

XI'AN JIAOTONG-LIVERPOOL UNIVERSITY
西 交 利 物 浦 大 学

YEAR 4
COURSE WORK SUBMISSION

| | | |
|----------------------|---------------------------|----|
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| Programme | Bioinformatics | |
| Module Title | Big Data Analytics | |
| Module Code | INT303 | |
| Assignment Title | Lab2 | |
| Submission Deadline | 20 th November | |
| Lecturer Responsible | Gangmin Li | |

I certify that:

- I have read and understood the University's definitions of COLLUSION and PLAGIARISM (available in the Student Handbook of Xi'an Jiaotong-Liverpool University).

With reference to these definitions, I certify that:

- I have not colluded with any other student in the preparation and production of this work;
- this document has been written solely by me and in my own words except where I have clearly indicated and acknowledged that I have quoted or used figures from published or unpublished sources (including the web);
- where appropriate, I have provided an honest statement of the contributions made to my work by other people including technical and other support staff.

I understand that unauthorised collusion and the incorporation of material from other works without acknowledgement (plagiarism) are serious disciplinary offences.

Signature吴宇轩.....

Date2020.11.11.....

| | | | |
|--------------------------|---------------|-----------|---------|
| For Academic Office use: | Date Received | Days Late | Penalty |
| | | | |

1. My results files:

File 1: top 10 bigram and occurrences (remove punctuations and simple count anything like Let's, it's, hasn't.... as two words)

| Bigram | Occurrences |
|---------|-------------|
| I am | 1830 |
| I ll | 1742 |
| I have | 1581 |
| in the | 1528 |
| I will | 1509 |
| of the | 1437 |
| to the | 1298 |
| my lord | 1189 |
| I do | 820 |

| | |
|-------|-----|
| | |
| to be | 809 |

```

I am      1830
I ll      1742
I have    1581
in the    1528
I will    1509
of the    1437
to the    1298
my lord   1189
I do      820
to be     809

```

2. My code with comments:

```

import java.io.IOException;
import java.util.*;
import java.util.regex.Matcher;
import java.util.regex.Pattern;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class WordCount {

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "Bigram count");
        job.setJarByClass(WordCount.class); //My class name is 'word
count'
        job.setMapperClass(TokenizerMapper.class); // Set my Mapper

```

```

class
    job.setReducerClass(TokenizerMapper.IntSumReducer.class); //
Set my Reducer class
    job.setOutputKeyClass(Text.class); // Set the key class for my
output class
    job.setOutputValueClass(IntWritable.class); // Set the value
class for the output data

    FileInputFormat.addInputPath(job, new Path(args[0]));
    FileOutputFormat.setOutputPath(job, new Path(args[1]));
    System.exit(job.waitForCompletion(true) ? 0 : 1);
}

public static class TokenizerMapper
    extends Mapper<Object, Text, Text, IntWritable> {

    private final static IntWritable one = new IntWritable(1);
    private Text word = new Text();

    // The method is to extract useful word
    public String deleteNotation(String words) {
        String regex = "[\\W[0-9]&&[^\']]";
        Pattern p = Pattern.compile(regex);
        Matcher matcher = p.matcher(words);
        return matcher.replaceAll("").trim();
    }

    public void map(Object key, Text value, Context context
    ) throws IOException, InterruptedException {
        ArrayList<String> bigrams = new ArrayList<String>();
        String[] single_word = value.toString().split("\\s+[^\']");

        // create and fill the bigram arraylist
        // the bigram has number of (single_word -1) since it has
two words
        for (int i = 0; i < single_word.length - 1; i++) {
            single_word[i] = deleteNotation(single_word[i]);
            single_word[i + 1] = deleteNotation(single_word[i +
1]);
            if (!(single_word[i].isEmpty()) && !(single_word[i +
1].isEmpty())) {
                bigrams.add(single_word[i] + " " + single_word[i +
1]);
            }
        }
        for (String token : bigrams) {
            //
            System.out.print(token);
            word.set(token);
            context.write(word, one);
        }
    }

    public static class IntSumReducer
        extends Reducer<Text, IntWritable, Text, IntWritable> {

```

```
private IntWritable result = new IntWritable();

public void reduce(Text key, Iterable<IntWritable> values,
                  Context context
                  ) throws IOException, InterruptedException {

    int sum = 0;
    for (IntWritable val : values) {
        sum += val.get();
    }
    result.set(sum);
    context.write(key, result);
}

}
```

