Starter Project for Sentiment Analysis

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Introduction

Sentiment analysis and text mining allows Data Scientists to classify text, novels, and other written forms of communication as data. Its practical applications can allow machine learning models and artificial intelligence understand how humans talk and how they feel. Imagine a world where mental health could be diagnosed from a few text messages, consumers could better find the products they need, and computers could speak a little more like humans. Although this project is merely an introductory level endeavor, it hopes to build a foundation to accomplish such feats in the future.

Purpose

The purpose of this project was to practice the basic techniques of data manipulation and working with text data. Text data often comes in forms that are difficult to work with and analyze. Text mining techniques and packages such as tidy text make this process a lot smoother.

The program is run by calling the following code.

```r
source("src/HorrorAnalysis.R")
```

The code reads through a csv "data/booklist.csv" and returns a word cloud for each book listed.

Important Packages

For this project several packages were used to make the data readable and to generate the graphics

dplyr

The dplyr package is used to manipulate and modify data frames. The included mutate() function was used to produce the line number and chapter columns in the tidy versions of the book.

gutenbergr

The gutenbergr package gives the user access to the thousands of books that have been uploaded to project Gutenberg that aims to provide the world with free and easy to access classic literature so that our collective human culture and knowledge does not get lost. This package was used to import several classical horror novels from the included csv file. Below is an example of how one would import a single file. By calling the head function, it is apparent that the formatting and whitespace make it difficult to perform any sort of analysis.

```
drjekyll<-gutenberg_download(42,meta_fields ="title")
head(drjekyll,12)
```

```
## # A tibble: 12 x 3
##    gutenberg_id text                                title
##           <int> <chr>                               <chr>
##  1           42 "                               ST~ The Strange Case of Dr. Jek~
##  2           42 "                               DR~ The Strange Case of Dr. Jek~
##  3           42 "                                 ~ The Strange Case of Dr. Jek~
##  4           42 ""                                  The Strange Case of Dr. Jek~
##  5           42 "                                 ~ The Strange Case of Dr. Jek~
##  6           42 "                            ROBER~ The Strange Case of Dr. Jek~
##  7           42 ""                                  The Strange Case of Dr. Jek~
##  8           42 ""                                  The Strange Case of Dr. Jek~
##  9           42 ""                                  The Strange Case of Dr. Jek~
## 10           42 ""                                  The Strange Case of Dr. Jek~
## 11           42 "1)"                                The Strange Case of Dr. Jek~
## 12           42 ""                                  The Strange Case of Dr. Jek~
```

Tidy Things

The function located in the sentiment_analysis.R file

```
create_tidy_books
```

```
## function (gutenberg_collection)
## {
##     result <- gutenberg_collection %>% group_by(gutenberg_id) %>%
##         mutate(linenumber = row_number(), chapter = cumsum(str_detect(text,
##             regex("^chapter [\\divxlc]", ignore_case = TRUE)))) %>%
##         ungroup() %>% unnest_tokens(word, text)
##     return(result)
## }
```

The tidytext, stringr, and tidyr packages are all designed to make the data more readable. The tidytext website describes a tidy data format as one observation per row with one attribute per column. The function create_tidy_books utilizes the functions from these packages separate the words from their line numbers without losing any information, other than capitalization.

```
tidy_jekyll <- create_tidy_books(drjekyll)

head(tidy_jekyll,12)
```

```
## # A tibble: 12 x 5
##    gutenberg_id title                                linenumber chapter word
##           <int> <chr>                                     <int>   <int> <chr>
##  1           42 The Strange Case of Dr. Jekyll and ~          1       0 strange
##  2           42 The Strange Case of Dr. Jekyll and ~          1       0 case
##  3          42 The Strange Case of Dr. Jekyll and ~         1       0 of
##  4          42 The Strange Case of Dr. Jekyll and ~         2       0 dr
##  5          42 The Strange Case of Dr. Jekyll and ~         2       0 jekyll
##  6          42 The Strange Case of Dr. Jekyll and ~         2       0 and
##  7          42 The Strange Case of Dr. Jekyll and ~         3       0 mr
##  8          42 The Strange Case of Dr. Jekyll and ~         3       0 hyde
##  9          42 The Strange Case of Dr. Jekyll and ~         5       0 by
## 10          42 The Strange Case of Dr. Jekyll and ~         6       0 robert
## 11          42 The Strange Case of Dr. Jekyll and ~         6       0 louis
## 12          42 The Strange Case of Dr. Jekyll and ~         6       0 stevens~
```

This package also comes with the get_sentiments function that queries text lexicons useful for the analysis.

