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CS 540

HW6

04.01.2019

Problem 1.1)

```
occurrence Count:170581
word Count:18788
```

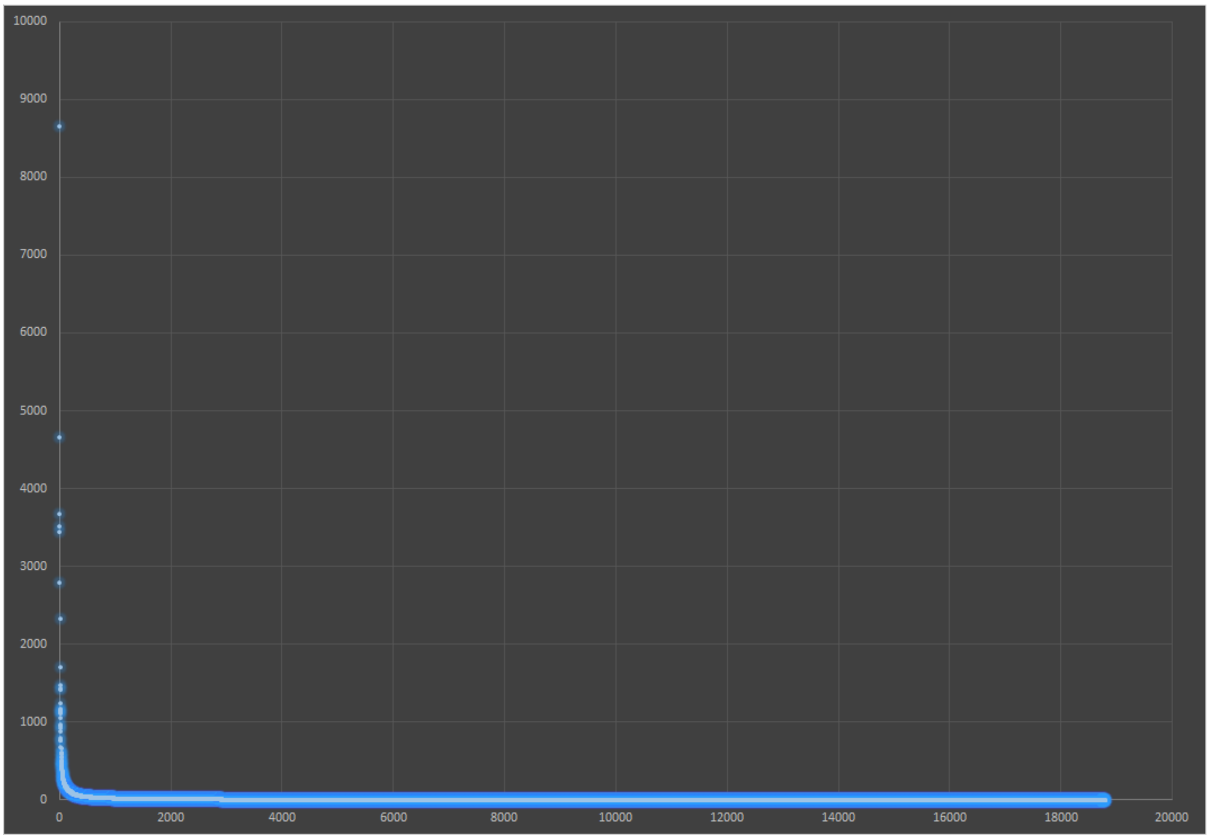
used JAVA to read text files and used Map to map them by key and value. Keys are the unique computer word and values are the number of occurrence of the word.

1.2)

