Brand Sentiment Analysis with Natural Language Processing (NLP)

September 2023

Overview

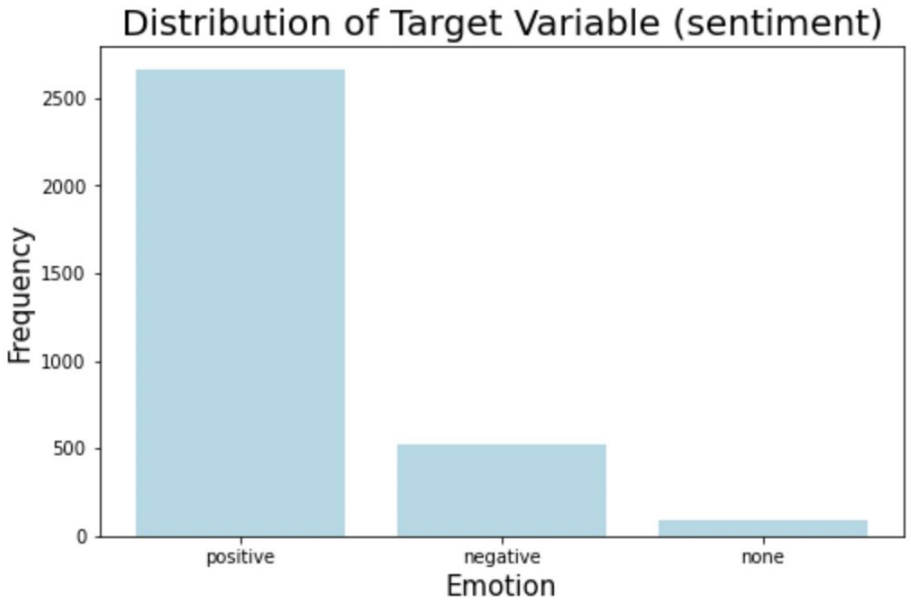
Use *NLP to analyze consumer attitudes* towards Google/Android and Apple and leverage *machine learning techniques to classify a given tweet* as having positive, negative, or neutral emotions

The Data: Original Version

	tweet_text	emotion_in_tweet_is_directed_at	is_there_an_emotion_directed_at_a_brand_or_product
0	.@wesley83 I have a 3G iPhone. After 3 hrs twe...	iPhone	Negative emotion
1	@jessedee Know about @fludapp ? Awesome iPad/i...	iPad or iPhone App	Positive emotion
2	@swonderlin Can not wait for #iPad 2 also. The...	iPad	Positive emotion
3	@sxsw I hope this year's festival isn't as cra...	iPad or iPhone App	Negative emotion
4	@sxtxstate great stuff on Fri #SXSW: Marissa M...	Google	Positive emotion

- The data comes from tweets posted by contributors at a festival
  - The dataset contains 3 columns and 9,093 rows
  - “is_there_an_emotion_directed_at_a_brand_or_product” is our target variable
  - The remaining columns contain the actual tweet and the product the tweet refers to

The Data: Target Variable



- The bar plot shows the distribution of our “sentiment” (target) variable
- **~81% of attitudes towards the brands at the conference is positive**
- We address the imbalance with weighted metrics and oversampling minority classes

The Data: Processing and Cleaning

- Cleaning and preprocessing consists of:
  - Removing duplicate entries
  - Renaming values and columns to be less ambiguous
  - Splitting tweets into lists of words without punctuations (tokens)
  - Assigning numerical values to the target variable

