DATA607 - Assignment Week 10

Sentiment Analysis

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Introduction

We were asked to recreate the R code from chapter 2 of the book "Text Mining with R: A Tidy Approach" then perform similar analysis on another authors set of works.

Load Packages

Load the packages required to complete the sentiment analysis.

```
library(tidyverse)
library(tidytext)
library(janeaustenr)
library(wordcloud)
library(reshape2)
```

Recreate Sentiment Analysis

Recreate the sentiment analysis from Chapter 2 in "Text Mining with R: A Tidy Approach." (Silge and Robinson 2017)

Sentiment Lexicons

A sentiment lexicon is a set of words and a sentiment score that is attributed to each word.

AFINN-111

The AFINN sentiment lexicon scores words on a scale of -5 (negative sentiment) to 5 (positive sentiment). (Nielsen 2011)

```
get_sentiments("afinn")
```

```
## # A tibble: 2,477 x 2
##    word       value
##    <chr>      <dbl>
##  1 abandon       -2
##  2 abandoned     -2
##  3 abandons      -2
##  4 abducted      -2
##  5 abduction     -2
##  6 abductions    -2
##  7 abhor         -3
##  8 abhorred      -3
##  9 abhorrent     -3
## 10 abhors        -3
## # ... with 2,467 more rows
```

Bing

The Bing sentiment lexicon assigns words as either positive or negative. (Hu and Liu 2004)

```
get_sentiments("bing")
```

```
## # A tibble: 6,786 x 2
##    word        sentiment
##    <chr>       <chr>
##  1 2-faces     negative
##  2 abnormal    negative
##  3 abolish     negative
##  4 abominable  negative
##  5 abominably  negative
##  6 abominate   negative
##  7 abomination negative
##  8 abort       negative
##  9 aborted     negative
## 10 aborts      negative
## # ... with 6,776 more rows
```

NRC Word-Emotion Association Lexicon

The nrc sentiment lexicon classifies words as positive or negative, but also by emotions such as fear or anger. (Mohammad and Turney 2013)

```
get_sentiments("nrc")
```

```
## # A tibble: 13,875 x 2
##    word        sentiment
##    <chr>       <chr>
##  1 abacus      trust
##  2 abandon     fear
##  3 abandon     negative
##  4 abandon     sadness
##  5 abandoned   anger
##  6 abandoned   fear
##  7 abandoned   negative
##  8 abandoned   sadness
##  9 abandonment anger
## 10 abandonment fear
## # ... with 13,865 more rows
```

Sentiment in Jane Austen’s Books

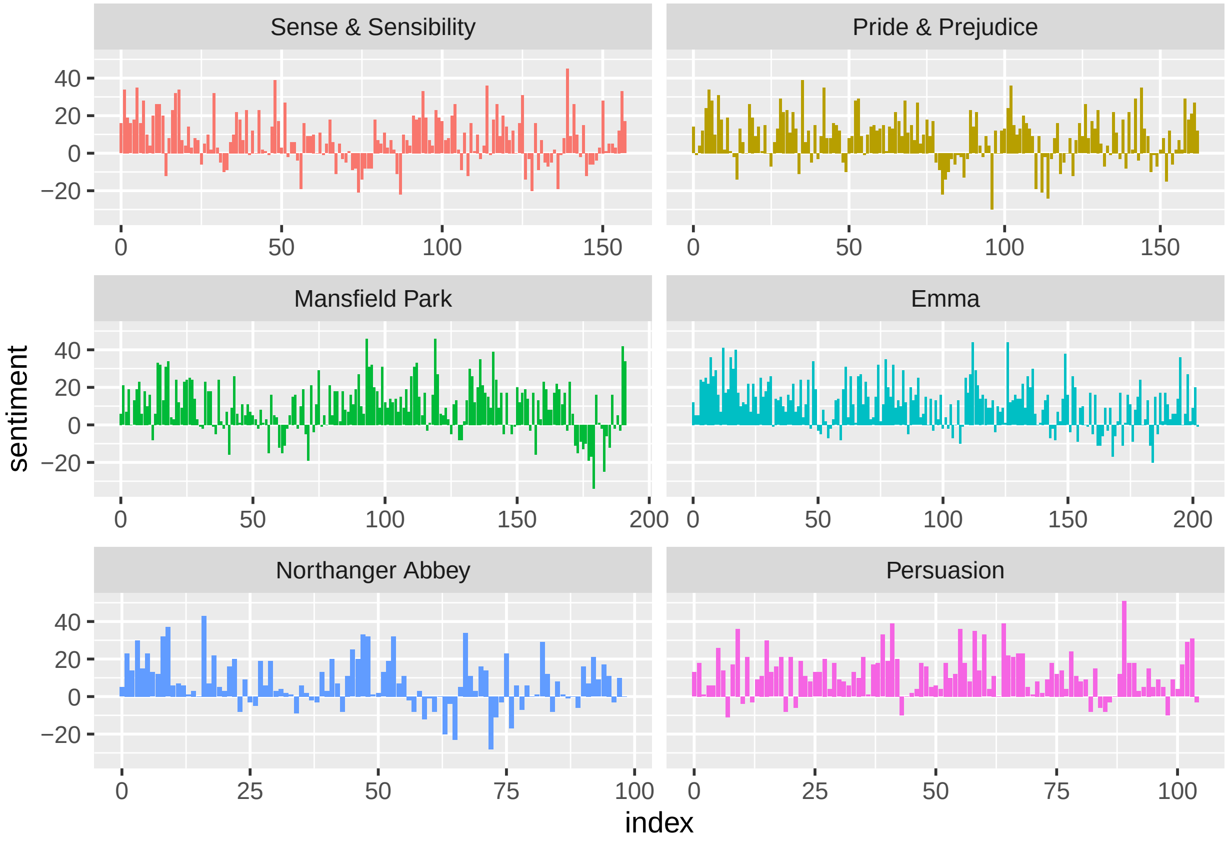
Using the Bing sentiment lexicon to compare the sentiment of all of Jane Austen’s books.

```
lines_per_index <- 80

tidy_books <- austen_books() %>%
  group_by(book) %>%
  mutate(
    linenumber = row_number(),
    chapter = cumsum(str_detect(text,regex("^chapter [\\divxlc]", ignore_case = TRUE)))
  ) %>%
  ungroup() %>%
  unnest_tokens(word,text)

jane_austen_sentiment <- tidy_books %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(book, index = linenumber %/% lines_per_index, sentiment) %>%
  pivot_wider(names_from = sentiment, values_from = n, values_fill = 0) %>%
  mutate(sentiment = positive - negative)

jane_austen_sentiment %>%
  ggplot(aes(index, sentiment, fill = book)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~book, ncol = 2, scales = "free_x")
```