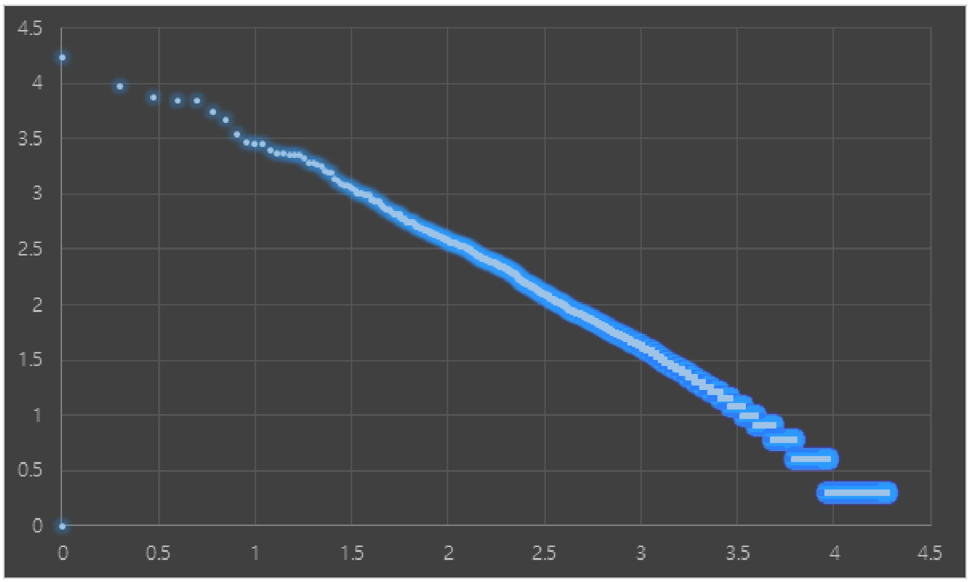
the	8651
to	4663
a	3673
in	3521
and	3446
of	2792
for	1771
is	1470
on	1432
was	1421
he	1244
with	1166
have	1152
at	1137
I	1126
his1	111
that	1060
has	965
be	950
but	931

assigned in array list in order of values

1.3)



The raw graph shows that value decrease as rank decrease. It shows that first several words are repeated a lot. However, it's hard to tell since most of keys are close to zero range and scale for y axes is huge.



The log graph also shows that value decrease as rank decrease. However, the scale for axes are smaller making it better to figure out the trend. It is clear on log graph to figure out that occurrences decrease as ranks decrease.

Used excel to create plot for data.

1.4)

4.

tfIdf of word contract = 0.54731

top 10 words:

Ronaldo

contract

United

World.

tomorrow.

first-team.

Trafford.

five-year-deal,

knows,”

club.

knows

"Nobody

resolved

agreeing

star,

sides.”

renew

future.”

News

Portugal

1.5)

The cosine similarity of v1 and v2 using bag of words: 0.99885

tfIdf: 0.98863

The values of cosine similarity are different. They are different because bag of words uses word count while tfIdf counts the significance of key.

1.6)

One issue of computer word is that it counts words like conjunctions that appears a lot but are meaningless and insignificant.

Another issue is that it’s not case sensitive. Moreover, special characters like commas and quotations attached can make the same word look different.

Problem 2.1)

11 dimensions

mean value of Retail: 32511.33146

mean value of horsepower: 213.2191011

Used =AVERAGE() and =STDEV in excel.

2.2)

	First	second	third
eigenvalue	7.167308	1.826552	0.834489
Retail($)	0.275262	0.444142	0.259044
Dealer($)	0.273531	0.44631	0.261497
Engine(L)	0.345189	-0.0135	0.064369
Cylinders	0.332857	0.092837	0.116059
Horsepower	0.318994	0.280542	0.094543
CityMPG	-0.30787	-0.01645	0.547298
HighwayMPG	-0.30506	-0.03009	0.605168
Weight(lb)	0.335202	-0.1593	-0.11482
Wheelbase(in)	0.263903	-0.43141	0.241694
Length(in)	0.250374	-0.43847	0.312575
Width(in)	0.291832	-0.33334	0.05384

Used initial data, average value, and standard deviation to get centered and normalized data using given formula. After getting covariance matrix, used excel visual basic to get eigenvectors and eigenvalue.

2.3)

First igenvector has coordinate.

