Machine Learning Project Work Space

June 15, 2025

0.1 Machine Learning Project Work Space

Title of Your Project: Understanding Customer Sentiment and QnA over Amazon Product Reviews Short Description of Your Project and Objectives:

We aim to analyze customer sentiment and extract key complaints from Amazon product reviews using transformer-based NLP techniques. Our project will try to leverage models to perform fine-grained sentiment analysis and topic modeling to uncover common issues or praise patterns across thousands of reviews. Additionally, we will try to prototype a QnA bot that enables users to query the reviews intelligently. For example, by asking "What do people say about the product?" or "What are some negative qualities of this product?". This system has the potential to scale across e-commerce platforms like Amazon and Shopify to improve user experience and support business decision-making.

Selected Dataset: Amazon Product Reviews (https://www.kaggle.com/datasets/datafiniti/consumer-reviews-of-amazon-products/)

Description of Your Selected Dataset (data source, number of variables, size of dataset, etc.)

0.2 First Level Analysis

The code below is to get a general idea of the data being used. After the analiysis we will know a gereral idea of customer sentiment, products being reviewed and the words that occur most in the reviews.

Second level and Third level will dive further into each product.

[1]:

```
#!pip install transformers
```

[2]:

```
import pandas as pd
from transformers import pipeline, AutoTokenizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.decomposition import LatentDirichletAllocation

# 1. Data preparation
df = pd.read_csv('amazon_reviews.csv')
reviews = df['reviews.text'].astype(str).tolist()

# 2. Sentiment analysis with truncation
model_name = "distilbert-base-uncased-finetuned-sst-2-english"
tokenizer = AutoTokenizer.from_pretrained(model_name)
```

```
sentiment_analyzer = pipeline(
    "sentiment-analysis",
    model=model_name,
    tokenizer=tokenizer,
    truncation=True,
    max_length=512
)
sentiments = sentiment_analyzer(reviews[:1000])

# 3. Topic modeling
vectorizer = TfidfVectorizer(max_df=0.95, min_df=2, stop_words='english')
tfidf = vectorizer.fit_transform(reviews)
lda = LatentDirichletAllocation(n_components=5, random_state=42)
lda.fit(tfidf)

# Display topics
feature_names = vectorizer.get_feature_names_out()
for topic_idx, topic in enumerate(lda.components_):
    print(f"Topic #{topic_idx + 1}:")
    print(" ".join([feature_names[i] for i in topic.argsort()[:-10 - 1:-1]]))
```

```
WARNING:tensorflow:From C:\Users\ianmc\AppData\Local\Packages\PythonSoftwareFoun
dation.Python.3.9_qbz5n2kfra8p0\LocalCache\local-packages\Python39\site-
packages\tf_keras\src\losses.py:2976: The name
tf.losses.sparse_softmax_cross_entropy is deprecated. Please use
tf.compat.v1.losses.sparse_softmax_cross_entropy instead.

WARNING:tensorflow:From C:\Users\ianmc\AppData\Local\Packages\PythonSoftwareFoun
dation.Python.3.9_qbz5n2kfra8p0\LocalCache\local-packages\Python39\site-
packages\tf_keras\src\backend.py:873: The name tf.get_default_graph is
deprecated. Please use tf.compat.v1.get_default_graph instead.


All PyTorch model weights were used when initializing
TFDistilBertForSequenceClassification.

All the weights of TFDistilBertForSequenceClassification were initialized from
the PyTorch model.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use TFDistilBertForSequenceClassification for predictions
without further training.
Device set to use 0
```

```
Topic #1:
great tablet price use easy games loves good old perfect
Topic #2:
bought gift loves christmas love purchased got loved great tablet
Topic #3:
batteries good price great work long value buy battery just
```

```
Topic #4:
kindle love echo alexa use music easy great read light
Topic #5:
tablet great kids amazon easy use love apps tv product
```

