Please note the participation at the end of these slides.

Data Analytics
CS301
Text Analysis: Sentiment Determination

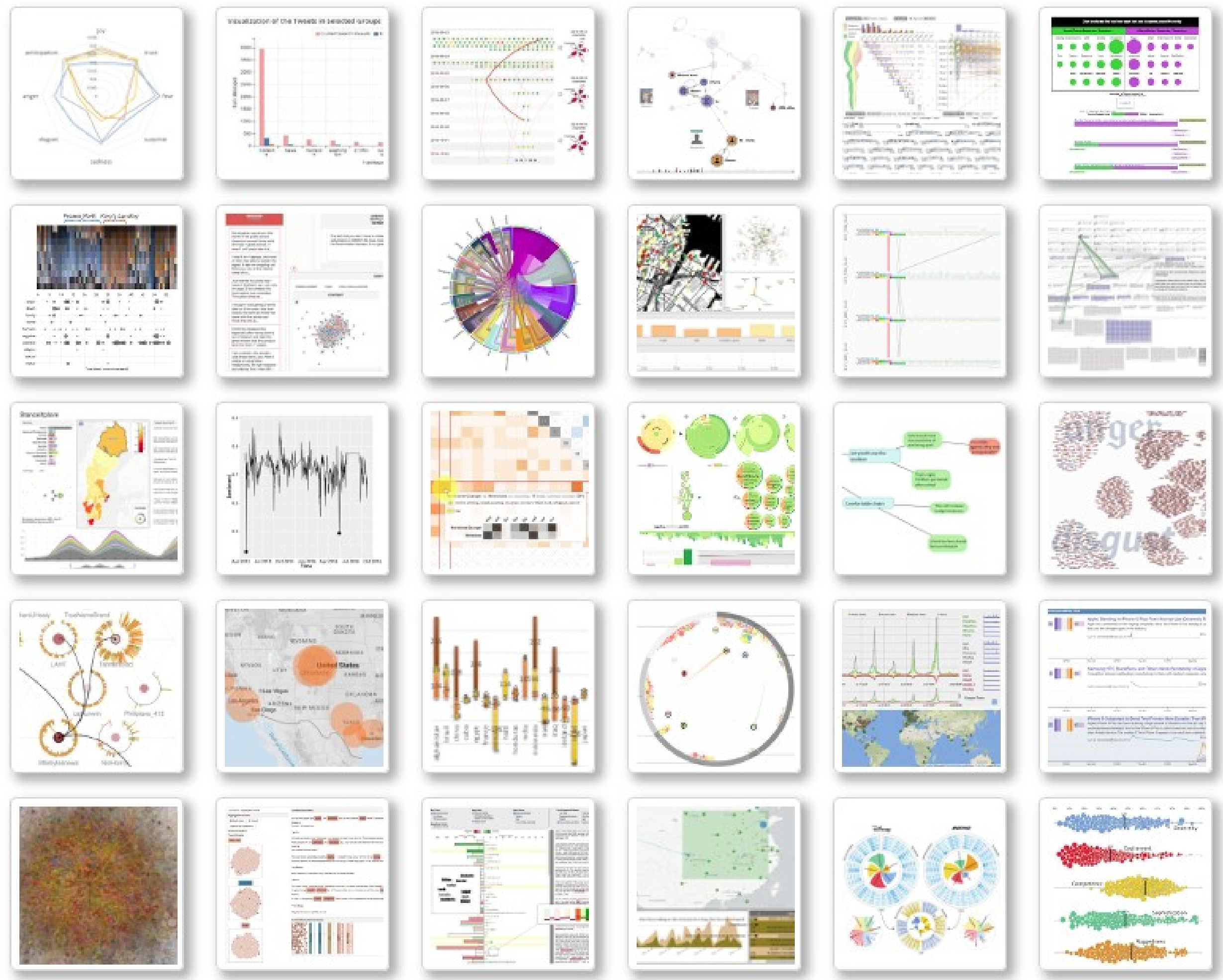
Week 12: 30th March
Spring 2020

Oliver BONHAM-CARTER

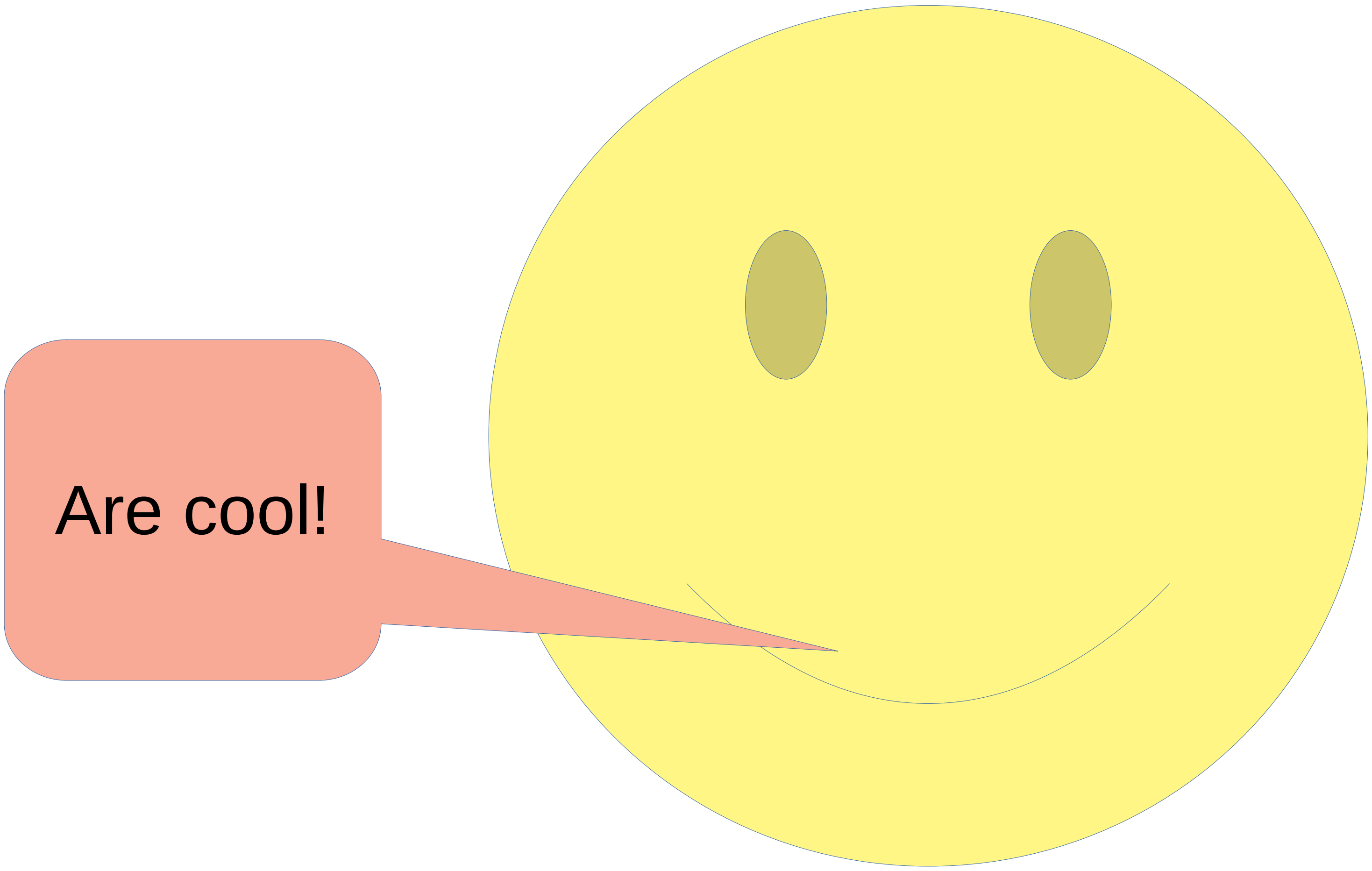
Visualizing Schemes are still being developed

- To find out about new work in visualizing analytics, check out the **SentimentVis Browser** at http://sentimentvis.lnu.se/

A Visual Survey of Sentiment Visualization Techniques: Have a look at all the different ways to determine sentiment in text!



The following tools ...



Text Analysis: *Sentiment* of Content

- The determination of the text’s “message” or “mood” based on the actual individual *words*.
- How good, how bad is the writer feeling about some topic?
- Is a body of text describing some idea where many of the words are emotionally charged with some type of feeling?
- Sentiment analysis is able to determine what the general feeling is behind some written work.