The Data: Processing and Cleaning

	tweet	product	sentiment	tweet_without_stopwords_and_punc
0	.@wesley83 i have a 3g iphone. after 3 hrs twe...	iPhone	negative	[3g, iphone, 3, hrs, tweeting, riseaustin, dea...
1	@jessedee know about @fludapp ? awesome ipad/i...	iPad or iPhone App	positive	[know, awesome, ipad, iphone, app, likely, app...
2	@swonderlin can not wait for #ipad 2 also. the...	iPad	positive	[wait, ipad, 2, also, sale, sxsw]
3	@sxsw i hope this year's festival isn't as cra...	iPad or iPhone App	negative	[hope, years, festival, crashy, years, iphone,...
4	@sxtxstate great stuff on fri #sxsw: marissa m...	Google	positive	[great, stuff, fri, sxsw, marissa, mayer, goog...
...	...	...	...	...
9088	ipad everywhere. #sxsw {link}	iPad	positive	[ipad, everywhere, sxsw, link]
9089	wave, buzz... rt @mention we interrupt your re...	unknown	none	[wave, buzz, , rt, interrupt, regularly, sched...
9090	google's zeiger, a physician never reported po...	unknown	none	[googles, zeiger, physician, never, reported, ...
9091	some verizon iphone customers complained their...	unknown	none	[verizon, iphone, customers, complained, time,...
9092	ïį ïà ü_ ê î ò £ á ââ _ £ â_ ûârt @...	unknown	none	[, ï, į, , ïà, , ü, , , ê, , , î, , ,...

8914 rows × 4 columns

Our processed dataset has shorter column names and 8,914 rows x 4 columns

Results

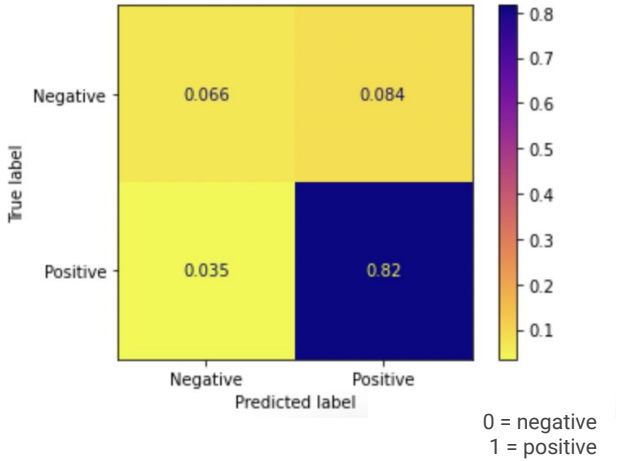
Naïve Bayes Classifier and Sentiment Analysis

- Optimal binary classification model
- Optimal multiclass classification model
- Sentiment Analysis by Brand

Results: Optimal Binary Classification

	precision	recall	f1-score
0	0.65	0.44	0.53
1	0.91	0.96	0.93
accuracy			0.88
macro avg	0.78	0.70	0.73
weighted avg	0.87	0.88	0.87

Test score: 0.88



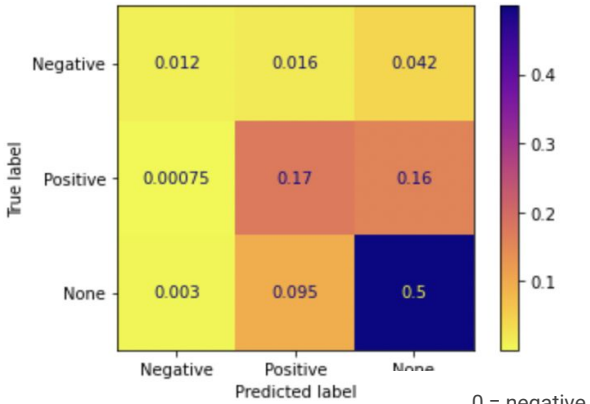
0 = negative
1 = positive

- A Naïve Bayes classifier with best parameters, over sampling techniques, tokenization, and stopword removal
- **Returns weighted f1 score of 0.87 and an overall test score (accuracy) of 0.88**
- The model emphasizes weighted f1, because it combines recall and precision and accounts for imbalance

