EECS 4312 Software Requirements

Assignment 1

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October 28, 2024

My signature below attests that this submission is my original work:

Following professional engineering practice, I bear the burden of proof for original work. I have read the Senate Policy on Academic Integrity posted on the York University website and confirm that this work is in accordance with the Policy.

Signature

October 28, 2024

Date

Contents

Task 1: Choosing a Mobile App

Loneliness in aging populations is an important issue, especially in Canada, whose population is aging. Given the strong link between social networks and well-being, it is important to find solutions to keep seniors connected to their loved ones as they age.

Introduction and Background

The well-being of the elderly population is strongly correlated to the quality of their social lives. Loneliness substantially increases the risk of depression, mood disorders, and feelings of hopelessness in the elderly [1]. This problem is especially daunting in Canada, where, according to estimates by the Government of Canada, 40% of Canadian adults will be seniors by 2038 [2].

Many apps exist that aim to fulfill the need of maintaining social connections and staying in contact with friends and family. Out of these apps and services, GrandPad stands out in its ability to meet user needs.

GrandPad

GrandPad (Google Play ID net.grandpad.puma) is an app used to maintain a private social network between loved ones, including a senior user who owns a GrandPad tablet.

The app's goals are to provide instant messaging and high-quality video-calling in real-time across the world with secure connections. As a simple, no-frills service to stay connected with loved ones, WhatsApp Messenger provides an easy-to-use app that can be utilized to maintain social connections across geographical barriers.

GrandPad's goal is to provide a platform for maintaining the social network of a senior loved one. The app, along with the GrandPad tablet for elderly users, provides a user-friendly interface for audio and video calls, messages, sharing of photos and videos, and online games. As a simple, no-frills service to keep a network of family members and friends connected, GrandPad provides an easy-to-use app that can be utilized to maintain social connections across geographical barriers.

Research conducted on this topic found that the majority of GrandPad users found the platform easy to use and felt more connected from using it [3]. GrandPad is especially promising when compared with modern social media services, whose newsfeed-style platforms have mixed results in fostering meaningful socialization [4]. Currently, GrandPad stands out to be a leading tool in the category of senior apps for maintaining social connections.

Task 2: Identify User, Software, and System Requirements

The identification of user, software, and system requirements were scraped and analyzed from the Google Play Store, both from the app's description and its reviews, and from GrandPad's website.

Analyzing GrandPad's Google Play Description and Website

First, analysis was conducted on the description of the GrandPad app on the Google Play Store and from their website.

User Requirements from GrandPad's Description and Website

The following user requirements were created from analyzing GrandPad's goals and desired outcomes for families. The Google Play Store description contains many needs that GrandPad claims to satisfy [5], and the GrandPad website lists product details that fill gaps for its users [6].

USER-01 As a member of a group of family members and friends with elderly members, I want to be able to make a private social network for us to stay connected.

USER-02 As an elderly member of a group of family members and friends, I want to have a private network to keep us connected without the distractions and complexity of modern social media.

USER-03 As a member of a GrandPad family network, I want to make video and voice calls to intimately connect with my loved ones.

USER-04 As a member of a GrandPad family network, I want to share photos and videos to stay in touch with my family members and friends.

USER-05 As a member of a GrandPad family network, I want to comment and react to posts from my family and friends to stay engaged with them and their lives.

