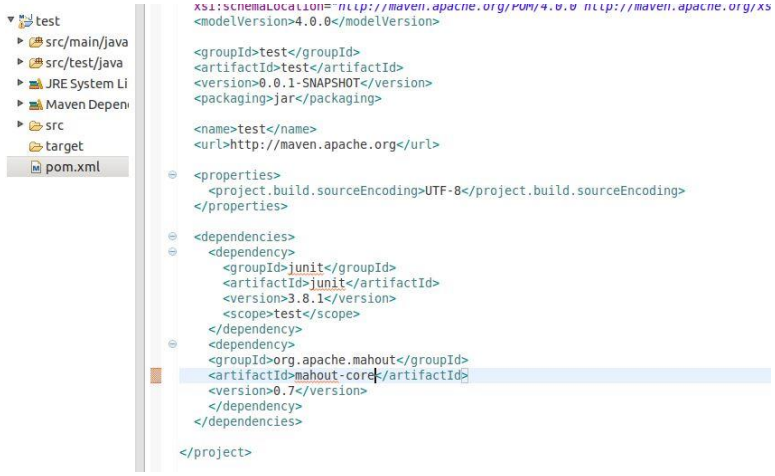
Anubha Bhargava
Homework 2

Recommendation:

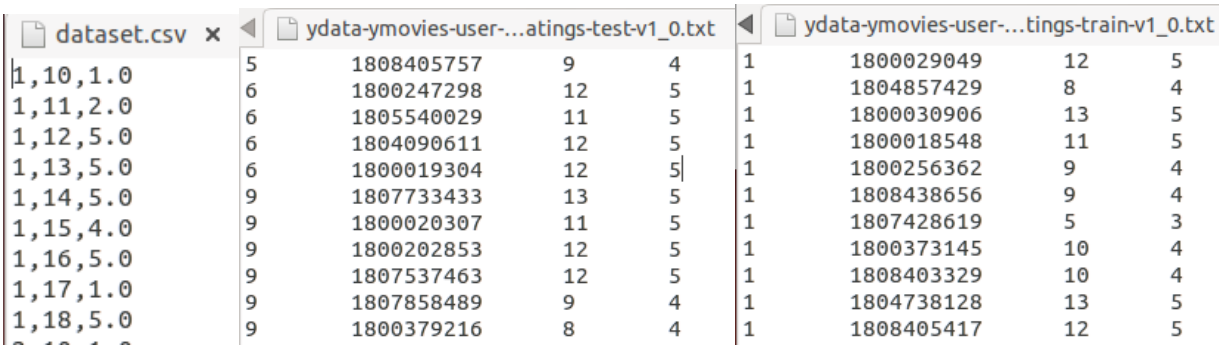
In order to run the recommendation algorithm, I installed Eclipse and configured the pom.xml file as shown below. I also built Maven in eclipse, shown by the second figure.




```
xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xs
  <modelVersion>4.0.0</modelVersion>

  <groupId>test</groupId>
  <artifactId>test</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <packaging>jar</packaging>

  <name>test</name>
  <url>http://maven.apache.org</url>

  <properties>
    <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
  </properties>

  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>3.8.1</version>
      <scope>test</scope>
    </dependency>
    <dependency>
    <groupId>org.apache.mahout</groupId>
    <artifactId>mahout-core</artifactId>
    <version>0.7</version>
    </dependency>
  </dependencies>

</project>
```

```
<terminated> /usr/lib/jvm/jdk1.6.0_45/bin/java (Oct 21, 2015, 6:23:16 AM)
Downloading: http://repo.maven.apache.org/maven2/org/apache/maven/maven-archiver/2.4.2/maven-a
Downloading: http://repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-archiver/2.0.1/ple
Downloaded: http://repo.maven.apache.org/maven2/org/apache/maven/maven-archiver/2.4.2/maven-ar
Downloaded: http://repo.maven.apache.org/maven2/org/codehaus/plexus/plexus-archiver/2.0.1/plex
[INFO] Building jar: /home/bigdata/workspace/Clustering/target/Clustering-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] --- maven-install-plugin:2.3.1:install (default-install) @ Clustering ---
[INFO] Installing /home/bigdata/workspace/Clustering/target/Clustering-0.0.1-SNAPSHOT.jar to /
[INFO] Installing /home/bigdata/workspace/Clustering/pom.xml to /home/bigdata/.m2/repository/R
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time: 6.734s
[INFO] Finished at: Wed Oct 21 06:23:25 PDT 2015
[INFO] Final Memory: 6M/30M
[INFO] ------------------------------------------------------------------------
```