Comparing Sentiment Lexicons

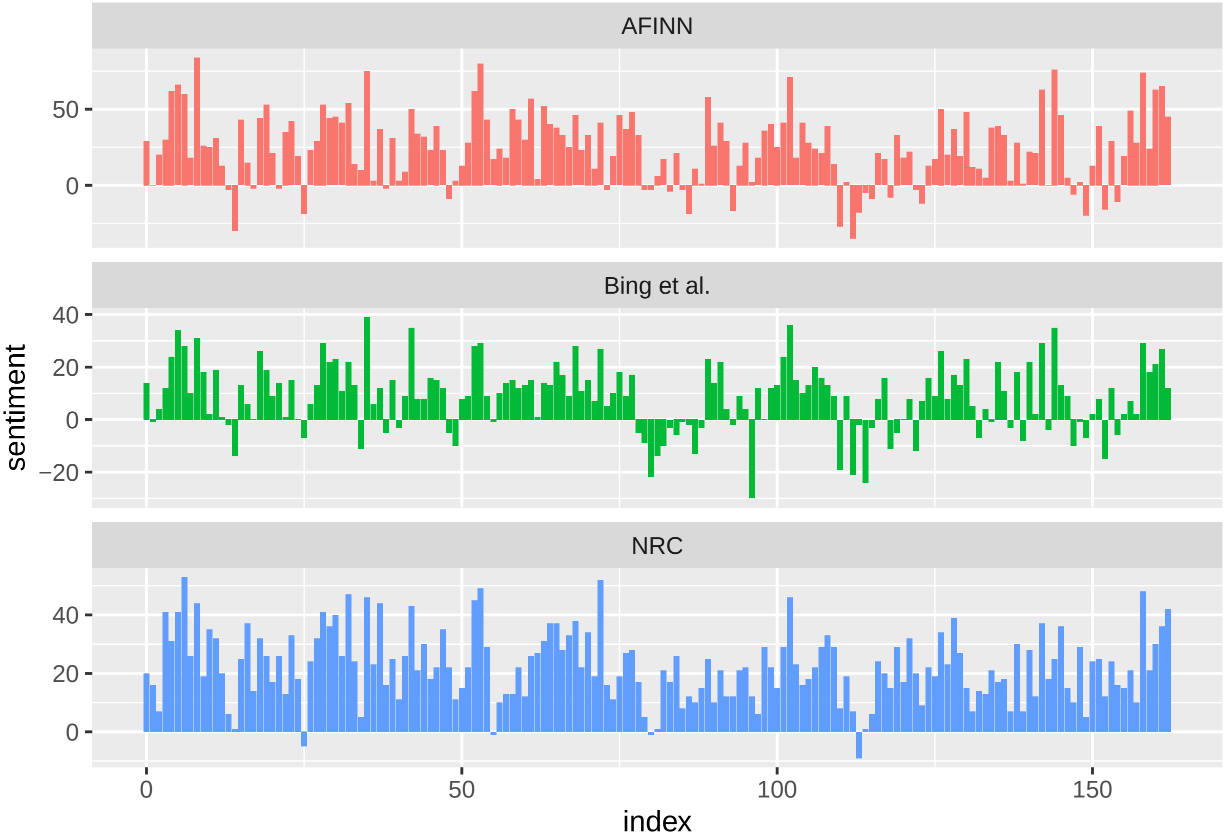
In Jane Austen's book "Pride and Prejudice," we will compare the three sentiment lexicons.

```
pride_prejudice <- tidy_books %>%
  filter(book == "Pride & Prejudice")

afinn <- pride_prejudice %>%
  inner_join(get_sentiments('afinn'), by = 'word') %>%
  group_by(index = linenumber %/% lines_per_index) %>%
  summarize(sentiment = sum(value)) %>%
  mutate(method = "AFINN")

bing_and_nrc <- bind_rows(
  pride_prejudice %>%
    inner_join(get_sentiments('bing'), by = 'word') %>%
    mutate(method = "Bing et al."),
  pride_prejudice %>%
    inner_join(get_sentiments('nrc') %>%
                 filter(sentiment %in% c('positive','negative')), by = 'word') %>%
    mutate(method = 'NRC')
) %>%
  count(method, index = linenumber %/% lines_per_index, sentiment) %>%
  pivot_wider(names_from = sentiment, values_from = n, values_fill = 0) %>%
  mutate(sentiment = positive - negative)
```

```
bind_rows(afinn, bing_and_nrc) %>%
  ggplot(aes(index, sentiment, fill = method)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~method, ncol = 1, scales = 'free_y')
```