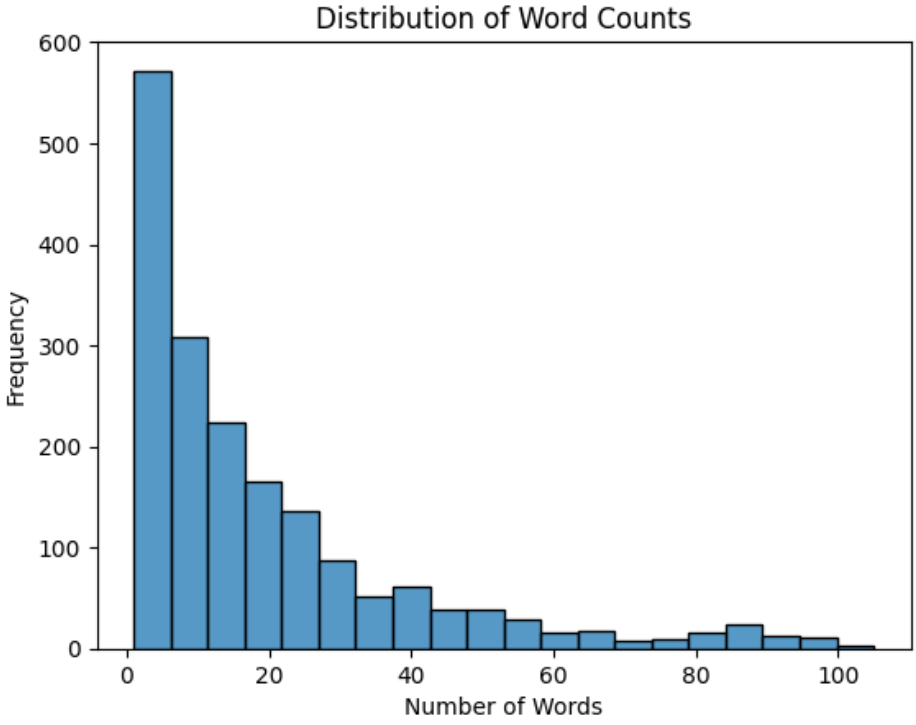
USER-06 As a member of a GrandPad family network, I want to play online games with my elderly loved one to connect with them and keep them engaged cognitively.

USER-07 As a caregiver for an elderly family member, I want to be able to remotely configure and administer their GrandPad tablet to help them with problems they are having with it.

Analyzing GrandPad's Google Play Reviews

Next, the reviews from the GrandPad Google Play Store app were analyzed. The following explanation of the analysis of GrandPad's reviews is a summary of the Jupyter Notebook in Appendix A.

Using the google-play-scraper Python library, reviews were scraped from the Google Play Store. Initially, 1,823 reviews were scraped, many of which were under 10 words. This is shown in the histogram below.



To reduce the amount of data to analyze, all reviews under 10 words were removed. The reviews were then split by their rating (5 stars: positive, 2-4 stars: mixed, 1 star: negative) and run through a Latent Dirichlet Allocation (LDA) algorithm from Scikit Learn to identify important topics from each category of the reviews.

User Requirements from Negative Reviews

The analysis of negative reviews led to some recurring topics, which included lack of professional support, intrusive app behavior, lack of personalization functionality, poor quality of video and voice calls, and frustrating notification experience.

USER-08 As a member of a GrandPad family network, I need to have access to support staff during work hours to help configure the network.

USER-09 As a senior user of GrandPad, I need to have access to support staff during work hours to help troubleshoot problems with the GrandPad tablet.

USER-10 As a user of the GrandPad app, I don't want the app to override Do Not Disturb mode on my phone.

USER-11 As an administrator of a GrandPad network, I want to be able to customize the elderly user's GrandPad tablet to suit their proficiency and comfort levels with technology.

USER-12 As an elderly user of the GrandPad tablet who is moderately comfortable with technology, I want to be able to customize the my GrandPad tablet to add or remove features.

USER-13 As a member of a GrandPad family network, I want to video call with high enough quality to see and hear my loved ones.

USER-14 As a member of a GrandPad family network, I want to voice call with high enough quality to hear my loved ones.

USER-15 As a user of the GrandPad app, I want to be able to receive notifications when a member of the network posts, comments, or reacts to a post, or calls me.

USER-16 As a user of the GrandPad app, I want to be able to clear all notifications at once, without having to individually clear each one.