Then, I created a user-based recommendation algorithm and ran it on a set of a few values called dataset.csv. Then, I ran the same algorithm on two sets of data from Yahoo!. All 3 files are shown below.



dataset.csv

```
1,10,1.0
1,11,2.0
1,12,5.0
1,13,5.0
1,14,5.0
1,15,4.0
1,16,5.0
1,17,1.0
1,18,5.0
```

ydata-ymovies-user-...atings-test-v1_0.txt

5	1808405757	9	4
6	1800247298	12	5
6	1805540029	11	5
6	1804090611	12	5
6	1800019304	12	5
9	1807733433	13	5
9	1800020307	11	5
9	1800202853	12	5
9	1807537463	12	5
9	1807858489	9	4
9	1800379216	8	4

ydata-ymovies-user-...tings-train-v1_0.txt

1	1800029049	12	5
1	1804857429	8	4
1	1800030906	13	5
1	1800018548	11	5
1	1800256362	9	4
1	1808438656	9	4
1	1807428619	5	3
1	1800373145	10	4
1	1808403329	10	4
1	1804738128	13	5
1	1808405417	12	5

The user-based algorithm I used is shown below, used on both Yahoo! datasets. The first was used on the Yahoo! Movies User Ratings Test v.1.0 txt file (the second text file shown above).

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```
package RecommenderTest1.Test1;

import java.io.File;

public class App
{
    public static void main( String[] args ) throws IOException, TasteException
    {
        DataModel model = new FileDataModel(new File("/home/bigdata/Documents/Homework2/Ya
        UserSimilarity similarity = new PearsonCorrelationSimilarity(model);
        UserNeighborhood neighborhood = new ThresholdUserNeighborhood(0.1, similarity, mod
        UserBasedRecommender recommender = new GenericUserBasedRecommender(model, neighbor
        List<RecommendedItem> recommendations = recommender.recommend(22,2);
        for (RecommendedItem recommendation: recommendations){
            System.out.println(recommendation);
        }
    }
}
```

```
Problems  @ Javadoc  Declaration  Console  Properties
<terminated> App (1) [Java Application] /usr/lib/jvm/jdk1.6.0_45/bin/java (Oct 20, 2015, 3:04:14 PM)
3 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Creating FileDataModel
72 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Reading file info...
621 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Read lines: 10136
826 [main] INFO org.apache.mahout.cf.taste.impl.model.GenericDataModel - Processed 2309 users
RecommendedItem[item:1802771079, value:13.0]
RecommendedItem[item:1808411996, value:13.0]
```

It produced two recommended items, as shown in the console. Below I ran user-based recommendation on the Yahoo! Movies User Ratings Train v1.0 txt file (the third text file shown above) and received one single output.

```
App.java  Test1/pom.xml  Test1/pom.xml
package RecommenderTest1.Test1;

import java.io.File;

public class App
{
    public static void main( String[] args ) throws IOException, TasteException
    {
        DataModel model = new FileDataModel(new File("/home/bigdata/Documents/Homework2/Ya
        UserSimilarity similarity = new PearsonCorrelationSimilarity(model);
        UserNeighborhood neighborhood = new ThresholdUserNeighborhood(0.1, similarity, mod
        UserBasedRecommender recommender = new GenericUserBasedRecommender(model, neighbor
        List<RecommendedItem> recommendations = recommender.recommend(9,1);
        for (RecommendedItem recommendation: recommendations){
            System.out.println(recommendation);
        }
    }
}
```