Online tool: Sentiment Viz

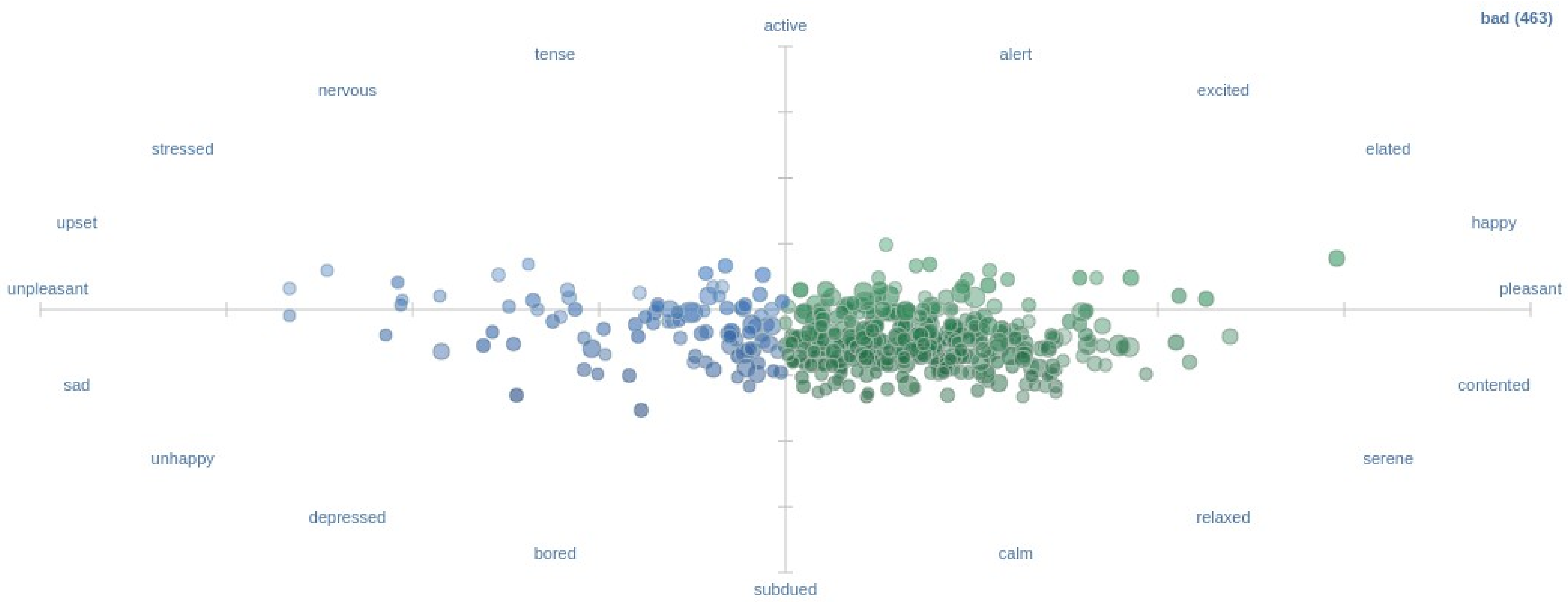
https://www.csc2.ncsu.edu/faculty/healey/tweet_viz/tweet_app/

What Is This Tool?

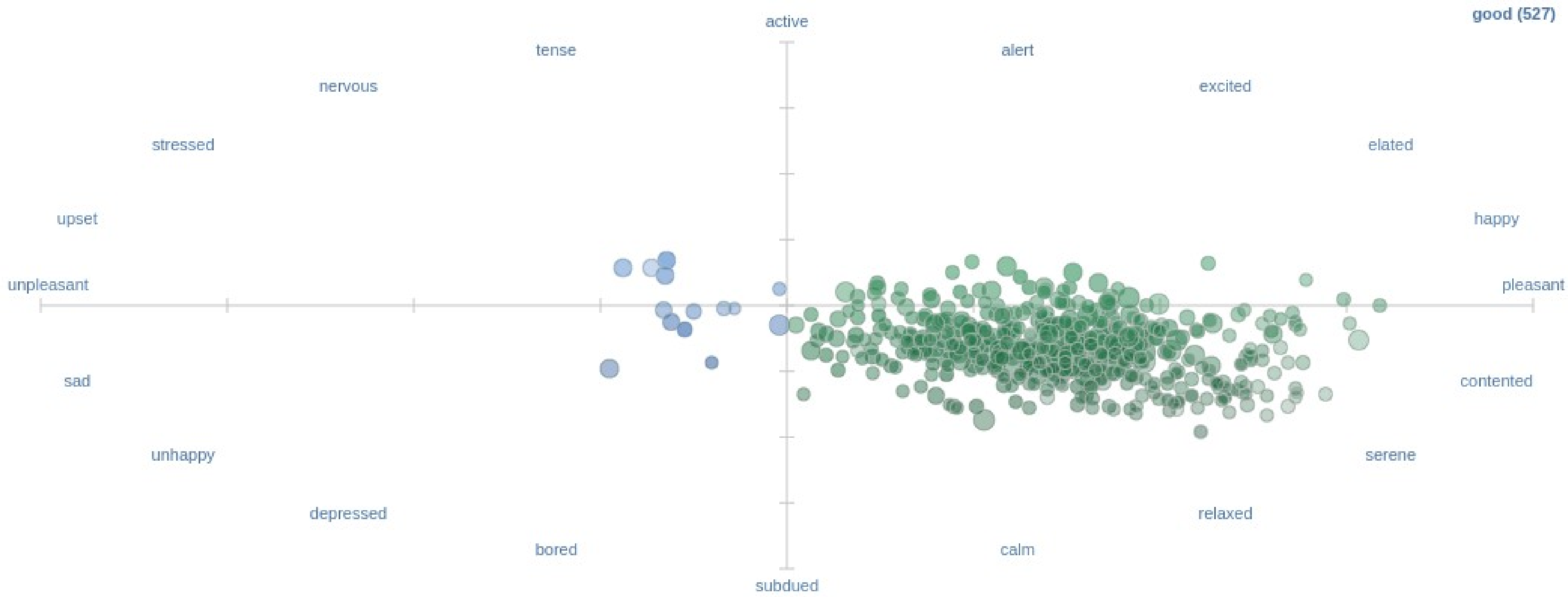
- User-entered keywords are parsed in the tweets of the day.
- Tweets are presented using several different visualization techniques. Each technique is designed to highlight different aspects of the tweets and their sentiment.
- The sentiment tab visualizes where tweets lie in an emotional scatterplot with pleasure and arousal on its horizontal and vertical axes.
- The spatial distribution of the tweets summarizes their overall sentiment.
- The number of queries per minute is limited...

https://www.csc2.ncsu.edu/faculty/healey/tweet_viz/tweet_app/

The word, "Bad"


bad (463)
active
tense
alert
nervous
excited
stressed
elated
upset
happy
unpleasant
pleasant
sad
contented
unhappy
serene
depressed
relaxed
bored
calm
subdued

The word, “Good”



Click around on the web site to discover new ways of viewing data.

Online Tool:
The Opportunity Atlas

The Opportunity Atlas

Which neighborhoods in America offer children the best chance to rise out of poverty?

The Opportunity Atlas answers this question using anonymous data following 20 million Americans from childhood to their mid-30s.

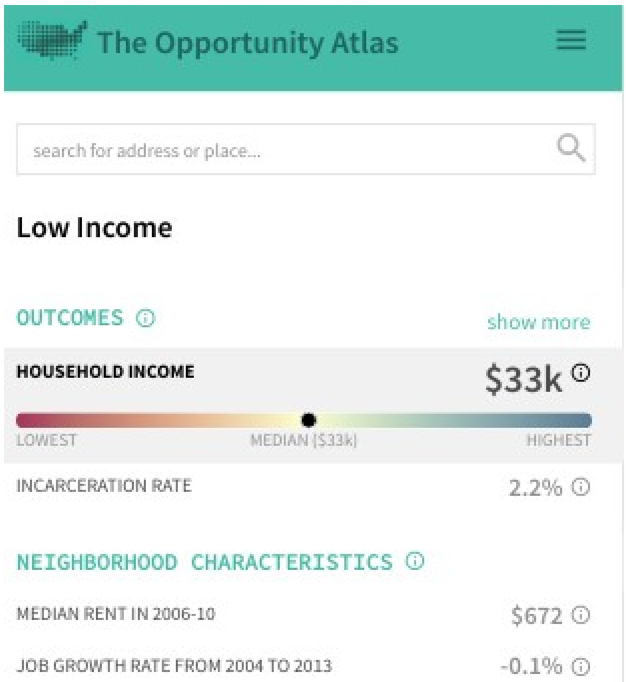
Now you can trace the roots of today's affluence and poverty back to the neighborhoods where people **grew up**.