User Requirements from Mixed Reviews

When analyzing the mixed reviews, some recurring topics were connecting multiple GrandPad tablets to a single network, being part of multiple networks, editing posts and comments, vague error messages, posting/downloading multiple files at once, and sending message to or calling specific people in a network.

USER-17 As an administrator of a GrandPad family network, I need to be able to add multiple users with GrandPad tablets to a single network, to accommodate multiple elderly family members.

USER-18 As a user of the GrandPad app, I want to be able to easily join and switch between multiple GrandPad family networks because I am part of multiple social circles with elderly people.

USER-19 As a user of the GrandPad app, I want to be able to edit the posts and comments that I make in case I wrote a typo.

USER-20 As a user of the GrandPad app, I want to know the reason when an upload fails so that I can take action to fix it.

USER-21 As a user of the GrandPad app, I want to post multiple files at once because I have many pictures and videos from a single event that I want to share.

USER-22 As a user of the GrandPad app, I want to download the files that my family members and friends share to have them saved on my device.

USER-23 As a caregiver of an elderly family member, I want to send messages to or call the elderly member specifically so that I can check up on them.

User Requirements from Positive Reviews

When analyzing positive reviews, prominent topics that were found include positive customer service experience, ease of use for non-tech savvy users, ability to connect over geographical barriers, privacy, lack of scams and telemarketers, lack of advertisements, and ability to connect multiple generations of users.

USER-24 As an elderly user of GrandPad, I need access to customer support that is patient and polite because I have difficulty using technology.

USER-25 As an elderly user of GrandPad, I need the interface to be simple enough to use with little to no technology experience.

USER-26 As a member of a GrandPad family network, I want to be able to stay connected with my loved ones even though they live far away or in places I cannot easily get to.

USER-27 As a member of a GrandPad family network, I don't want strangers to be able to join our network.

USER-28 As an administrator of a GrandPad family network, I want to be able to choose who can join the network to keep elderly members safe.

USER-29 As a caregiver of an elderly family member, I want the peace of mind of knowing that they are safe from scammers on the app.

USER-30 As a member of a GrandPad family network, I want to use the app to stay connected without being distracted by advertisements.

USER-31 As a younger member of a GrandPad family network, I want the app to be engaging for me, while being simple enough for non tech-savvy members to use.

References

[1] J. Golden, R. M. Conroy, I. Bruce, A. Denihan, E. Greene, M. Kirby, and B. A. Lawlor, "Loneliness, social support networks, mood and wellbeing in community-dwelling elderly," *International Journal of Geriatric Psychiatry*, vol. 24, no. 7, pp. 694–700, 2009. [Online]. Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/gps.2181

[2] Government of Canada, "Social isolation of seniors - volume 1: Understanding the issue and finding solutions," https://www.canada.ca/en/employment-social-development/corporate/seniors-forum-federal-provincial-territorial/social-isolation-toolkit-vol1.html.

[3] C. Perissinotto, C. Zhang, T. Oseau, D. Balik, C. Sou, C. Burnight, and K. Burnight, "Feasibility of a tablet designed for older adults to facilitate telemedicine visits," *Innovation in Aging*, vol. 3, no. Supplement 1, pp. S975–S975, 11 2019. [Online]. Available: https://doi.org/10.1093/geroni/igz038.3534

[4] L.-J. Hsu, H.-P. Yueh, and S.-H. Hsu, "Subjective social capital and loneliness for the elderly: The moderator role of line and facebook use," *Social Media + Society*, vol. 7, no. 3, p. 20563051211043906, 2021. [Online]. Available: https://doi.org/10.1177/20563051211043906

[5] GrandPad Inc., "Grandpad - apps on google play," https://play.google.com/store/apps/details?id=net.grandpad.puma&hl=en_CA.

[6] ——, "Grandpad product details," https://www.grandpad.net/tablet-features/overview.