```
Problems  @ Javadoc  Declaration  Console  Properties
<terminated> App (1) [Java Application] /usr/lib/jvm/jdk1.6.0_45/bin/java (Oct 20, 2015, 3:02:58 PM)
10 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Creating FileDataMode
160 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Reading file info...
677 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Read lines: 10136
796 [main] INFO org.apache.mahout.cf.taste.impl.model.GenericDataModel - Processed 2309 users
RecommendedItem[item:1800183448, value:13.0]
```

I tried another algorithm on the Yahoo! datasets. I changed the algorithms from user-based recommendation to item-based recommendation and received different recommended outputs:

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```java
import java.util.List;

import org.apache.mahout.cf.taste.common.TasteException;
import org.apache.mahout.cf.taste.impl.model.file.FileDataModel;
import org.apache.mahout.cf.taste.impl.recommender.GenericItemBasedRecommender;
import org.apache.mahout.cf.taste.impl.similarity.PearsonCorrelationSimilarity;
import org.apache.mahout.cf.taste.model.DataModel;
import org.apache.mahout.cf.taste.recommender.RecommendedItem;
import org.apache.mahout.cf.taste.similarity.ItemSimilarity;

public class App
{
    public static void main( String[] args ) throws IOException, TasteException
    {
        DataModel model = new FileDataModel(new File("/home/bigdata/Documents/Homework2/Ya
        ItemSimilarity similarity = new PearsonCorrelationSimilarity(model);
        GenericItemBasedRecommender recommender = new GenericItemBasedRecommender(model, s
        List<RecommendedItem> recommendations = recommender.recommend(1,2);
        for (RecommendedItem recommendation: recommendations){
            System.out.println(recommendation);
        }
    }
}
```

```
Problems  Javadoc  Declaration  Console  Properties

<terminated> App (3) [Java Application] /usr/lib/jvm/jdk1.7.0_79/bin/java (Oct 29, 2015, 11:38:36 AM)
8 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Creating FileDataModel
92 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Reading file info...
1445 [main] INFO org.apache.mahout.cf.taste.impl.model.file.FileDataModel - Read lines: 211231
1806 [main] INFO org.apache.mahout.cf.taste.impl.model.GenericDataModel - Processed 7642 users
RecommendedItem[item:1800127818, value:13.0]
RecommendedItem[item:1800147796, value:13.0]
```

Clustering:

I ran clustering on the synthetic control data, Reuters data and Wikipedia data. After putting the synthetic_control.data file onto HDFS, I ran the clustering algorithm and received the following output results:

```
bigdata@ubuntu:/usr/local/eclipse/mahout-distribution-0.9$ hadoop jar mahout-exa
mples-0.9-job.jar org.apache.mahout.clustering.syntheticcontrol.kmeans.Job
```

```
20.841,21.189,27.999,33.274,37.098,46.94,37.891,31.12,29.039,18.015,21.467,26.29
,31.476,36.344,42.412,39.284,34.666,27.746,19.489,17.466,14.161,18.294,26.514,34
.013,40.329,38.44,38.222,26.448,20.689,17.714,14.618,14.382]
        1.0 : [distance=76.52337014895532]: [26.24,35.063,48.123,49.951,35.547,4
0.524,24.295,20.726,19.711,21.393,25.407,31.618,37.473,35.773,38.988,45.535,37.1
95,26.407,18.761,24.149,11.399,20.869,25.102,33.357,36.633,37.64,41.725,42.374,3
4.15,32.215,22.921,17.116,13.989,15.962,21.162,38.315,35.831,46.373,47.746,33.05
5,34.929,22.782,13.369,21.997,16.906,20.107,32.456,43.196,42.651,47.739,41.398,4
0.825,25.242,17.258,14.702,17.765,17.287,28.627,31.652,38.961]
        1.0 : [distance=56.71859744952735]: [26.891,43.616,46.491,41.635,42.21,3
4.433,20.803,13.055,14.923,15.482,30.787,38.131,39.014,41.858,40.022,35.192,23.0
42,22.366,11.799,18.675,24.888,34.396,38.611,45.156,43.438,38.218,28.174,24.715,
20.483,17.374,22.727,36.105,44.437,42.92,43.577,42.392,35.561,27.745,15.829,21.8
64,18.412,29.645,39.517,44.572,38.629,40.567,35.29,22.683,16.195,19.235,24.257,2
2.592,34.713,44.764,39.443,40.623,36.059,24.643,23.876,16.2]
        1.0 : [distance=45.84111577700582]: [30.889,32.489,37.018,39.645,45.914,
31.508,21.637,21.944,16.339,11.605,23.196,26.46,42.842,40.764,45.469,45.3,37.122
,23.297,21.292,12.301,12.031,23.394,28.881,37.382,37.317,45.073,35.787,39.555,28
.424,14.686,18.112,15.185,26.378,27.795,35.08,37.005,37.855,37.93,36.44,25.022,1
6.131,18.664,18.489,25.011,23.513,42.732,42.599,47.651,36.176,39.035,25.058,21.8
18,10.813,22.535,21.182,31.802,31.936,37.568,46.937,35.429]
15/10/24 14:38:30 INFO ClusterDumper: Wrote 6 clusters
15/10/24 14:38:30 INFO MahoutDriver: Program took 413661 ms (Minutes: 6.89435)
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$
```

For the Reuters dataset, I copied the Reuters dataset to the directory and extracted the articles from .sgm files to .txt files. The process is shown in the below 3 figures.

