

Sentiment Analysis of Spotify Reviews

By Dana DiVincenzo

Spotify Background

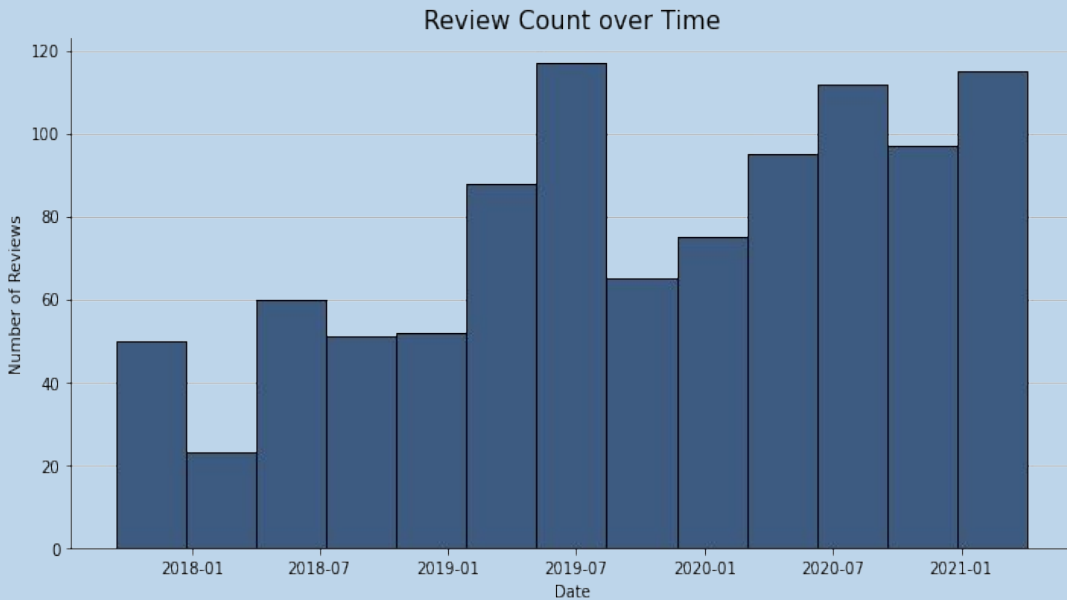
- Spotify is one of the world's largest music streaming service providers
 - As of December 2020, Spotify had 345 million monthly active users
 - 155 million were paying subscribers
 - Spotify costs \$9.99 per month for an individual user
- The company was founded in 2006 but has skyrocketed in popularity in the past half decade
- Spotify currently has 17 million ratings on the US Apple App Store
 - The average rating is currently 4.8 out of 5 stars

Introduction to the Data

- Using an API, 1000 Spotify reviews were scraped from the App Store
 - 1000 of the “most helpful” reviews were gathered
 - “Most helpful” does not mean that they are super positive or negative - it means that other app store users found that review helpful
- Each review scraped contained data on:
 - Date of review
 - Rating out of 5 attached to review
 - The title of the review
 - If the review was edited
 - The username of the person leaving the review
 - The text of the review itself
- This information will be used to give us insight into how user’s are feeling about the app