Results: Optimal Multiclass Classification

	precision	recall	f1-score
0	0.77	0.17	0.28
1	0.61	0.52	0.56
2	0.71	0.84	0.77
accuracy			0.69
macro avg	0.70	0.51	0.54
weighted avg	0.68	0.69	0.67

Test score: 0.69



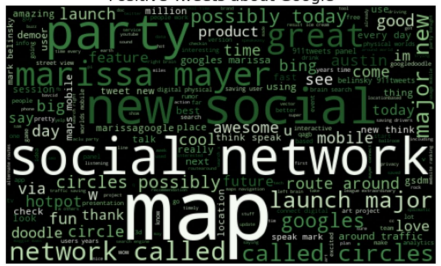
0 = negative
1 = positive
2 = none

- A Naïve Bayes classifier with best parameters, tokenization, and stopword removal
- **Returns weighted f1 score of 0.67 and an overall test score (accuracy) of 0.69**
- The model emphasizes weighted f1, because it combines recall and precision and accounts for imbalance
- This model performs better without oversampling, as the new target variable increases overfitting

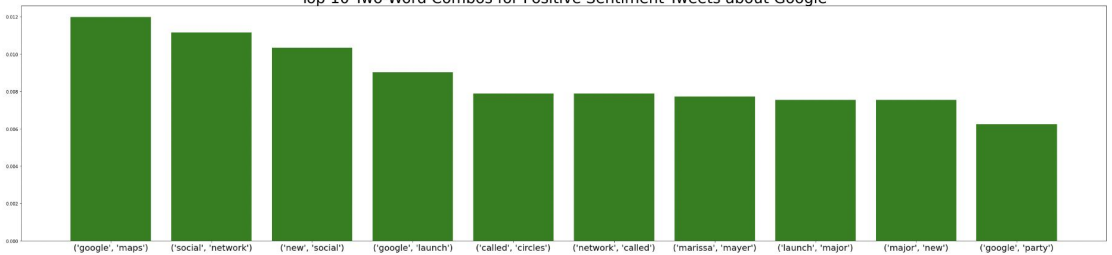
Results: Sentiment Analysis

We also use NLP to visualize the top ten bigrams associated with positive and negative tweets for Google/Android and Apple. An example of visualizations are below. Please refer to the Appendix for a complete version.

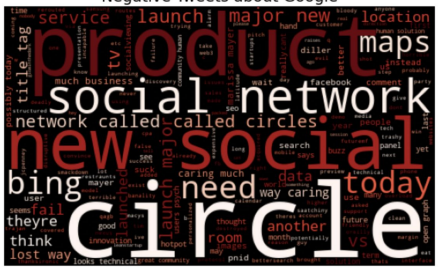
Positive Tweets about Google



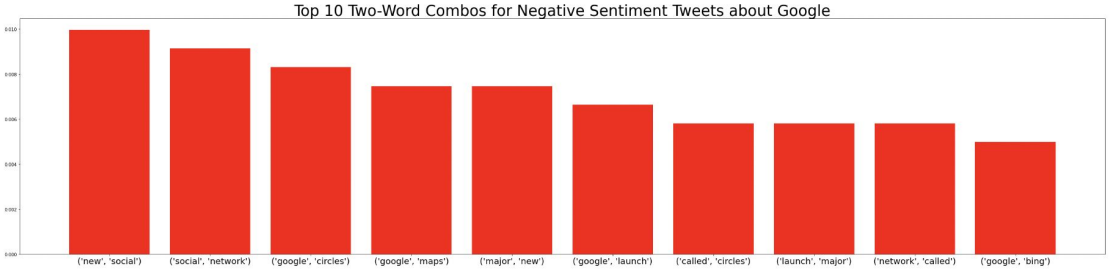
Top 10 Two-Word Combos for Positive Sentiment Tweets about Google