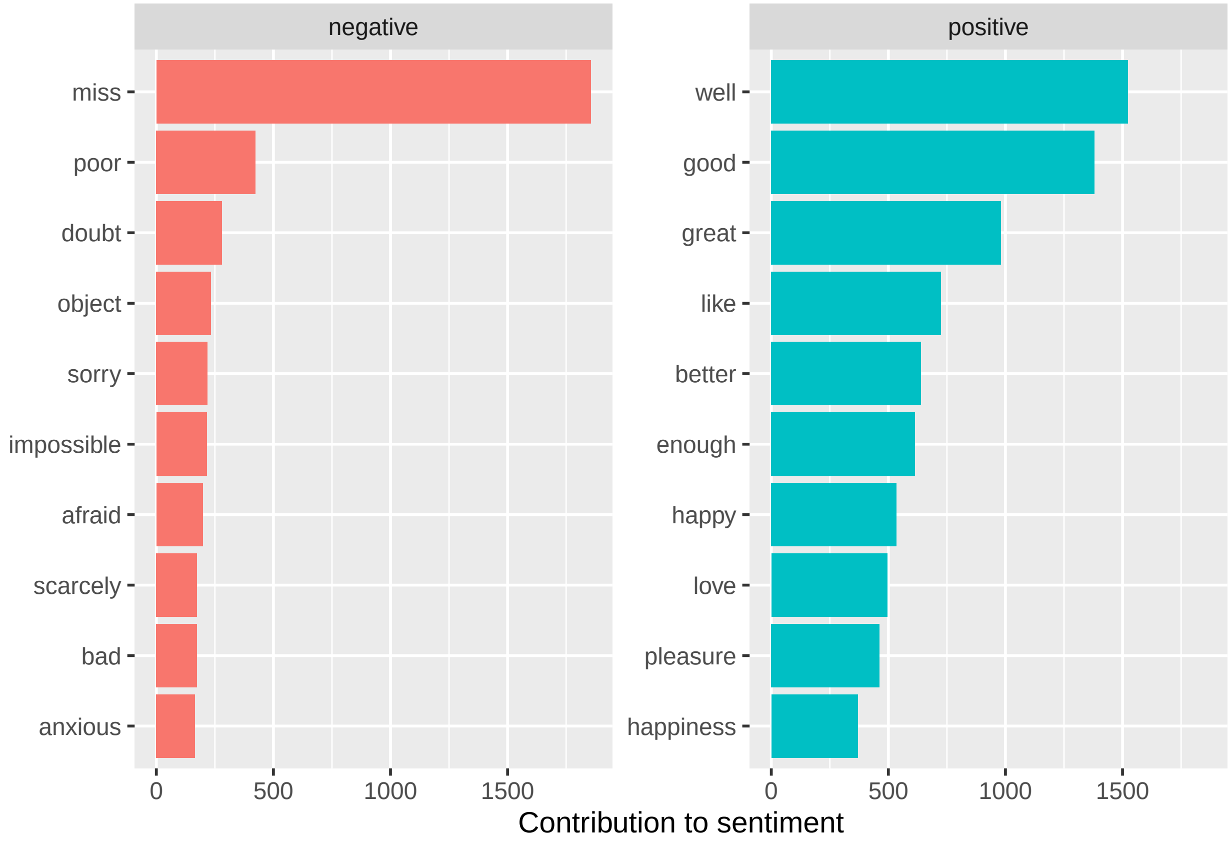


Common Positive and Negative Words

Determine the most common positive and negative words in Jane Austen's books.

```
bing_word_counts <- tidy_books %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(word, sentiment, sort = TRUE) %>%
  ungroup()

bing_word_counts %>%
  group_by(sentiment) %>%
  slice_max(n, n = 10) %>%
  ungroup() %>%
  mutate(word = reorder(word, n)) %>%
  ggplot(aes(n, word, fill = sentiment)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~sentiment, scales = 'free_y') +
  labs(x = 'Contribution to sentiment', y = NULL)
```



Custom Stop Words

The word 'miss' is contributing significantly towards negative sentiment, but it's use within Jane Austen's books isn't used in that context. Create a custom stop word list to adjust for anomalies in the sentiment lexicon used.

```
custom_stop_words <- bind_rows(tibble(word = c('miss'), lexicon = c('custom')), stop_words)

custom_stop_words
```

```
## # A tibble: 1,150 x 2
##    word        lexicon
##    <chr>       <chr>
##  1 miss        custom
##  2 a           SMART
##  3 a's         SMART
##  4 able        SMART
##  5 about       SMART
##  6 above       SMART
##  7 according   SMART
##  8 accordingly SMART
##  9 across      SMART
## 10 actually    SMART
## # ... with 1,140 more rows
```