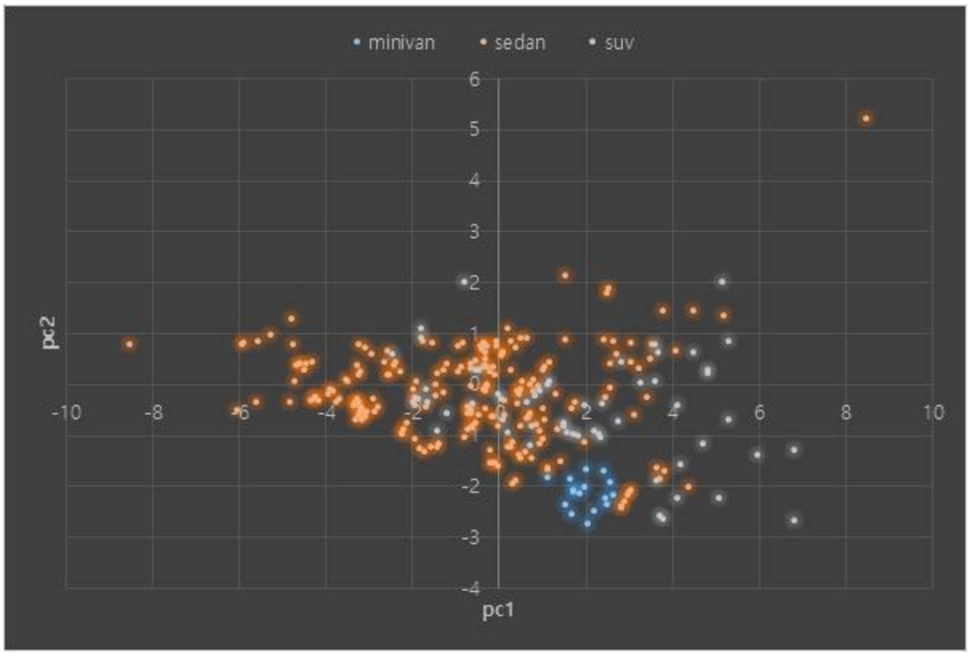
Retail($)	0.275262
Dealer($)	0.273531
Engine(L)	0.345189
Cylinders	0.332857

Horsepower	0.318994
CityMPG	-0.30787
HighwayMPG	-0.30506
Weight(lb)	0.335202
Wheelbase(in)	0.263903
Length(in)	0.250374
Width(in)	0.291832

Every features except for CityMPG and HighwayMPG had positive correlation.

Since igenvectors show components direction or slope, positive coordinates show how important each principal is and that values had pattern of positive correlation. Higher igenvalue shows that there's large variation in that dimension and how important and dominant the component is.

2.4)



Used normalized data of minivan, sedan, SUV to create covariance matrix and used =MMULT() command to perform matrix multiplication with first two igenvectors. Made graph with the output.

2.5)

Based on the plot, it seems that values for minivans are clustered most strongly. Since igenvalues of pc1 and pc2 were strongly dominant, it is plausible to believe that plot successfully represents original data. However, pc1 is much more important than pc2. Data for sedan and SUV seems to be spread out over pc1 while data for minivan are clustered. So, data for minivan are highly correlated to each other. Since data of minivan are similar to each other, they are likely to be the reasonable merchandise. So, Bob can choose to buy a minivan to avoid making poor choices. Since data for sedan and SUV are not similar to each other, Bob should make careful decisions. However, there are multiple outliers that might result from car brands and other factors.