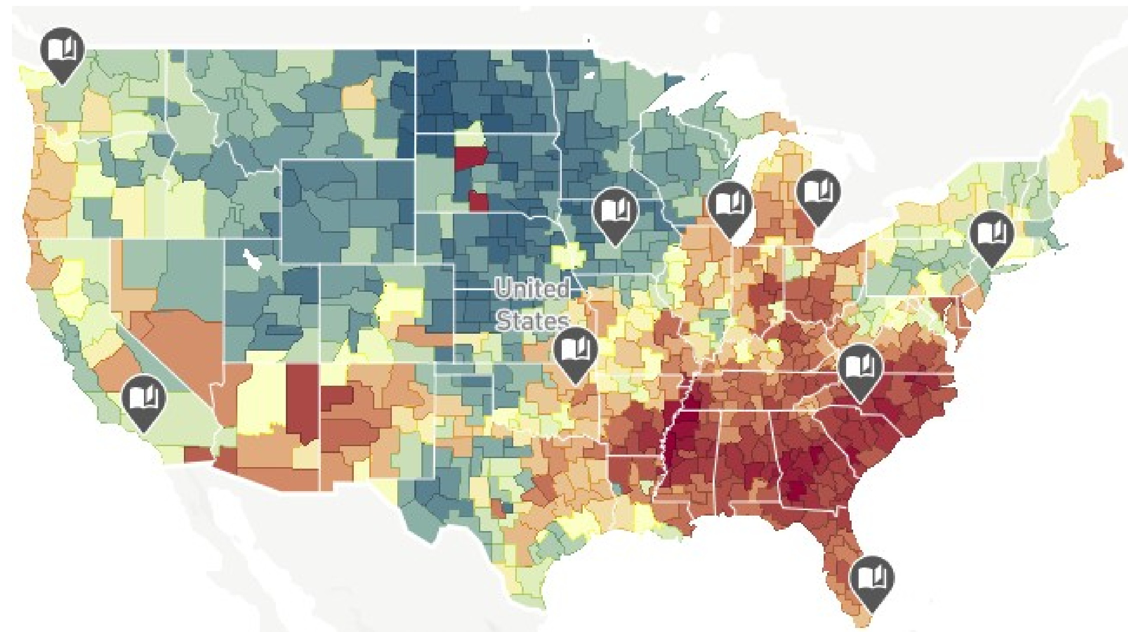
See where and for whom opportunity has been missing, and develop local solutions to help more children rise out of poverty.

BEGIN EXPLORING

https://www.opportunityatlas.org/

Online Tool:
The Opportunity Atlas

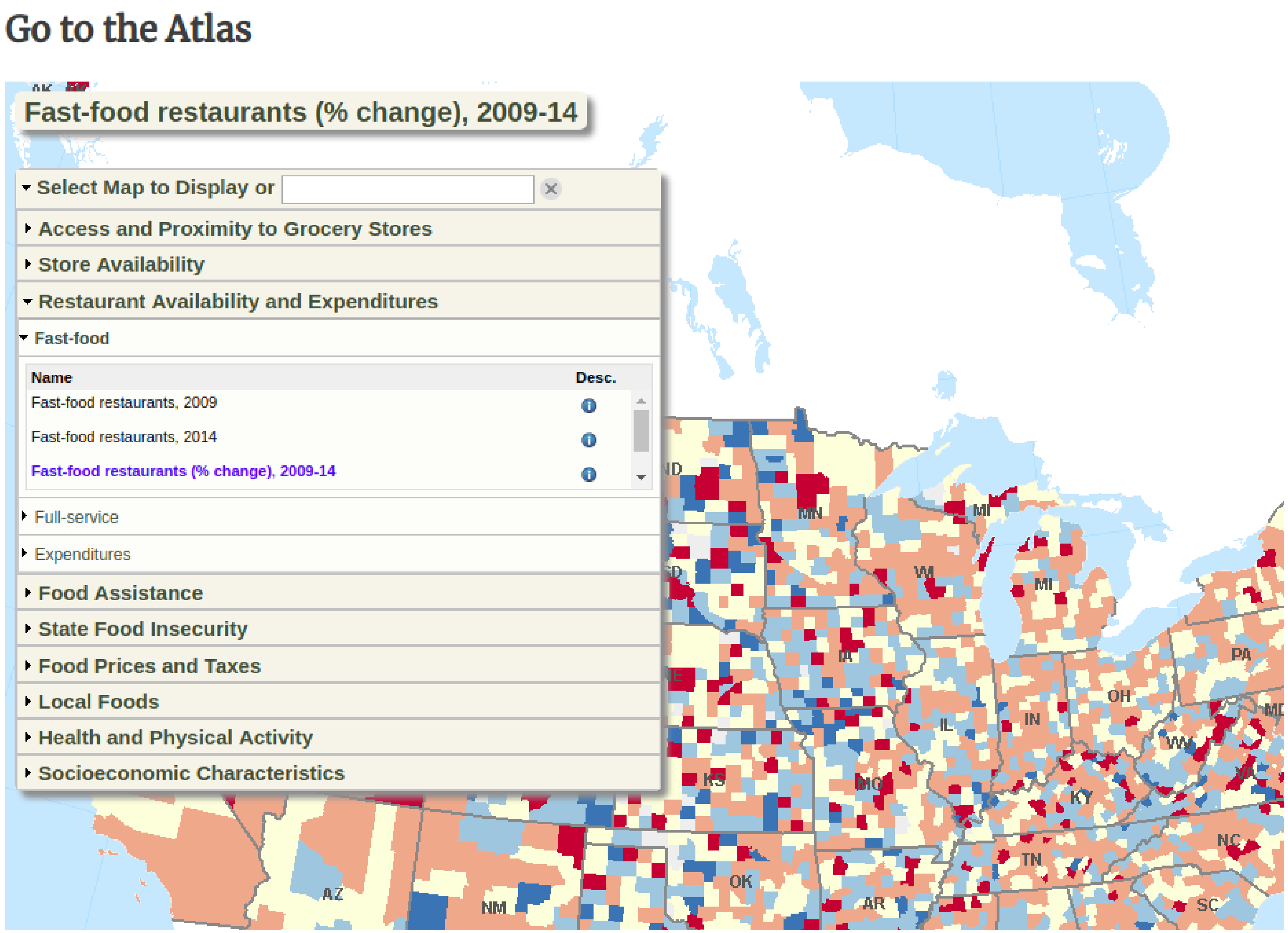




Determine the statistical amount of opportunity for careers, educational development and similar by a map.