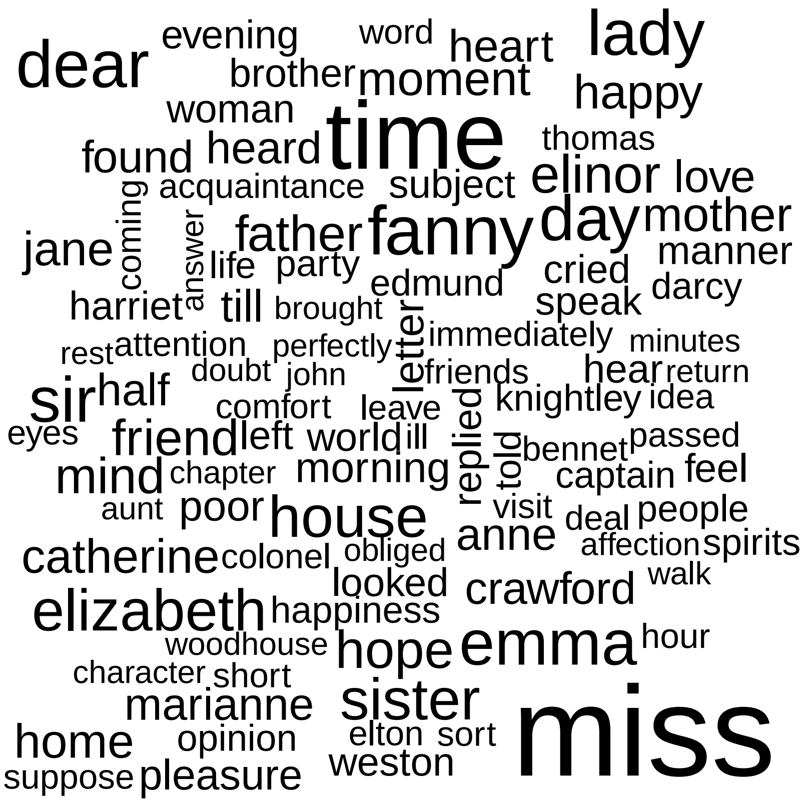
Wordclouds

Construct a wordcloud of the most common words in Jane Austen's books.

```
tidy_books %>%
  anti_join(stop_words, by = 'word') %>%
  count(word) %>%
  with(wordcloud(word, n, max.words = 100))
```

```
## Warning in wordcloud(word, n, max.words = 100): feelings could not be fit on
## page. It will not be plotted.
```

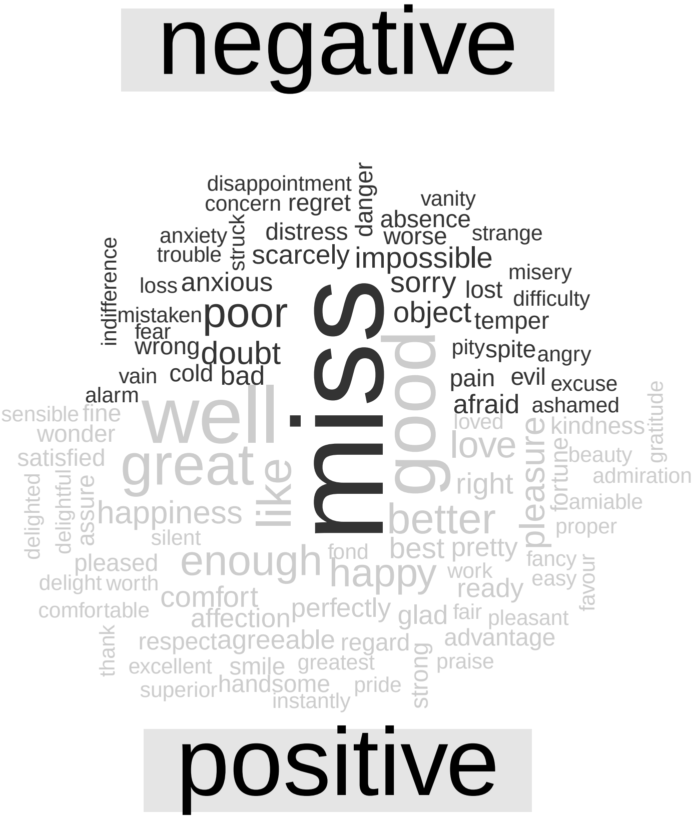
```
## Warning in wordcloud(word, n, max.words = 100): family could not be fit on page.
## It will not be plotted.
```



Wordcoulds by Sentiment

Construct a wordcloud of the positive and negative words in Jane Austen's books.

```
tidy_books %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(word, sentiment, sort = TRUE) %>%
  acast(word ~ sentiment, value.var = 'n', fill = 0) %>%
  comparison.cloud(colors = c('gray20', 'gray80'), max.words = 100)
```



Sentiment based on other units

Instead of considering sentiment on a word for word basis, we can look at it based on other units of text such as chapters. Determine the most negative chapter in each book.

```r
austen_chapters <- austen_books() %>%
  group_by(book) %>%
  unnest_tokens(chapter, text, token = 'regex', pattern = "Chapter|CHAPTER|chapter [\\divxlc]") %>%
  ungroup()

austen_chapters %>%
  group_by(book) %>%
  summarize(chapters = n())
```

```
## # A tibble: 6 x 2
##   book                chapters
##   <fct>                  <int>
## 1 Sense & Sensibility       51
## 2 Pride & Prejudice         62
## 3 Mansfield Park            49
## 4 Emma                      56
## 5 Northanger Abbey          32
## 6 Persuasion                25
```

```
bing_negative <- get_sentiments('bing') %>%
  filter(sentiment == 'negative')

wordcounts <- tidy_books %>%
  group_by(book, chapter) %>%
  summarize(words = n())
```

```
## `summarise()` has grouped output by 'book'. You can override using the `.groups` argument.
```

```
tidy_books %>%
  semi_join(bing_negative, by = 'word') %>%
  group_by(book, chapter) %>%
  summarize(negativewords = n()) %>%
  left_join(wordcounts, by = c('book','chapter')) %>%
  mutate(ratio = negativewords / words) %>%
  filter(chapter != 0) %>%
  slice_max(ratio, n = 1) %>%
  ungroup()
```

```
## `summarise()` has grouped output by 'book'. You can override using the `.groups` argument.
```

```
## # A tibble: 6 x 5
##   book                chapter negativewords words  ratio
##   <fct>                 <int>         <int> <int>  <dbl>
## 1 Sense & Sensibility      43           161  3405 0.0473
## 2 Pride & Prejudice        34           111  2104 0.0528
## 3 Mansfield Park           46           173  3685 0.0469
## 4 Emma                     15           151  3340 0.0452
## 5 Northanger Abbey         21           149  2982 0.0500
## 6 Persuasion                4            62  1807 0.0343
```

Sir Arthur Conan Doyle

Perform a similar analysis based on the works of author Sir Arthur Conan Doyle.