Graphics

This project created two main types of graphics. Below

Word Clouds

```
## function (id, title, tidy_books)
## {
##     filename = paste("results/", title, ".jpeg", sep = "")
##     jpeg(file = filename)
##     tidy_books %>% filter(gutenberg_id == id) %>% anti_join(stop_words) %>%
##         count(word) %>% with(wordcloud(word, n, max.words = 100,
##         min.freq = 10, scale = c(4, 0.5)))
##     dev.off()
## }
## <bytecode: 0x000000001e1be5b8>
```

The first type of data visualization involves getting a a word for each novel and creating a word cloud of the 100 most common words. The names of the protagonists and supporting cast are over-represented. To address this, a file “ignore.csv” was created. The word cloud will ignore anything in that file

```
all_stop_words <- create_stop_words("data/ignore.csv")
```

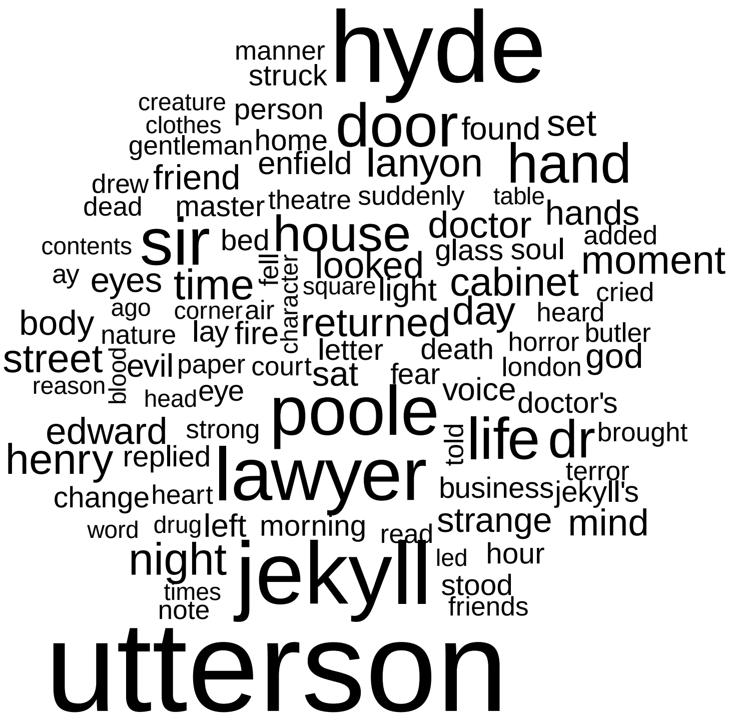
```
## Parsed with column specification:
## cols(
##   word = col_character()
## )
```

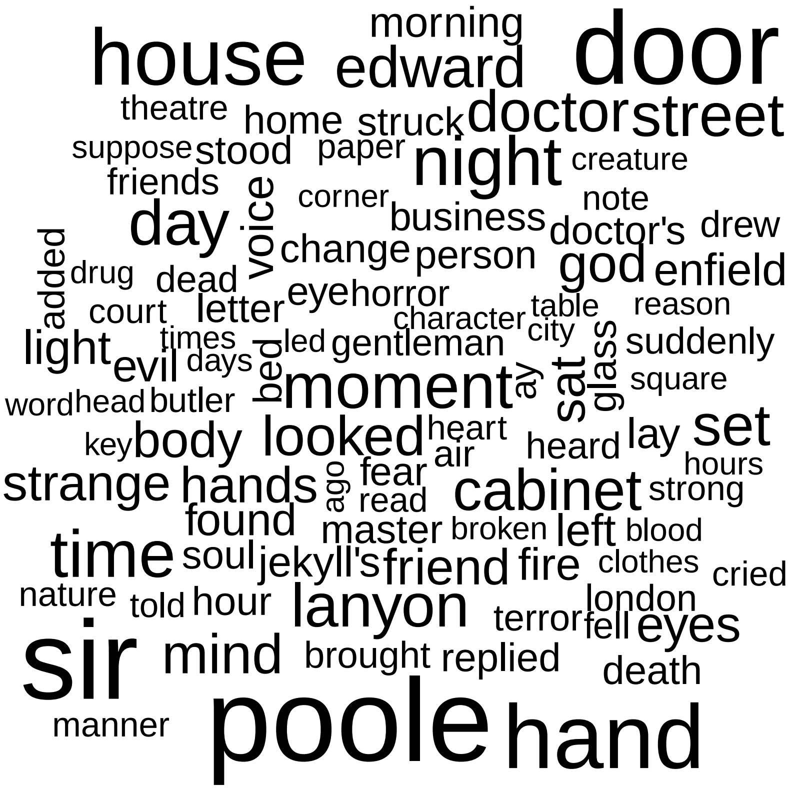
```
tidy_jekyll_no_stop <- tidy_jekyll%>%
  anti_join(all_stop_words,by="word")

tibble(
  total_words = nrow(tidy_jekyll),
  after_cleanup= nrow(tidy_jekyll_no_stop)
)
```

```
## # A tibble: 1 x 2
##   total_words after_cleanup
##         <int>         <int>
## 1       25899          8122
```