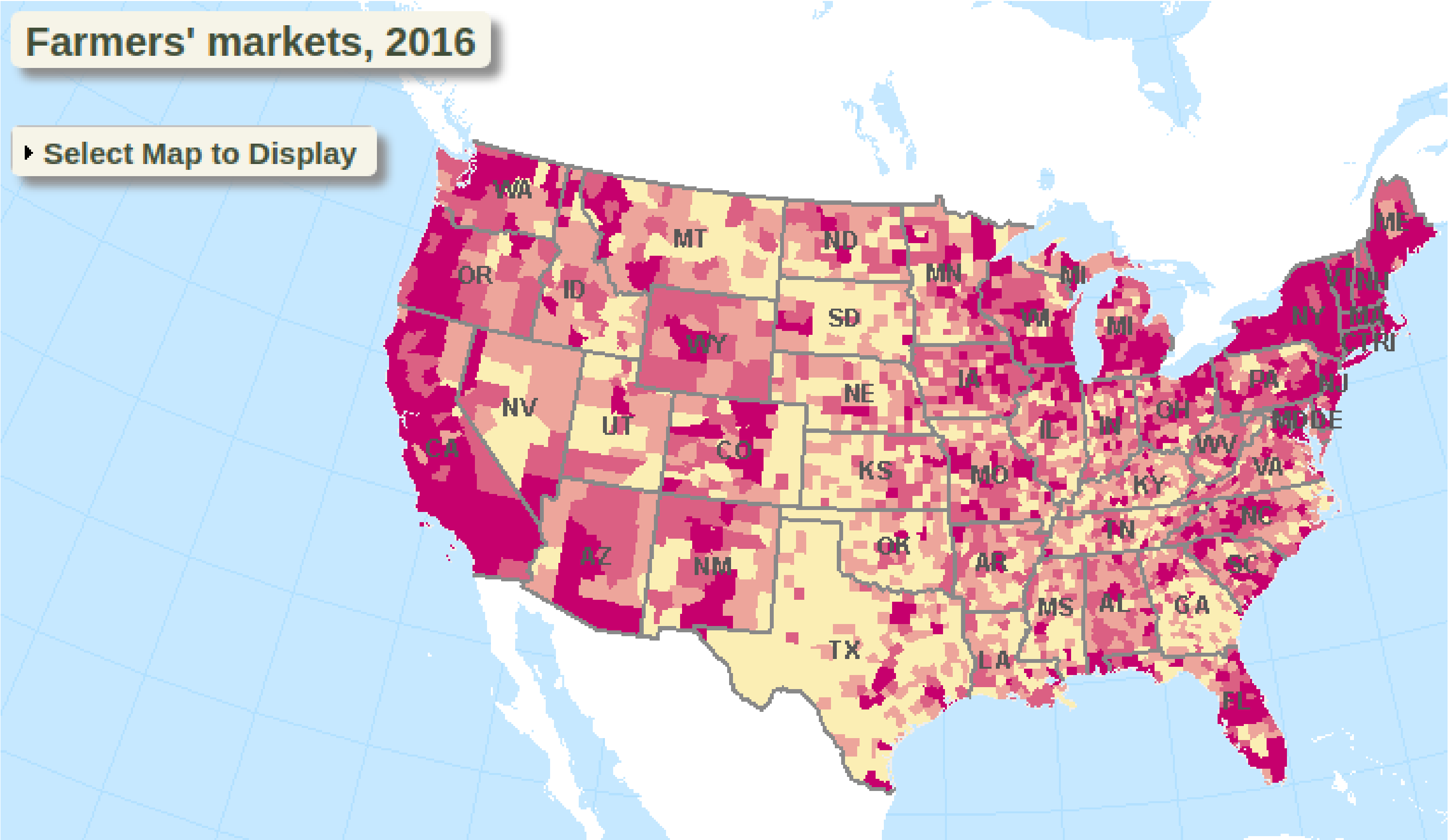
https://www.opportunityatlas.org/

Online Tool:
The US Dept of Agriculture



https://www.ers.usda.gov/data-products/food-environment-atlas/go-to-the-atlas/

Online Tool:
The US Dept of Agriculture



Mapping the number of Farmer’s Markets available in 2016

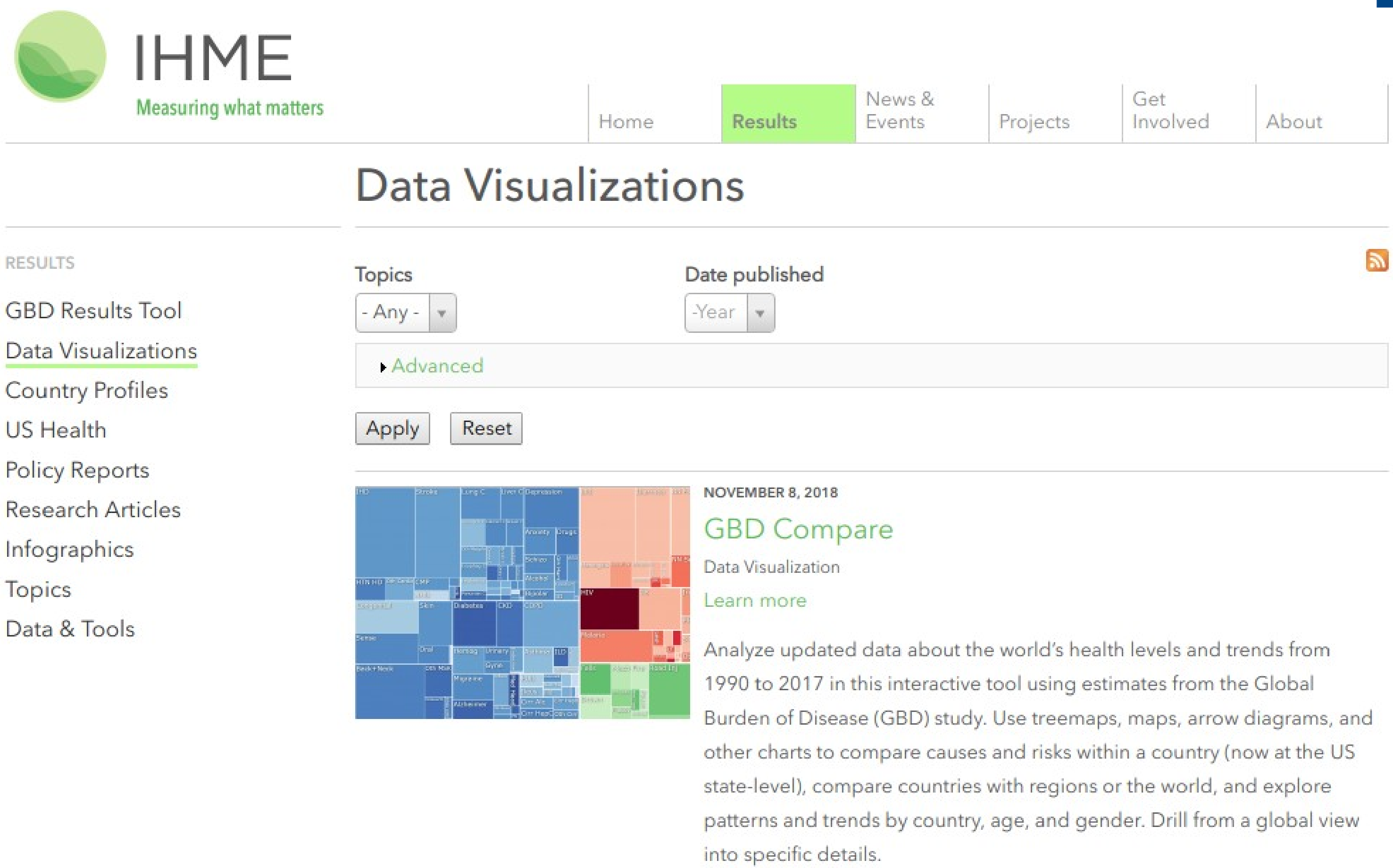
https://www.ers.usda.gov/data-products/food-environment-atlas/go-to-the-atlas/

