milestoneReport

Ellen 2019/2/18

Executive summary

This milestone report for the Data Science Capstone project provides a summary of data preprocessing and exploratory data analysis of the data sets provided. Plans for creating the prediction algorithm and the Shiny app will also be discussed.

```
library(tm)
library(RWeka)
library(stringi)
library(ggplot2)
library(dplyr)
```

Data description and summary statistics

In this project, the following data is provided.

```
file1 <- file("./final/en_US/en_US.blogs.txt", "rb")</pre>
blogs <- readLines(file1, encoding = "UTF-8")</pre>
close(file1)
file2 <- file("./final/en_US/en_US.news.txt", "rb")</pre>
news <- readLines(file2, encoding = "UTF-8")</pre>
close(file2)
file3 <- file("./final/en US/en US.twitter.txt", "rb")
twitter <- readLines(file3, encoding = "UTF-8")</pre>
## Warning in readLines(file3, encoding = "UTF-8"): line 167155 appears to
## contain an embedded nul
## Warning in readLines(file3, encoding = "UTF-8"): line 268547 appears to
## contain an embedded nul
## Warning in readLines(file3, encoding = "UTF-8"): line 1274086 appears to
## contain an embedded nul
## Warning in readLines(file3, encoding = "UTF-8"): line 1759032 appears to
## contain an embedded nul
close(file3)
```

A summary statistics is given below:

```
words_blogs <- stri_count_words(blogs)
words_news <- stri_count_words(news)
words_twitter <- stri_count_words(twitter)
size_blogs <- file.info("final/en_US/en_US.blogs.txt")$size/1024^2
size_news <- file.info("final/en_US/en_US.news.txt")$size/1024^2
size_twitter <- file.info("fianl/en_US/en_US.twitter.txt")$size/1024^2
summary_table <- data.frame(filename = c("blogs","news","twitter"),</pre>
```

```
file_size_MB = c(size_blogs, size_news, size_twitter),
                            num_lines = c(length(blogs), length(news), length(twitter)),
                            num_words = c(sum(words_blogs), sum(words_news), sum(words_twitter)),
                            mean_num_words = c(mean(words_blogs),mean(words_news),mean(words_twitter)))
summary_table
##
     filename file_size_MB num_lines num_words mean_num_words
        blogs
                  200.4242
                              899288 37546239
## 1
                                                     41.75107
## 2
         news
                  196.2775
                             1010242 34762395
                                                     34.40997
```

12.75063

Data preprocessing

NΔ

3 twitter

We will randomly choose 1% of each data set to demonstrate data preprocessing and exploratory data analysis. The full dataset will be used later in creating the prediction algorithm.

```
set.seed(1)
blogsSample <- sample(blogs, length(blogs)*0.01)
newsSample <- sample(news, length(news)*0.01)
twitterSample <- sample(twitter, length(twitter)*0.01)
twitterSample <- sapply(twitterSample, function(row) iconv(row, "latin1", "ASCII", sub = ""))</pre>
```

We combine the three samples. The number of lines and total number of words are as follows:

2360148 30093372

```
text_sample <- c(blogsSample, newsSample, twitterSample)
length(text_sample)</pre>
```

```
## [1] 42695
```

```
sum(stri_count_words(text_sample))
```

```
## [1] 1020011
```

```
text_sample <- enc2utf8(text_sample)</pre>
```

```
## Warning in readLines(file0, encoding = "UTF-8"): line 1 appears to contain
## an embedded nul
## Warning in readLines(file0, encoding = "UTF-8"): line 3 appears to contain
## warning in readLines(file0, encoding = "UTF-8"): incomplete final line
## found on 'profanities.RData'
```

The basic procedure for data preprocessing consists of the following key steps:

- 1. Construct a corpus from the files.
- 2. Tokenization. Clean up the corpus by removing special characters, punctuation, numbers etc. We also remove profanity that we do not want to predict.
- 3. Build basic n-gram model.

