



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

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



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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



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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
```



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```
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));
```



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```
}
```

```
}
```

```
}
```

```
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);
```



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```
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:



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[Hadoop](#) [Overview](#) [Datanodes](#) [Datanode Volume Failures](#) [Snapshot](#) [Startup Progress](#) [Utilities](#)

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-d7a-44ee-a644-d41c94627671
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 Committed Non Heap Memory. Max Non Heap Memory is <unbounded>.

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

```
Project
├── WordCount
│   ├── .idea
│   ├── src
│   │   ├── main
│   │   │   ├── java
│   │   │   │   ├── org.samarth
│   │   │   │   │   ├── resources
│   │   │   │   │   └── test
│   │   │   └── pom.xml
│   ├── External Libraries
│   └── Scratches and Consoles
└── pom.xml (WordCount)
1  <?xml version="1.0" encoding="UTF-8"?>
2  <project xmlns="http://maven.apache.org/POM/4.0.0"
3    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
4    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
5    <modelVersion>4.0.0</modelVersion>
6
7    <groupId>org.samarth</groupId>
8    <artifactId>WordCount</artifactId>
9    <version>1.0-SNAPSHOT</version>
10
11    <properties>
12      <maven.compiler.source>11</maven.compiler.source>
13      <maven.compiler.target>11</maven.compiler.target>
14      <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
15    </properties>
16
17    <dependencies>
18      <dependency>
19        <groupId>org.apache.hadoop</groupId>
20        <artifactId>hadoop-common</artifactId>
21        <version>3.3.3</version>
22      </dependency>
23      <dependency>
24        <groupId>org.apache.hadoop</groupId>
25        <artifactId>hadoop-mapreduce-client-core</artifactId>
26        <version>3.3.3</version>
27      </dependency>
28    </dependencies>
29
30  </project>
```



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```
1 package org.samarth;
2 import java.io.IOException;
3 import java.util.StringTokenizer;
4 import org.apache.hadoop.io.IntWritable;
5 import org.apache.hadoop.io.LongWritable;
6 import org.apache.hadoop.io.Text;
7 import org.apache.hadoop.mapred.MapReduceBase;
8 import org.apache.hadoop.mapred.Mapper;
9 import org.apache.hadoop.mapred.OutputCollector;
10 import org.apache.hadoop.mapred.Reporter;
11
12 public class WC_Mapper extends MapReduceBase implements Mapper<LongWritable, Text, Text, IntWritable> {
13     private final static IntWritable one = new IntWritable(1);
14     private Text word = new Text();
15
16     public void map(LongWritable key, Text value, OutputCollector<Text, IntWritable> output,
17                     Reporter reporter) throws IOException {
18         String line = value.toString();
19         StringTokenizer tokenizer = new StringTokenizer(line);
20         while (tokenizer.hasMoreTokens()) {
21             word.set(tokenizer.nextToken());
22             output.collect(word, one);
23         }
24     }
25 }
```

```
1 package org.samarth;
2
3 import java.io.IOException;
4 import java.util.Iterator;
5 import org.apache.hadoop.io.IntWritable;
6 import org.apache.hadoop.io.Text;
7 import org.apache.hadoop.mapred.MapReduceBase;
8 import org.apache.hadoop.mapred.OutputCollector;
9 import org.apache.hadoop.mapred.Reducer;
10 import org.apache.hadoop.mapred.Reporter;
11
12 public class WC_Reducer extends MapReduceBase implements Reducer<Text, IntWritable, Text, IntWritable> {
13     public void reduce(Text key, Iterator<IntWritable> values, OutputCollector<Text, IntWritable> output,
14                       Reporter reporter) throws IOException {
15         int sum=0;
16         while (values.hasNext()) {
17             sum+=values.next().get();
18         }
19         output.collect(key, new IntWritable(sum));
20     }
21 }
```




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The screenshot shows an IDE with the following project structure:

- Project: WordCount (C:\Users\admin\IdeaProjects\WordCount)
- src/main/java/org.samarth
 - WC_Mapper
 - WC_Reducer
 - WC_Runner
- resources
- test
- pom.xml
- External Libraries
- Scratches and Consoles

The main editor displays the `WC_Reducer.java` file with the following code:

```
1 package org.samarth;
2
3 import java.io.IOException;
4 import java.util.Iterator;
5 import org.apache.hadoop.io.IntWritable;
6 import org.apache.hadoop.io.Text;
7 import org.apache.hadoop.mapred.MapReduceBase;
8 import org.apache.hadoop.mapred.OutputCollector;
9 import org.apache.hadoop.mapred.Reducer;
10 import org.apache.hadoop.mapred.Reporter;
11
12 2 usages
13 public class WC_Reducer extends MapReduceBase implements Reducer<Text,IntWritable,Text,IntWritable> {
14     public void reduce(Text key, Iterator<IntWritable> values,OutputCollector<Text,IntWritable> output,
15         Reporter reporter) throws IOException {
16         int sum=0;
17         while (values.hasNext()) {
18             sum+=values.next().get();
19         }
20         output.collect(key,new IntWritable(sum));
21     }
22 }
```