Online Tool: The Institute for Health Metrics and Evaluation

http://www.healthdata.org/

https://vizhub.healthdata.org/epi/

Online Tool: The Institute for Health Metrics and Evaluation

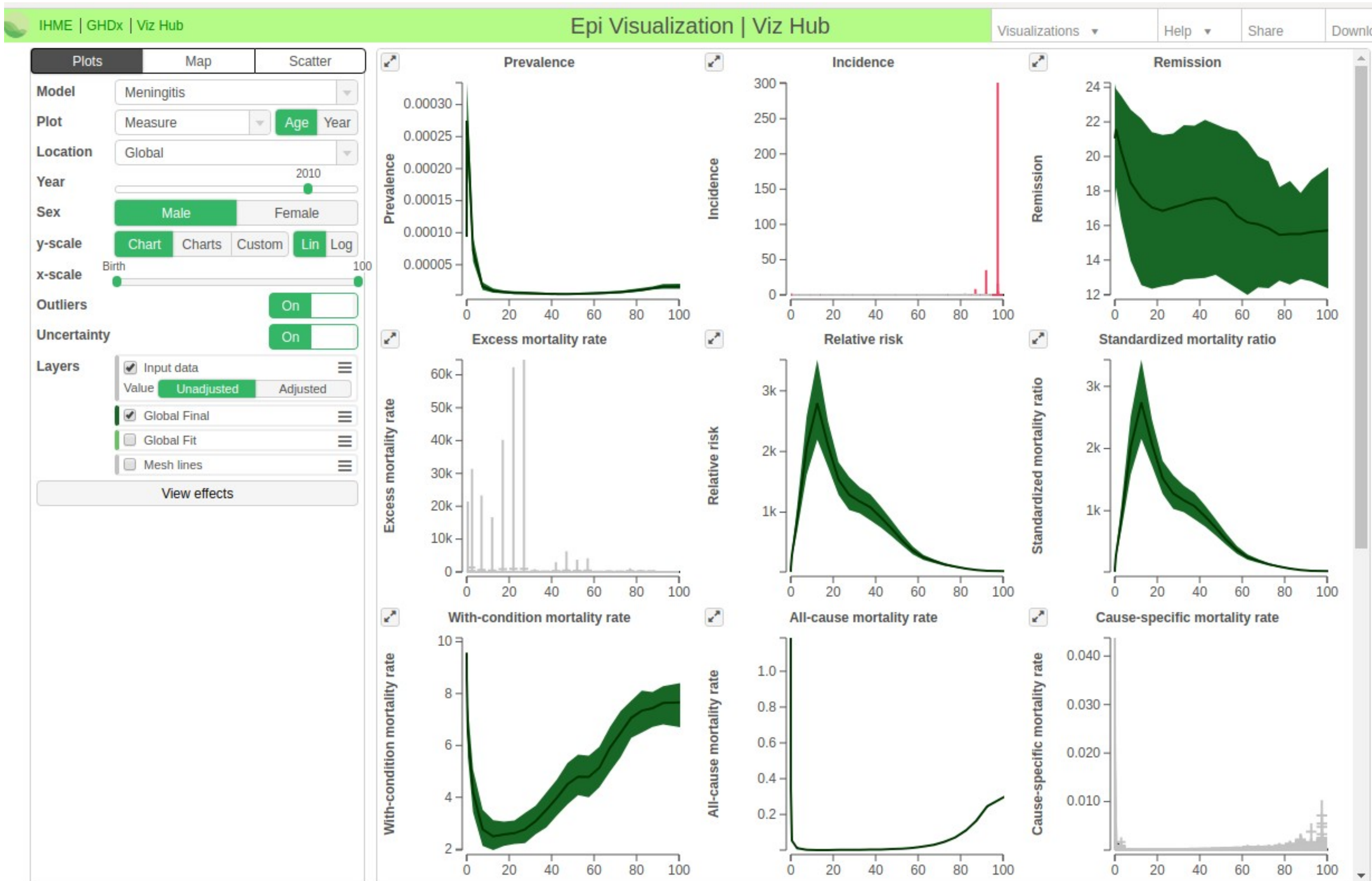


Visualize data on seemingly any topic of health

http://www.healthdata.org/

https://vizhub.healthdata.org/epi/

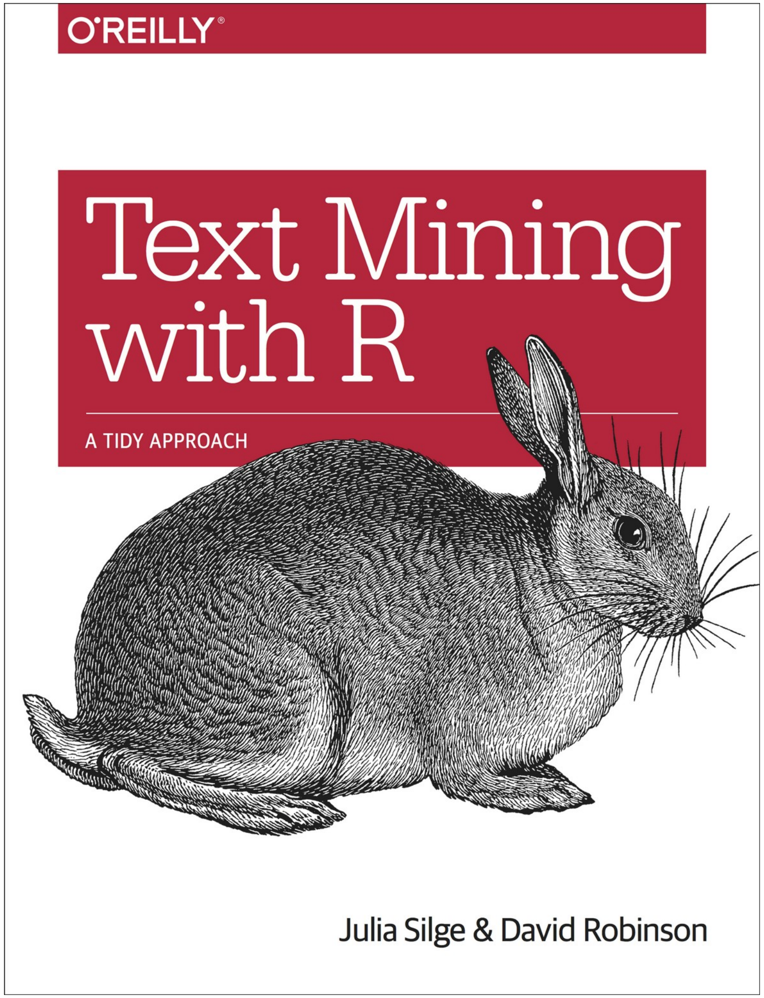
Online Tool: The Institute for Health Metrics and Evaluation



https://vizhub.healthdata.org/epi/

Another Type of Analysis...

Please Follow the Book



This slide material below has been taken from Silge *et al*.

Chapter: 2
Sentiment analysis with tidy data

https://www.tidytextmining.com/sentiment.html

Packages and Libraries

```
# install.packages(“janeaustenr")
# install.packages(“stringr”)
rm(list = ls())
library(janeaustenr)
library(dplyr)
library(stringr)
library(tidyverse)
```

Data: Jane Austen’s Text

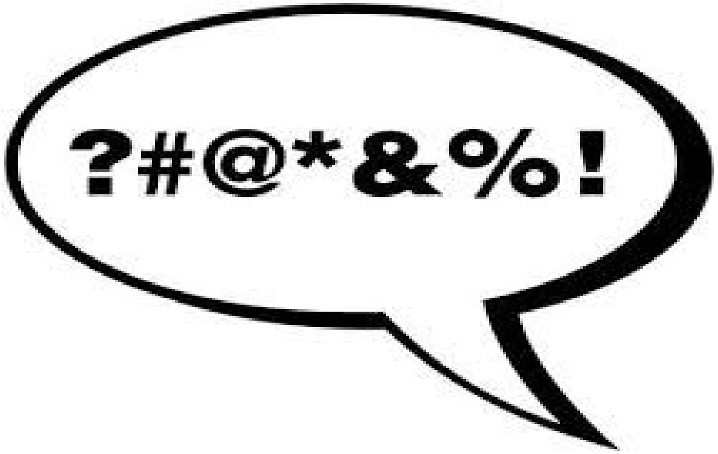
- Jane Austen’s 6 completed, published novels from the *janeaustenr* package.
  - Sense & Sensibility
  - Pride & Prejudice
  - Mansfield Park
  - Emma
  - Northanger Abbey
  - Persuasion

Research Question

- Jane Austen's written work:

How many *Bad (pessimistic)* words did she use?

How many *Good* (optimistic) words did she use?



The *Sentiments* dataset

```
#install.packages("tidytext")
library(tidytext)
sentiments
```

```
## # A tibble: 27,314 × 4
##           word sentiment lexicon score
##          <chr>     <chr>   <chr> <int>
## 1       abacus     trust     nrc    NA
## 2      abandon      fear     nrc    NA
## 3      abandon  negative     nrc    NA
## 4      abandon   sadness     nrc    NA
## 5    abandoned     anger     nrc    NA
## 6    abandoned      fear     nrc    NA
## 7    abandoned  negative     nrc    NA
```

Three general-purpose lexicons

- ***AFINN*** from Finn Årup Nielsen,
  - assigns words with a score that runs between -5 and 5, with negative scores indicating negative sentiment and positive scores indicating positive sentiment
- ***bing*** from Bing Liu and collaborators,
  - categorizes words in a binary fashion into positive and negative categories
- ***nrc*** from Saif Mohammad and Peter Turney
  - categorizes words in a binary fashion (“yes”/“no”) into categories of positive, negative, anger, anticipation, disgust, fear, joy, sadness, surprise, and trust.

- Used to determine the general mood of words.
- Lexicons are based on unigrams, (i.e., single words).
- Words are assigned scores for positive/negative sentiment,
- Emotions: joy, anger, sadness and etc.