[3]:

```python
print(df.head())
```

```
                   asins  reviews.rating  \
0  B00QWO9P0O,B00LH3DMUO             3.0
1  B00QWO9P0O,B00LH3DMUO             4.0
2  B00QWO9P0O,B00LH3DMUO             5.0
3  B00QWO9P0O,B00LH3DMUO             5.0
4  B00QWO9P0O,B00LH3DMUO             5.0

                                              name         brand  \
0  AmazonBasics AAA Performance Alkaline Batterie…  Amazonbasics
1  AmazonBasics AAA Performance Alkaline Batterie…  Amazonbasics
2  AmazonBasics AAA Performance Alkaline Batterie…  Amazonbasics
3  AmazonBasics AAA Performance Alkaline Batterie…  Amazonbasics
4  AmazonBasics AAA Performance Alkaline Batterie…  Amazonbasics

                                        categories  \
0  AA,AAA,Health,Electronics,Health & Household,C…
1  AA,AAA,Health,Electronics,Health & Household,C…
2  AA,AAA,Health,Electronics,Health & Household,C…
3  AA,AAA,Health,Electronics,Health & Household,C…
4  AA,AAA,Health,Electronics,Health & Household,C…

                                      reviews.text  \
0  I order 3 of them and one of the item is bad q…
1  Bulk is always the less expensive way to go fo…
2  Well they are not Duracell but for the price i…
3  Seem to work as well as name brand batteries a…
4  These batteries are very long lasting the pric…

                                   reviews.title  reviews.username
0  … 3 of them and one of the item is bad quali…        Byger yang
1  … always the less expensive way to go for pr…              ByMG
2  … are not Duracell but for the price i am ha…  BySharon Lambert
3  … as well as name brand batteries at a much …     Bymark sexson
4  … batteries are very long lasting the price …           Bylinda
```

[4]:

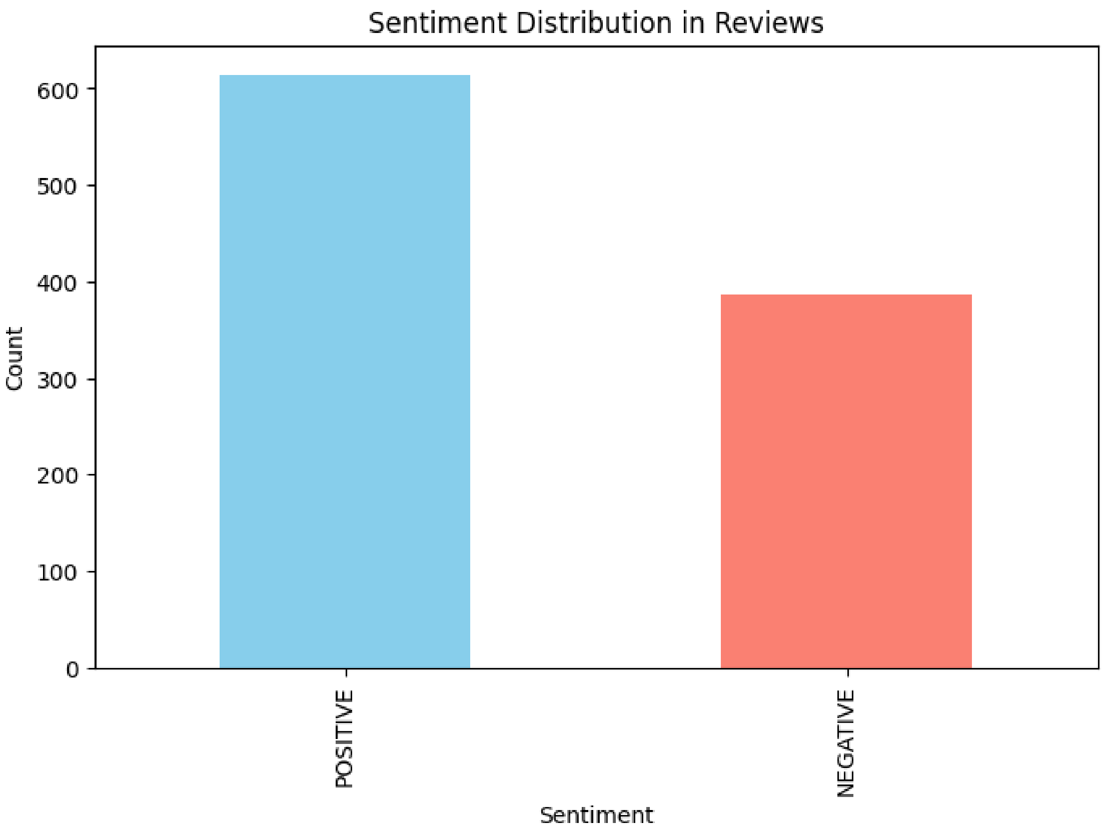
```python
import matplotlib.pyplot as plt
from wordcloud import WordCloud
```