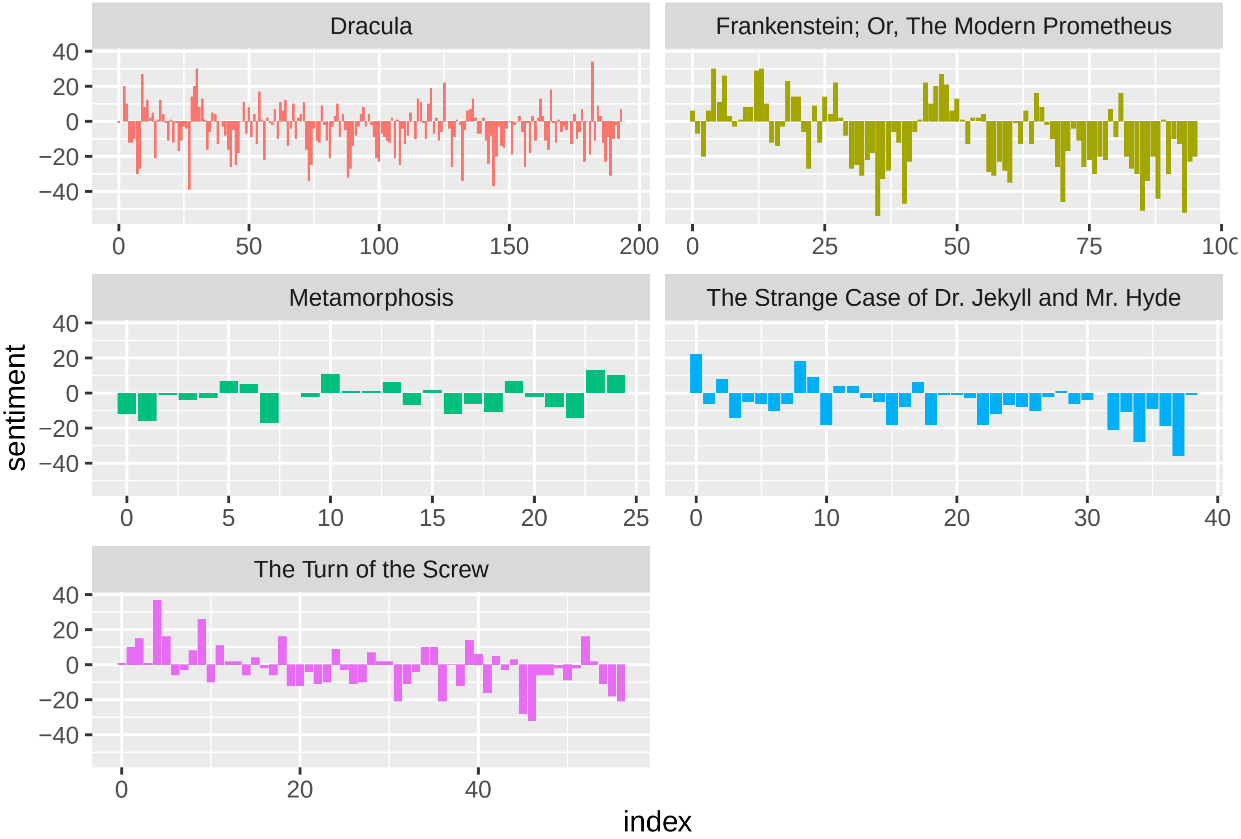
By cleaning up the data and removing stop words, we can reduce the dimensionality of the data and make analysis easier. We can also see the change in the word cloud.




morning
house
edward
door
theatre
home
struck
doctor
street
suppose
stood
paper
night
creature
friends
voice
corner
note
day
business
doctor's
drew
added
change
person
drug
dead
god
enfield
eye
horror
court
letter
character
table
reason
light
times
led
gentleman
city
glass
suddenly
evil
days
bed
moment
ay
sat
square
word
head
butler
key
body
looked
heart
heard
lay
set
air
hours
strange
hands
ago
fear
cabinet
strong
read
found
master
broken
left
blood
time
soul
jekyll's
friend
fire
clothes
cried
nature
told
hour
lanyon
london
terror
fell
eyes
sir
mind
brought
replied
death
manner
poole
hand