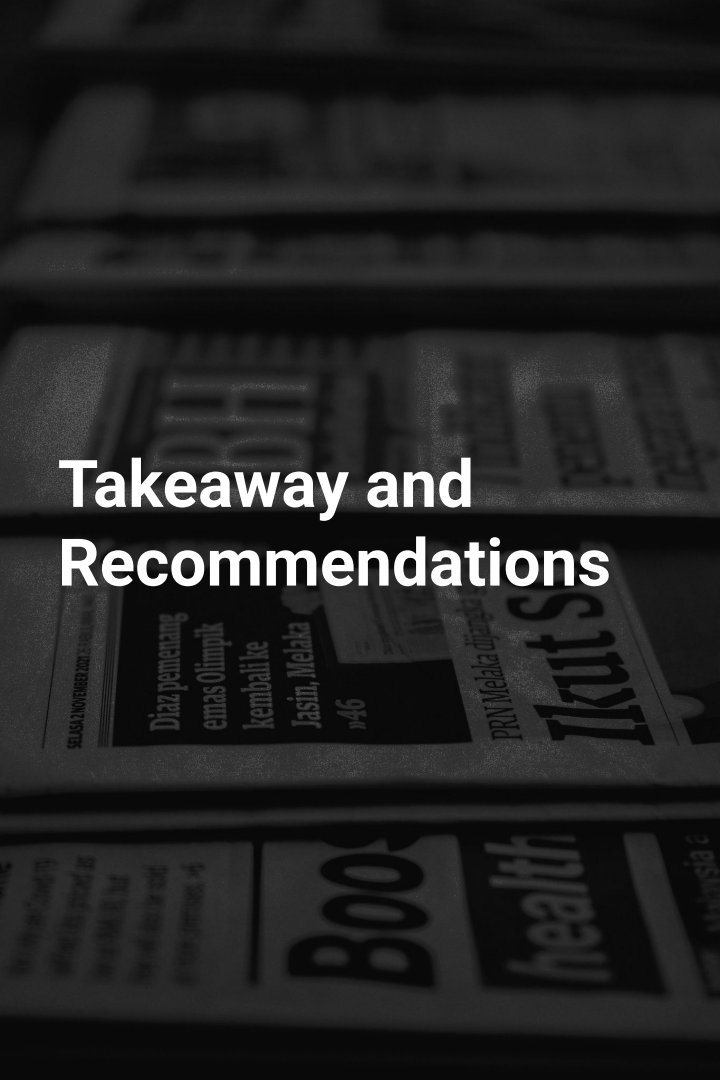
Negative Tweets about Google



Top 10 Two-Word Combos for Negative Sentiment Tweets about Google



Takeaway: **Google Maps appears to be popular** among users and launch events featuring guests garner positive attitudes. Conversely, sentiment surrounding the **Google Circles launch is negative and requires further research**.



Takeaway and Recommendations

Brands can leverage machine learning algorithms like Naïve Bayes to categorize large quantities of online text data

Google/Android

- Invest in Google Maps' competitive advantage
- Hold live events with guests like Marissa Mayer
- Address compatibility issues with Android