Appendices

The following appendices contain the code that was referenced throughout this report. Appendix A contains the Jupyter Notebook for the data preprocessing of the WhatsApp Messenger reviews.

GrandPad Reviews Analysis

October 28, 2024

1 Retrieving and Preprocessing GrandPad Google Play Reviews

Import required libraries.

[1]:
```
import pandas as pd
from langdetect import detect_langs
import re
import seaborn as sns
import matplotlib.pyplot as plt
import os
from pathlib import Path
from utils.review_utils import get_google_play_data
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.decomposition import LatentDirichletAllocation
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from pathlib import Path
import os
import pyLDAvis
import pyLDAvis.lda_model
from utils.review_utils import find_reviews_by_keyword_list
```

1.1 Scraping Data

First, scrape the reviews from the Google Play Store.

[2]:
```
# Get reviews
APP_ID = 'net.grandpad.puma'
reviews = get_google_play_data(APP_ID)
df = pd.DataFrame(reviews)

# Print a few reviews (just the score and content)
print('Score  Content')
print('--------------')
for i in range(5):
    print(f"{df.iloc[i]['score']:<7}{df.iloc[i]['content']}")
```

```
Score  Content
--------------
5      Love the app for keeping my family in touch.
5      Grandpad is a great way to stay connected to those near and far.
5      My 94 year old aunt always tells me how much she loves her GrandPad!
She's become very proficient at making phone calls, & sending voice & text
messages. And she loves the photo display!
5      Enjoyed and used by the whole family
4      Great medium to remain in contact with our loved ones.
```

[3]:
```
# Print number of rows in the data
rows0 = df.shape[0]
print(f'Initially there are {rows0:,} reviews')
```

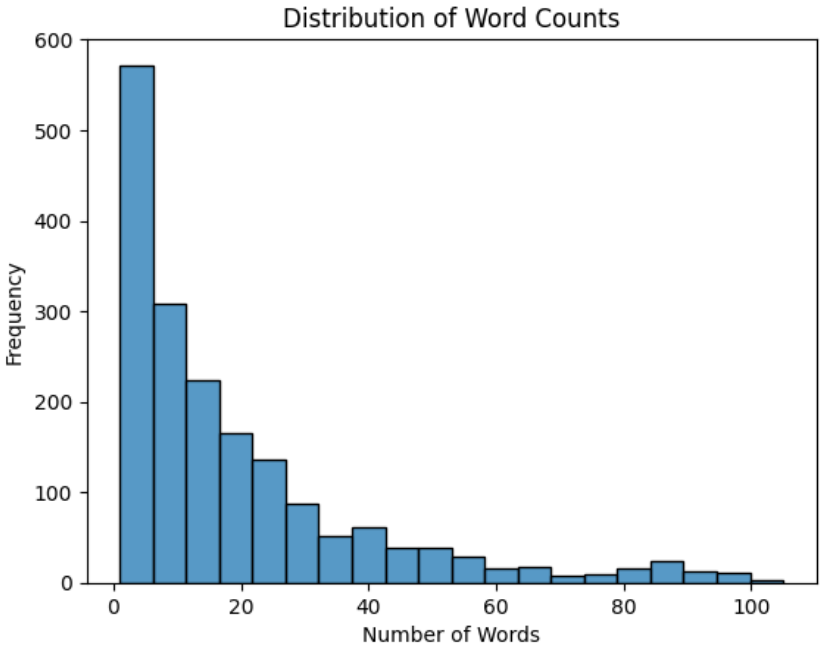
```
Initially there are 1,823 reviews
```

The length of the reviews might give important insight into the quality of the review.

[4]:
```
# Make column for word count (of the review content)
df['word_count'] = df['content'].str.split().apply(lambda s: 0 if s == None␣
 ↪else len(s))
```

Plotting the distribution of the word counts of the reviews, we see that the vast majority of the reviews contain fewer than 10 words.