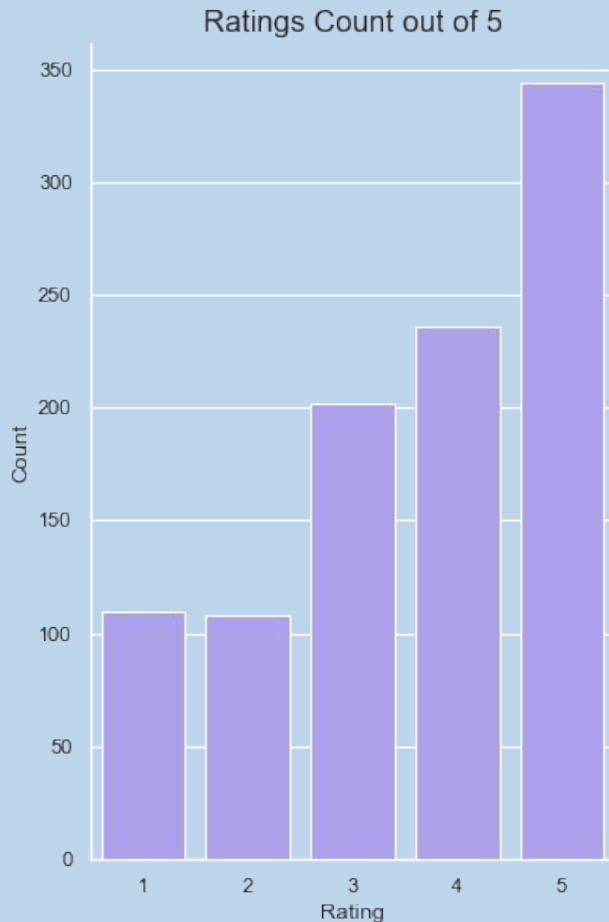
Initial Data Inspection

- Date Range
 - The earliest scraped review was written on 2017-09-15 03:29:50
 - The latest scraped review was written on 2021-04-04 08:35:35
- This histogram shows the frequency of reviews left over time
- We can see that the number of reviews left over time has been steadily increasing since 2017, with a notably high number of reviews being left in July of 2019



Initial Data Inspection

- The average rating of the scraped reviews was 3.596
 - The average rating on the app store is 4.8
 - This difference is likely because not all users on the app store leave reviews with their ratings, but all of the ratings scraped had reviews attached to them
 - Studies have shown that users are more likely to leave a negative review after a negative experience than a positive review after a positive experience, which explains why ratings with reviews attached would likely have a lower average rating than ratings without reviews
- This histogram shows the frequency of ratings
 - We can see that as the rating increases, the frequency increases, with the exception of 2 having a slightly smaller frequency than 1



Splitting Reviews into Sentiment Categories

- Each review was then given a sentiment category
 - Reviews with a 4 or 5 rating were put in the “positive” category
 - Reviews with a 3 rating were put in the “neutral” category
 - Reviews with a 1 or 2 rating were put in the “negative” category
- Splitting the information like this will allow us to create visualizations that can help us understand what is being said in each category
 - It can also help us make predictions later on
- Number of reviews in each category
 - Positive: 580
 - Neutral: 202
 - Negative: 218