We will require the following helper functions in order to prepare our corpus.

```
toSpace <- content_transformer(function(x, pattern) gsub(pattern, " ", x))
preprocessCorpus <- function(corpus){
    # Helper function to preprocess corpus
    corpus <- tm_map(corpus, toSpace, "/|@|\\|")</pre>
```

```
corpus <- tm_map(corpus, content_transformer(tolower))</pre>
  corpus <- tm_map(corpus, removeNumbers)</pre>
  corpus <- tm_map(corpus, removePunctuation)</pre>
  corpus <- tm_map(corpus, removeWords, stopwords("english"))</pre>
  corpus <- tm_map(corpus, removeWords, profanities)</pre>
  corpus <- tm_map(corpus, stripWhitespace)</pre>
  return(corpus)
}
freq_frame <- function(tdm){</pre>
  # Helper function to tabulate frequency
  freq <- sort(rowSums(as.matrix(tdm)), decreasing = TRUE)</pre>
  freq_frame <- data.frame(word=names(freq), freq=freq)</pre>
  return(freq_frame)
BigramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min=2, max=2))</pre>
trigramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min=3, max=3))</pre>
QuadgramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min=4, max=4))
```

We preprocess the text sample to form Term Document Matrices.

```
text_sample <- VCorpus(VectorSource(text_sample))

#text_sample <- preprocessCorpus(text_sample)

tdm1a <- TermDocumentMatrix(text_sample)

tdm1 <- removeSparseTerms(tdm1a, 0.99)
freq1_frame <- freq_frame(tdm1)

tdm2a <- TermDocumentMatrix(text_sample, control = list(tokenize=BigramTokenizer))

tdm2 <- removeSparseTerms(tdm2a, 0.999)
freq2_frame <- freq_frame(tdm2)

tdm3a <- TermDocumentMatrix(text_sample, control = list(tokenize=trigramTokenizer))

tdm3 <- removeSparseTerms(tdm3a, 0.9999)
freq3_frame <- freq_frame(tdm3)

tdm4a <- TermDocumentMatrix(text_sample, control = list(tokenize=QuadgramTokenizer))

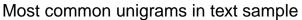
tdm4 <- removeSparseTerms(tdm4a, 0.9999)
freq4_frame <- freq_frame(tdm4)</pre>
```

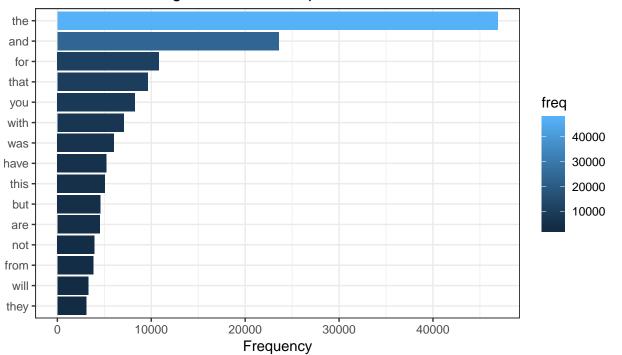
Exploratory analysis

For each Term Document Matrix, we list the most common unigrams, bigrams, trigrams and fourgrams.

```
#wordcloud(freq1_frame$word, freq1_frame$freq, min.freq=200)

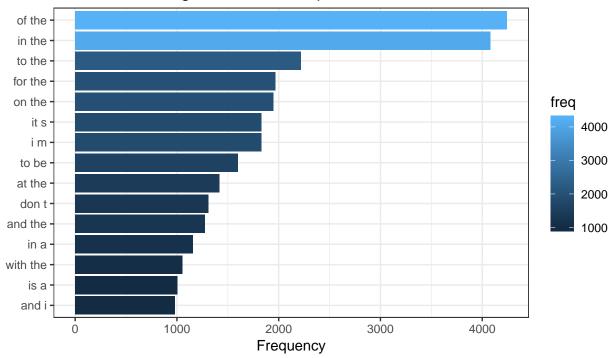
ggplot(freq1_top15, aes(x=reorder(word, freq), y=freq, fill=freq)) +
    geom_bar(stat="identity") +
    theme_bw() +
    coord_flip() +
    theme(axis.title.y = element_blank()) +
    labs(y="Frequency", title = "Most common unigrams in text sample")
```