The screenshot shows a Windows Command Prompt window with the following commands and output:

```
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>
```



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Hadoop Overview Datanodes Datanode Volume Failures Snapshot Startup Progress Utilities ▾

Browse Directory

Show entries Search:

<input type="checkbox"/>	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name	<input type="button" value="Download"/>
<input type="checkbox"/>	-rw-r--r--	admin	supergroup	36 B	Sep 13 04:53	1	128 MB	input.txt	<input type="button" value="Download"/>

Showing 1 to 1 of 1 entries Previous **1** Next

Hadoop, 2022.

Hadoop Overview Datanodes

Browse Directory

Show entries Search:

<input type="checkbox"/>	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name	<input type="button" value="Download"/>
<input type="checkbox"/>	-rw-r--r--	samarth	supergroup	36 B	Sep 13 04:53	1	128 MB	input.txt	<input type="button" value="Download"/>

Showing 1 to 1 of 1 entries Previous **1** Next

Hadoop, 2022.

File information - input.txt

Block information

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






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


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```
msi 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.NMProxy: 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 18:57:44,404 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=0
  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=1
```

Browse Directory

/ Go!   

Show 25 entries Search:

<input type="checkbox"/>	Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name	
<input type="checkbox"/>	drwxr-xr-x	samar	supergroup	0 B	Sep 29 18:56	0	0 B	input	
<input type="checkbox"/>	drwxr-xr-x	samar	supergroup	0 B	Sep 29 18:57	0	0 B	output	
<input type="checkbox"/>	drwx-----	samar	supergroup	0 B	Sep 29 18:57	0	0 B	tmp	

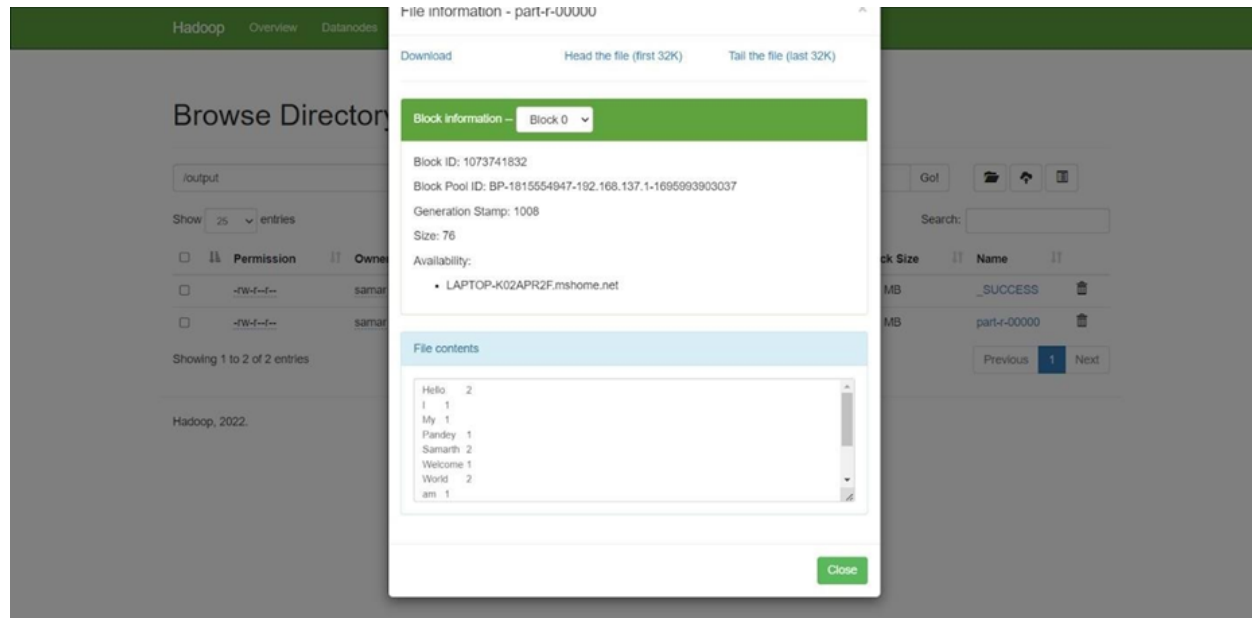
Showing 1 to 3 of 3 entries Previous 1 Next

Hadoop, 2022.



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Conclusion:

In order to illustrate Hadoop's data processing capabilities, this experiment created a Word Count software using the MapReduce paradigm. The Word Count application consists of three primary components: the Mapper, Reducer, and Driver. The Mapper divides the input data into words after processing it, then outputs <word, 1> pairs. The Reducer totals these pairings and adds them together to determine the final count for each word. The MapReduce job is managed by the Driver through task execution and input/output pathway configuration.