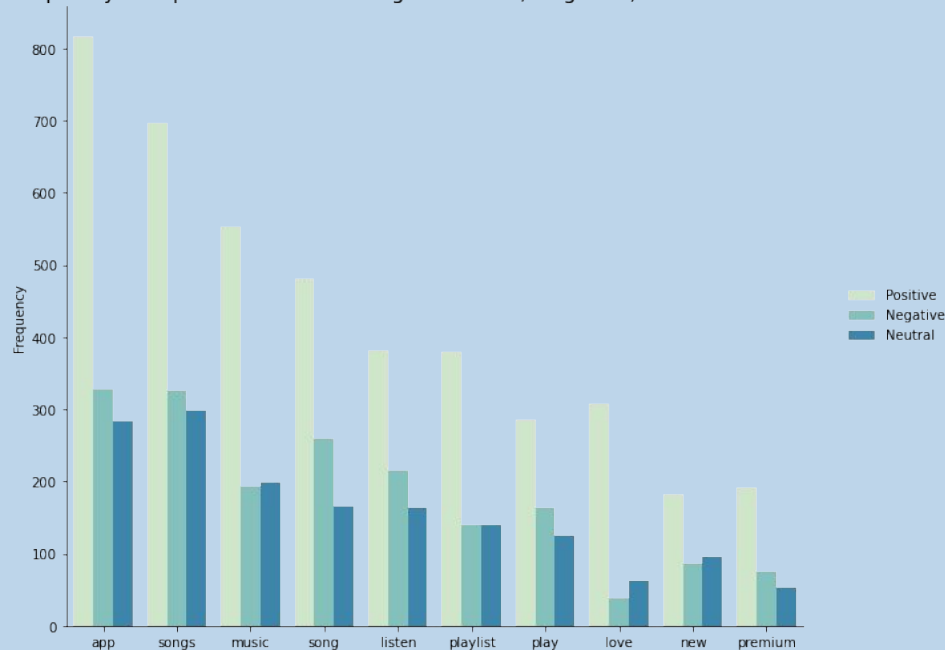
Top Ten Words

- The top ten words used most frequently in all the reviews were found and put in a list (excluding words such as I, a, to, the, etc.)
- Top Ten Words = app, songs, music, song, listen, playlist, play, love, new, premium
- In each of the “positive”, “neutral”, and “negative” reviews, the frequency and percentage of reviews containing the top ten words were found
 - Frequency is simply the number of occurrences within all reviews in that category
 - The percentage was found by taking the frequency and dividing it by the total number of reviews in that category. Therefore, it is possible for a word to have a percentage greater than 100, as a word may be used more than the number of reviews in that category
- The following graphs show information about the top ten words in these different categories

Frequency of Top Ten Words For Positive, Negative, and Neutral Reviews

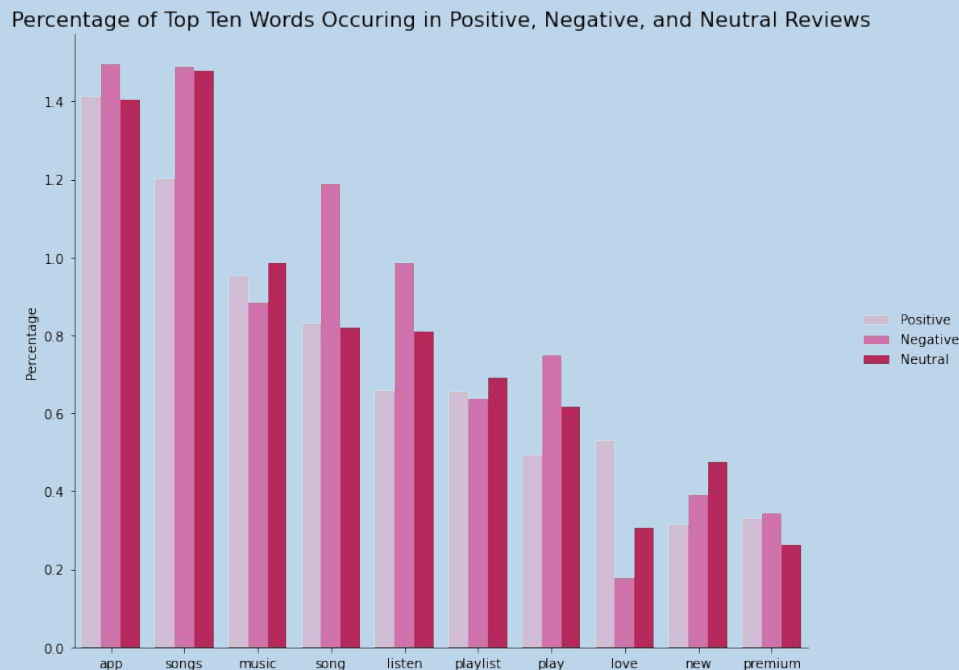
- This graph shows the frequency of the top 10 words in each sentiment category
- Because “positive” is the largest group by far, it makes sense that that group has the highest frequency for every word
 - Because of this, we also need to look at this proportionally of frequency to category size to get a better understanding of what is being said and when

