



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

| |
|---------------------------------|
| 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));
```

```
CSL702: Big Data Analytics Lab
```



```
}  
  
}  
  
}  
  
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]));  
    CSL702: Big Data Analytics Lab
```



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

```
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, r7e5d9983b388e372fe640f21048f2f2ae6e9eba |
| 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 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%) |
| DFS Remaining: | 417.65 GB |



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

```
<?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>
```

```
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);
    }
  }
}
```



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

```
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));
    }
}
```

```
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);
    }
}
```



```
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 x BDA EXP 4 MAPREDUCE - Google x Browsing HDFS x +

localhost:5870/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 |
|--------------------------|------------|-------|------------|------|---------------|-------------|------------|-----------|
| <input type="checkbox"/> | 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



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

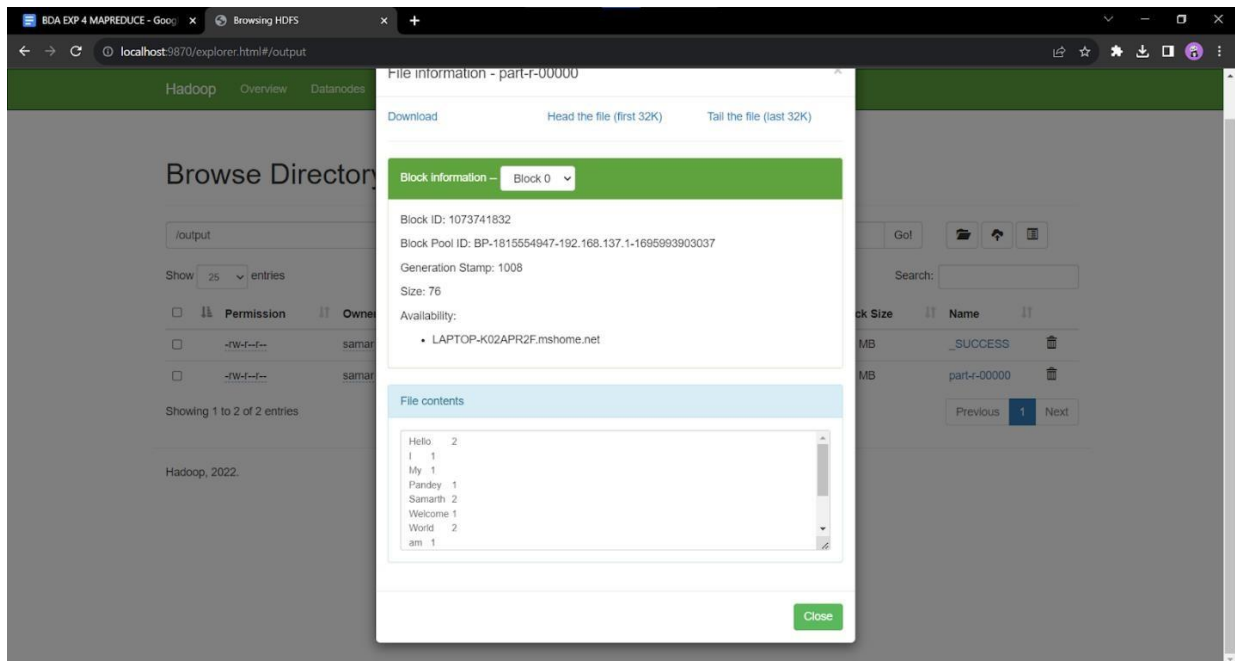
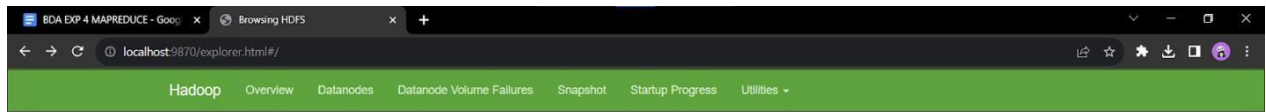
The screenshot shows the Hadoop web interface at localhost:9870. A modal window titled "File information - input.txt" is open, displaying details for the file "input.txt". The modal includes a "Download" button, a "Head the file (first 32K)" button, and a "Tail the file (last 32K)" button. The "Block Information" section shows the block ID as 1073741825, the block pool ID as BP-1815554947-192.168.137.1-1695993903037, the generation stamp as 1001, the size as 75, and the availability as LAPTOP-K02APR2F.mshome.net. The "File contents" section shows the text: "Hello World", "Hello My name is Samarth Pandey I am Samarth", and "Welcome to World".

```
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 18:57:10,607 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.VarnClientImpl: 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=478889
  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
```



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering





Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

CONCLUSION: The experiment to implement a word count program using MapReduce was successful. MapReduce proved its scalability and efficiency in processing large datasets, distributing tasks across multiple nodes for parallel processing. It showcased fault tolerance, ensuring data processing integrity in distributed systems. MapReduce's simplicity, with its straightforward mapper and reducer functions, makes it accessible to various developers. The experiment's real-world applicability extends to more complex data processing tasks like log analysis and machine learning. Performance optimizations such as combiners and partitioners can enhance the program's efficiency. In summary, this experiment provided a solid foundation in distributed computing, a valuable skill in today's data-driven landscape.



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering