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```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/mahout org.
apache.lucene.benchmark.utils.ExtractReuters /home/bigdata/Documents/Homework2/Reuters/Reut
ers21578/ /home/bigdata/Documents/Homework2/Reuters/Reuters-Outk2/Reuters/Reuter
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/target/mahou
t-examples-0.11.1-SNAPSHOT-job.jar
15/10/27 20:07:53 WARN MahoutDriver: No org.apache.lucene.benchmark.utils.ExtractReuters.pr
ops found on classpath, will use command-line arguments only
Deleting all files in /home/bigdata/Documents/Homework2/Reuters/Reuters-Out-tmp
15/10/27 20:08:00 INFO MahoutDriver: Program took 6808 ms (Minutes: 0.11346666666666666)
```

```
bigdata@ubuntu:~/Documents/Homework2/Reuters/Reuters21578$ ls
all-exchanges-strings.lc.txt        README.txt     reut2-007.sgm  reut2-015.sgm
all-orgs-strings.lc.txt             reut2-000.sgm  reut2-008.sgm  reut2-016.sgm
all-people-strings.lc.txt           reut2-001.sgm  reut2-009.sgm  reut2-017.sgm
all-places-strings.lc.txt           reut2-002.sgm  reut2-010.sgm  reut2-018.sgm
all-topics-strings.lc.txt           reut2-003.sgm  reut2-011.sgm  reut2-019.sgm
cat-descriptions_120396.txt         reut2-004.sgm  reut2-012.sgm  reut2-020.sgm
feldman-cia-worldfactbook-data.txt  reut2-005.sgm  reut2-013.sgm  reut2-021.sgm
lewis.dtd                           reut2-006.sgm  reut2-014.sgm
```

Reuters-Out directory:

```
reut2-005.sgm-427.txt  reut2-010.sgm-783.txt  reut2-016.sgm-238.txt  reut2-021.sgm-73.txt
reut2-005.sgm-428.txt  reut2-010.sgm-784.txt  reut2-016.sgm-239.txt  reut2-021.sgm-74.txt
reut2-005.sgm-429.txt  reut2-010.sgm-785.txt  reut2-016.sgm-23.txt   reut2-021.sgm-75.txt
reut2-005.sgm-42.txt   reut2-010.sgm-786.txt  reut2-016.sgm-240.txt  reut2-021.sgm-76.txt
reut2-005.sgm-430.txt  reut2-010.sgm-787.txt  reut2-016.sgm-241.txt  reut2-021.sgm-77.txt
reut2-005.sgm-431.txt  reut2-010.sgm-788.txt  reut2-016.sgm-242.txt  reut2-021.sgm-78.txt
reut2-005.sgm-432.txt  reut2-010.sgm-789.txt  reut2-016.sgm-243.txt  reut2-021.sgm-79.txt
```

Afterwards, I converted the raw data into a Hadoop sequence file:

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/mahout seqdirectory -i /
uters/Reuters-Out/ -o /Reuters/Reuters-Out-SeqDir/ -c UTF-8 -chunk 5
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/target/mahout-examples-0.
.1-SNAPSHOT-job.jar
```

```
5/10/27 21:04:29 INFO Job: Counters: 23
        File System Counters
                FILE: Number of bytes read=237483063
                FILE: Number of bytes written=242307932
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=49018603
                HDFS: Number of bytes written=30146692
                HDFS: Number of read operations=239338
                HDFS: Number of large read operations=88
                HDFS: Number of write operations=24
        Map-Reduce Framework
                Map input records=21578
                Map output records=21578
                Input split bytes=1724120
                Spilled Records=0
                Failed Shuffles=0
                Merged Map outputs=0
                GC time elapsed (ms)=310
                CPU time spent (ms)=0
                Physical memory (bytes) snapshot=0
                Virtual memory (bytes) snapshot=0
                Total committed heap usage (bytes)=369098752
        File Input Format Counters
                Bytes Read=0
        File Output Format Counters
                Bytes Written=10827429
5/10/27 21:04:29 INFO MahoutDriver: Program took 76672 ms (Minutes: 1.277866666
666667)
```

Then, I generated vectors from the sequence file:

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```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/mahout seq2sparse -i /Reuters/R
euters-Out-SeqDir/ -o /Reuters/Reuters-Out-SeqDir-sparse-kmeans
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/target/mahout-examples-0.11.1-SN
APSHOT-job.jar
```

```
15/10/27 21:09:19 INFO Job: Job job_local1847790156_0009 completed successfully
15/10/27 21:09:19 INFO Job: Counters: 38
        File System Counters
                FILE: Number of bytes read=1371814836
                FILE: Number of bytes written=1404282137
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=298184980
                HDFS: Number of bytes written=224009025
                HDFS: Number of read operations=449
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=128
        Map-Reduce Framework
                Map input records=21578
                Map output records=21578
                Map output bytes=16606217
                Map output materialized bytes=16688735
                Input split bytes=158
                Combine input records=0
                Combine output records=0
                Reduce input groups=21578
                Reduce shuffle bytes=16688735
                Reduce input records=21578
                Reduce output records=21578
                Spilled Records=43156
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=176
                CPU time spent (ms)=0
                Physical memory (bytes) snapshot=0
                Virtual memory (bytes) snapshot=0
                Total committed heap usage (bytes)=394280960
        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=16906791
        File Output Format Counters
                Bytes Written=16906791
15/10/27 21:09:19 INFO HadoopUtil: Deleting /Reuters/Reuters-Out-SeqDir-sparse-kmeans/partial-vectors-0
15/10/27 21:09:19 INFO MahoutDriver: Program took 58373 ms (Minutes: 0.9728833333333333)
```

I ran the commands to cluster with k-means as shown below:

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/mahout kmeans -i /Reuters/Reute
rs-Out-SeqDir-sparse-kmeans/tfidf-vectors/ -c /Reuters/kmeans-clusters -o /Reuters/reuters-kmeans -dm org.apach
e.mahout.common.distance.CosineDistanceMeasure -cd 0.1 -x 10 -k 20 -ow -cl
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/target/mahout-examples-0.11.1-SN
APSHOT-job.jar
```

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```
                HDFS: Number of bytes written=29273258
                HDFS: Number of read operations=188
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=49
        Map-Reduce Framework
                Map input records=21579
                Map output records=21579
                Input split bytes=154
                Spilled Records=0
                Failed Shuffles=0
                Merged Map outputs=0
                GC time elapsed (ms)=54
                CPU time spent (ms)=0
                Physical memory (bytes) snapshot=0
                Virtual memory (bytes) snapshot=0
                Total committed heap usage (bytes)=183730176
        File Input Format Counters
                Bytes Read=16909529
        File Output Format Counters
                Bytes Written=17927868
15/10/27 22:11:16 INFO MahoutDriver: Program took 28898 ms (Minutes: 0.481633333
33333336)
```

Lastly, I dumped the results to files.

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/
mahout clusterdump -i /Reuters/Reuters-kmeans/clusters-*-final -d /Reuters/Reute
rs-Out-SeqDir-sparse-kmeans/dictionary.file-0 -dt sequencefile -o /home/bigdata/
Documents/Homework2/Reuters/Reuters-kmeans-dump -n 5 -b 100
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/t
arget/mahout-examples-0.11.1-SNAPSHOT-job.jar
15/10/27 22:28:35 INFO AbstractJob: Command line arguments: {--dictionary=[/Reut
ers/Reuters-Out-SeqDir-sparse-kmeans/dictionary.file-0], --dictionaryType=[seque
ncefile], --distanceMeasure=[org.apache.mahout.common.distance.SquaredEuclideanD
istanceMeasure], --endPhase=[2147483647], --input=[/Reuters/Reuters-kmeans/clust
ers-*-final], --numWords=[5], --output=[/home/bigdata/Documents/Homework2/Reuter
s/Reuters-kmeans-dump], --outputFormat=[TEXT], --startPhase=[0], --substring=[10
0], --tempDir=[temp]}
15/10/27 22:28:41 INFO ClusterDumper: Wrote 20 clusters
15/10/27 22:28:41 INFO MahoutDriver: Program took 5276 ms (Minutes: 0.0879333333
3333334)
```

When viewing the output, I received these results:

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```
                he                                      =>  1.6951136977467316
:{"r":[{"0.003":0.338},{"0.006913":0.338},{"0.007050":0.239},{"0.05":0.206},{"0
06":0.239},{"0.07":0.
        Top Terms:
                bank                                    =>  2.9254567329312713
                said                                    =>  2.9071813958211683
                banks                                   =>  2.7144628161555726
                he                                      =>   2.446499566656883
                market                                  =>  2.2318716627051574
:{"r":[{"0":0.26},{"0.01":0.314},{"0.59":0.246},{"00":0.606},{"00.03":0.235},{"
0.11":0.231},{"00.13"
        Top Terms:
                said                                    =>  1.7359546045931618
                its                                     =>  1.2637971808591226
                inc                                     =>   1.234903767665853
                corp                                    =>  1.1474406615955624
                mar                                     =>    1.09485300835662
:{"r":[{"00":0.622},{"00.18":0.444},{"00.20":0.421},{"00.56":0.444},{"00.84":0.
11},{"00.89":0.435},{
        Top Terms:
                officer                                 =>   3.826718148220791
                president                               =>  3.8211704173784575
                chief                                   =>   3.813937988709868
                executive                               =>  3.8014617866344667
                chairman                                =>  2.9587232139673127
:{"r":[{"0.01":0.291},{"0.02":0.222},{"0.05":0.349},{"0.07":0.349},{"0.1":0.736
,{"0.10":0.576},{"0.1
```

```
Key: 18816: Value: wt: 1.0 distance: 0.6519258161127899  vec: [{"2689":3.135},{"
3731":3.051},{"5085":3.633},{"5245":3.4
Key: 7052: Value: wt: 1.0 distance: 0.8337635422085907  vec: [{"2689":3.135},{"3
731":3.051},{"5085":3.633},{"6001":1.1
Key: 18816: Value: wt: 1.0 distance: 0.5395841312700682  vec: [{"2460":2.742},{"
2689":3.135},{"3731":3.051},{"4922":3.6
Key: 7427: Value: wt: 1.0 distance: 0.6029572342398424  vec: [{"1512":7.514},{"1
528":9.602},{"1890":9.37},{"2215":9.18
Key: 3051: Value: wt: 1.0 distance: 0.8065843938926417  vec: [{"2689":3.135},{"3
731":3.051},{"3949":3.953},{"4751":4.0
Key: 5067: Value: wt: 1.0 distance: 0.8371259470140552  vec: [{"2689":3.135},{"3
731":3.051},{"4485":7.647},{"4751":4.0
Key: 21148: Value: wt: 1.0 distance: 0.8128485258514935  vec: [{"2490":7.129},{"
2689":3.135},{"3731":3.051},{"3862":8.4
Key: 5067: Value: wt: 1.0 distance: 0.8393221999654109  vec: [{"2563":8.677},{"2
689":3.135},{"3556":3.035},{"3731":3.0
Key: 7427: Value: wt: 1.0 distance: 0.544270057257653  vec: [{"834":8.677},{"155
5":7.453},{"2689":3.135},{"3731":3.051
Count: 21579
15/10/27 22:30:44 INFO MahoutDriver: Program took 15795 ms (Minutes: 0.26325)
```

I conducted the same steps for the Wikipedia file – enwiki-latest-pages-articles1.xml-p000000010p000010000. The first step for the Wikipedia files was slightly different. It is shown below.

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```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/
mahout seqwiki -all -i /Wikipedia/enwiki-latest-pages-articles1.xml-p000000010p0
00010000 -o /Wikipedia/Wikipedia-out-seqdir
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/t
arget/mahout-examples-0.11.1-SNAPSHOT-job.jar
15/10/29 10:57:43 INFO WikipediaToSequenceFile: Input: /Wikipedia/enwiki-latest-
pages-articles1.xml-p000000010p000010000 Out: /Wikipedia/Wikipedia-out-seqdir Ca
tegories:  All Files: true
```

```
                Combine input records=0
                Combine output records=0
                Reduce input groups=6269
                Reduce shuffle bytes=159715397
                Reduce input records=6269
                Reduce output records=6269
                Spilled Records=17589
                Shuffled Maps =2
                Failed Shuffles=0
                Merged Map outputs=2
                GC time elapsed (ms)=2554
                CPU time spent (ms)=0
                Physical memory (bytes) snapshot=0
                Virtual memory (bytes) snapshot=0
                Total committed heap usage (bytes)=732966912
        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=168902037
        File Output Format Counters
                Bytes Written=159832019
15/10/29 10:54:19 INFO MahoutDriver: Program took 145336 ms (Minutes: 2.42226666
6666667)
```

I generated vectors from the sequence file.