[5]:
```
# Histogram of the word count of the reviews
sns.histplot(df['word_count'], bins=20)
plt.xlabel('Number of Words')
plt.ylabel('Frequency')
plt.title('Distribution of Word Counts')
plt.show()
```



1.2 Removing Short Reviews

We will remove short reviews, since they probably don't contain much useful information.

[6]:
```
# Make column for word count (of the review content)
df['word_count'] = df['content'].str.split().apply(lambda s: 0 if s == None␣
 ↪else len(s))

# Remove short reviews
REVIEW_WORD_COUNT_THRESHOLD = 10
df = df[df['word_count'] >= REVIEW_WORD_COUNT_THRESHOLD]
```

[7]:
```
# Print number of rows in the data after filtering out short reviews
rows1 = df.shape[0]
print(f'After filtering out short reviews, we have {rows1:,} reviews (removed␣
 ↪{rows0 - rows1:,} reviews)')
```

```
After filtering out short reviews, we have 1,063 reviews (removed 760 reviews)
```

1.3 Splitting Reviews By Rating

It is likely that reviews that rate the app highly will have positive things to say about the app, whereas reviews with lower ratings will contain complaints about the app. Positive reviews can be used to detect requirements that are being satisfied and negative reviews can point to ignored requirements (or new, previously unspecified requirements).

Shown below, most of the reviews are 1 star, with 5 star reviews following close behind. Reviews with 2, 3, and 4 stars are significantly smaller in number, but when combined together have almost the same amount as the 1 and 5 star reviews.

[8]:
```
# Print the counts of each rating
print(df['score'].value_counts().sort_index())
```

```
score
1     46
2     17
3     36
4     80
5    884
Name: count, dtype: int64
```

[9]:
```
# Split the reviews into negative (1 star), mixed (2, 3, and 4 stars), and
# positive (5 stars)
df_negative = df[df['score'] == 1].copy()
df_mixed = df[(df['score'] == 2) | (df['score'] == 3) | (df['score'] == 4)].
 ↪copy()
df_positive = df[df['score'] == 5].copy()
```

Shown below, the 1 star reviews are mostly negative,

[10]:
```
for i in range(5):
    print(f"{df_negative.iloc[i]['content']}\n")
```

```
Speakerphone no longer working I would give zero stars if possible

95% of the time, it seems, this is worthless. My aunt is in a nursing home --
that's why I bought a grandpad, but I usually cannot hear her. Yes, I have tried
numerous times w the help center.

This app is not functioning as it should. I was on a regular phone call and the
Grandpad rang through while I was on the phone call, interrupting my call.
Additionally, I had my phone on no not disturb and the Grandpad app still
somehow rang through. There are bugs that need to be worked out because this app
is terrible.

I am so upset right now because I put in my email address and they say it's
wrong what does this app want lies a am starting to believe that this app is a
scam I am Uninstalling they won't let me do my email account because they say
they don't have it developers please fix this issue I am feeling sad  right now
```

```
so disappointed  this app looked like fun only problem is that they don't like
my email account

Unable to Personalize GrandPad as Administrator. Calling Support hasn't helped.
```

the 2, 3, and 4 star reviews are mixed,

[11]:
```
for i in range(5):
    print(f"{df_mixed.iloc[i]['content']}\n")
```

```
Great medium to remain in contact with our loved ones.

Once you have figured out how to set it up it's an awesome device. It almost got
thrown across the room while I was trying to get it up and running for my 86 yo
mother who has dementia. Once it's set up though it's easy. I highly recommend
to get this before the senior citizen is as advanced in dementia as my mom is.
She is scared of it and even though I tell her to practice and reassure her she
can't mess it up she still won't use it alone.

So far, this app is great. My grandma is having an easier time with this than
other social apps

I have a few questions on posting things & submitted it. Waiting on a response.

The app is fantastic. It's a great way to keep in touch with loved ones. I love
that I can post videos and pictures or do video calls with anyone in my family
who has access to the app. Also I love some of the recent changes. Keep up the
good work, Grandpad!
```

and the 5 star reviews are mostly positive.