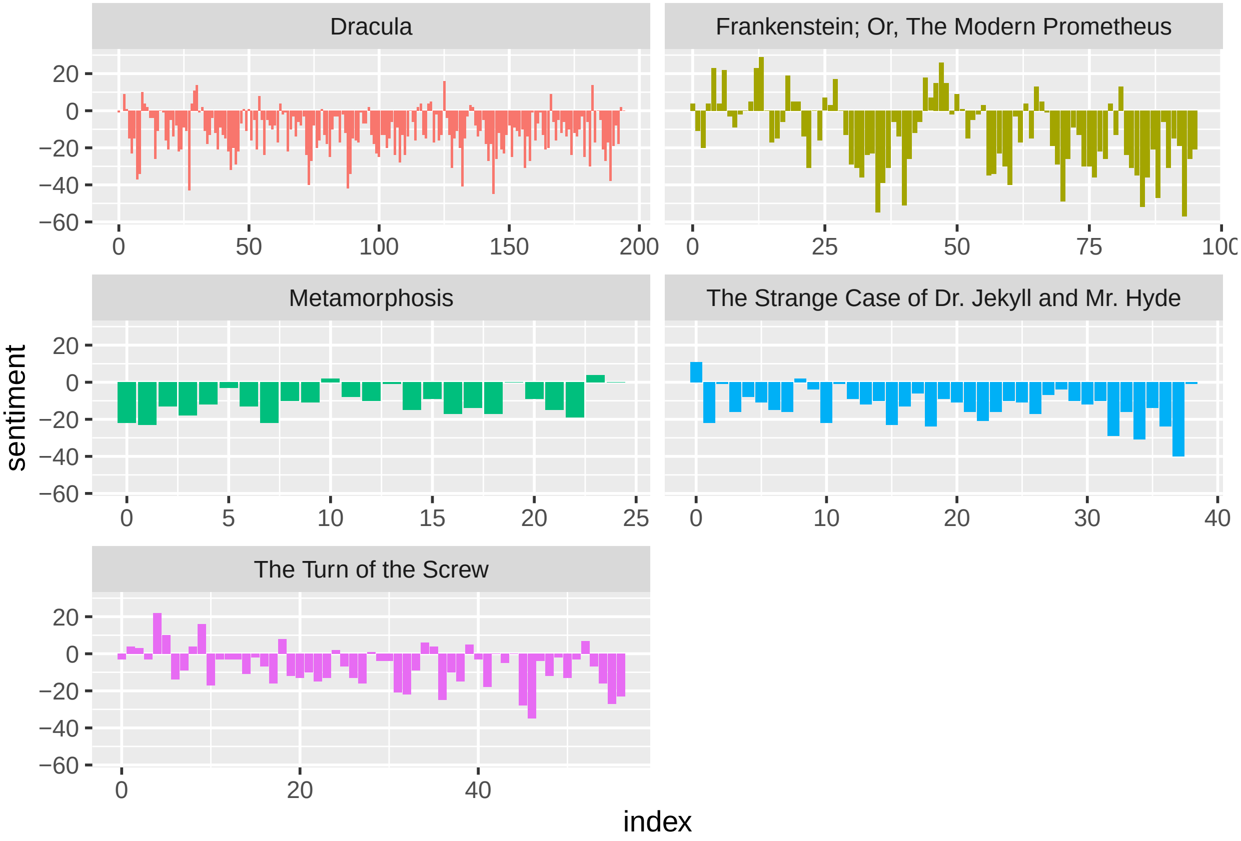
Plot Progression and Trajectory

Figure: Trajectory Graph of Raw Text



The bing lexicon provides a negative or positive designation for English words. These scores were obtained in 2004. The sentiments are relevant for that time period and can be anachronistic compared to some classic literature. For instance, English speakers in 2004 might view the word miss as a negative word meaning "fail to hit or notice"; however, in older settings and literature this can mean "young woman of nobility". To address these anachronisms, they will be similarly added to the ignore.csv file and processed in the same way. Below is the result of plot trajectory when the stop words library is applied

Figure: Trajectory Graph of Cleaned Text



The result is closer to what one would expect from a horror novel. Further testing and processing is necessary to determine if this is appropriate for analysis or if it causes a worse interpretation of storylines.

Difficulties and Opportunities

Although the program is much better than its first iteration, there is still room for improvement. The lexicon with anachronistic words removed is still not as good as mining lexicons from a group of scholars proficient in the English language at the time each book was written. Unfortunately, machine learning is not good at handling out of sample data. The code is most likely better applied to modern literature or social media data. Another challenge that would improve the reading is the inclusion of bigrams. Bigrams allow one to analyze a series of words and measure their net meaning. While “happy” connotes joy, “not happy” connotes sadness. When measuring sentiment in a word by word algorithm, the net measurement might be zero; however, if they were analyzed as a bigram, the program could interpret the net effect as a negative emotion.

References

1. In press. Text Mining with R: A Tidy Approach, year = 2020, url = https://www.tidytextmining.com/index.html, urldate = 2020-11-10.

2. In press. Sentiment analysis using tidytext.