Project Gutenberg

Project Gutenberg is a library of public domain works. The gutenbergr package allows access to these works. (Robinson 2021) Retrieve a list of the Sherlock Holmes books that are available.

```
library(gutenbergr)

doyle_books <- gutenberg_works(author == 'Doyle, Arthur Conan') %>%
  filter(gutenberg_bookshelf == 'Detective Fiction')

doyle_books
```

```
## # A tibble: 13 x 8
##    gutenberg_id title   author gutenberg_autho~ language gutenberg_books~ rights
##           <int> <chr>   <chr>              <int> <chr>    <chr>             <chr>
##   1         108 The Re~ Doyle~                69 en       Detective Ficti~ Publi~
##   2         244 A Stud~ Doyle~                69 en       Detective Ficti~ Publi~
##   3         834 The Me~ Doyle~                69 en       Detective Ficti~ Publi~
##   4        2097 The Si~ Doyle~                69 en       Detective Ficti~ Publi~
##   5        2343 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##   6        2344 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##   7        2345 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##   8        2346 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##   9        2347 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##  10        2348 The Di~ Doyle~                69 en       Detective Ficti~ Publi~
##  11        2349 The Ad~ Doyle~                69 en       Detective Ficti~ Publi~
##  12        2350 His La~ Doyle~                69 en       Detective Ficti~ Publi~
##  13        3289 The Va~ Doyle~                69 en       Detective Ficti~ Publi~
## # ... with 1 more variable: has_text <lgl>
```

With the list of books, download the works and tidy.

```
tidy_doyle <- doyle_books %>%
  gutenberg_download(meta_fields = 'title') %>%
  group_by(gutenberg_id) %>%
  mutate(linenumber = row_number()) %>%
  ungroup() %>%
  unnest_tokens(word, text)
```

```
## Determining mirror for Project Gutenberg from http://www.gutenberg.org/robot/harvest
```

```
## Using mirror http://aleph.gutenberg.org
```

Unfortunately, in this collection of works, chapter pages are not present, so we are unable to consider a units by chapter.

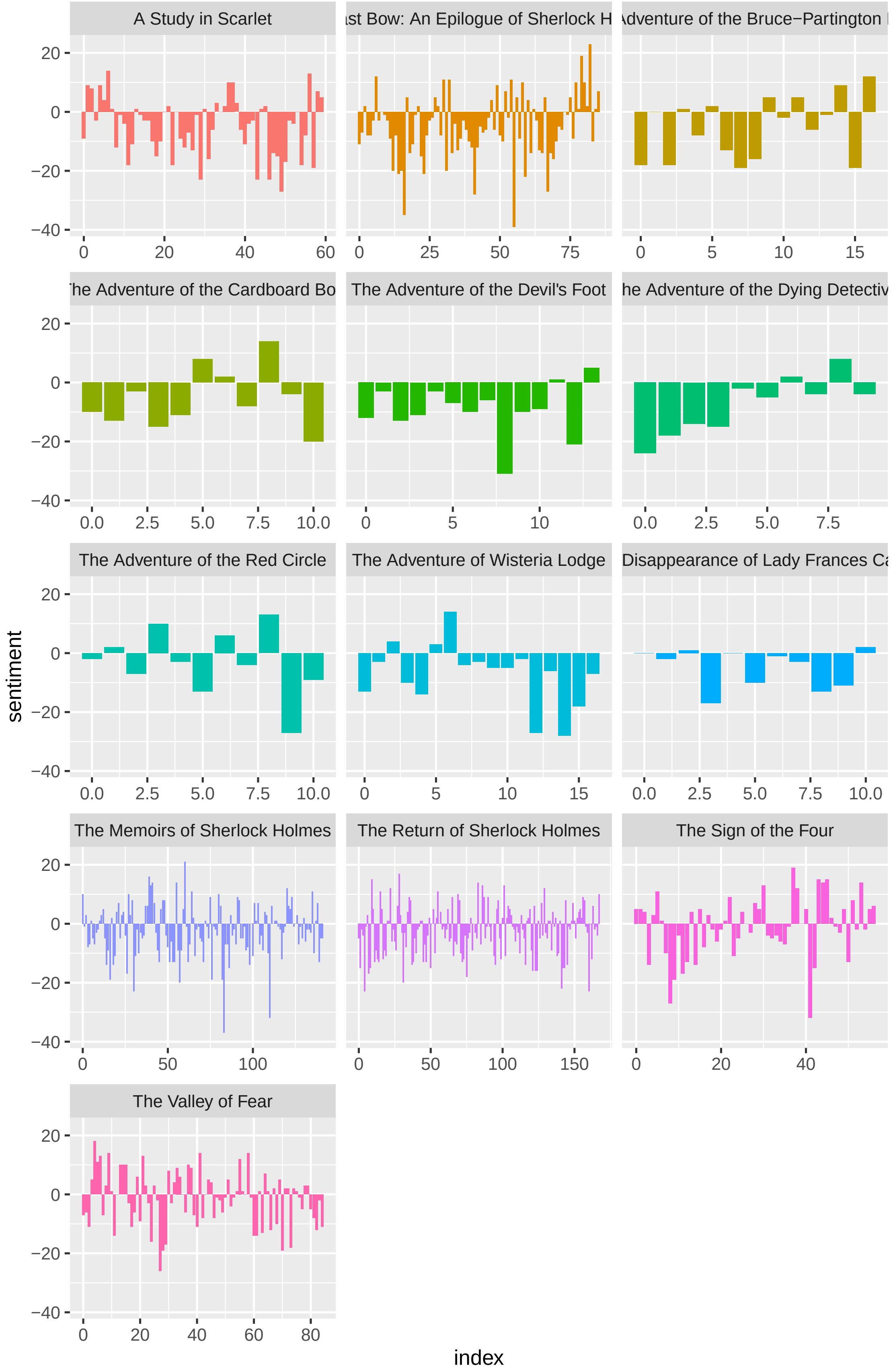
Sentiment in Sir Arthur Conan Doyal's Books

