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Applied Data Science

IST687 Intro to Data Science, Spring 2019
Due Date: 06/11/2019
Homework: 10
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#R Code - unexecuted

```
## Homework Week 10: Text      Mining
##    -Create our own termDocMatrix


##---- Instructions -------------------------------------------------------
# Word ranking scale ranking 'AFINN', scale of -5 to 5 (negative to positive)
# This homework task is to adapt the lab that we did in class, to compute the
# score for the MLK speech using the AFINN word list (as opposed to the positive
# and negative word lists).
# Learning Goals for this activity:
# A. Consider how a simple text mining technique can be applied to a variety of kinds of source data
# B. Provide practice in conditioning data to prepare for analysis
# C. Develop skill in the setup, execution, and interpretation of text mining analytics
# D. Increase familiarity with bringing external data sets into R.


#--- Preprocess Steps:-------------------------------------------------------------------

### Clear objects from Memory
rm(list=ls())
```

```
### Clear Console:
cat("\014")
### Set Working Directory
setwd("C:\\workspaces\\ms_datascience_su\\IST687-IntroDataScience\\R_workspace\\hw")


#---- Load Required Packages ------------------------------------------------
if(!require("tidytext")){install.packages("tidytext")}
if(!require("readtext")){install.packages("readtext")}
if(!require("OptimalCutpoints")){install.packages("OptimalCutpoints")}
if(!require("tm")){install.packages("tm")}
if(!require("wordcloud")){install.packages("wordcloud")}
if(!require("slam")){install.packages("slam")}
if(!require("ggplot2")){install.packages("ggplot2")}
if(!require("dplyr")) {install.packages("dplyr")}
if(!require("webshot")){install.packages("webshot")}

#---- Global Variable Assignments -------------------------------------------
mlkFileName <- "MLK.txt"
afinnFileName <- "AFINN.txt"


##---- TDM Step 1: Process in the MLK speech ----
#3) Read the text file
#4) Create a term matrix
#5) Create a list of counts for each word

# TDM 1.1: Read in the MLK Speech file
# returns a vector with as many elements as there are lines of text in the file
# grabs each line and is stored as a character string in a vector of character strings
mlkFile <- readLines(file(mlkFileName))
mlkFile <- mlkFile[which(mlkFile != "")] # remove all blank lines
```

```
str(mlkFile)
head(mlkFile,10)

View(mlkFile)

# TDM 1.2: Create a term matrix
wordsVec <- VectorSource(mlkFile)
wordsCorpus <- Corpus(wordsVec)
wordsCorpus
View(wordsCorpus)

# make all words in corpus lowercase
wordsCorpus <- tm_map(wordsCorpus, content_transformer(tolower))
wordsCorpus <- tm_map(wordsCorpus, removePunctuation)
wordscorpus <- tm_map(wordsCorpus, removeNumbers)
wordsCorpus <- tm_map(wordsCorpus, removeWords, stopwords("english"))

# create a term document matrix
tdm <- TermDocumentMatrix(wordsCorpus)
tdm
View(tdm)
inspect(tdm)

# 1.3: Create a list of counts for each word
# The wordcloud function expects two vectors as input arguments
# - The first a list of the terms
# - The second a list of the frequencies of occurrence of the terms, both must be sorted

m <- as.matrix(tdm)
wordCounts <- rowSums(m)
wordCounts <- sort(wordCounts, decreasing=TRUE)
```

```
head(wordCounts,10)

# calculate the total number of words
totalWords <- sum(wordCounts)
totalWords

# vector of all the words
words <- names(wordCounts)
head(words,10)

# build a word cloud
cloudFrame <- data.frame(word=names(wordCounts),freq=wordCounts)
View(cloudFrame)
wordcloud(cloudFrame$word, cloudFrame$freq)

# prety up the wordcloud & save as
wordcloud(names(wordCounts), wordCounts, min.freq = 2, max.words = 50, rot.per = .35, colors = brewer.pal(8,"Dark2"))


#---- AFINN Step 1: Load the data ----------------------------------------------------