0.3 Sentiment Analysis

[5]:

```python
# Analyze a sample (first 1000 reviews for speed)
sample = reviews[:1000]
sentiments = sentiment_analyzer(sample)

# Extract labels and scores
labels = [result['label'] for result in sentiments]
scores = [result['score'] for result in sentiments]

# Count sentiment labels
label_counts = pd.Series(labels).value_counts()
print(label_counts)

# Plot sentiment distribution
plt.figure(figsize=(8, 5))
label_counts.plot(kind='bar', color=['skyblue', 'salmon'])
plt.title('Sentiment Distribution in Reviews')
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.show()

# Print the first few results
for i, (review, label, score) in enumerate(zip(sample, labels, scores)):
    print(f"Review {i+1}: {label} (score: {score:.2f})")
    print(review[:200] + "...")
    print()
    if i >= 4:  # Print only first 5
        break
```

```
POSITIVE    614
NEGATIVE    386
dtype: int64
```

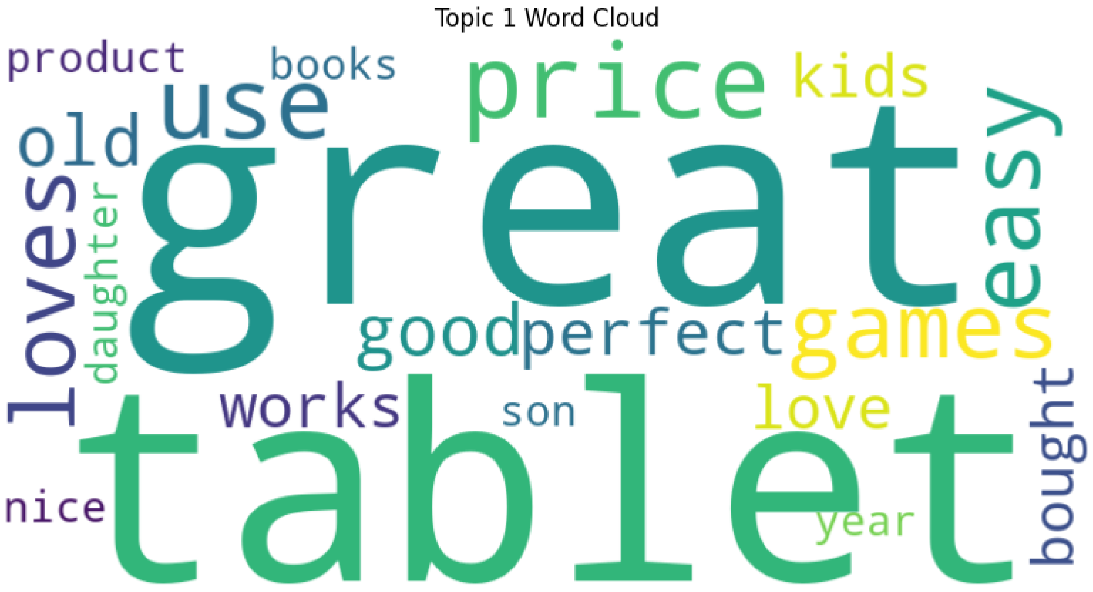


```
Review 1: NEGATIVE (score: 1.00)
I order 3 of them and one of the item is bad quality. Is missing backup spring
so I have to put a pcs of aluminum to make the battery work…

Review 2: NEGATIVE (score: 1.00)
Bulk is always the less expensive way to go for products like these…

Review 3: POSITIVE (score: 1.00)
Well they are not Duracell but for the price i am happy…

Review 4: POSITIVE (score: 0.66)
Seem to work as well as name brand batteries at a much better price…

Review 5: POSITIVE (score: 1.00)
These batteries are very long lasting the price is great…
```