Using the Bing sentiment lexicon to compare the sentiment of all of the Sherlock Holmes books.

```
lines_per_index <- 80

doyle_sentiment <- tidy_doyle %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(title, index = linenumber %/% lines_per_index, sentiment) %>%
  pivot_wider(names_from = sentiment, values_from = n, values_fill = 0) %>%
  mutate(sentiment = positive - negative)

doyle_sentiment %>%
  ggplot(aes(index, sentiment, fill = title)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~title, ncol = 3, scales = "free_x")
```


A Study in Scarlet
ıst Bow: An Epilogue of Sherlock H
\dventure of the Bruce−Partington I
'he Adventure of the Cardboard Bo
The Adventure of the Devil's Foot
he Adventure of the Dying Detectiv
The Adventure of the Red Circle
The Adventure of Wisteria Lodge
Disappearance of Lady Frances Ca
The Memoirs of Sherlock Holmes
The Return of Sherlock Holmes
The Sign of the Four
The Valley of Fear
sentiment
index
20
0
−20
−40
0
20
40
60
0
25
50
75
0
5
10
15
0.0
2.5
5.0
7.5
10.0
0
50
100
150
80

Comparing Sentiment Lexicons

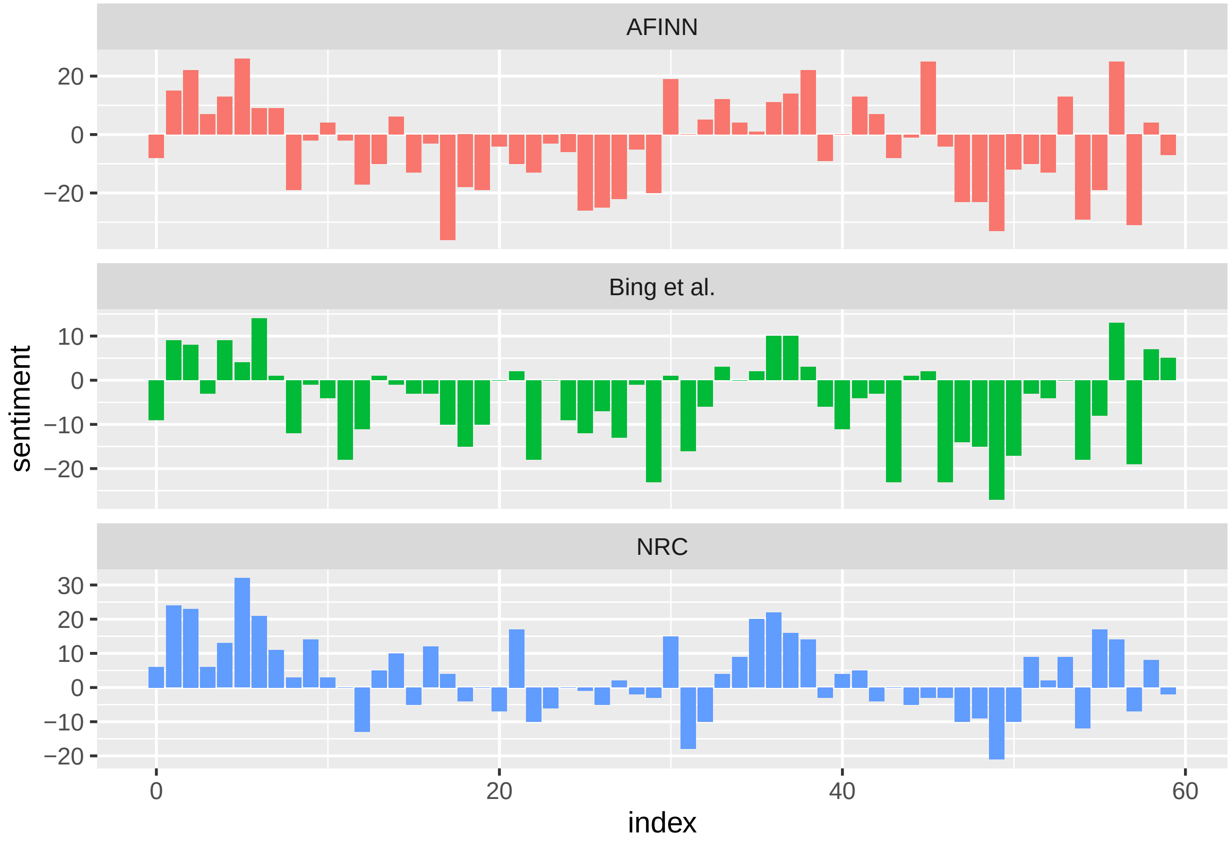
In “A Study in Scarlet,” we will compare the three sentiment lexicons.

```r
study_scarlet <- tidy_doyle %>%
  filter(title == "A Study in Scarlet")

scarlet_afinn <- study_scarlet %>%
  inner_join(get_sentiments('afinn'), by = 'word') %>%
  group_by(index = linenumber %/% lines_per_index) %>%
  summarize(sentiment = sum(value)) %>%
  mutate(method = "AFINN")

scarlet_bing_and_nrc <- bind_rows(
  study_scarlet %>%
    inner_join(get_sentiments('bing'), by = 'word') %>%
    mutate(method = "Bing et al."),
  study_scarlet %>%
    inner_join(get_sentiments('nrc') %>%
                 filter(sentiment %in% c('positive','negative')), by = 'word') %>%
    mutate(method = 'NRC')
) %>%
  count(method, index = linenumber %/% lines_per_index, sentiment) %>%
  pivot_wider(names_from = sentiment, values_from = n, values_fill = 0) %>%
  mutate(sentiment = positive - negative)

bind_rows(scarlet_afinn, scarlet_bing_and_nrc) %>%
  ggplot(aes(index, sentiment, fill = method)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~method, ncol = 1, scales = 'free_y')
```