# First read in the AFINN word list. Each line is both a word and a score (between -5 and 5)
# Split the line and create two vectors (one for words and one for scores).

# Read Affinity file
afinn <- read.delim(afinnFileName, sep="\t", header = FALSE)
str(afinn)
colnames(afinn) <- c("Word", "Score")
View(afinn)

# join the df match with afinn by "word" col in match and "Word" col in afinn
mergedTable <- merge(cloudFrame, afinn, by.x = "word", by.y = "Word")
str(mergedTable)
```

```
View(mergedTable)

#---- Step 2: Compute the overall score ----------------------------------------
# Compute the overall score for the MLK speech using the AFINN word list (as opposed
# to the positive and negative word lists).

overallScore <- sum(mergedTable$freq*mergedTable$Score)
overallScore

#---- Step 3: Compute the sentiment score ---------------------------------------
# Compute the sentiment score for each quarter (25%) of the speech to see how this sentiment
# analysis is the same or different than what was computing with just the positive and negative word files.
getQuarterlySentimentScore <- function(table,quarter){
 score <- 0
 qRange <- round(nrow(table)/4)
 switch(quarter,
        "Q1" = {
         t <- table[1:qRange,]
         score <- sum(t$freq*t$Score)
         },
        "Q2" = {
         t <- table[(qRange+1):(qRange*2),]
         score <- sum(t$freq*t$Score)
         },
        "Q3" = {
         t <- table[(qRange*2+1):(qRange*3),]
         score <- sum(t$freq*t$Score)
         },
        "Q4" = {
         t <- table[(qRange*3+1):nrow(table),]
         score <- sum(t$freq*t$Score)
         },
```

```
      stop("Error, invalid quarter value. Acceptiable values are: 'Q1', 'Q2', 'Q3', 'Q4'
           ")
  )

  return(score)
}

mlkSplitQuarters <- c('Q1','Q2','Q3','Q4')
mlkSentimentScores <- NULL
for(e in mlkSplitQuarters){
  mlkSentimentScores <- c(mlkSentimentScores,getQuarterlySentimentScore(mergedTable,e))
  print(paste0(e," = ",getQuarterlySentimentScore(mergedTable,e)))
}
mlkSentimentScores

mlkSentQuartDf <- data.frame(mlkSplitQuarters,mlkSentimentScores)
colnames(mlkSentQuartDf) <- c('Quarter', 'Score')
View(mlkSentQuartDf)

#---- Step 4: Plot the results -----------------------------------------------
# 4 numbers via a bar chart
ggplot(data=mlkSentQuartDf) +
  geom_col(aes(x=Quarter, y=Score)) +
  labs(title="MLK Quarterly Sentiment Scores")
ggsave("MLK_Quarterly_Sentiment_Scores.jpg", width = 6, height = 6)
```

#R Code – executed

```
 ### Set Working Directory
 > setwd("C:\\workspaces\\ms_datascience_su\\IST687-IntroDataScience\\R_workspace\\hw")
 >
 >
 > #---- Load Required Packages -----------------------------------------------
 > if(!require("tidytext")){install.packages("tidytext")}
```

```
> if(!require("readtext")){install.packages("readtext")}
> if(!require("OptimalCutpoints")){install.packages("OptimalCutpoints")}
> if(!require("tm")){install.packages("tm")}
> if(!require("wordcloud")){install.packages("wordcloud")}
> if(!require("slam")){install.packages("slam")}
> if(!require("ggplot2")){install.packages("ggplot2")}
> if(!require("dplyr")) {install.packages("dplyr")}
> if(!require("webshot")){install.packages("webshot")}
>
> #---- Global Variable Assignments -------------------------------------------
> mlkFileName <- "MLK.txt"
> afinnFileName <- "AFINN.txt"
>
>
> ##---- TDM Step 1: Process in the MLK speech ----
> #3) Read the text file
> #4) Create a term matrix
> #5) Create a list of counts for each word
>
> # TDM 1.1: Read in the MLK Speech file
> # returns a vector with as many elements as there are lines of text in the file
> # grabs each line and is stored as a character string in a vector of character strings
> mlkFile <- readLines(file(mlkFileName))
> mlkFile <- mlkFile[which(mlkFile != "")] # remove all blank lines
>
> str(mlkFile)
 chr [1:29] "I am happy to join with you today in what will go down in history as the greatest demonstration for
freedom in "| __truncated__ ...