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/
mahout seq2sparse -i /Wikipedia/Wikipedia-out-seqdir -o /Wikipedia/Wikipedia-out
-seqdir-sparse-kmeans
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/t
arget/mahout-examples-0.11.1-SNAPSHOT-job.jar
```

Then, I clustered the produced vectors with k-means.

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/
mahout kmeans -i /Wikipedia/Wikipedia-out-seqdir-sparse-kmeans/tfidf-vectors/ -c
 /Wikipedia/kmeans-clusters -o /Wikipedia/Wikipedia-kmeans -dm org.apache.mahout
.common.distance.CosineDistanceMeasure -cd 0.1 -x 10 -k 20 -ow -cl
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/t
arget/mahout-examples-0.11.1-SNAPSHOT-job.jar
```

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Finally, I dumped the clusters into files.

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./bin/
mahout clusterdump -i /Wikipedia/Wikipedia-kmeans/clusters-*-final -d /Wikipedia
/Wikipedia-out-seqdir-sparse-kmeans/dictionary.file-0 -dt sequencefile -o /home/
bigdata/Documents/Homework2/Wikipedia/Wikipedia-kmeans-dump -n 5 -b 100
Running on hadoop, using /usr/local/hadoop-2.5.0/bin/hadoop and HADOOP_CONF_DIR=
MAHOUT-JOB: /usr/local/apache-mahout-distribution-0.11.0/mahout-trunk/examples/t
arget/mahout-examples-0.11.1-SNAPSHOT-job.jar
15/10/29 11:26:21 INFO AbstractJob: Command line arguments: {--dictionary=[/Wiki
pedia/Wikipedia-out-seqdir-sparse-kmeans/dictionary.file-0], --dictionaryType=[s
equencefile], --distanceMeasure=[org.apache.mahout.common.distance.SquaredEuclid
eanDistanceMeasure], --endPhase=[2147483647], --input=[/Wikipedia/Wikipedia-kmea
ns/clusters-*-final], --numWords=[5], --output=[/home/bigdata/Documents/Homework
2/Wikipedia/Wikipedia-kmeans-dump], --outputFormat=[TEXT], --startPhase=[0], --s
ubstring=[100], --tempDir=[temp]}
15/10/29 11:26:36 INFO ClusterDumper: Wrote 20 clusters
15/10/29 11:26:36 INFO MahoutDriver: Program took 14846 ms (Minutes: 0.247433333
33333334)
```

Here are the generated results from running the Wikipedia commands:

```
:{"r":[{"11th":0.724},{"1914":0.688},{"1956":0.641},{"1970s":0.592},{"19th":0.53
},{"2008":0.355},{"4t
        Top Terms:
                nahmc                                   =>   4.480807799559373
                subpage                                 =>  1.8690807635967548
                redirect                                =>   1.816250360929049
                aba                                     =>  1.5084163959209735
                relations                               =>  1.4852837232443004
:{"r":[{"0":1.305},{"0,3":0.922},{"0.0":0.703},{"0.00":0.852},{"0.05":2.146},{"0
.1":0.78},{"0.13":0.7
        Top Terms:
                telecommunications                      =>   7.862010623469497
```

```
Key: 5023: Value: wt: 1.0 distance: 0.8115312160816286  vec: [{"2500":2.457},{"6
186":3.148},{"8517":1.999},{"10932":2.
Key: 5035: Value: wt: 1.0 distance: 0.7793875613407406  vec: [{"102587":2.858},{
"127111":3.684},{"190246":6.91},{"2032
Key: 5023: Value: wt: 1.0 distance: 0.7280789820938538  vec: [{"0":3.75},{"1862"
:2.479},{"3334":3.001},{"4537":2.329},
Key: 5035: Value: wt: 1.0 distance: 0.6059475083876485  vec: [{"84623":2.871},{"
130923":4.023},{"226150":2.146}]
Key: 5035: Value: wt: 1.0 distance: 0.7590970363806326  vec: [{"84737":8.645},{"
226150":2.146}]
Key: 6048: Value: wt: 1.0 distance: 0.81
```

Classification:

I ran classification on the 20 newsgroups data and the Wikipedia data. For the 20 newsgroups data, I selected the 1st choice – cnaivebayes. Then, it proceeded to download data. The results I received are in the second figure below.

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Homework 2

```
bigdata@ubuntu:/usr/local/eclipse/mahout-distribution-0.9$ ./examples/bin/classi
fy-20newsgroups.sh
Please select a number to choose the corresponding task to run
1. cnaivebayes
2. naivebayes
3. sgd
4. clean -- cleans up the work area in /tmp/mahout-work-bigdata
Enter your choice : 1
```