Apple

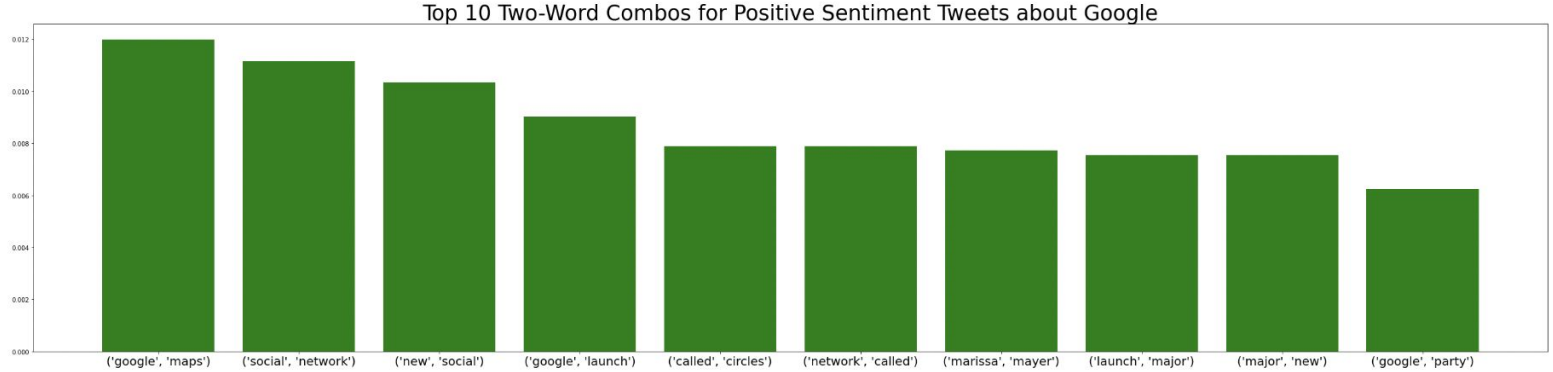
- Open popup stores frequently and promote launches
- Increase product testing for design and battery
- Strengthen corporate social responsibility and values