> head(mlkFile,10)
 [1] "I am happy to join with you today in what will go down in history as the greatest demonstration for freedo
m in the history of our nation."
 [2] "Five score years ago, a great American, in whose symbolic shadow we stand today, signed the Emancipation P
roclamation. This momentous decree came as a great beacon light of hope to millions of Negro slaves who had been
seared in the flames of withering injustice. It came as a joyous daybreak to end the long night of their captivi
ty."
 [3] "But one hundred years later, the Negro still is not free. One hundred years later, the life of the Negro i
s still sadly crippled by the manacles of segregation and the chains of discrimination. One hundred years later,
the Negro lives on a lonely island of poverty in the midst of a vast ocean of material prosperity. One hundred y
ears later, the Negro is still languishing in the corners of American society and finds himself an exile in his
own land. So we have come here today to dramatize a shameful condition."
 [4] "In a sense we have come to our nation's capital to cash a check. When the architects of our republic wrote
the magnificent words of the Constitution and the Declaration of Independence, they were signing a promissory no
te to which every American was to fall heir. This note was a promise that all men, yes, black men as well as whi
te men, would be guaranteed the unalienable rights of life, liberty, and the pursuit of happiness."
 [5] "It is obvious today that America has defaulted on this promissory note insofar as her citizens of color ar
e concerned. Instead of honoring this sacred obligation, America has given the Negro people a bad check, a check
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which has come back marked \"insufficient funds.\" But we refuse to believe that the bank of justice is bankrupt
. We refuse to believe that there are insufficient funds in the great vaults of opportunity of this nation. So w
e have come to cash this check -- a check that will give us upon demand the riches of freedom and the security o
f justice. We have also come to this hallowed spot to remind America of the fierce urgency of now. This is no ti
me to engage in the luxury of cooling off or to take the tranquilizing drug of gradualism. Now is the time to ma
ke real the promises of democracy. Now is the time to rise from the dark and desolate valley of segregation to t
he sunlit path of racial justice. Now is the time to lift our nation from the quick sands of racial injustice to
the solid rock of brotherhood. Now is the time to make justice a reality for all of God's children."
 [6] "It would be fatal for the nation to overlook the urgency of the moment. This sweltering summer of the Negr
o's legitimate discontent will not pass until there is an invigorating autumn of freedom and equality. Nineteen
sixty-three is not an end, but a beginning. Those who hope that the Negro needed to blow off steam and will now
be content will have a rude awakening if the nation returns to business as usual. There will be neither rest nor
tranquility in America until the Negro is granted his citizenship rights. The whirlwinds of revolt will continue
to shake the foundations of our nation until the bright day of justice emerges."
 [7] "But there is something that I must say to my people who stand on the warm threshold which leads into the p
alace of justice. In the process of gaining our rightful place we must not be guilty of wrongful deeds. Let us n
ot seek to satisfy our thirst for freedom by drinking from the cup of bitterness and hatred."