Syuzhet

I tried playing with the Syuzhet package to use another sentiment lexicon. (**syuzhet?**) The package computes a sentiment score for each line of the book text.

```
library(syuzhet)

study_in_scarlet <- doyle_books %>%
  filter(title == 'A Study in Scarlet') %>%
  gutenberg_download(meta_fields = 'title') %>%
  filter(grepl('[A-Za-z]',text))

syuzhet_sentiment <- get_sentiment(study_in_scarlet$text, method = 'syuzhet')
summary(syuzhet_sentiment)
```

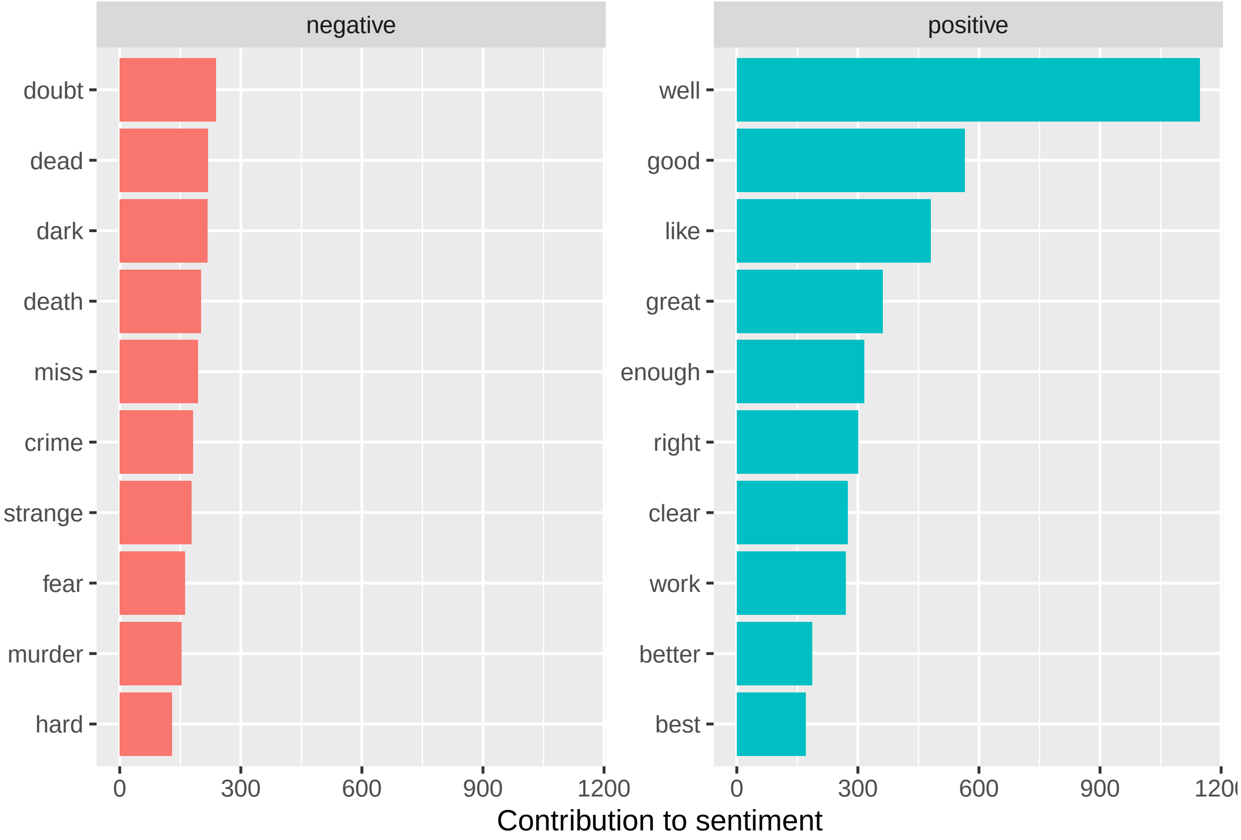
```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -3.60000 -0.40000  0.00000  0.01536  0.50000  2.60000
```