```
        0       0       0       0       1       0       1       0       1
|  394          i     = rec.motorcycles
0       1       0       0       0       0       0       0       2       386     6
        0       2       0       1       2       0       4       1       0
|  405          j     = rec.sport.baseball
1       0       1       0       0       0       1       0       1       1       3
69      0       0       0       0       1       0       0       0       2
|  377          k     = rec.sport.hockey
0       2       1       0       1       2       0       0       0       0       0
        391     1       0       0       0       0       2       1       2
|  403          l     = sci.crypt
0       2       1       9       5       2       6       2       1       1       2
        3       354     2       5       7       1       1       2       3
|  409          m     = sci.electronics
1       0       1       0       0       1       6       1       2       0       0
        0       2       418     4       3       2       6       2       2
|  451          n     = sci.med
2       0       0       0       1       0       1       2       0       0       0
        2       0       2       388     0       2       0       2       0
|  402          o     = sci.space
0       0       1       3       0       1       0       0       1       1       0
        0       1       3       2       386     2       0       4       1
|  406          p     = soc.religion.christian
3       0       0       1       0       0       0       0       0       1       0
        0       0       0       1       3       386     0       0       0
|  395          q     = talk.politics.mideast
0       0       1       0       0       2       0       0       1       0       1
        2       0       0       1       1       1       357     1       7
|  375          r     = talk.politics.guns
24      0       0       0       1       0       1       0       0       1       1
        0       0       0       0       24      1       8       189     6
|  256          s     = talk.religion.misc
3       0       1       0       0       1       1       0       0       3       2
        1       1       2       2       0       10      10      2       259
|  298          t     = talk.politics.misc

=======================================================
Statistics
-------------------------------------------------------
Kappa                                       0.8622
Accuracy                                   89.7072%
Reliability                                85.1807%
Reliability (standard deviation)             0.212
Weighted precision                          0.8967
Weighted recall                             0.8971
Weighted F1 score                           0.8957
```

I ran the classification algorithms on Wikipedia and selected CBayes.

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Homework 2

```
bigdata@ubuntu:/usr/local/apache-mahout-distribution-0.11.0/mahout-trunk$ ./exam
ples/bin/classify-wikipedia.sh
Discovered Hadoop v2.
Setting dfs command to /usr/local/hadoop-2.5.0/bin/hdfs dfs, dfs rm to /usr/loca
l/hadoop-2.5.0/bin/hdfs dfs -rm -r -skipTrash.
Please select a number to choose the corresponding task to run
1. CBayes (may require increased heap space on yarn)
2. BinaryCBayes
3. clean -- cleans up the work area in /tmp/mahout-work-wiki
Enter your choice : 1
ok. You chose 1 and we'll use CBayes
creating work directory at /tmp/mahout-work-wiki
Downloading wikipedia XML dump
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0  282M    0 1073k    0     0  54546      0  1:30:25  0:00:20  1:30:05 55094
```

The results I received are displayed below. It provides a summary of the data categorized by country. Also, the statistics of these results are displayed at the bottom. At the top, the number of classified instances are displayed.

```
=======================================================
Confusion Matrix
-------------------------------------------------------
a       b       c       d       e       f       g       h       i       j
--Classified as
350     9       12      1       4       3       1       14      16      7
|  417          a     = australia
0       98      2       0       4       1       0       3       0       1
|  109          b     = austria
0       0       6       0       1       1       0       0       0       0
|  8            c     = bahamas
0       4       8       362     11      3       2       8       10      6
|  414          d     = canada
0       0       0       0       23      1       0       1       0       0
|  25           e     = colombia
0       0       1       0       1       20      0       0       0       2
|  24           f     = cuba
0       0       0       0       1       1       58      0       0       0
|  60           g     = pakistan
0       0       1       0       4       0       0       3       1       2
|  11           h     = panama
3       15      32      5       20      9       9       40      360     6
|  499          i     = united kingdom
1       0       0       0       1       0       0       0       0       48
|  50           j     = vietnam

=======================================================
Statistics
-------------------------------------------------------
Kappa                                       0.7469
Accuracy                                   82.1274%
Reliability                                73.0634%
Reliability (standard deviation)            0.3098
Weighted precision                          0.9111
Weighted recall                             0.8213
Weighted F1 score                           0.8539
```