Sentiments: **afinn**

- get_sentiments("afinn")

```
> get_sentiments("afinn")
# A tibble: 2,476 x 2
          word score
         <chr> <int>
 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 2,466 more rows
```

Returns
a score
for each word
[-5, 5]
(Bad to Good)

Sentiments: **nrc**

- get_sentiments("nrc")

```
> get_sentiments("nrc")
# A tibble: 13,901 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 13,891 more rows
```

Returns a *synonym* for each word

Sentiments: **bing**

get_sentiments("bing")

```
> get_sentiments("bing")
# A tibble: 6,788 x 2
          word sentiment
         <chr>     <chr>
 1     2-faced  negative
 2     2-faces  negative
 3          a+  positive
 4    abnormal  negative
 5     abolish  negative
 6  abominable  negative
 7  abominably  negative
 8   abominate  negative
 9 abomination  negative
10       abort  negative
# ... with 6,778 more rows
```

Returns
a Positive
or
a Negative
measurement
for each word

Setup

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


View(original_books) # words from all novels
```

Chapter Words

- The words in the order that they appear in the text.
- Note the first line is the title of the book.

```
## # A tibble: 73,422 x 4
##    text                  book                linenumber chapter
##    <chr>                 <fctr>                   <int>   <int>
##  1 SENSE AND SENSIBILITY Sense & Sensibility          1       0
##  2 ""                    Sense & Sensibility          2       0
##  3 by Jane Austen        Sense & Sensibility          3       0
##  4 ""                    Sense & Sensibility          4       0
##  5 (1811)                Sense & Sensibility          5       0
##  6 ""                    Sense & Sensibility          6       0
##  7 ""                    Sense & Sensibility          7       0
##  8 ""                    Sense & Sensibility          8       0
##  9 ""                    Sense & Sensibility          9       0
## 10 CHAPTER 1             Sense & Sensibility         10       1
## # ... with 73,412 more rows
```

Unnesting Book Words

We need the words in list (un-nested) to work with them.

```
tidy_books <- original_books %>%
  unnest_tokens(word, text) #make a list of words from the paragraphs

View(tidy_books)
```

Unnested Words

```
## # A tibble: 725,055 x 4
##    book                  linenumber chapter word
##    <fctr>                     <int>   <int> <chr>
##  1 Sense & Sensibility            1       0 sense
##  2 Sense & Sensibility            1       0 and
##  3 Sense & Sensibility            1       0 sensibility
##  4 Sense & Sensibility            3       0 by
##  5 Sense & Sensibility            3       0 jane
##  6 Sense & Sensibility            3       0 austen
##  7 Sense & Sensibility            5       0 1811
##  8 Sense & Sensibility           10       1 chapter
##  9 Sense & Sensibility           10       1 1
## 10 Sense & Sensibility           13       1 the
## # ... with 725,045 more rows
```

When words are in one-word-per-row format, manipulation with tidy tools like *dplyr* is possible

Stop Words

- Remove *stop words:* words which do not add any distinguishing information to a body of text.
  - Contractions: hasn’t, didn’t won’t
  - In-betweens: been, is, had, having

```
data("stop_words")

View(stop_words)

cleaned_books <- tidy_books %>% anti_join(stop_words)

# anti_join() returns all rows from x where there are not matching values in y, keeping just columns from x.
```

Counting Common Words Across All Books

```
cleaned_books %>%
  count(word, sort = TRUE)
```

```
## # A tibble: 13,914 x 2
##    word       n
##    <chr>  <int>
##  1 miss    1855
##  2 time    1337
##  3 fanny    862
##  4 dear     822
##  5 lady     817
##  6 sir      806
##  7 day      797
##  8 emma     787
##  9 sister   727
## 10 house    699
## # ... with 13,904 more rows
```

Joy in Emma

- We will consider the common words having scores indicating that they are of Joy, according to the *nrc* lexicon in the novel, Emma

```
#install.packages("textdata")
library(textdata)
# Note: enter '1', when prompted
nrcjoy <- get_sentiments("nrc") %>%
  filter(sentiment == "joy")
tidy_books %>%
  filter(book == "Emma") %>%
  semi_join(nrcjoy) %>%
  count(word, sort = TRUE)
```

Oh Joy ...

```
tidy_books %>%
  filter(book == "Emma") %>%
  semi_join(nrcjoy) %>%
 count(word, sort = TRUE)
```

```
## # A tibble: 303 x 2
##     word        n
##     <chr>   <int>
##  1 good       359
##  2 young      192
##  3 friend     166
##  4 hope       143
##  5 happy      125
##  6 love       117
##  7 deal        92
##  8 found       92
##  9 present     89
## 10 kind        82
## # ... with 293 more rows
```

We find counts of the *joy* words in the novel, <u>Emma</u>

How Does Sentiment Change? (In each novel?)

```
library(tidyr)

bing <- get_sentiments("bing")


janeaustensentiment <- tidy_books %>%
  inner_join(bing) %>%
  count(book, index = linenumber %/% 80, sentiment)
        %>% spread(sentiment, n, fill = 0) %>%
     mutate(sentiment = positive - negative)
```

What Are The Most Common Good and Bad Words?

- Count the common positive words across the books.

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

View(bing_word_counts)
```

Such Positivity ...

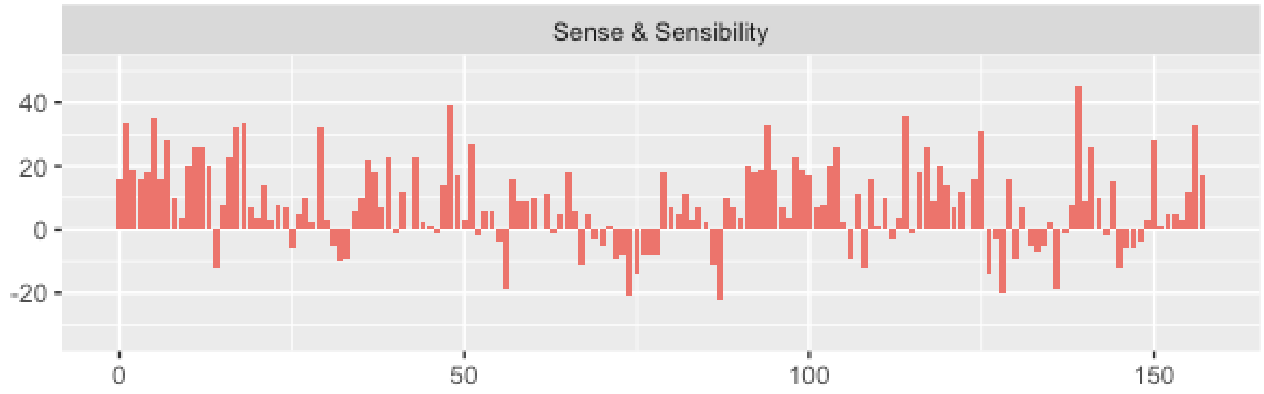
View(bing_word_counts)

```
## # A tibble: 2,585 x 3
##    word      sentiment     n
##    <chr>     <chr>     <int>
##  1 miss      negative   1855
##  2 well      positive   1523
##  3 good      positive   1380
##  4 great     positive    981
##  5 like      positive    725
##  6 better    positive    639
##  7 enough    positive    613
##  8 happy     positive    534
##  9 love      positive    495
## 10 pleasure  positive    462
## # ... with 2,575 more rows
```