Frequency of Top Ten Words Occuring in Positive, Negative, and Neutral Reviews



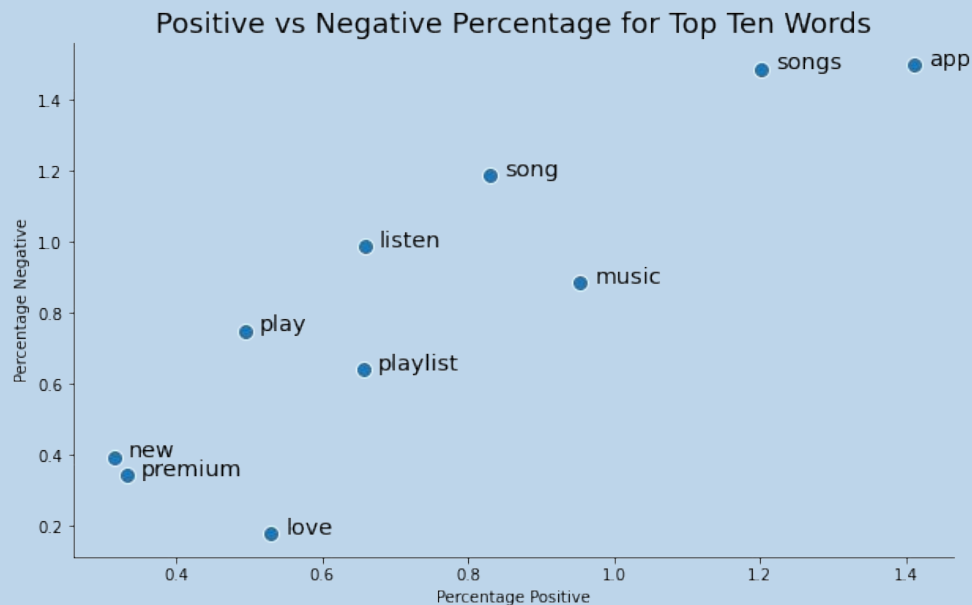
Percentage of Top Ten Words For Positive, Negative, and Neutral Reviews

- This graph shows the percentage of the top 10 words in each sentiment category
- This graph is a better representation of how likely each word is to be used in each category
- We can see that the bars are far more even than in the frequency graph
- Notably, the word “song” has a much higher percentage of negative reviews than positive or neutral ones
- The word “love” has the lowest percentage of negative reviews



Scatterplot of Top Ten Words Percentage

- This scatterplot shows the percentage used of the top ten words, in the positive category vs the negative category
- We can see that the word “love” is more likely to be used positively, while the words “new” and “premium” are more likely to be used negatively
 - Perhaps reviews are complaining about new features and updates more often than they are praising them
 - Reviewers without premium may be complaining more often about not having access to premium features (which cost money) compared to users with premium praising premium features



Rolling Average

- We then calculated the rolling average of the ratings with a 60 day period
 - This means that the every 60 days, the average of the ratings in that time was taken and plotted on a graph
 - This helps us to see changes in ratings more smoothly over time, rather than dealing with daily fluctuations in rating scores
- Any point shown on the graph represents the past 60 days average, not the current average rating of that day
- This graph will be shown on the next slide

Rolling 60 Day Review Average on top of Frequency of Reviews Over Time



Rolling Average vs Reviews Histogram Graph

- This graph shows the rolling average rating over the histogram of reviews over time
- The left axis tells us the number of reviews, while the right axis tells us the rolling average
- We can see that there was a sharp decrease in rolling average in the springtime of 2019, with the lowest point being in July of 2019
 - This means that the 60 days before July 2019 has the lowest average ratings
 - At this time, there was a significant increase in the number of reviews, which possibly implies that many spotify users were upset about some change, and left negative reviews on the app store, dropping the rolling average
- We can also see another sharp decrease in the end of 2020
 - There is a jump in the number of reviews given at this time as well