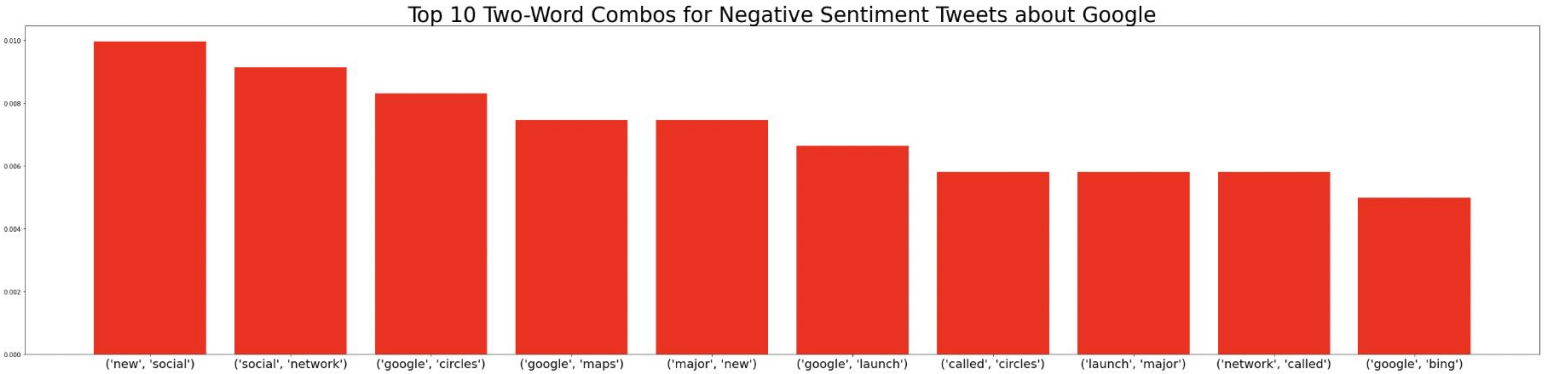
Contact Information

- Email
- Github
- LinkedIn

Appendix

Appendix: Google Sentiment



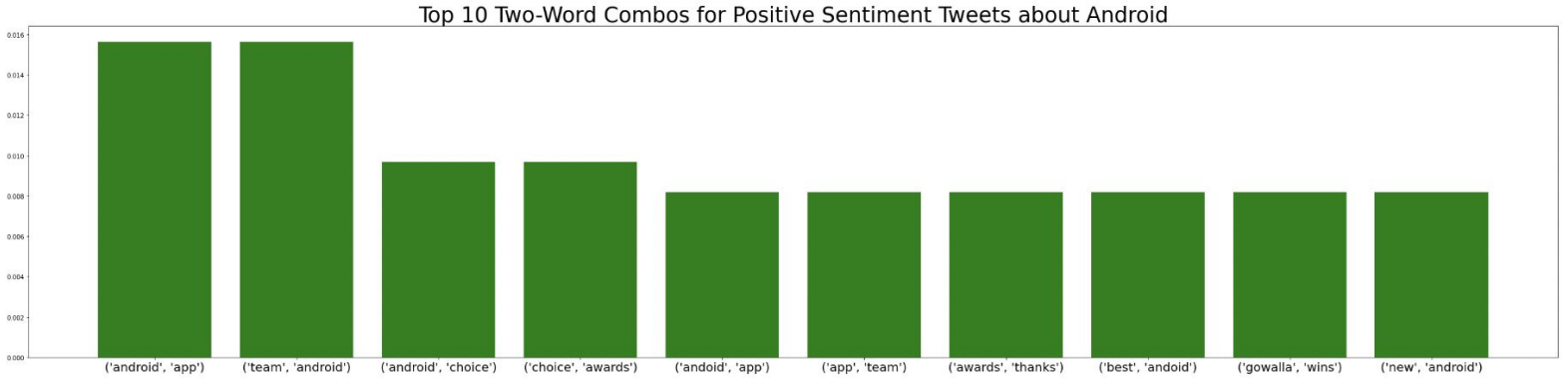


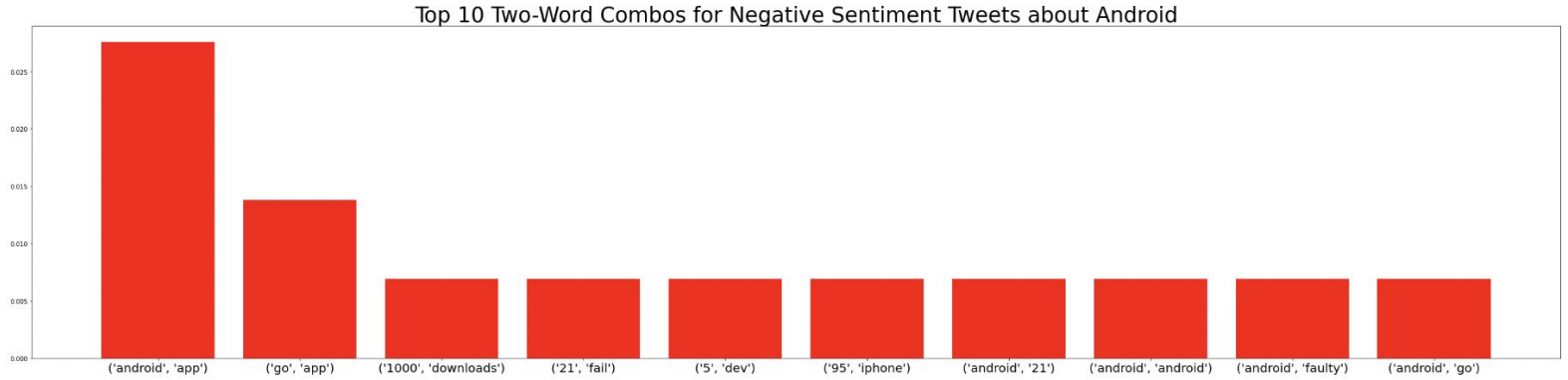
Appendix: Google Sentiment

Positive Tweets about Google

Negative Tweets about Google