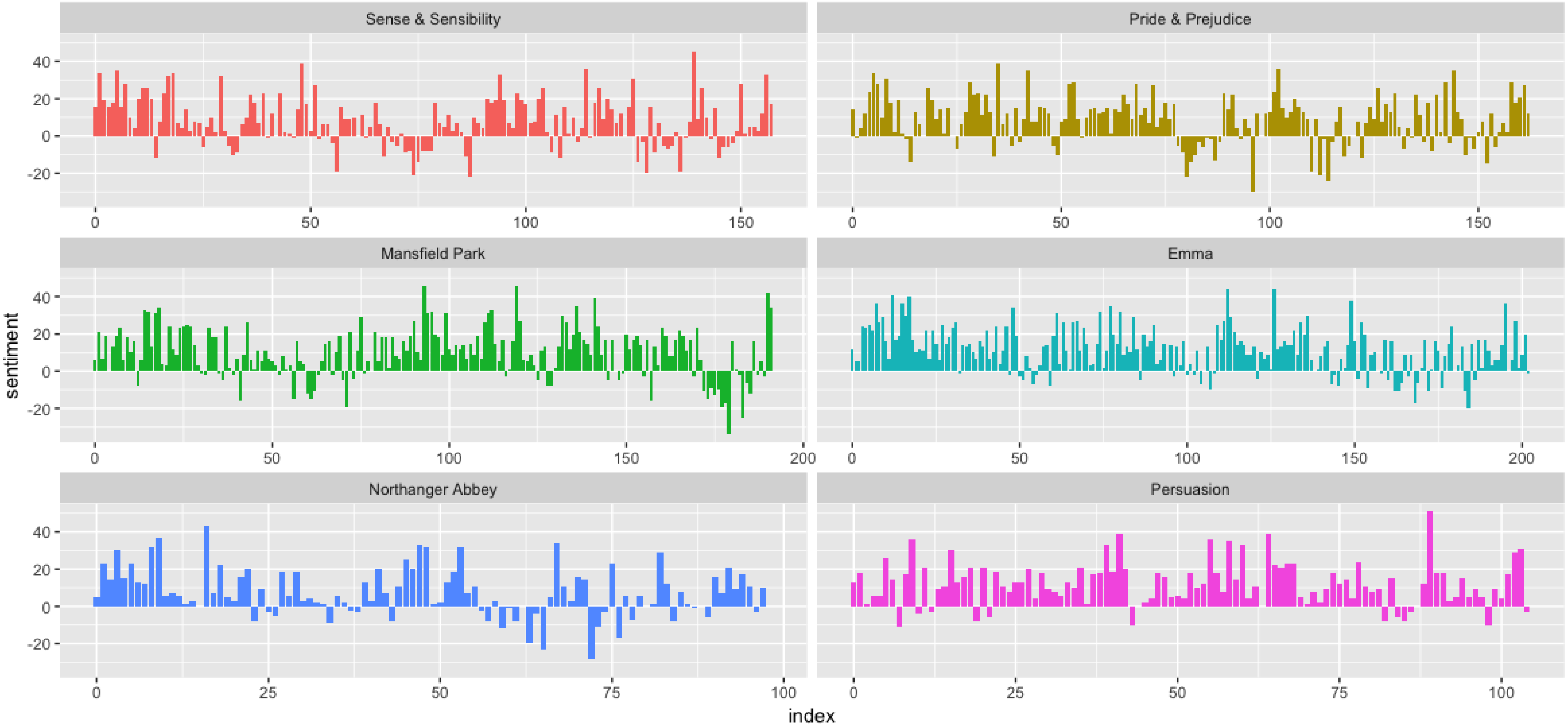
Plot the Good and Bad Words Across Each Book

- # plot the sentiment in each book

```
ggplot(janeaustensentiment, aes(index, sentiment, fill = book)) + geom_bar(stat = "identity", show.legend = FALSE) + facet_wrap(~book, ncol = 2, scales = "free_x")
```



Plot the Good and Bad Words Across Each Book



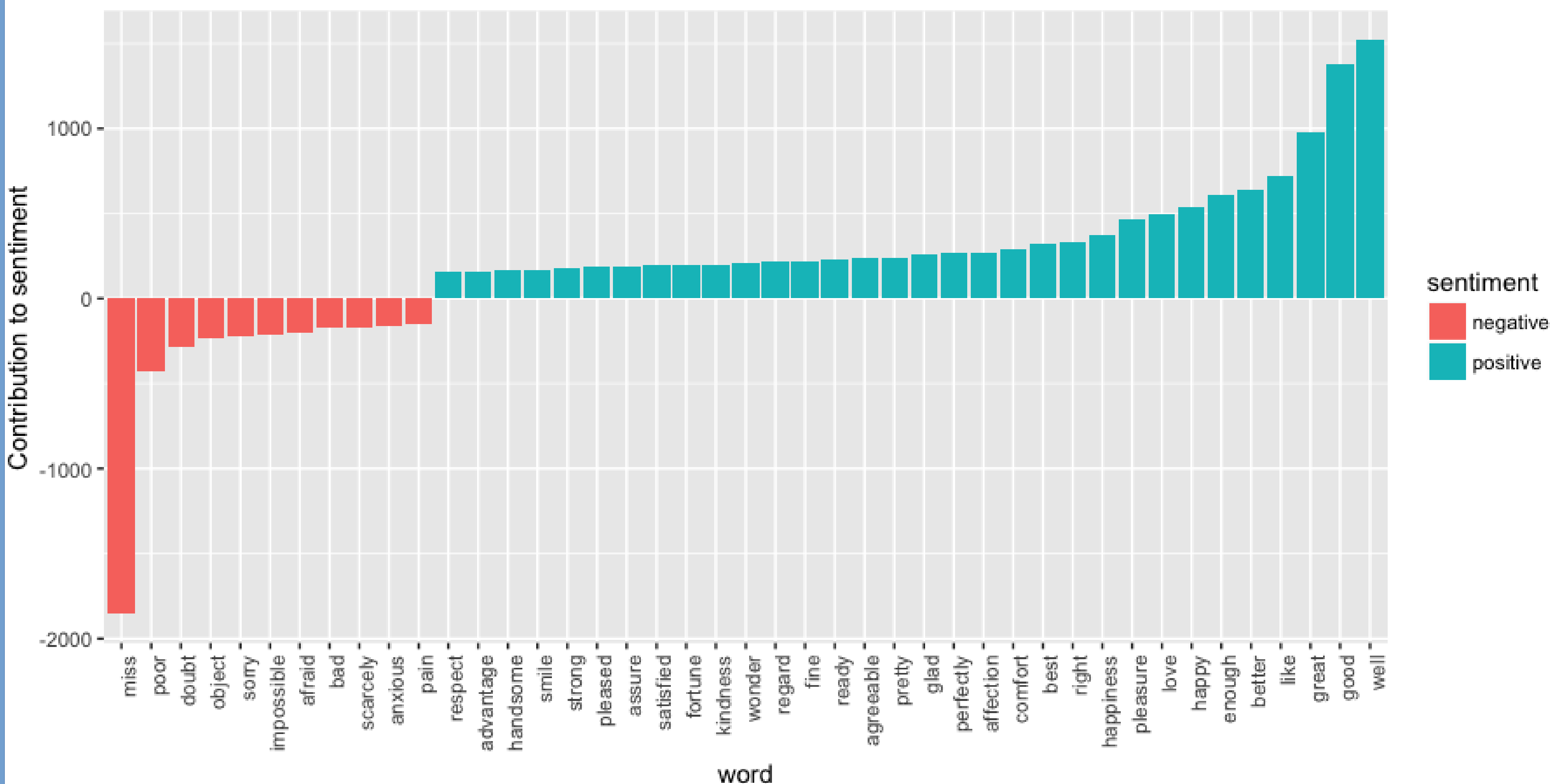
An optimistic writer: there appears to be a similar pattern of optimistic / pessimistic word usage across all her books!

Plot of The Common Positive and Negative Words

- Plot the common positive words across the books.

```
bing_word_counts %>%
  filter(n > 150) %>%
  mutate(n = ifelse(sentiment == "negative", -n, n)) %>%
  mutate(word = reorder(word, n)) %>%
  ggplot(aes(word, n, fill = sentiment)) +
  geom_bar(stat = "identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
 ylab("Contribution to sentiment")
```

Plot of Positive and Negative Sentiment Words

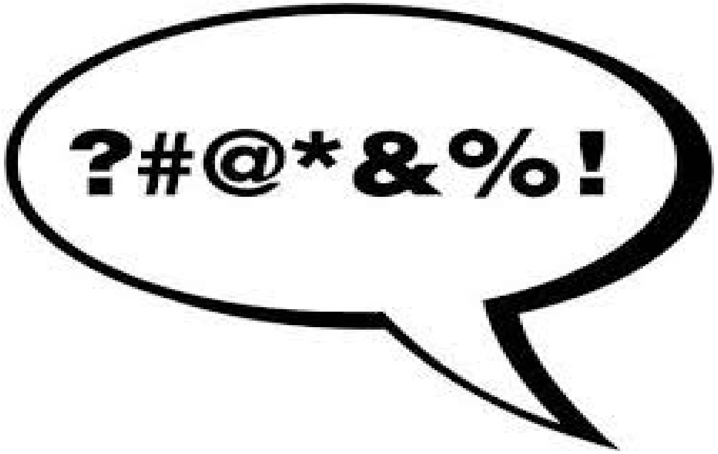


And Now. Back to the Research Question!

- Jane Austen's written work:

How many *Bad (pessimistic)* words did she use?

How many *Good* (optimistic) words did she use?