2. Hadoop command list and order you have used to run your job and get your results

I successfully install and configure the Hadoop environment on my own MAC

<http://localhost:50070/dfshealth.html#tab-overview>

localhost:50070/dfshealth.html#tab-overview

Hadoop

Overview
Datanodes
Datanode Volume Failures
Snapshot
Startup Progress
Utilities

Overview 'localhost:9000' (active)

| | |
|----------------|---|
| Started: | Fri Nov 06 18:07:21 +0800 2020 |
| Version: | 2.9.2, r826afbeae31ca687bc2f8471dc841b66ed2c6704 |
| Compiled: | Tue Nov 13 20:42:00 +0800 2018 by ajisaka from branch-2.9.2 |
| Cluster ID: | CID-9fdd14c1-7e05-4c35-8d0e-1f6247a2c937 |
| Block Pool ID: | BP-919230353-192.168.1.101-1604657107775 |

Summary


Security is off.

Safemode is off.

13 files and directories, 5 blocks = 18 total filesystem object(s).

<http://localhost:8088/cluster>

localhost:8088/cluster



All Applications

Cluster

About
Nodes
Node Labels
Applications
NEW
NEW SAVING
SUBMITTED
ACCEPTED
RUNNING
FINISHED
FAILED
KILLED
Scheduler
Tools

Cluster Metrics

| Apps Submitted | Apps Pending | Apps Running | Apps Completed | Containers Running | Memory Used | Memory Total | Memory Reserved | VCores Used | VCores Total |
|----------------|--------------|--------------|----------------|--------------------|-------------|--------------|-----------------|-------------|--------------|
| 0 | 0 | 0 | 0 | 0 | 0 B | 8 GB | 0 B | 0 | 8 |

Cluster Nodes Metrics

| Active Nodes | Decommissioning Nodes | Decommissioned Nodes | Lost Nodes | Unhealthy Nodes | Rebooted Nodes |
|--------------|-----------------------|----------------------|------------|-----------------|----------------|
| 1 | 0 | 0 | 0 | 0 | 0 |

Scheduler Metrics

| Scheduler Type | Scheduling Resource Type | Minimum Allocation | Maximum Allocation | Maximum Clusters |
|--------------------|--------------------------|-------------------------|-------------------------|------------------|
| Capacity Scheduler | [MEMORY] | <memory:1024, vCores:1> | <memory:8192, vCores:4> | 0 |

Show 20 entries

| ID | User | Name | Application Type | Queue | Application Priority | StartTime | FinishTime | State | FinalStatus | Running Containers | Allocated CPU VCoers | Allocated Memory MB | Reserved CPU VCoers | Reserved Memory MB | % of Queue | % of Cluster | Progress |
|----------------------------|------|------|------------------|-------|----------------------|-----------|------------|-------|-------------|--------------------|----------------------|---------------------|---------------------|--------------------|------------|--------------|----------|
| No data available in table | | | | | | | | | | | | | | | | | |

Showing 0 to 0 of 0 entries

First, you need to configure the Hadoop path and print to check it

```
export HADOOP_CLASSPATH=$(hadoop classpath)
echo $HADOOP_CLASSPATH
```

```
/Users/yuxuan/hadoop-2.9.2/etc/hadoop:/Users/yuxuan/hadoop-2.9.2/share/hadoop/common/lib/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/common/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/hdfs:/Users/yuxuan/hadoop-2.9.2/share/hadoop/hdfs/lib/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/hdfs/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/yarn:/Users/yuxuan/hadoop-2.9.2/share/hadoop/yarn/lib/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/yarn/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/mapreduce/lib/*:/Users/yuxuan/hadoop-2.9.2/share/hadoop/mapreduce/*:/Users/yuxuan/hadoop-2.9.2/contrib/capacity-scheduler/*.jar
```

Make a direction on HDFS and a file inside the directory

```
hadoop fs -mkdir /pg100
hadoop fs -mkdir /pg100/input
hadoop fs -put '/Users/yuxuan/Desktop/pg100.txt' /pg100/input
```

check the file on <http://localhost:50070/dfshealth.html#tab-overview>

Hadoop

Overview Datanodes Datanode Volume Failures Snapshot Startup Progress Utilities

Browse Directory

/pg100/input Go!

