Project Report: Sentiment Trends in Amazon Product Reviews Using NLP & LLMs

🌐 Overview

This project explores customer sentiment trends in Amazon product reviews using natural language processing (NLP) and large language models (LLMs). The goal is to identify which products receive the most negative feedback, both in terms of quantity and intensity, and summarize the underlying reasons for customer dissatisfaction.

The analysis was performed on a publicly available Amazon review dataset using Python in a Jupyter Notebook environment. Hugging Face transformer models were leveraged for sentiment analysis and review summarization.

📊 Dataset and Preprocessing

- Sampled **10,000 reviews** from Amazon product data.
- Selected key columns: `name`, `reviews.text`, `reviews.date`, and `reviews.rating`.
- Applied cleaning and dropped rows with missing values.
- Created a shortened version of the product name (`short name`) for grouping purposes.

📊 Sentiment Analysis

- Applied Hugging Face's `cardiffnlp/twitter-roberta-base-sentiment` model for sentiment classification.
- Converted model labels using a custom map:
  - `LABEL_0` → Negative
  - `LABEL_1` → Neutral
  - `LABEL_2` → Positive
- Added a new column `roberta_sentiment` with sentiment predictions.

📊 Key Findings

- Majority of products had positive sentiment.
- Certain products showed disproportionately high negative sentiment.
- Top products by **volume** of negative reviews and **percentage** of negative sentiment were identified separately.

🔷 High % Negative Product Reviews

These products had the highest proportion of negative sentiment despite lower review volume:

🔷 All-New Kindle E-reader

9 negative reviews (11.1%)

- Too expensive for what it offers
- Packaging issues (missing items)
- Complaints about lack of bundled charger

Sample complaints:

- "Too expensive. Should be included, at no extra cost, with the Kindle."
- "Just got home and found the packet is empty..."

🔷 High Volume Negative Products Reviews (LLM Summarized)

Products with the highest absolute number of negative reviews were selected for in-depth LLM-powered summarization using `facebook/bart-large-cnn`.

🔷 Brand New Amazon Kindle

227 negative reviews (5.5%)

Top Complaints:

- Slow performance
- Fragile charging port
- Excessive ads and poor support
- Heavy and hard to use

Summarized Insights:

1. "Slow downloads, heavy feel, and poor usability."
2. "Touch controls too sensitive, issues with browser and library checkout."

3. "Manual app updates are frustrating, and the camera is poor."
4. "Charging ports fail often; warranty is inadequate."
5. "Too many ads, battery issues, and app instability."

🔷 Fire Kids Edition Tablet

36 negative reviews (6.3%)

Top Complaints:

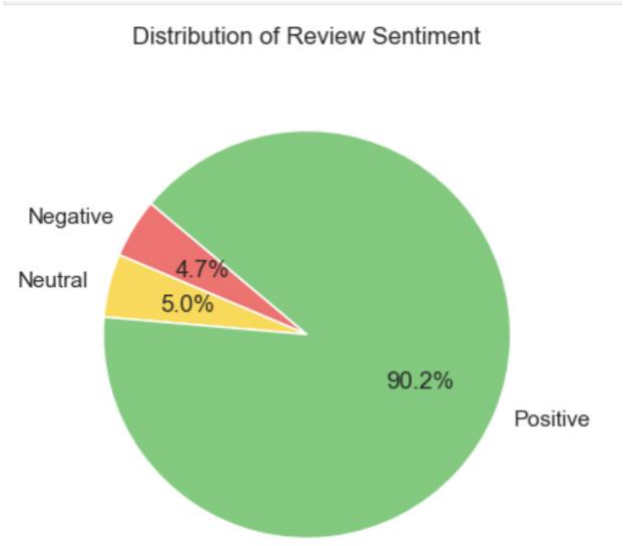
- Breaks easily (fragile screen)
- Lacks storage and parental control
- Netflix and Google apps unsupported

Summarized Insights:

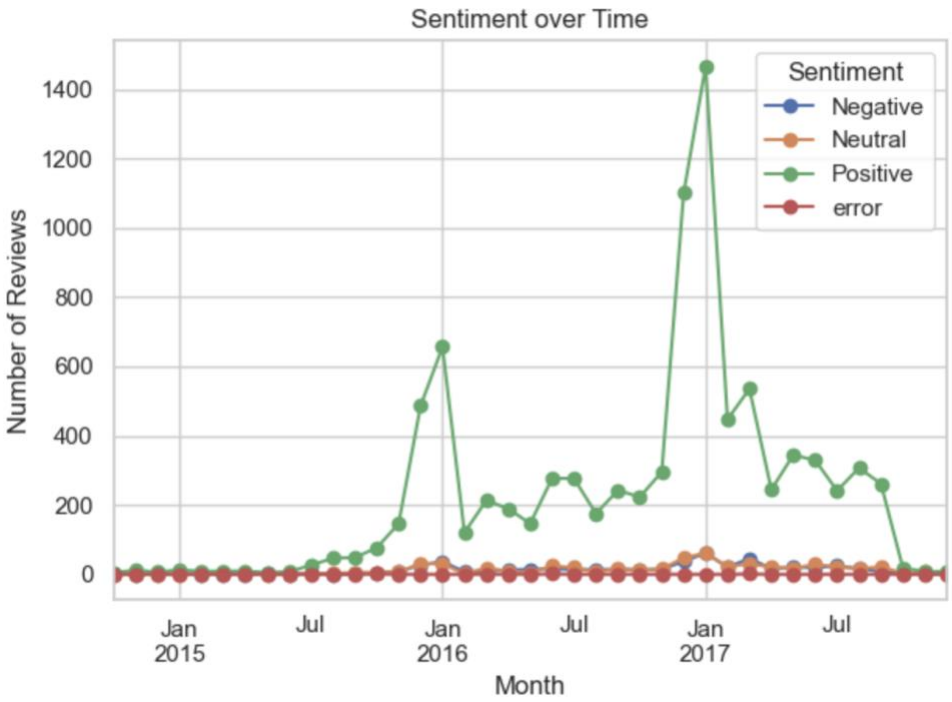
1. "Lacks HD display; works okay for the price."
2. "Screen broke after one drop; poor parental content control."
3. "Can't lock screen during playback; freezes frequently."
4. "Not user-friendly and requires SD card."
5. "Charging port is unreliable; lacks Google app support."

📈 Visualizations

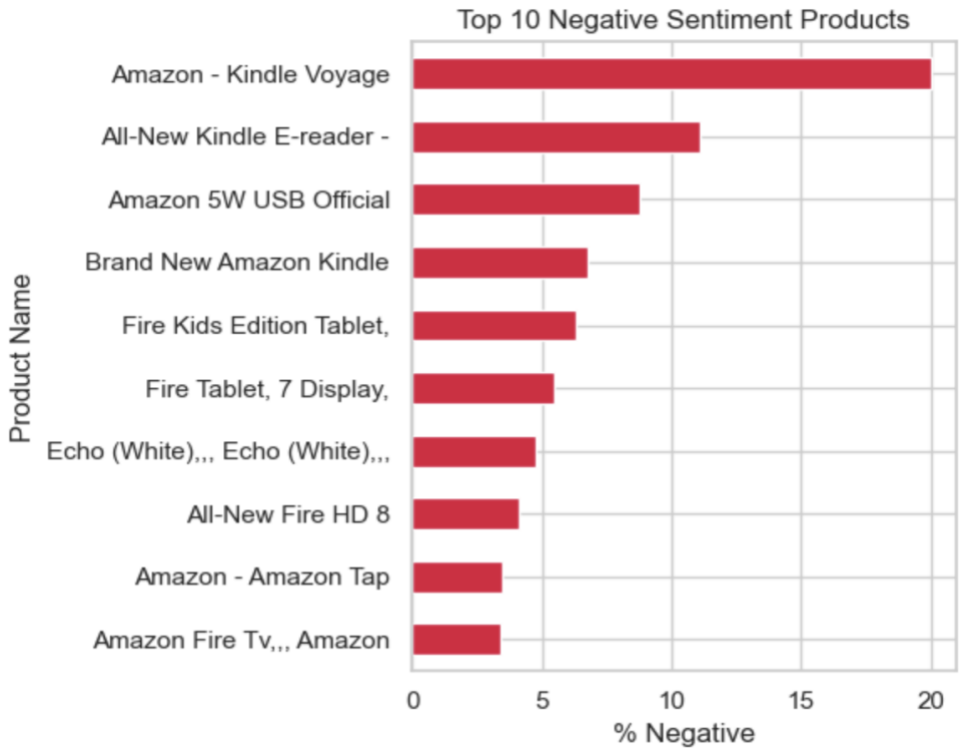
- **Sentiment distribution pie chart of all products**



- **Sentiment trends of all products over time by review month**



- **Top 10 products by % negative sentiment**



🔧 Recommendations

- **Fire Tablet, 7**: Improve SD card support, reduce forced ads, and address screen freezing.
- **Amazon Kindle**: Offer better build quality and reduce ad interruptions.
- **Fire Kids Edition**: Improve durability, add screen-locking features, and support common apps like Netflix and YouTube Kids.

📘 Conclusion

This project demonstrates how NLP and LLMs can extract actionable product insights from unstructured review data. Businesses can leverage such analysis to improve customer satisfaction, reduce return rates, and prioritize product improvements.

Future work could include emotion/tone classification, clustering similar complaints, or building an interactive dashboard for product sentiment monitoring.