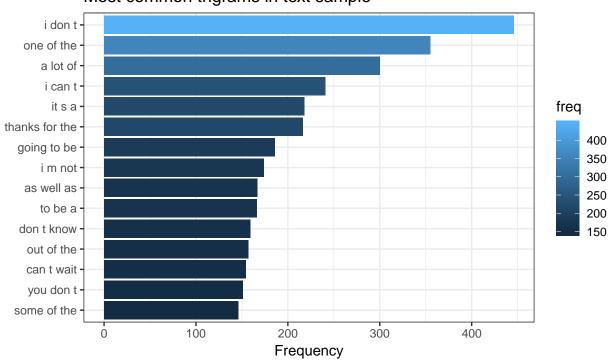
```
ggplot(freq2_top15, aes(x=reorder(word, freq), y=freq, fill=freq)) +
  geom_bar(stat = "identity") +
  theme_bw() +
  coord_flip() +
  theme(axis.title.y = element_blank()) +
  labs(y="Frequency", title = "Most common bigrams in text sample")
```

Most common bigrams in text sample



```
ggplot(freq3_top15, aes(x=reorder(word, freq), y=freq, fill=freq)) +
  geom_bar(stat = "identity") +
  theme_bw() +
  coord_flip() +
  theme(axis.title.y = element_blank()) +
  labs(y="Frequency", title = "Most common trigrams in text sample")
```

Most common trigrams in text sample



```
ggplot(freq4_top15, aes(x=reorder(word, freq), y=freq, fill=freq)) +
  geom_bar(stat = "identity") +
  theme_bw() +
  coord_flip() +
  theme(axis.title.y = element_blank()) +
 labs(y="Frequency", title = "Most common quadgrams in text sample")
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i don't know if' in 'mbcsToSbcs': dot substituted
## for <e2>
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot substituted
## for <99>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i don't know if' in 'mbcsToSbcs': dot substituted
## for <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i don't know if' in 'mbcsToSbcs': dot substituted
## for <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i don't know if' in 'mbcsToSbcs': dot substituted
## for <99>
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## for <80>
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```

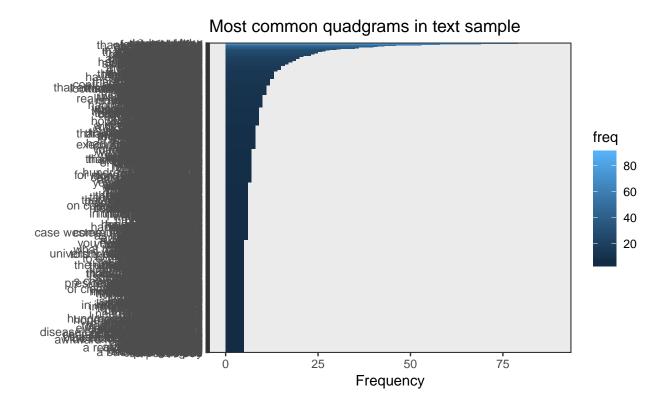
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## for <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'you don't have to' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot substituted
\verb|## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot substituted
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i don't know if' in 'mbcsToSbcs': dot
## substituted for <e2>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i don't know if' in 'mbcsToSbcs': dot
## substituted for <80>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i don't know if' in 'mbcsToSbcs': dot
## substituted for <99>
```

```
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't want to' in 'mbcsToSbcs': dot
## substituted for <e2>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't want to' in 'mbcsToSbcs': dot
## substituted for <80>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't want to' in 'mbcsToSbcs': dot
## substituted for <99>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't have to' in 'mbcsToSbcs': dot
## substituted for <e2>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't have to' in 'mbcsToSbcs': dot
## substituted for <80>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'you don't have to' in 'mbcsToSbcs': dot
## substituted for <99>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot
## substituted for <e2>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot
## substituted for <80>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'don't get me wrong' in 'mbcsToSbcs': dot
## substituted for <99>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot
## substituted for <e2>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot
## substituted for <80>
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x,
## x$y, : conversion failure on 'i'm not going to' in 'mbcsToSbcs': dot
## substituted for <99>
```



Prediction strategies and plans for Shiny app

While the strategy for modeling and prediction has not been finalized, the n-gram model with a frequency look-up table might be used based on the analysis above. A possible method of prediction is to use the 4-gram model to find the most likely next word first. If none is found, then the 3-gram model is used, and so forth. Furthermore, stemming might also be done in data preprocessing.