Show 25 entries Search:

| Permission | Owner | Group | Size | Last Modified | Replication | Block Size | Name |
|------------|---------|------------|---------|---------------|-------------|------------|-----------|
| -rw-r--r-- | hopezhu | supergroup | 5.33 MB | Nov 06 22:09 | 1 | 128 MB | pg100.txt |

Showing 1 to 1 of 1 entries

Previous 1 Next

Hadoop, 2018.

Now, I successfully transferred the pg100.txt file on HDFS

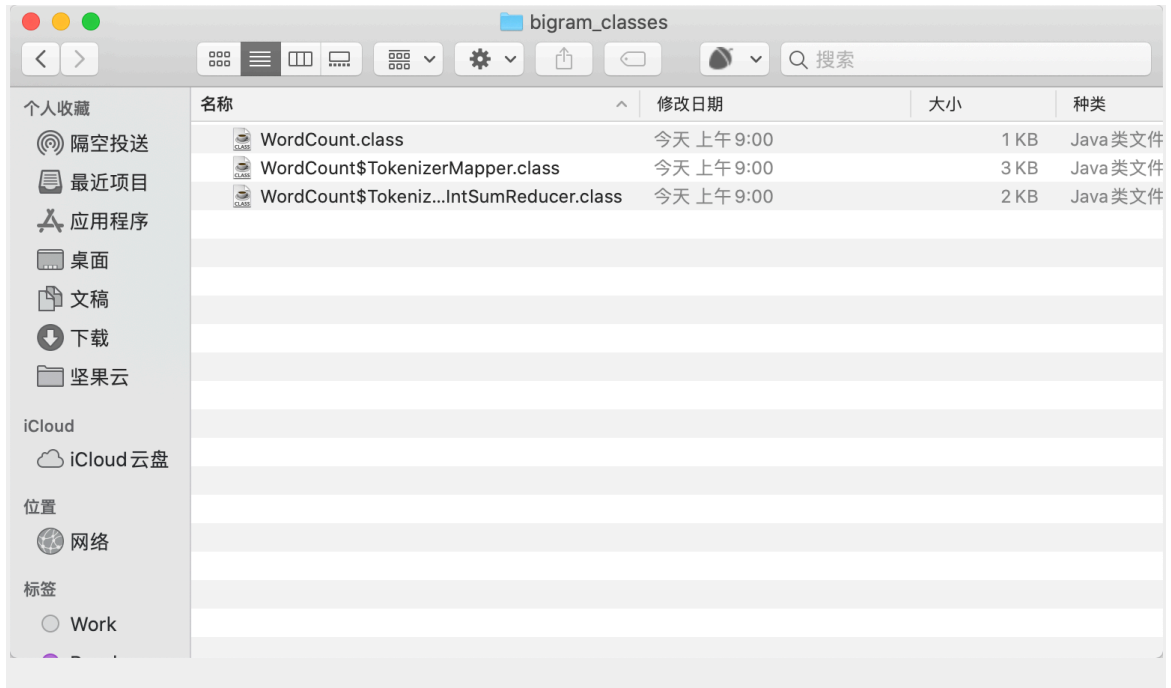
Enter my own directory

Create a directory called bigram_classes to store the classes of WordCount.java,

and use javac to compile the java file

```
javac -classpath ${HADOOP_CLASSPATH} -d '/Users/yuxuan/hadoop-2.9.2/input/bigram_classes'
'/Users/yuxuan/coding/IDEA/Hadoop_cw2/src/WordCount.java'
```

It will generate three classes in the bigram_classes file



Combine these classes into one jar file called bigram.jar

```
jar -cvf bigram.jar -C bigram_classes/ .
```

Run the jar file on Hadoop and output to Output_cw on hadoop clusters

```
hadoop jar '/Users/yuxuan/hadoop-2.9.2/input/bigram.jar' WordCount
/pg100/input_cw /pg100/Output_cw
```

Return the Top 10 frequency bigram words

```
hadoop dfs -cat /pg100/Output_cw/* | sort -n -k3 -r | head -n10
```



```
I am      1830
I ll      1742
I have    1581
in the    1528
I will    1509
of the    1437
to the    1298
my lord   1189
I do      820
to be     809
```

1. My results files:

File 2: the single line contains “torture”

All length is torture. Since the torch is out,
And torture him with grievous ling'ring death.
But purgatory, torture, hell itself.
By a sharp torture.
Drawn on with torture.
For torturers ingenious. It is I
From thee to die were torture more than death.
He may at pleasure whip or hang or torture,
I play the torturer, by small and small
In leads or oils? What old or newer torture
Let hell want pains enough to torture me!
O happy torment, when my torturer
O, torture me no more! I will confess.

On pain of torture, from those bloody hands
On thy soul's peril and thy body's torture,
Refuse me, hate me, torture me to death!
Say he be taken, rack'd, and tortured;
Strange tortures for offenders, never heard of,
Than on the torture of the mind to lie
That same Berowne I'll torture ere I go.
That so her torture may be shortened.
The time, the place, the torture. O, enforce it!
This torture should be roar'd in dismal hell.
To torture thee the more, being what thou art.
Turning despiteous torture out of door!
Which is our honour, bitter torture shall
Which to be spoke would torture thee.
With vilest torture let my life be ended.
You go about to torture me in vain.
curses he shall have, the tortures he shall feel, will break the
hand, to th' infernal deep, with Erebus and tortures vile also.
then torture my wife, pluck the borrowed veil of modesty
Do in consent shake hands to torture me,
FIRST SOLDIER. He calls for the tortures. What will you say without
GEORGE. While we devise fell tortures for thy faults.
IACHIMO. Thou'lt torture me to leave unspoken that

Is't not enough to torture me alone,

OTHELLO. If thou dost slander her and torture me,

Rom. 'Tis torture, and not mercy. Heaven is here,

SHYLOCK. I am very glad of it; I'll plague him, I'll torture him; I

SHYLOCK. Out upon her! Thou torturest me, Tubal. It was my

```
Shuffled Maps=1
Failed Shuffles=0
Merged Map outputs=1
GC time elapsed (ms)=8
Total committed heap usage (bytes)=51302240

Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0

File Input Format Counters
  Bytes Read=5585891
File Output Format Counters
  Bytes Written=2063
(base) Yuxuan:input hopezhu$ hadoop dfs -cat /pg100/Output_cw_torture6/*
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.

20/11/07 14:28:32 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
All length is torture. Since the torch is out,
And torture him with grievous ling'ring death.
But purgatory, torture, hell itself.
By a sharp torture.
Drawn on with torture.
For torturers ingenious. It is I
From thee to die were torture more than death.
He may at pleasure whip or hang or torture,
I play the torturer, by small and small
In leads or oils? What old or newer torture
Let hell want pains enough to torture me!
O happy torment, when my torturer
O, torture me no more! I will confess.
On pain of torture, from those bloody hands
On thy soul's peril and thy body's torture,
Refuse me, hate me, torture me to death!
Say he be taken, rack'd, and tortured;
Strange tortures for offenders, never heard of,
Than on the torture of the mind to lie
That same Berowne I'll torture ere I go.
That so her torture may be shortned.
The time, the place, the torture, O, enforce it!
This torture should be roar'd in dismal hell.
To torture thee the more, being what thou art.
Turning dispiteous torture out of door!
Which is our honour, bitter torture shall
Which to be spoke would torture thee.
With vilest torture let my life be ended.
You go about to torture me in vain.
curses he shall have, the tortures he shall feel, will break the
hand, to th' infernal deep, with Erebus and tortures vile also.
then torture my wife, pluck the borrowed veil of modesty
Do in consent shake hands to torture me.
FIRST SOLDIER. He calls for the tortures. What will you say without
GEORGE. While we devise fell tortures for thy faults.
IACHIMO. Thou'lt torture me to leave unspoken that
Is't not enough to torture me alone.
OTHELLO. If thou dost slander her and torture me,
Rom. 'Tis torture, and not mercy. Heaven is here,
SHYLOCK. I am very glad of it; I'll plague him; I'll torture him; I
SHYLOCK. Out upon her! Thou torturest me, Tubal. It was my
(base) Yuxuan:input hopezhu$ \Do\ in\ consent\ shake\ hands\ to\ torture\ me\.
```

2. My code with comments:

```
import java.io.IOException;
import java.util.*;

import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
```

```

import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;

public class WordCount_torture {

    public static void main(String[] args) throws Exception {
        Configuration conf = new Configuration();
        Job job = Job.getInstance(conf, "torture count");
        job.setJarByClass(WordCount_torture.class); //My class name is
'word count'

        job.setMapperClass(TokenizerMapper.class); // Set my Mapper
class
        job.setReducerClass(IntSumReducer.class); // Set my Reducer
class

        job.setOutputKeyClass(Text.class); // Set the key class for my
output class
        job.setOutputValueClass(Text.class); // Set the value class for
the output data

        job.setInputFormatClass(TextInputFormat.class); // Set input
format for this job
        job.setOutputFormatClass(TextOutputFormat.class); // Set output
format for this job

        FileInputFormat.addInputPath(job, new Path(args[0]));
        FileOutputFormat.setOutputPath(job, new Path(args[1]));
        System.exit(job.waitForCompletion(true) ? 0 : 1);
    }

    public static class TokenizerMapper
        extends Mapper<LongWritable, Text, Text, Text> {

        private Text word = new Text();

        public void map(LongWritable key, Text value, Context context
        ) throws IOException, InterruptedException {

            String line[] = value.toString().split("\\n{1,}");
            ArrayList<String> results = new ArrayList<>();

            for (int i = 0; i < line.length; i++) {
                if (line[i].contains("torture")) {
                    results.add(line[i]);
                }
            }

            for (String result : results) {
                word.set(result);
                context.write(word, new Text(" "));
            }
        }
    }
}

```

```

    }
}

public static class IntSumReducer
    extends Reducer<Text, IntWritable, Text, Text> {
    public void reduce(Text key, Iterable<IntWritable> values,
        Context context
    ) throws IOException, InterruptedException {

        context.write(new Text(key), new Text(" "));

    }
}
}

```

3. Hadoop command list and order you have used to run your job and get your results

Since we have uploaded the pg100.txt file to our HDFS, so we simply ignore the procedure.

We create a file called torture_classes in my directory to store the classes and create a jar file by javac command

```

javac -classpath ${HADOOP_CLASSPATH} -d '/Users/yuxuan/hadoop-2.9.2/input/torture_classes'
'/Users/yuxuan/coding/IDEA/Hadoop_cw2/src/WordCount_torture.java'

jar -cvf torture.jar -C torture_classes/ .

```

We compile the jar file and obtain the results

```

hadoop jar '/Users/yuxuan/hadoop-2.9.2/input/torture.jar'
WordCount_torture /pg100/input_cw /pg100/Output_cw_torture

```

```

20/11/07 14:28:09 INFO reduce.MergeManagerImpl: Merging 1 files, 2151 bytes from disk
20/11/07 14:28:09 INFO reduce.MergeManagerImpl: Merging 0 segments, 0 bytes from memory into reduce
20/11/07 14:28:09 INFO mapred.Merger: Merging 1 sorted segments
20/11/07 14:28:09 INFO mapred.Merger: Down to the last merge-pass, with 1 segments left of total size: 2094 bytes
20/11/07 14:28:09 INFO mapred.LocalJobRunner: 1 / 1 copied.
20/11/07 14:28:09 INFO Configuration.deprecation: mapred.skip.on is deprecated. Instead, use mapreduce.job.skiprecords
20/11/07 14:28:09 INFO mapred.Task: Task attempt_local503205696_0001_r_000000_0 is done. And is in the process of committing
20/11/07 14:28:09 INFO mapred.LocalJobRunner: 1 / 1 copied.
20/11/07 14:28:09 INFO mapred.Task: Task attempt_local503205696_0001_r_000000_0 is allowed to commit now
20/11/07 14:28:09 INFO output.FileOutputCommitter: Saved output of task 'attempt_local503205696_0001_r_000000_0' to hdfs://localhost:9000/pg100/Output_cw_torture6/_temporary/0/task_local503205696_0001_r_000000
20/11/07 14:28:09 INFO mapred.LocalJobRunner: reduce > reduce
20/11/07 14:28:09 INFO mapred.Task: Task 'attempt_local503205696_0001_r_000000_0' done.
20/11/07 14:28:09 INFO mapred.LocalJobRunner: Finishing task: attempt_local503205696_0001_r_000000_0
20/11/07 14:28:09 INFO mapred.LocalJobRunner: reduce task executor complete.
20/11/07 14:28:10 INFO mapreduce.Job: map 100% reduce 100%
20/11/07 14:28:10 INFO mapreduce.Job: Job job_local503205696_0001 completed successfully
20/11/07 14:28:10 INFO mapreduce.Job: Counters: 35
File System Counters
  FILE: Number of bytes read=11554
  FILE: Number of bytes written=974195
  FILE: Number of read operations=0
  FILE: Number of large read operations=0
  FILE: Number of write operations=0
  HDFS: Number of bytes read=11179782
  HDFS: Number of bytes written=2063
  HDFS: Number of read operations=13
  HDFS: Number of large read operations=0
  HDFS: Number of write operations=4
Map-Reduce Framework
  Map input records=124787
  Map output records=41
  Map output bytes=2063
  Map output materialized bytes=2151
  Input split bytes=101
  Combine input records=0
  Combine output records=0
  Reduce input groups=41
  Reduce shuffle bytes=2151
  Reduce input records=41
  Reduce output records=41
  Spilled Records=82
  Shuffled Haps=1
  Failed Shuffles=0
  Merged Map outputs=1
  GC time elapsed (ms)=8
  Total committed heap usage (bytes)=513802240
Shuffle Errors
  BAD_ID=0
  CONNECTION=0
  IO_ERROR=0
  WRONG_LENGTH=0
  WRONG_MAP=0
  WRONG_REDUCE=0
File Input Format Counters
  Bytes Read=5189891
File Output Format Counters
  Bytes Written=2063
(base) Yuxuan:input hopezhu$ hadoop dfs -cat /pg100/Output_cw_torture6/*
DEPRECATED: Use of this script to execute hdfs command is deprecated.
Instead use the hdfs command for it.

20/11/07 14:28:32 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

```

Here, we successfully run the file and we need to output the file and check the results

```
hadoop dfs -cat /pg100/Output_cw_torture/*
```

```

  Shuffled Haps=1
  Failed Shuffles=0
  Merged Map outputs=1
  GC time elapsed (ms)=8
  Total committed heap usage (bytes)=513802240
Shuffle Errors
  BAD_ID=0
  CONNECTION=0
  IO_ERROR=0
  WRONG_LENGTH=0
  WRONG_MAP=0
  WRONG_REDUCE=0
File Input Format Counters
  Bytes Read=5189891
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(base) Yuxuan:input hopezhu$ hadoop dfs -cat /pg100/Output_cw_torture6/*
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20/11/07 14:28:32 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
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And torture him with grievous ling'ring death.
But purgatory, torture, hell itself.
By a sharp torture.
Drawn on with torture.
For torturers ingenious. It is I
From thee to die were torture more than death.
He may at pleasure whip or hang or torture.
I play the torturer, by small and small.
In leads or oils? What old or newer torture
Let hell want pains enough to torture me!
O happy torment, when my torturer
O, torture me no more! I will confess.
On pain of torture, from those bloody hands
On thy soul's peril and thy body's torture.
Refuse me, hate me, torture me to death!
Say he be taken, rack'd, and tortured;
Strange tortures for offenders, never heard of.
Then on the torture of the mind to lie
That same Berowne I'll torture ere I go.
That so her torture may be shortened.
The time, the place, the torture, O, enforce it!
This torture should be rack'd in dismal hell.
To torture thee the more, being what thou art.
Turning spiteous torture out of door!
Which is our honour, bitter torture shall
Which to be spoke would torture thee.
With vilest torture let my life be ended.
You go about to torture me in vain,
curses he shall have, the tortures he shall feel, will break the
hand, to th' infernal deep, with Erebus and tortures vile also.
then torture my wife, pluck the borrowed veil of modesty
Do in consent shake hands to torture me.
FIRST SOLDIER. He calls for the tortures. What will you say without
GEORGE. While we devise fell tortures for thy faults.
IACKING. Thou'lt torture me to leave unspoken that
Is't not enough to torture me alone,
OTHELLO. If thou dost slander her and torture me,
Rem... 'Tis torture, and not mercy: Heaven is here.
SHYLOCK. I am very glad of it: I'll plague him, I'll torture him; I
SHYLOCK. Out upon her! Thou torturest me, Tubal. It was my
(base) Yuxuan:input hopezhu$ \ Do\ in\ consent\ shake\ hands\ to\ torture\ me\.
```