Possible Reason for Rolling Average Drop - Summer 2019

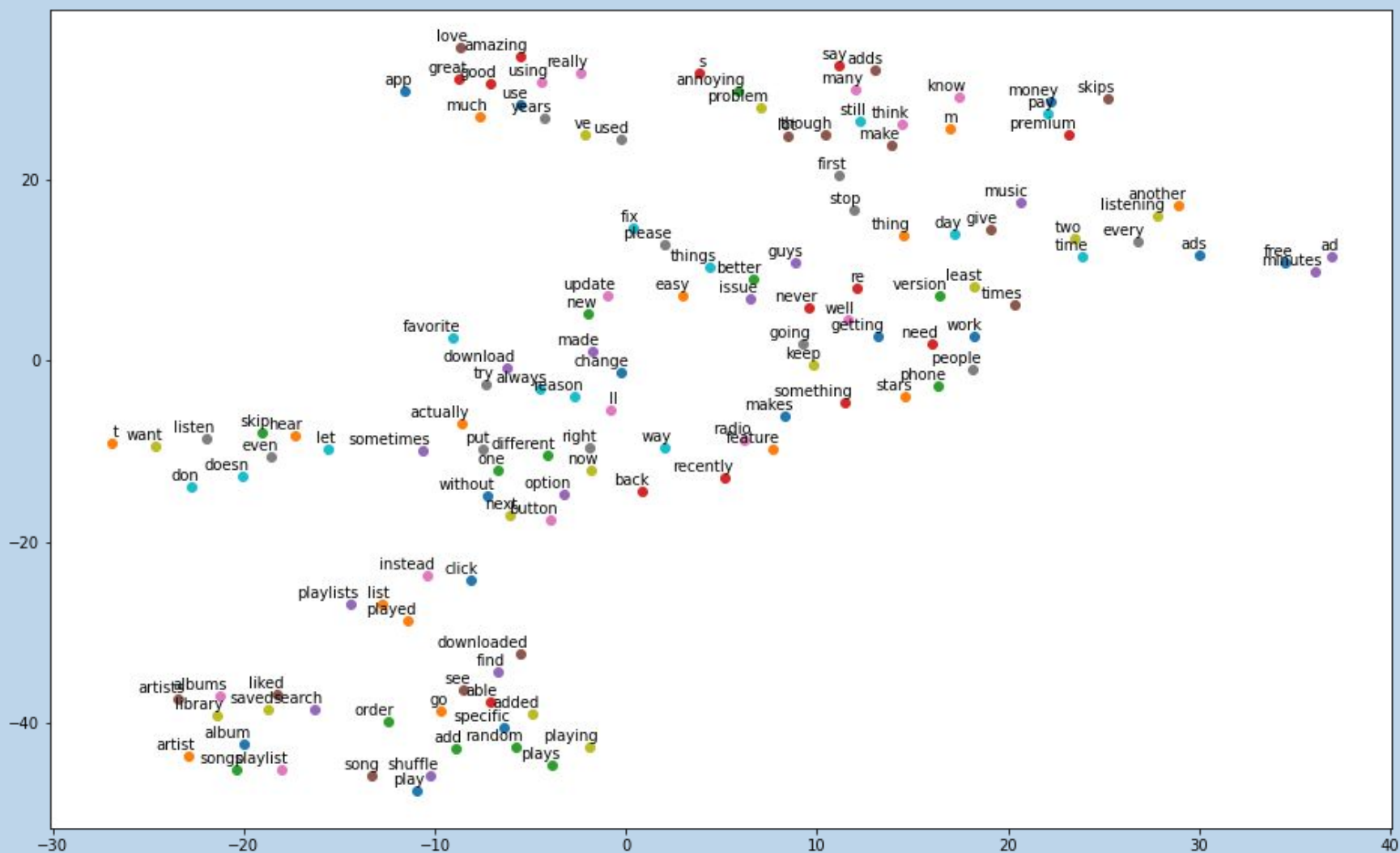
- On 6/13/2019, Spotify announced that they were updating the app to “streamline the user experience”
- However, 2 of the changes caused a large upset with Spotify users
 - Spotify removed the alphabetical scroll bar
 - This means that users would have to scroll a lot in order to find their saved songs which start with letters lower in the alphabet
 - Spotify replaced the “Recently Played” tab with “Playlists”, “Albums”, and “Artists”
 - This means that if you recently played a song but did not save it, you would have to find the song and save it to a list, rather than Spotify saving the song for you
- Frustrated Spotify users posted on Reddit, Twitter, and likely, the App Store - which would have caused the spike in the number of reviews combined with the stark drop in rolling rating average