 [8] "We must forever conduct our struggle on the high plane of dignity and discipline. We must not allow our cr
eative protest to degenerate into physical violence. Again and again we must rise to the majestic heights of mee
ting physical force with soul force. The marvelous new militancy which has engulfed the Negro community must not
lead us to a distrust of all white people, for many of our white brothers, as evidenced by their presence here t
oday, have come to realize that their destiny is tied up with our destiny. They have come to realize that their
freedom is inextricably bound to our freedom. We cannot walk alone."
 [9] "As we walk, we must make the pledge that we shall always march ahead. We cannot turn back. There are those
who are asking the devotees of civil rights, \"When will you be satisfied?\" We can never be satisfied as long a
s the Negro is the victim of the unspeakable horrors of police brutality. We can never be satisfied, as long as
our bodies, heavy with the fatigue of travel, cannot gain lodging in the motels of the highways and the hotels o
f the cities. We cannot be satisfied as long as the Negro's basic mobility is from a smaller ghetto to a larger
one. We can never be satisfied as long as our children are stripped of their selfhood and robbed of their dignit
y by signs stating \"For Whites Only\". We cannot be satisfied as long as a Negro in Mississippi cannot vote and
a Negro in New York believes he has nothing for which to vote. No, no, we are not satisfied, and we will not be
satisfied until justice rolls down like waters and righteousness like a mighty stream."
[10] "I am not unmindful that some of you have come here out of great trials and tribulations. Some of you have
come fresh from narrow jail cells. Some of you have come from areas where your quest for freedom left you batter
ed by the storms of persecution and staggered by the winds of police brutality. You have been the veterans of cr
eative suffering. Continue to work with the faith that unearned suffering is redemptive."
>
> View(mlkFile)
>
> # TDM 1.2: Create a term matrix
> wordsVec <- VectorSource(mlkFile)
> wordsCorpus <- Corpus(wordsVec)
> wordsCorpus
<<SimpleCorpus>>
Metadata:  corpus specific: 1, document level (indexed): 0
Content:  documents: 29
```

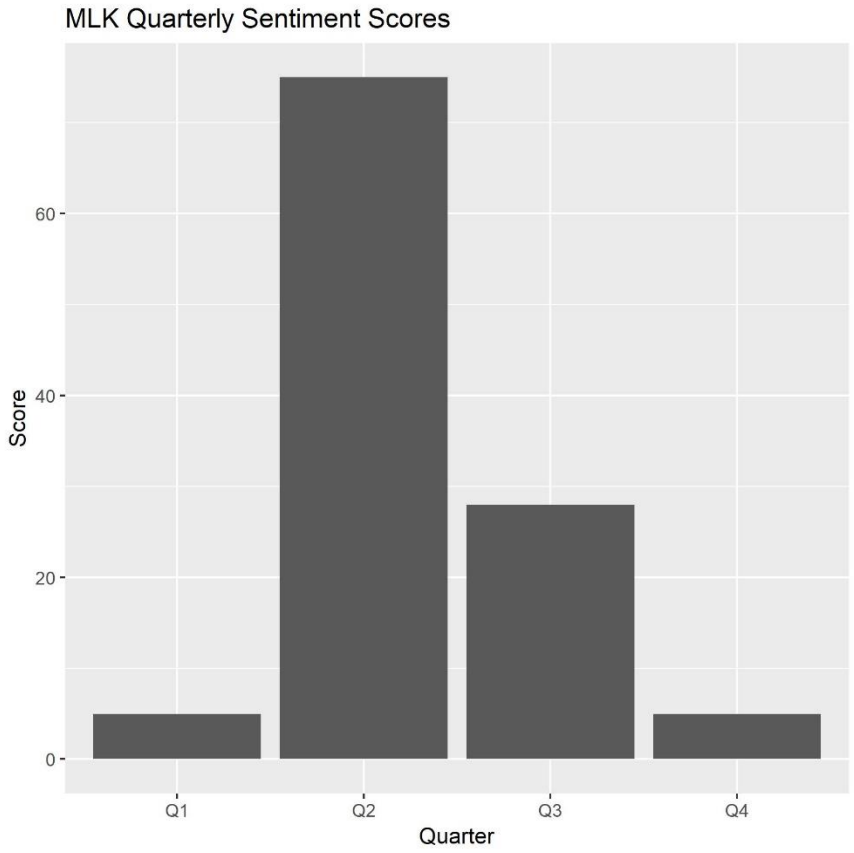
```
> View(wordsCorpus)
>
> # make all words in corpus lowercase
> wordsCorpus <- tm_map(wordsCorpus, content_transformer(tolower))
Warning message:
In tm_map.SimpleCorpus(wordsCorpus, content_transformer(tolower)) :
  transformation drops documents
> wordsCorpus <- tm_map(wordsCorpus, removePunctuation)
Warning message:
In tm_map.SimpleCorpus(wordsCorpus, removePunctuation) :
  transformation drops documents
> wordscorpus <- tm_map(wordsCorpus, removeNumbers)
Warning message:
In tm_map.SimpleCorpus(wordsCorpus, removeNumbers) :
  transformation drops documents
> wordsCorpus <- tm_map(wordsCorpus, removeWords, stopwords("english"))
Warning message:
In tm_map.SimpleCorpus(wordsCorpus, removeWords, stopwords("english")) :
  transformation drops documents
>
> # create a term document matrix
> tdm <- TermDocumentMatrix(wordsCorpus)
> tdm
<<TermDocumentMatrix (terms: 463, documents: 29)>>
Non-/sparse entries: 682/12745
Sparsity           : 95%
Maximal term length: 14
Weighting          : term frequency (tf)
> View(tdm)
> inspect(tdm)
<<TermDocumentMatrix (terms: 463, documents: 29)>>
Non-/sparse entries: 682/12745
Sparsity           : 95%
Maximal term length: 14
Weighting          : term frequency (tf)
Sample             :
        Docs
Terms    18 2 21 29 3 4 5 6 8 9
  come    0 0  0  0 1 1 3 0 2 0
  day     2 0  1  1 0 0 0 1 0 0
  dream   1 0  0  0 0 0 0 0 0 0
  freedom 0 0  1  1 0 0 1 1 2 0
  let     0 0  0  1 0 0 0 0 0 0
  nation  0 0  1  0 0 0 2 3 0 0
  negro   0 1  0  1 4 0 1 2 1 3
  one     2 0  1  0 4 0 0 0 0 1
```

```
  ring     0 0  0  2 0 0 0 0 0 0
  will     1 0  4  2 0 0 1 5 0 2
>
> # 1.3: Create a list of counts for each word
> # The wordcloud function expects two vectors as input arguments
> # - The first a list of the terms
> # - The second a list of the frequencies of occurrence of the terms, both must be sorted
>
> m <- as.matrix(tdm)
> wordCounts <- rowSums(m)
> wordCounts <- sort(wordCounts, decreasing=TRUE)
> head(wordCounts,10)
   will freedom   negro     one     let    ring     day   dream  nation    come
     26      20      13      13      13      12      11      11      10      10
>
> # calculate the total number of words
> totalWords <- sum(wordCounts)
> totalWords
[1] 841
>
> # vector of all the words
> words <- names(wordCounts)
> head(words,10)
 [1] "will"    "freedom" "negro"   "one"     "let"     "ring"    "day"     "dream"   "nation"
[10] "come"
>
> # build a word cloud
> cloudFrame <- data.frame(word=names(wordCounts),freq=wordCounts)
> View(cloudFrame)
> wordcloud(cloudFrame$word, cloudFrame$freq)
> # prety up the wordcloud & save as
> wordcloud(names(wordCounts), wordCounts, min.freq = 2, max.words = 50, rot.per = .35, colors = brewer.pal(8,"D
ark2"))
```


```
>
>
> #---- AFINN Step 1: Load the data ----------------------------------------------------
> # First read in the AFINN word list. Each line is both a word and a score (between -5 and 5)
> # Split the line and create two vectors (one for words and one for scores).