[12]:
```
for i in range(5):
    print(f"{df_positive.iloc[i]['content']}\n")
```

```
Grandpad is a great way to stay connected to those near and far.

My 94 year old aunt always tells me how much she loves her GrandPad! She's
become very proficient at making phone calls, & sending voice & text messages.
And she loves the photo display!

Easy to use! Large variety of music, easy to load photos!

This makes sharing photos and memories with my senior citizen father much
easier. We are able to connect very easily and he can call me without memorizing
a phone number. That adds to helping him feel more independent as he ages.

The screen and user interface are simple, and easy to use for mom. Just the
right features to stay in touch and share photos/videos.
```

1.4 Saving Preprocessed Data to Files

As the last step, we will save the dataframes to CSV files so that they can be used later.

[13]:
```
# Path of this notebook
NOTEBOOK_PATH = Path(os.path.abspath(''))

# Path of data files
DATA_PATH = NOTEBOOK_PATH.parent / 'data'

# Ensure data directory exists
DATA_PATH.mkdir(exist_ok=True)

# Save dataframes
df_positive.to_csv(DATA_PATH / 'positive_reviews.csv', index=False)
df_mixed.to_csv(DATA_PATH / 'mixed_reviews.csv', index=False)
df_negative.to_csv(DATA_PATH / 'negative_reviews.csv', index=False)
```

2 Performing LDA Analysis

Now that the reviews have been preprocessed, we will analyze each category of reviews by applying an LDA (Latent Dirichlet Allocation) model.

First, we define a function for preparing text for LDA analysis.

[14]:
```
nltk.download('wordnet')

numbers_re = re.compile(r'\d+')
punctuation_re = re.compile(r'[^\w\s]')
extra_spaces_re = re.compile(r'\s+')

lemmatizer = WordNetLemmatizer()

def preprocess_text(text):
    """
    Cleans `text` by:
      - setting it to lower case,
      - removing numbers,
      - removing punctuation,
      - removing extra spaces,
      - lemmatizing words, and
      - removing stopwords.
    """
    text = text.lower()
    text = numbers_re.sub(r'', text)
    text = punctuation_re.sub('', text)
```

```
    text = extra_spaces_re.sub(' ', text)
    text = ' '.join([lemmatizer.lemmatize(word) for word in text.split() if␣
↪word not in stopwords.words('english')])
    return text
```

```
[nltk_data] Downloading package wordnet to /home/daniel/nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
```

Next, we define a function for creating the LDA model given a dataframe containing reviews.

[15]:
```
def make_lda_model(df: pd.DataFrame):
    """
    Makes a LatentDirichletAllocation (LDA) model of the data in `df` DataFrame.
    `df` must have a `'cleaned_content'` column that contains the cleaned
    content of the reviews.

    Returns:

    `lda_model` - the generated LDA model.

    `vectorizer` - the vectorizer that was used on the reviews to convert the
    text data into numbers.

    `X` - the vectorized data of the cleaned reviews.
    """
    # Vectorize the text (turn words into numerical data)
    vectorizer = CountVectorizer(max_df=0.95, min_df=2, stop_words='english')
    X = vectorizer.fit_transform(df['cleaned_content'])

    # Apply LDA for topic modeling
    NUMBER_OF_TOPICS = 5
    lda_model = LatentDirichletAllocation(n_components=NUMBER_OF_TOPICS,␣
↪random_state=42)
    lda_model.fit(X)

    # Assign topics to reviews
    df['topic'] = lda_model.transform(X).argmax(axis=1)

    # Map topic numbers so that they start at 1 instead of 0 and are sorted in
    # decreasing order
    topic_sizes = df['topic'].value_counts().sort_values(ascending=False)
    size_based_mapping = {old_topic: new_topic + 1 for new_topic, old_topic in␣
↪enumerate(topic_sizes.index)}
    df['topic'] = df['topic'].map(size_based_mapping)

    def print_top_words(model, feature_names, n_top_words=10):
        """
        Prints the top words in each topic.
```

```
        """
        topics_map = {}
        for i, topic in enumerate(model.components_):
            topics_map[size_based_mapping[i]] = " ".join([feature_names[j] for␣
↪j in topic.argsort()[:-n_top_words - 1:-1]])
        for i in sorted(topics_map.keys()):
            print(f'Topic #{i}: {topics_map[i]}')

    # Print top words in each topic
    print_top_words(lda_model, vectorizer.get_feature_names_out())

    return lda_model, vectorizer, X
```

2.1 LDA Model for Positive Reviews

Creating and analyzing an LDA model for positive reviews.

[16]:
```
# Clean the content in the dataframe for positive reviews
df_positive['cleaned_content'] = df_positive['content'].apply(preprocess_text)
```

[17]:
```
# Make LDA model for positive reviews
lda_model_positive, vectorizer_positive, X_positive =␣
↪make_lda_model(df_positive)
```

```
Topic #1: family easy use great touch way stay grandpad year connected
Topic #2: love family great video picture mom app share able photo
Topic #3: grandpad service family easy use mom customer wonderful phone best
Topic #4: grandpad use able love mother phone easy home mom computer
Topic #5: family life way great able far wonderful away senior time
```

[18]:
```
# Visualizing the LDA model for positive reviews
pyLDAvis.enable_notebook()
panel = pyLDAvis.lda_model.prepare(lda_model_positive, X_positive,␣
↪vectorizer_positive)
pyLDAvis.display(panel)
```

[18]:
```
<IPython.core.display.HTML object>
```

2.2 LDA Model for Mixed Reviews

Creating and analyzing an LDA model for mixed reviews.

[19]:
```
# Clean the content in the dataframe for mixed reviews
df_mixed['cleaned_content'] = df_mixed['content'].apply(preprocess_text)
```

[20]:
```
# Make LDA model for mixed reviews
lda_model_mixed, vectorizer_mixed, X_mixed = make_lda_model(df_mixed)
```

```
Topic #1: video phone app work use time easy love need great
Topic #2: app able pad contact picture sister family mom like add
Topic #3: family great love mom easy grandpad app use user picture
Topic #4: video phone app great family photo elderly internet issue device
Topic #5: family photo comment touch great app picture delete like posted
```

[21]:
```
# Visualizing the LDA model for mixed reviews
panel = pyLDAvis.lda_model.prepare(lda_model_mixed, X_mixed, vectorizer_mixed)
pyLDAvis.display(panel)
```

[21]:
```
<IPython.core.display.HTML object>
```

2.3 LDA Model for Negative Reviews

Creating and analyzing an LDA model for negative reviews.

[22]:
```
# Clean the content in the dataframe for negative reviews
df_negative['cleaned_content'] = df_negative['content'].apply(preprocess_text)
```

[23]:
```
# Make LDA model for negative reviews
lda_model_negative, vectorizer_negative, X_negative =␣
  ↪make_lda_model(df_negative)
```

```
Topic #1: grandpad account grand pad time installed help try log create
Topic #2: app phone grandpad answer work suck need way ive fine
Topic #3: picture say make app link account dont ive notification actually
Topic #4: app like email account phone dont say problem wont let
Topic #5: app open registered tried wont let email sign isnt say
```

[24]:
```
# Visualizing the LDA model for negative reviews
panel = pyLDAvis.lda_model.prepare(lda_model_negative, X_negative,␣
  ↪vectorizer_negative)
pyLDAvis.display(panel)
```

[24]:
```
<IPython.core.display.HTML object>
```