Possible Reason for Rolling Average Drop - Winter 2020

- In October of 2020, conspiracy theorist Alex Jones appeared on Spotify's flagship podcast, "The Joe Rogan Experience"
 - Joe Rogan, the host of the podcast, has a 100 million dollar deal with Spotify
- Alex Jones was previously kicked off of Spotify's platform due to hate content
- Many Spotify users were upset that Spotify would allow Alex Jones on their platform again after previously kicking him off, citing his content as "gross" and "dangerous"
- Spotify did not comment on the event, but a leaked email from Spotify said that Spotify is "not going to ban specific individuals from being guests on other people's shows"
- This event may have caused users to leave negative reviews on the app store, accounting for the drastic increase in the number of reviews and the sharp drop in rolling average at that time

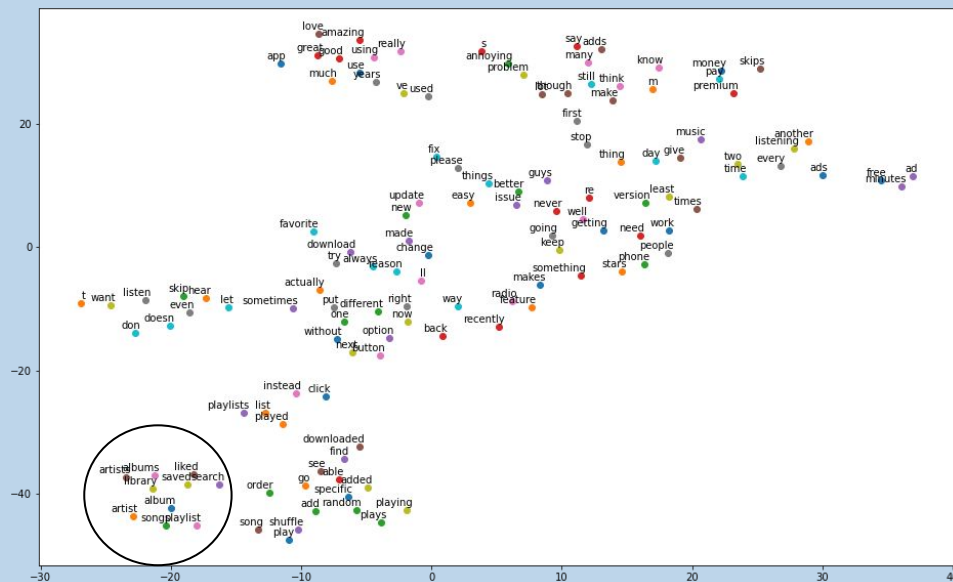
TSNE plot

- The plot on the next slide shows all the words used in the scraped reviews, which occurred at least 100 times in total
 - Ignoring words such as I, to, a, so, the, etc.
- This plot can help us understand how the words reviewers use relate to each other
 - Words used in the reviews appear near each other if they are similar, meaning they are likely to be used together in a review
 - They appear in far away from each other if they are dissimilar
- The next few slides will discuss some of the information we can gather from this plot