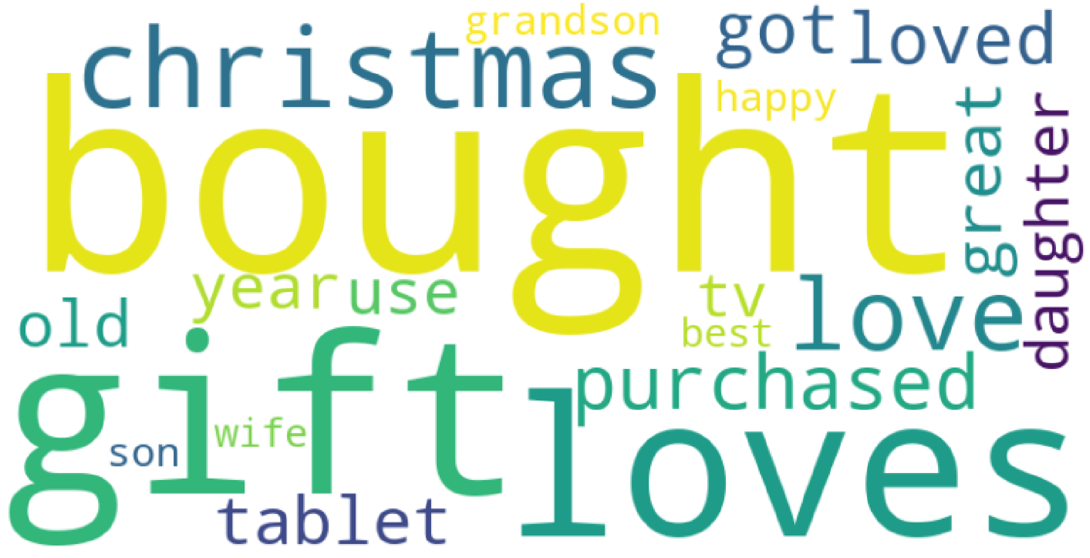
0.4 Topic Modeling

[6]:

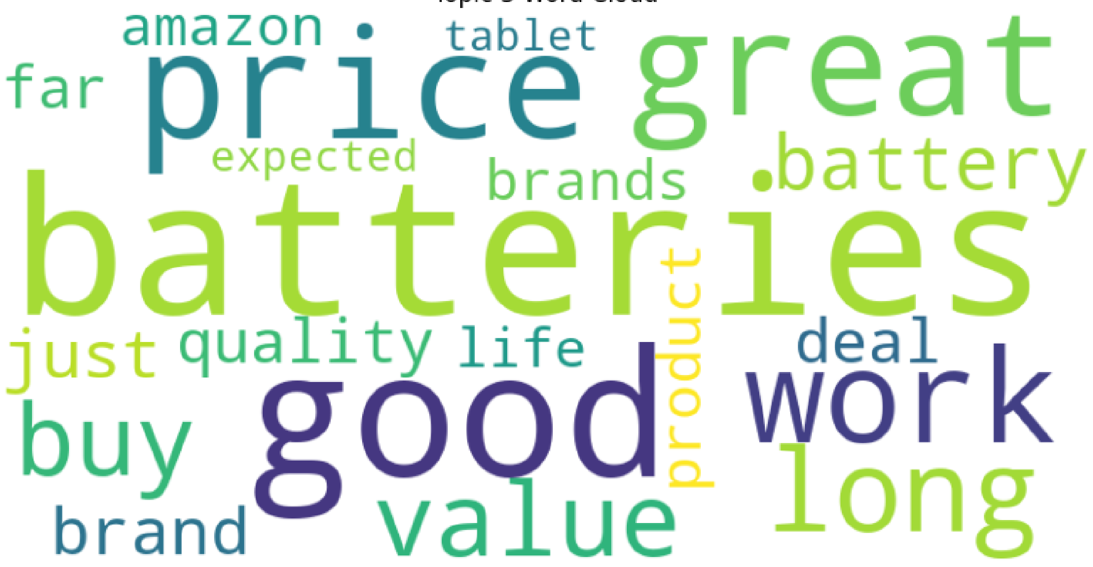
```python
# Preprocess and vectorize
vectorizer = TfidfVectorizer(max_df=0.95, min_df=2, stop_words='english')
tfidf = vectorizer.fit_transform(reviews)
feature_names = vectorizer.get_feature_names_out()

# Fit LDA
lda = LatentDirichletAllocation(n_components=5, random_state=42)
lda.fit(tfidf)

# Function to generate word cloud for a topic
def topic_wordcloud(topic_idx, n_words=20):
    topic = lda.components_[topic_idx]
    top_words_idx = topic.argsort()[-n_words:][::-1]
    top_words = [feature_names[i] for i in top_words_idx]
    freqs = {word: topic[i] for word, i in zip(top_words, top_words_idx)}
    wordcloud = WordCloud(width=800, height=400, background_color='white').
  ↪generate_from_frequencies(freqs)
    plt.figure(figsize=(10, 5))
    plt.imshow(wordcloud, interpolation='bilinear')
    plt.axis('off')
    plt.title(f'Topic {topic_idx + 1} Word Cloud')
    plt.show()

# Generate word clouds for each topic
for topic_idx in range(lda.n_components):
    topic_wordcloud(topic_idx)
```