Appendix

```
import java.io.File;
import java.io.FileNotFoundException;
import java.io.PrintStream;
import java.util.*;

public class NLP {
        Map<String, Double> map = new HashMap<>();

        // construct dictionary with key and value
        public void makeDict(File file) throws FileNotFoundException{
                Scanner scr = new Scanner(file);
                while (scr.hasNextLine()){
                        String[] line = scr.nextLine().split(" ");
                        for (int i = 0; i < line.length; i++){
                                String s = line[i];
                                if (!map.containsKey(s)){
                                        map.put(s, 1.0);
                                }
                                else{
                                        map.put(s, map.get(s) + 1);
                                }
                        }
                scr.close();
                }
        }
        // count the number of words in a document
        public int countWords(Map<String, Double> map){
                int count = 0;
                for (int i = 0; i < map.size(); i++){
                        count++;
                }
                return count;
        }
        // number of docs of certain word
        public int getDocCount(String word, File[] files) throws FileNotFoundException{
                int docs = 0;
                boolean isdoc;
                for (int i = 0; i < files.length; i++){
                        isdoc = false;
                        if (files[i].isFile()){
                                isdoc = isDoc(word, files[i]);
                        }
                        if (isdoc == true){
                                docs++;
                        }
                }
                        return docs;
        }
        //tf-idf
        public Map<String,Double> ifIdf(HashMap<String,Double> map, File[] files, Map<String, Double>
allMap) throws FileNotFoundException{
                double max = 0;
                for (String keys : map.keySet()){
                        max = map.get(keys);
                        break;
                }
```

```java
                  for (String keys : map.keySet()){
                           double tf = (double)map.get(keys) / max;
                           double docCount = getDocCount(keys, files);
                           double idf = Math.log10(511/docCount);
                           double tfidf = tf * idf;
                           allMap.put(keys, tfidf);
                  }
                  for (String keys : allMap.keySet()){
                           if (!map.containsKey(keys)){
                                    allMap.put(keys, 0.0);
                           }
                  }
                  return allMap;
         }
         // bagOfWords
         public Map<String,Double> bagOfWords(HashMap<String,Double> map, Map<String, Double> allMap)
throws FileNotFoundException{
                  double sum = 0;
                  for (String keys : allMap.keySet()){
                           if (!map.containsKey(keys)){
                                    allMap.put(keys, 0.0);
                           }
                  }
                  for (String keys : map.keySet()){
                           sum += map.get(keys);
                  }
                  for (String keys : allMap.keySet()){
                           allMap.put(keys, allMap.get(keys) / sum);
                  }
                  return allMap;

         }
         // returns true if a word is present in the document
         public boolean isDoc(String word, File file) throws FileNotFoundException{
                  boolean isdoc = false;
                  Scanner scr = new Scanner(file);
                  while (scr.hasNextLine()){
                           String[]line = scr.nextLine().split(" ");

                           for (int i = 0; i < line.length; i++)
                           {
                                    String s = line[i];
                                    if (s.equals(word))
                                    {
                                             isdoc = true;
                                             break;
                                    }
                           }
                  }
                  scr.close();
                  return isdoc;
         }


         // hashmap
         public HashMap<String, Double> sortMap(Map<String, Double> map){
                  List<Map.Entry<String, Double> > list = new LinkedList<Map.Entry<String, Double>
>(map.entrySet());
                  Collections.sort(list, new Comparator<Map.Entry<String, Double> >() {
           public int compare(Map.Entry<String, Double> o1,
                            Map.Entry<String, Double> o2) {
               return (o2.getValue()).compareTo(o1.getValue());
           }
       });
                  HashMap<String, Double> curr = new LinkedHashMap<String, Double>();
       for (Map.Entry<String, Double> aa : list) {
           curr.put(aa.getKey(), aa.getValue());
       }
       return curr;
         }
         // sort the hashmap
         public HashMap<String, Double> sortMapDouble(Map<String, Double> map){
                  List<Map.Entry<String, Double> > list = new LinkedList<Map.Entry<String, Double>
```

```
>(map.entrySet());

                  Collections.sort(list, new Comparator<Map.Entry<String, Double> >() {
           public int compare(Map.Entry<String, Double> o1,
                            Map.Entry<String, Double> o2) {
               return (o2.getValue()).compareTo(o1.getValue());
           }
       });
                  HashMap<String, Double> curr = new LinkedHashMap<String, Double>();
       for (Map.Entry<String, Double> aa : list) {
           curr.put(aa.getKey(), aa.getValue());
       }
       return curr;
         }
         // cosine similarity
         public static double cosineSimilarity(Map<String, Double> map, Map<String, Double> mapB){
                  double sum = 0.0;
                  double normA = 0.0;
                  double normB = 0.0;
                  for (int i = 0; i < map.size(); i++){
                           Object keyA = map.keySet().toArray()[i];
                           Object keyB = mapB.keySet().toArray()[i];
                           double valA = map.get(keyA);
                           double valB = mapB.get(keyB);
                           sum += valA * valB;
                           normA += Math.pow(map.get(keyA), 2);
                           normB += Math.pow(mapB.get(keyB), 2);
                  }
                  return sum / (Math.sqrt(normA) * Math.sqrt(normB));
         }

         public static void main(String args[]) throws FileNotFoundException{
                  int count = 0;
                  File folder = new File("/Users/user/Desktop/CS 540/projects/hw6/src/news");
                  File[] listOfFile = folder.listFiles();
                  NLP a = new NLP();

                  for (int i = 0; i < listOfFile.length; i++)           {

                           a.makeDict(listOfFile[i]);
                  }
                  HashMap<String, Double> sorted = new HashMap<>();
                  sorted = a.sortMap(a.map);
                  for (String keys : sorted.keySet()){
                           if (count < 21){
                                    System.out.println(keys + " " + sorted.get(keys));
                                    count++;
                           }
                  }
         }
}
```