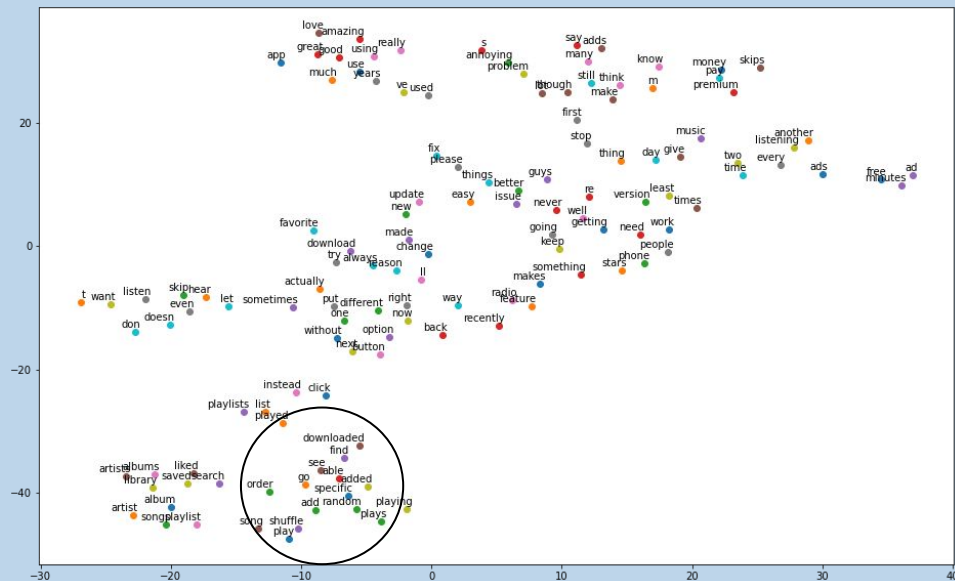
TSNE Section 1

- This section contains words such as artist, album, liked, saved, search, song, playlist
 - These words all seem to be related to finding/listening to specific music (whether it's a song, album, or artist), and saving it to a playlist
 - These words are all related to the usability and functionality of the app
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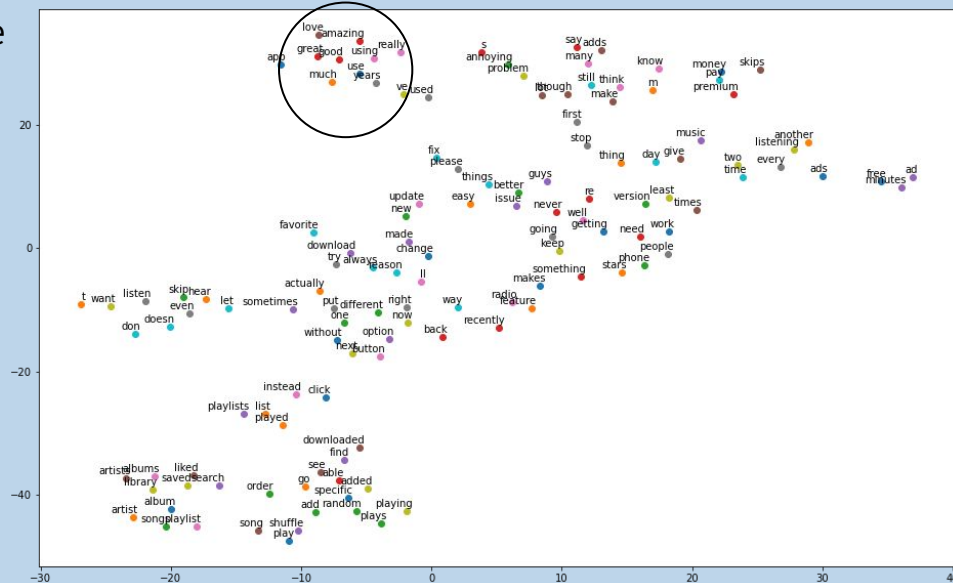
TSNE Section 2

- This section contains words such as download, find, play, add, shuffle, random, song, etc.
- These words seem to be related to finding, downloading, and playing songs
- These words are also related to the usability and functionality of the app
 - One reason user's are willing to pay for Spotify is because of its extensive music library and the ability to save specific songs to playlists and download them for offline listening
 - It makes sense that this cluster of words are close to the cluster of words on the last slide, as they are both related to usability



