Overview
Datanodes
Browse Directory
/input
Go!
Show 25 entries
Search:
Permission
Owne
lock Size
Name
-rw-r--r--
28 MB
input.txt
Showing 1 to 1 of 1 entries
Previous
1
Next
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


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
Hadoop
Overview
Datanodes
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
Go!
Show 25 entries
Search:
Permission
Name
-rw-r--r-- _SUCCESS
-rw-r--r-- part-r-00000
Showing 1 to 2 of 2 entries
Previous
1
Next
Hadoop, 2022.

CONCLUSION:

The MapReduce experiment to implement a word count programme was successful. MapReduce demonstrated its scalability and efficiency in large dataset processing by distributing tasks across numerous nodes for parallel processing. It demonstrated fault tolerance in distributed systems, maintaining data processing integrity. The simplicity of MapReduce, with its easy mapper and reducer methods, makes it accessible to a wide range of developers. The experiment's practical application includes more complex data processing tasks such as log analysis and machine learning. Combiners and partitioners are examples of performance optimisations that can improve the program's efficiency. In conclusion, this experiment gave a good foundation in distributed computing, which is an essential ability in today's data-driven world.