Plot of Positive and Negative Sentiment Words

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

bing_word_counts
```

```
> bing_word_counts
# A tibble: 2,585 x 3
   word     sentiment     n
   <chr>    <chr>     <int>
 1 miss     negative   1855
 2 well     positive   1523
 3 good     positive   1380
 4 great    positive    981
 5 like     positive    725
 6 better   positive    639
 7 enough   positive    613
 8 happy    positive    534
 9 love     positive    495
10 pleasure positive    462
# … with 2,575 more rows
```

What are the Sentiments’ Words?

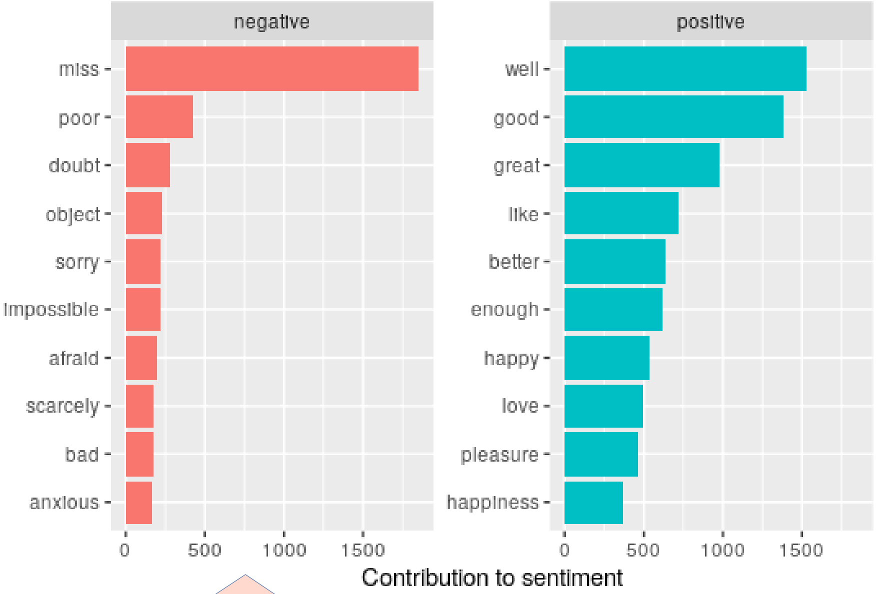
```
bing_word_counts <- tidy_books %>%
  inner_join(get_sentiments("bing")) %>%
  count(word, sentiment, sort = TRUE) %>%
  ungroup()

bing_word_counts
```

```
> bing_word_counts
# A tibble: 2,585 x 3
   word      sentiment     n
   <chr>     <chr>     <int>
 1 miss      negative   1855
 2 well      positive   1523
 3 good      positive   1380
 4 great     positive    981
 5 like      positive    725
 6 better    positive    639
 7 enough    positive    613
 8 happy     positive    534
 9 love      positive    495
10 pleasure  positive    462
# … with 2,575 more rows
```

Each word has an associated sentiment. Each sentiment is represented by a number of words in the lexicon. Here we note the number of words that may be associated to each of the sentiments.

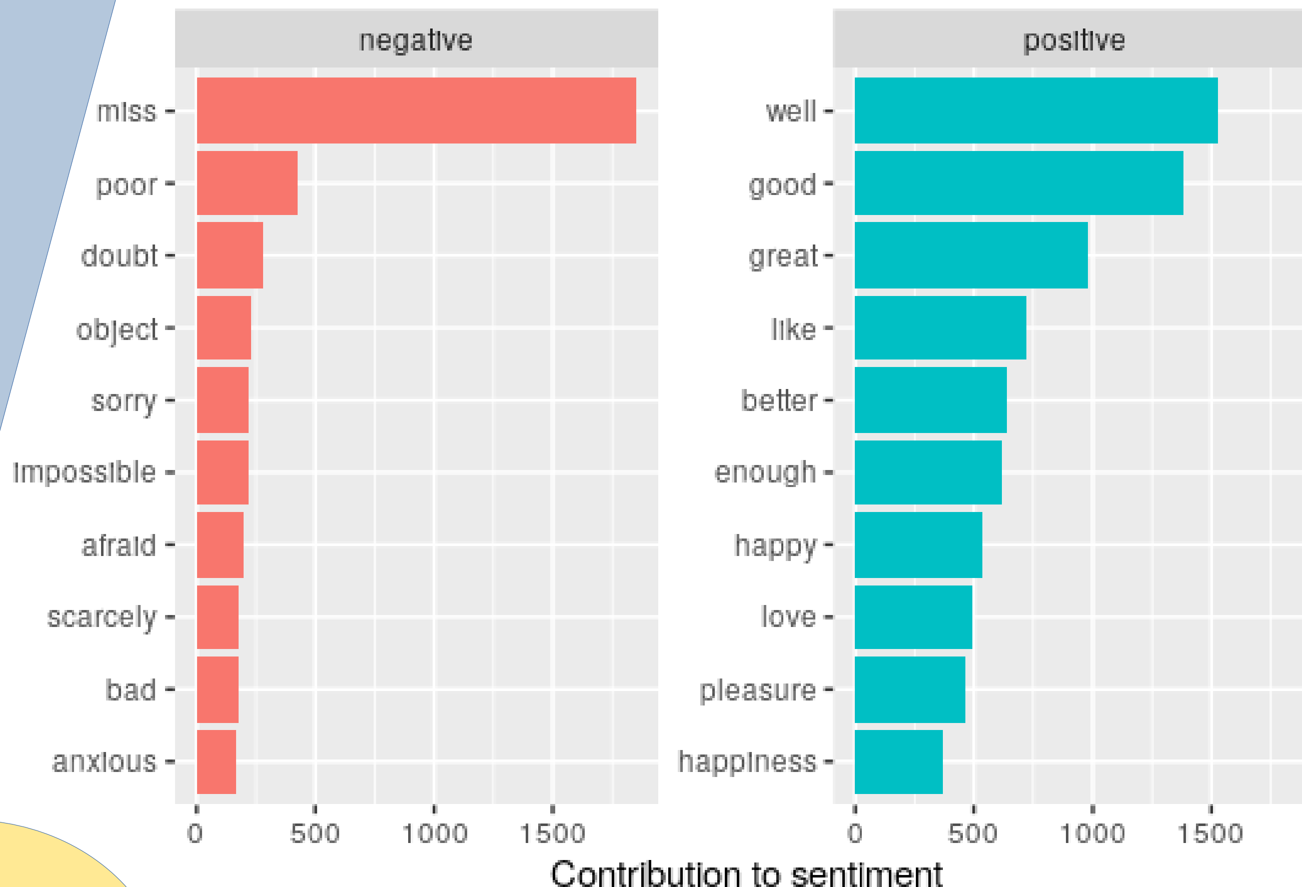
Visually Shown, The Sentiment Words

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



Gimme the top ten, and then show me how many lexicon words are associated to that sentiment.

Many more words associated to “miss” (pessimistic max) than “well” (optimistic max)



Could “well” also have other types of optimistic uses as well? And ***Good***? Why not ***Great***!

Participation 4:
Topic Modeling!

- Go to your book to complete this part of the participation
- Ref: https://www.tidytextmining.com/topicmodeling.html
- Copy and paste all the code for **Topic Modeling** into a script file. Please be sure that your code runs correctly to perform as expected by the reading. Also, please add comments to help the reader understand what each code block is doing.
- Place code in file: `src/topicModeling` in repository
- **GitHub repository: http://https://classroom.github.com/a/MeBeJScv**

ALLEGHENY COLLEGE

Participation 5: Ethics!

- Go to the article (see below) to read
- Respond to the **Questions in Blue**, see next slide
- Leave responses in file: `writing/reflection.md`
- These participation activities (04 and 05) use the same repository and are each worth a check mark
- Submit to your GitHub repository by Friday 3rd April, 11:50pm

ALLEGHENY COLLEGE

Participation 5: Article

- Read the article, reflect, and think about the analysis to prepare policy.
- https://www.rollingstone.com/culture/culture-features/plastic-problem-recycling-myth-big-oil-950957/

Participation 5:
Questions in Blue

- **Q0: In a few sentences, summarize the article.**
- **Q1: Describe a type of plastic pollution study.**
- **Q2: What kind of data would you have to have for this study?**
- **Q3: What challenges do you see in using analysis to change a policy concerning plastic pollution?**
- **Q4: Who stands to lose something (anything) from a policy that would ultimately reduce plastic in the environment?**