Analyzing Consumer Sentiment on Twitter with Machine Learning

Outline

I. Introduction

II. Project Goals

III. Data

IV. Methods and Models

V. Results

VI. Value and Application

VII. Conclusion

Introduction

An Automated Approach to Business Consumer Research

- **Social media platforms**, such as **Twitter**, provide a wealth of data that can be used to **analyze consumer opinions**

- **The Problem:**
  - **Manually** analyzing this data can be **time-consuming** and **resource-intensive**

- **The Answer: Machine Learning**
  - By using **machine learning** to **automate** this process, we can access this data without spending time and resources, and make more informed decisions based on data-driven insights

Project Goals

1. Develop a machine learning model to predict sentiment about apple products on Twitter

2. Demonstrate the effectiveness of the model in predicting sentiment

3. Outline the benefits and limitations of using a sentiment analysis model for business consumer opinion research

Data

Source

- Combined and filtered two datasets resulting in ~6,000 tweets about various products and services
  1. CrowdFlower
     a. Human raters rated the sentiment in over 9,000 Tweets as positive, negative, or neither.
  2. Sentiment Analysis: Emotion in Text
     a. Kaggle Dataset with >25k tweets
     b. filtered for those with reference to products and services

Text Processing

1. **Cleaning**
    a. Remove irrelevant data such as URLs, capitalization, and punctuation.
2. **Normalization**
    a. Convert words to their base form
        i. "running" and "ran" are converted to "run"
    b. Replace specific products with the word “product”
3. **Vectorization**
    a. Using a technique called bag-of-words, each word is assigned a numerical value.

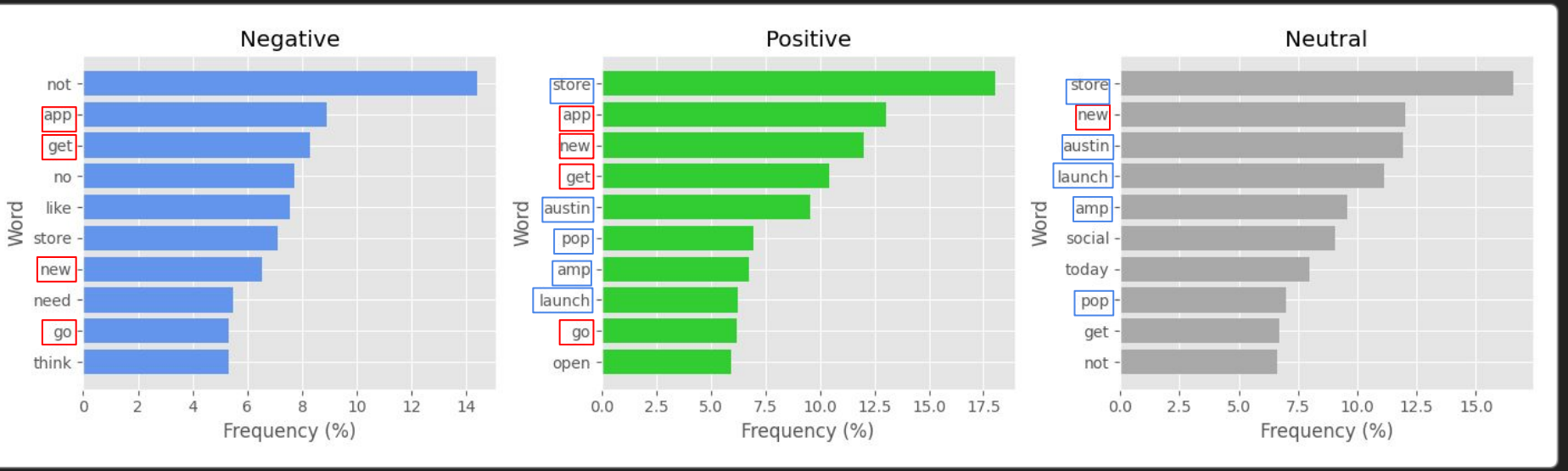
Cleaning
Normalization

love use new product best christmas gift ever

Vectorization

47, 26, 3, 1, 65, 1083, 740, 119

Most Common Words by Sentiment



Methods and Models

Evaluation

- The data was split into **Train**, **Validation**, and **Test** sets.
  - Models **learned** on the train set
  - **Tweaked** using the validation set performance
  - **Evaluated** on the test set performance

- Models were evaluated on several test metrics, and models which could most accurately predict all sentiments were selected.

- Two types of models were trained:
  1. **Binary** - predicts tweets as either Positive or Negative
  2. **Multiclass** - predicts tweets as either Positive, Negative, or Neutral

Models Used

Simple

Logistic Regression

SVC (Support Vector Classifier)

Recurrent Neural Networks (RNN)

Convolutional Neural Networks (CNN)

Complex

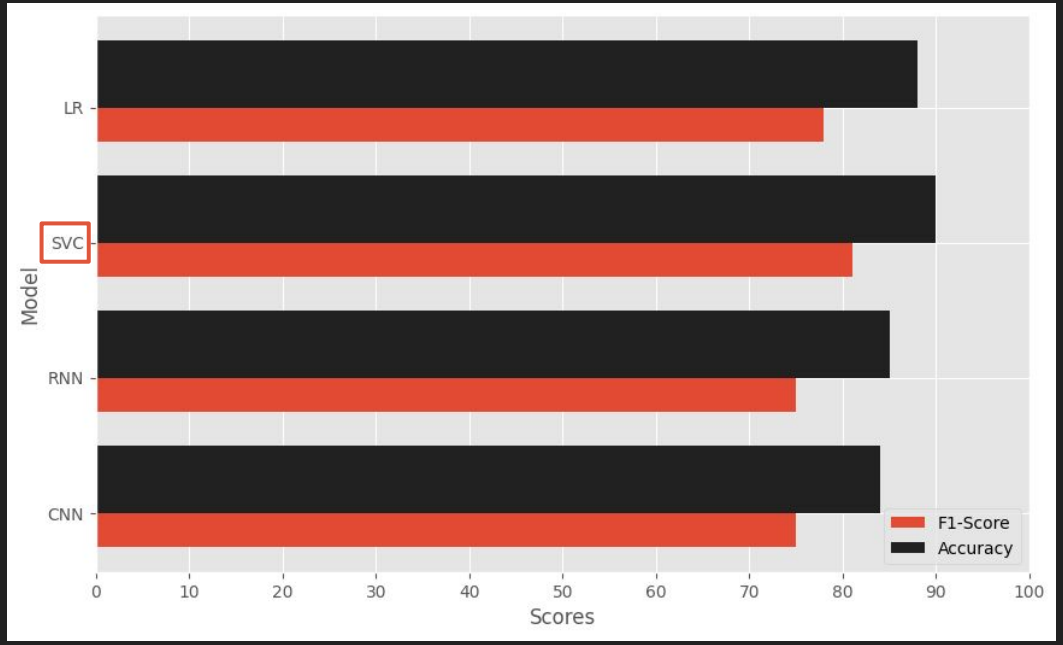
Results

Binary Models

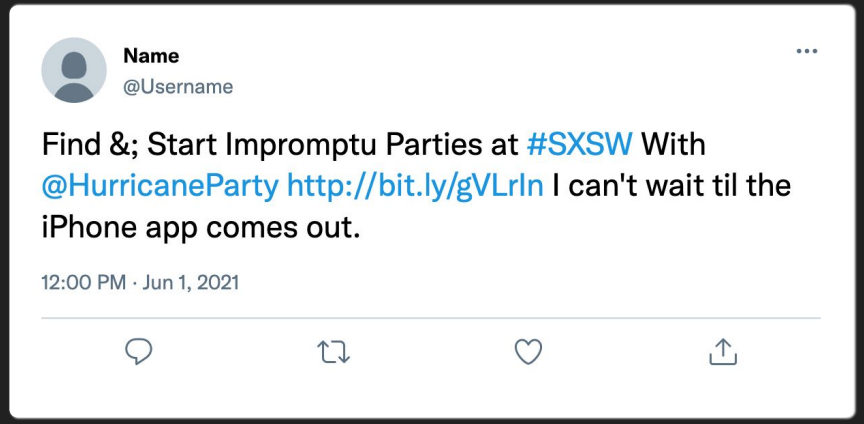
The **SVC model** performed the best

- **Accuracy (90%)**
- **Average F1-Score (81)**
  - Accurately predicts each sentiment

- This indicates that the level of complexity of the problem is suited to the level of complexity of the SVC model
- SVC is also faster than the more complex neural nets