>
> # Read Affinity file
> afinn <- read.delim(afinnFileName, sep="\t", header = FALSE)
> str(afinn)
'data.frame':  2477 obs. of  2 variables:
 $ V1: Factor w/ 2477 levels "abandon","abandoned",..: 1 2 3 4 5 6 7 8 9 10 ...
 $ V2: int  -2 -2 -2 -2 -2 -2 -3 -3 -3 -3 ...
> colnames(afinn) <- c("Word", "Score")
> View(afinn)
>
> # join the df match with afinn by "word" col in match and "Word" col in afinn
```

```
> mergedTable <- merge(cloudFrame, afinn, by.x = "word", by.y = "Word")
> str(mergedTable)
'data.frame':  61 obs. of  3 variables:
 $ word : Factor w/ 463 levels "able","ago","ahead",..: 6 8 19 21 25 36 74 89 91 93 ...
 $ freq : num  2 1 1 1 1 1 2 1 1 2 ...
 $ Score: int  1 -2 -3 -3 3 1 2 -1 -1 -3 ...
> View(mergedTable)
>
> #---- Step 2: Compute the overall score ------------------------------------
> # Compute the overall score for the MLK speech using the AFINN word list (as opposed
> # to the positive and negative word lists).
>
> overallScore <- sum(mergedTable$freq*mergedTable$Score)
> overallScore
[1] 113
>
> #---- Step 3: Compute the sentiment score ----------------------------------
> # Compute the sentiment score for each quarter (25%) of the speech to see how this sentiment
> # analysis is the same or different than what was computing with just the positive and negative word files.
> getQuarterlySentimentScore <- function(table,quarter){
+   score <- 0
+   qRange <- round(nrow(table)/4)
+   switch(quarter,
+          "Q1" = {
+            t <- table[1:qRange,]
+            score <- sum(t$freq*t$Score)
+            },
+          "Q2" = {
+            t <- table[(qRange+1):(qRange*2),]
+            score <- sum(t$freq*t$Score)
+            },
+          "Q3" = {
+            t <- table[(qRange*2+1):(qRange*3),]
+            score <- sum(t$freq*t$Score)
+            },
+          "Q4" = {
+            t <- table[(qRange*3+1):nrow(table),]
+            score <- sum(t$freq*t$Score)
+            },
+          stop("Error, invalid quarter value. Acceptiable values are: 'Q1', 'Q2', 'Q3', 'Q4'
+               ")
+   )
+
+   return(score)
+ }
>
```

```
> mlkSplitQuarters <- c('Q1','Q2','Q3','Q4')
> mlkSentimentScores <- NULL
> for(e in mlkSplitQuarters){
+   mlkSentimentScores <- c(mlkSentimentScores,getQuarterlySentimentScore(mergedTable,e))
+   print(paste0(e," = ",getQuarterlySentimentScore(mergedTable,e)))
+ }
[1] "Q1 = 5"
[1] "Q2 = 75"
[1] "Q3 = 28"
[1] "Q4 = 5"
> mlkSentimentScores
[1]  5 75 28  5
>
> mlkSentQuartDf <- data.frame(mlkSplitQuarters,mlkSentimentScores)
> colnames(mlkSentQuartDf) <- c('Quarter', 'Score')
> View(mlkSentQuartDf)
>
> #---- Step 4: Plot the results -----------------------------------------------
> # 4 numbers via a bar chart
> ggplot(data=mlkSentQuartDf) +
+   geom_col(aes(x=Quarter, y=Score)) +
+   labs(title="MLK Quarterly Sentiment Scores")
> ggsave("MLK_Quarterly_Sentiment_Scores.jpg", width = 6, height = 6)
```


MLK Quarterly Sentiment Scores
Score
60
40
20
0
Q1
Q2
Q3
Q4
Quarter