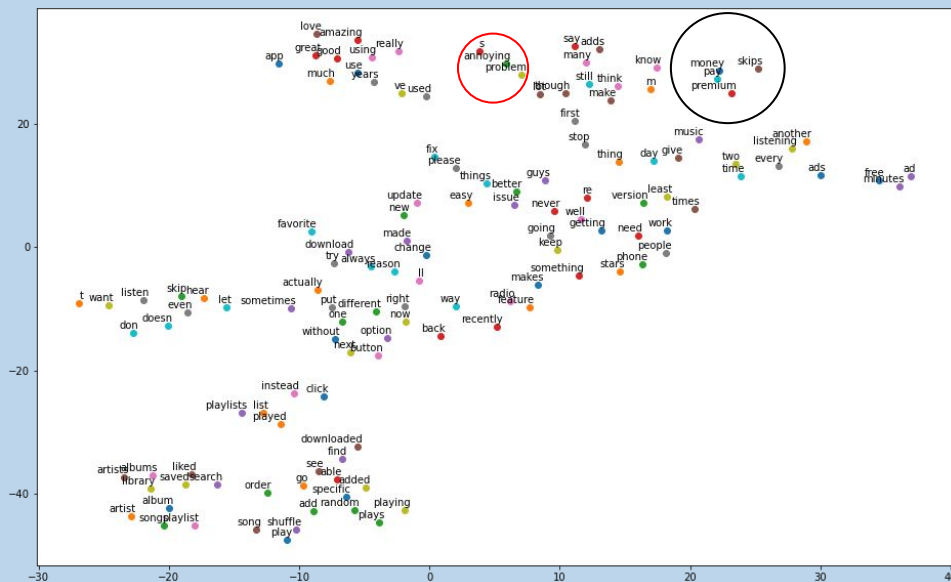
TSNE Section 3

- This section contains words such as love, amazing, great, years, app, much, really, etc.
- These words all seem to be expressing strong positive feelings about Spotify
- These “positive feeling” words are located far from the functionality words
 - This implies that users expressing positive feelings about the app are not necessarily discussing the features of the app itself



TSNE Section 4

- This section contains the words money, pay, skips, and premium
 - Spotify Premium is a paid service, so it makes sense that money, pay, and premium all appear together
 - The ability to skip unwanted songs on an album or playlist is a Premium feature, which is likely why it appears in this section as well
- This section is farther away from the “positive feeling” words than it is to the words “annoying” and “problem”
 - This implies that reviewers may be complaining about premium more than they compliment it
 - This could be for two reasons:
 - They have premium and don't think it's worth the money
 - They do not have premium and dislike the lack of features that come with the basic plan



Sentiment Predictions

- A Word2Vec model was then created to try and predict which ratings would be in the “positive” category (4 or 5 stars), based on the words within the review
- The dataset was broken into a training set and a testing set
 - The training set was used to develop the model
 - The testing set was used to test the accuracy of the model
- The model was found to be 73.33% accurate
 - This means that 73.33% of the time, the model was able to correctly predict if the rating associated with a review would be in the “positive” category or not

Model Issues

- This model was created using Word2Vec, which works best with very large collections of text
 - This dataset was only made up of 1000 reviews, which is not large in comparison to many other training collections used
 - Because of this, many data scientists use pre-trained word vectors - but that was not applicable in this case
 - Therefore, our model accuracy may be able to be improved if we increased the number of reviews included significantly
- Word2Vec cannot consider the context in which a word is used
 - For example, the model would not be able to tell the difference between the word “bark” used in different contexts
 - “My dog loves to bark.”
 - “The tree has bark.”

Conclusions

- Overall, Spotify has very positive reviews on the App Store
- Events that upset Spotify users (such as app updates or news about the app) can cause a significant drop in rolling rating average, but the average tends to recover over time
 - This means that Spotify should listen to users if they express they are unhappy, but do not necessarily have to make changes to appease them in order to save their ratings
- Reviews that praise Spotify do not necessarily discuss the specific features of the app itself
 - If Spotify wants to gain information about user's favorite features, they may have to gather feedback in a different way
 - Online surveys
 - User studies/ market research panels
- More pertinent sentiment information could potentially be found by taking a larger sample of reviews from the App Store

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