Common Positive and Negative Words

Determine the most common positive and negative words in the Sherlock Holmes books.

```
doyle_bing_word_counts <- tidy_doyle %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(word, sentiment, sort = TRUE) %>%
  ungroup()

doyle_bing_word_counts %>%
  group_by(sentiment) %>%
  slice_max(n, n = 10) %>%
  ungroup() %>%
  mutate(word = reorder(word, n)) %>%
  ggplot(aes(n, word, fill = sentiment)) +
  geom_col(show.legend = FALSE) +
  facet_wrap(~sentiment, scales = 'free_y') +
  labs(x = 'Contribution to sentiment', y = NULL)
```



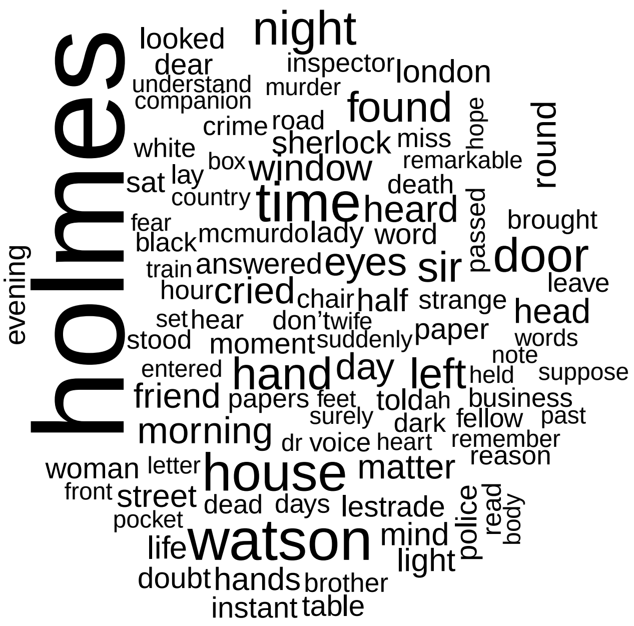
Custom Stop Words

Again we see the word ‘miss’ on the common negative list, although not as impacting with Jane Austen’s work, but based on the time period I would expect a fair number of instances are referring to a women and not the negative context.

Wordclouds

Construct a wordcloud of the most common words in the Sherlock Holmes books.

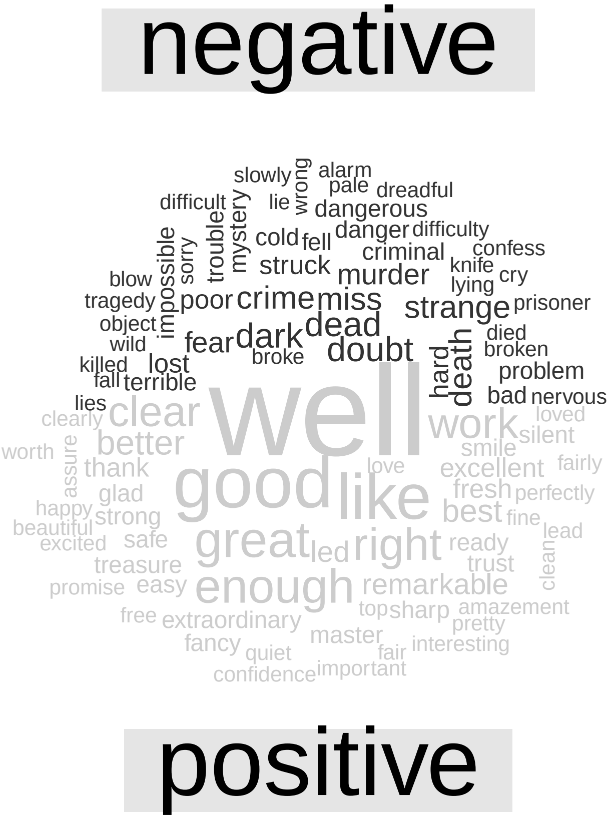
```
tidy_doyle %>%
  anti_join(stop_words, by = 'word') %>%
  count(word) %>%
  with(wordcloud(word, n, max.words = 100))
```



Wordcoulds by Sentiment

Construct a wordcloud of the positive and negative words in Jane Austen’s books.

```
tidy_doyle %>%
  inner_join(get_sentiments('bing'), by = 'word') %>%
  count(word, sentiment, sort = TRUE) %>%
  acast(word ~ sentiment, value.var = 'n', fill = 0) %>%
  comparison.cloud(colors = c('gray20', 'gray80'), max.words = 100)
```



Sentiment based on other units

Unfortunately the chapter pages that were in Jane Austen's books, do not appear in the files for Sir Arthur Conan Doyle, so a similar analysis cannot be performed.

References

Hu, Minqing, and Bing Liu. 2004. "Mining and Summarizing Customer Reviews," KDD '04, 168–77. https://doi.org/10.1145/1014052.1014073.

Mohammad, Saif M., and Peter D. Turney. 2013. "Crowdsourcing a Word-Emotion Association Lexicon." *Computational Intelligence* 29 (3): 436–65. https://doi.org/10.1111/j.1467-8640.2012.00460.x.

Nielsen, F. Å. 2011. "AFINN." Richard Petersens Plads, Building 321, DK-2800 Kgs. Lyngby: Informatics; Mathematical Modelling, Technical University of Denmark. http://www2.compute.dtu.dk/pubdb/pubs/6010-full.html.

Robinson, David. 2021. *Gutenbergr: Download and Process Public Domain Works from Project Gutenberg.* https://CRAN.R-project.org/package=gutenbergr.

Silge, Julia, and David Robinson. 2017. *Text Mining with r: A Tidy Approach.* 1st ed. O'Reilly Media, Inc. https://www.tidytextmining.com.