Appendix: Android Sentiment



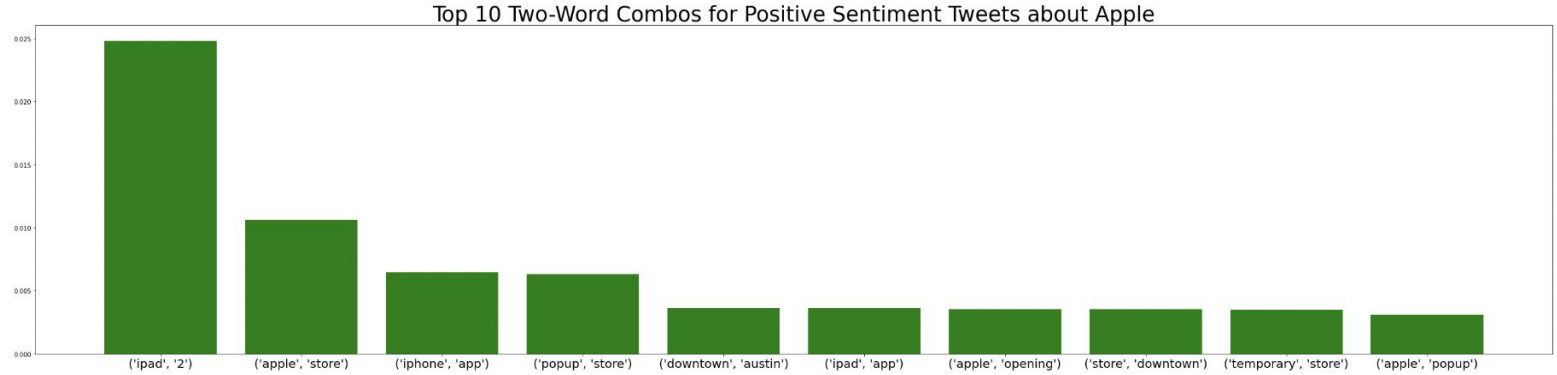


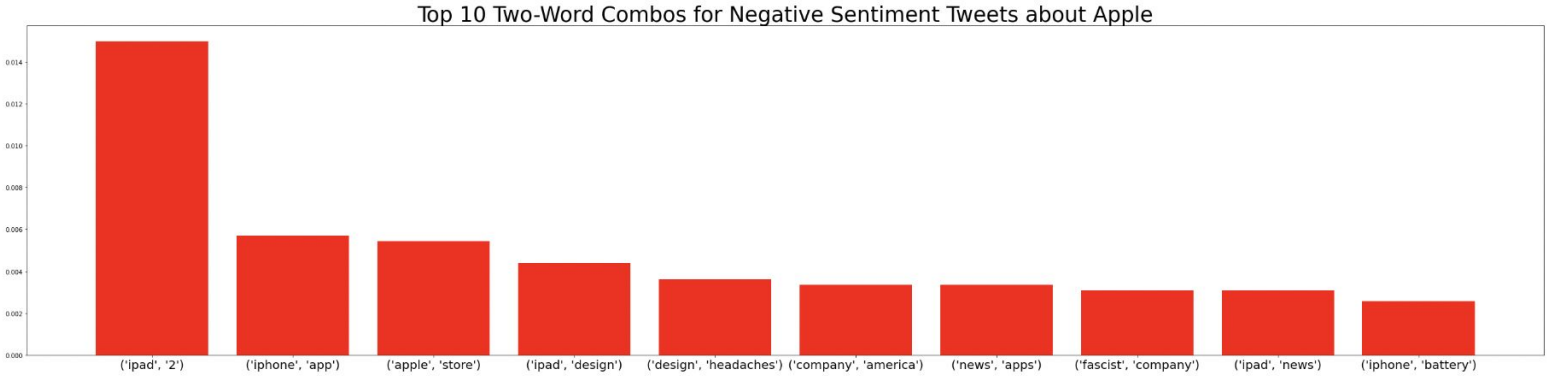
Appendix: Android Sentiment

Positive Tweets about Android

Negative Tweets about Android

Appendix: Apple Sentiment





Appendix: Apple Sentiment

Positive Tweets about Apple

Negative Tweets about Apple