Binary Model Correct examples



Positive

Negative

Binary Model Error Examples

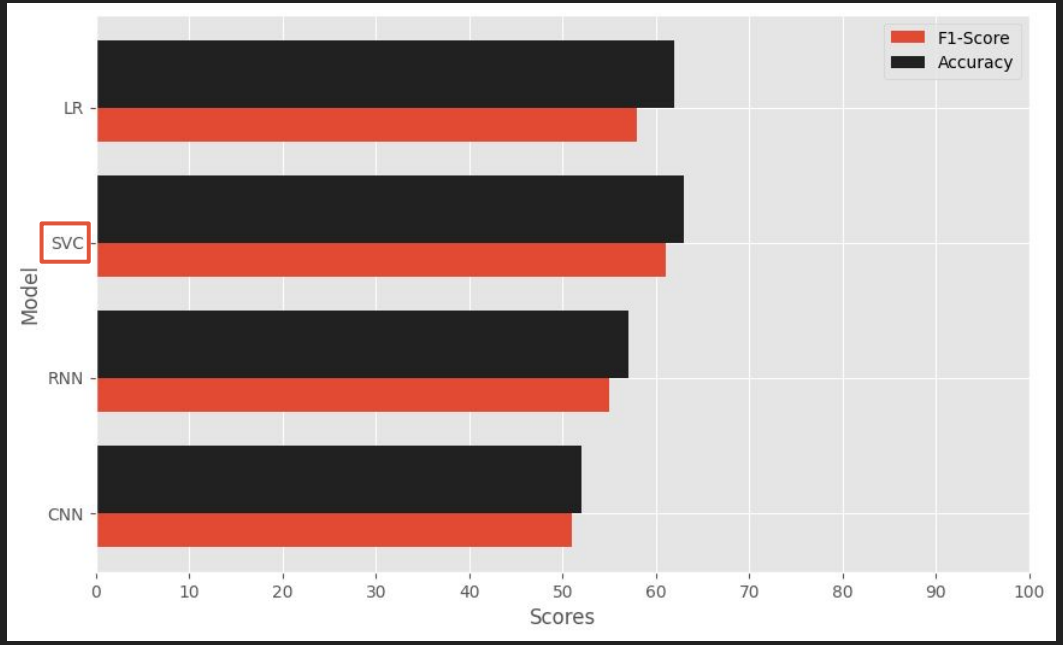
Tweet	True Label	Model Prediction
Just opened a facebook account, I`m a little confused I don`t really get it. Twitter seems much better	+	–
RT @mention Line for Source Code is even longer than for iPad 2. Take that, Apple. #sxsw	–	+

- Many of the incorrectly classified tweets had both positive and negative aspects

Multi-class Models

- The **SVC model** performed the best
  - **Accuracy (63%)**
  - **F1-Score (61)**

- The poor performance is due to the difficulty of determining the **Neutral** class due to the significant overlap as described earlier



Multi-class Model Error Examples

Tweet	**True Label** (O = Neutral)	**Model Prediction**
RT @mention Hello, Holler Gram! Come take a look at our new (and first!) iPad app {link} #hollergram #sxsw	O	+
We can't wait to give an iPad to someone at #sxsw. Want in? Just head to www.pep.jobs/upc to enter. (must be present to win)	O	+
Win free iPad 2 from webdoc.com #sxsw RT	+	O

- The poor performance is due to the difficulty of determining the **Neutral class**
- Most errors assumed the neutral class was positive or vice versa

Value and Application

Improving Business Decision-Making with Sentiment Analysis

- Identifying areas for improvement
  - For example, if the model detects a high volume of negative sentiment related to a particular product feature or customer service issue, Apple can investigate the issue and take steps to address it.

- Respond to customer feedback
  - By monitoring sentiment in real-time, Apple can identify and address customer issues and concerns before they escalate, improving customer satisfaction and loyalty.

- Informing product development
  - By understanding which features or products are most commonly associated with positive or negative sentiment, Apple can prioritize development efforts and make more informed decisions about product features and design.

- Monitoring competitors
  - The sentiment analysis model can be used to monitor sentiment about Apple's competitors on Twitter, providing insights into the strengths and weaknesses of competing products and brands.

Applying Our Binary Model: Confidence Thresholding

- Our binary model can output a probability score indicating how "confident" it is that its prediction is correct.
- By setting a confidence threshold, such as 75%, we can improve the quality of our predictions by only including tweets we are very confident are polarized.
- By using confidence thresholding, we can ensure that our sentiment analysis model is providing valuable and reliable insights to businesses.

Conclusion

- Model Performance
  - Our Binary Model outperformed our Multi-class model
  - These models could both be improved by larger and better datasets
  - Although both can still be useful, the Binary model is preferred

- Automating sentiment analysis can help us:
  - Stay competitive
  - Improve customer satisfaction
  - Increase revenue and market share

Questions?

Thank you!

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