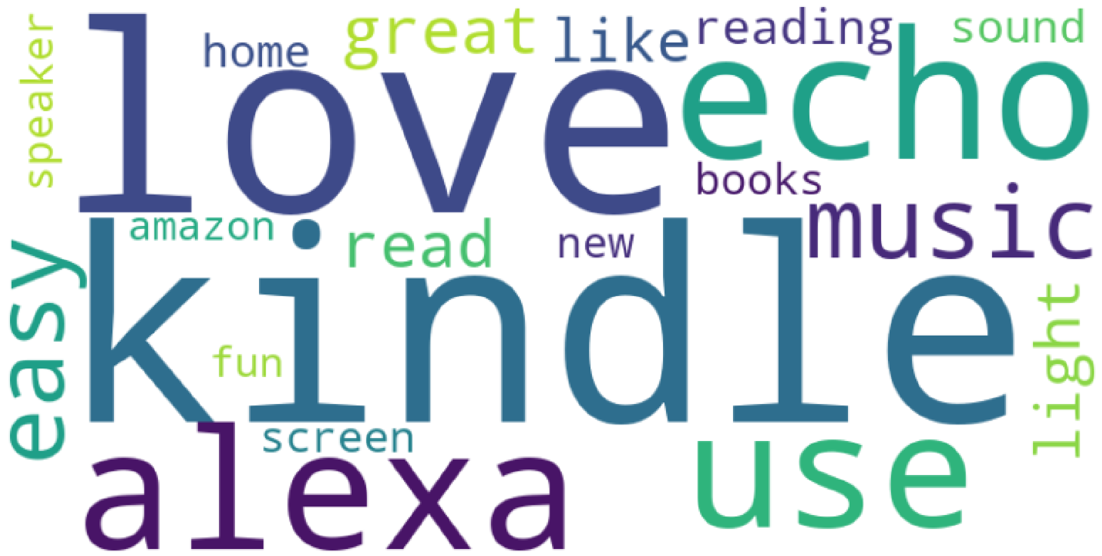
Topic 2 Word Cloud



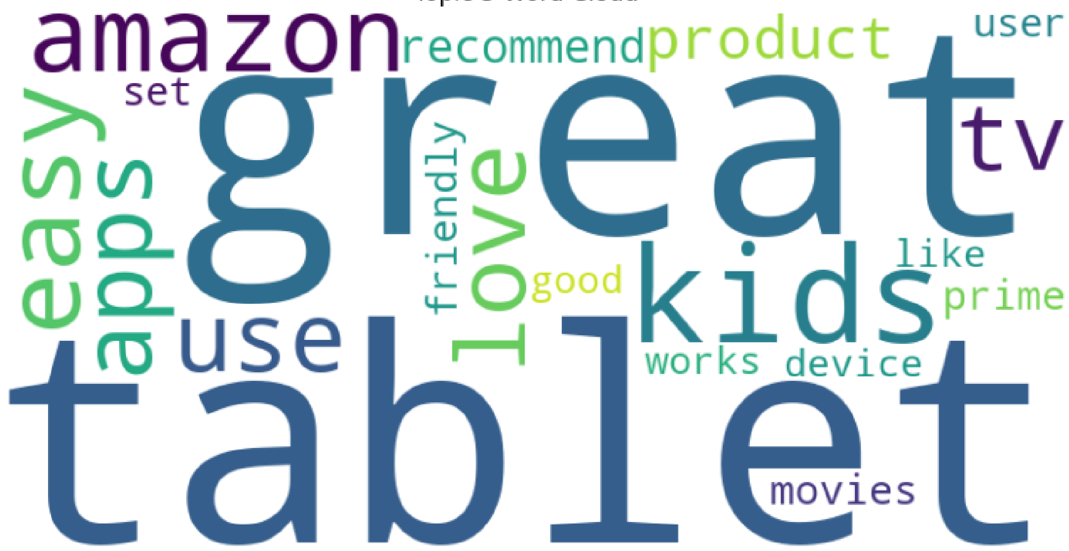
Topic 3 Word Cloud



Topic 4 Word Cloud



Topic 5 Word Cloud



[ ]: