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SENTIMENT ANALYSIS OF FIFA WORLD CUP TWEETS: A COMPARATIVE STUDY OF NEURAL NETWORK ARCHITECTURES

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INTRODUCTION & PROBLEM STATEMENT

- Our project addresses sentiment analysis on social media, specifically classifying tweets from the first day of the FIFA World Cup 2022.

- The goal was to determine if the sentiment expressed in these tweets was Positive, Negative, or Neutral.

- To achieve this, we implemented and compared the performance of different Neural Network architectures: a Dense Network, a Vanilla RNN, and an LSTM. We also established a baseline using a Dummy Classifier.

- We will present our methodology, model results, and the key findings from comparing these approaches for text sentiment classification.

METHODOLOGY

Exploratory data analysis

The first step in our project was the explorative data analysis, this step is crucial for our data to be normalized and realiable for our models

Data processing

With the results of out explorative data analysis we then take action to make the data readable for our models and to expose meaningful information

Defining the baseline

We implemented a dummy classifier to define a baseline to as a reference to the results of our actual models

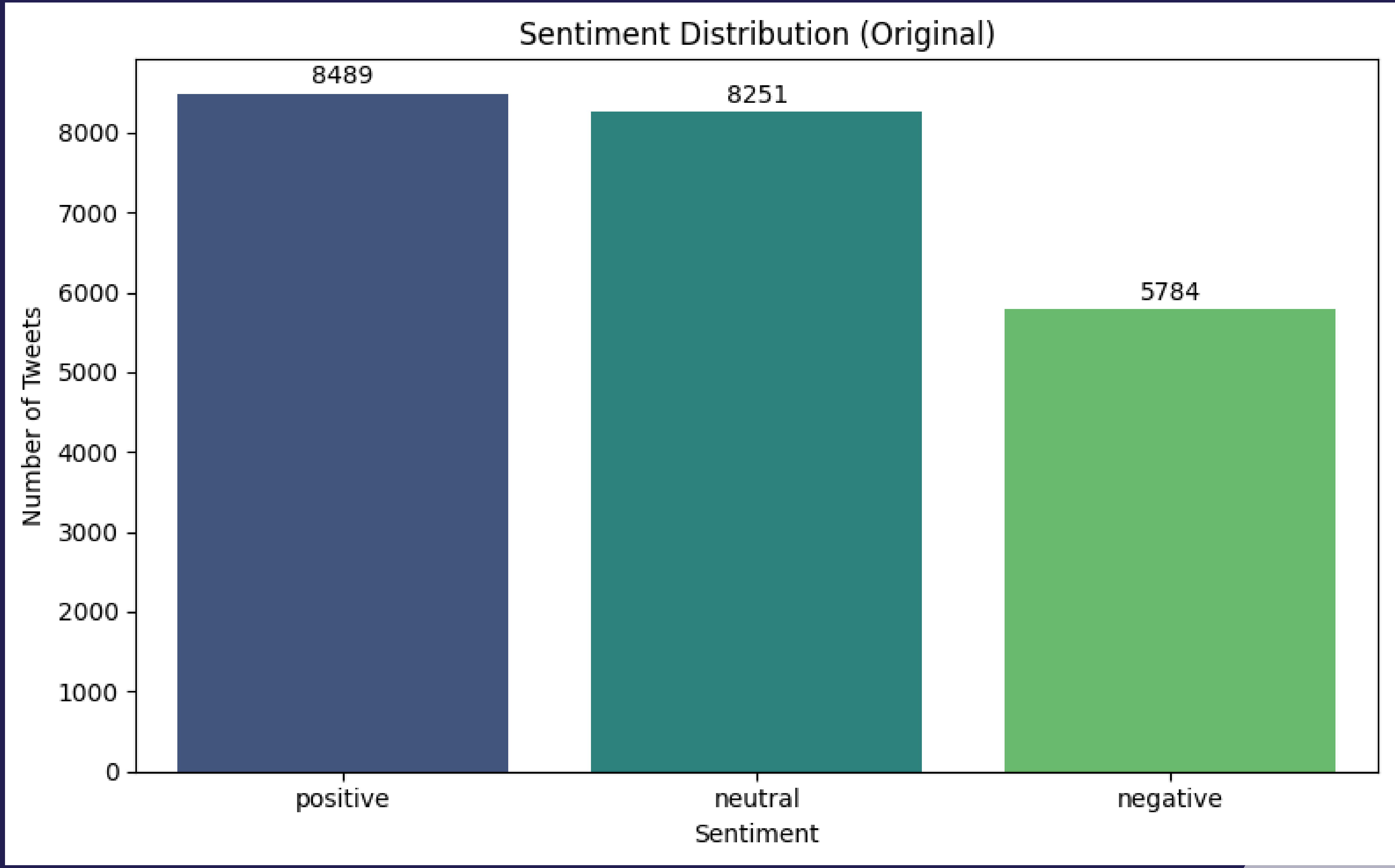
Defining the baseline

We the procced to build our models, with try and mistake to get the most out of our networks and finally find the best hyperparameters

DATA AND PREPROCESSING

- Our data comes from FIFA World Cup 2022 tweets with pre-assigned sentiment labels.
- We preprocessed the raw text to make it suitable for Neural Networks, which require numerical input.
- Key steps included:
  - Text cleaning (lowercasing, removing URLs).
  - Replacing mentions, hashtags, and emojis with specific special tokens (e.g., _MENTION_, _HASHTAG_, _EMOJI_).
  - Tokenization (splitting into words) and stopword removal (excluding negations).
- Finally, we converted these tokens into numerical sequences and applied padding for uniform input length.

DATA AND PREPROCESSING



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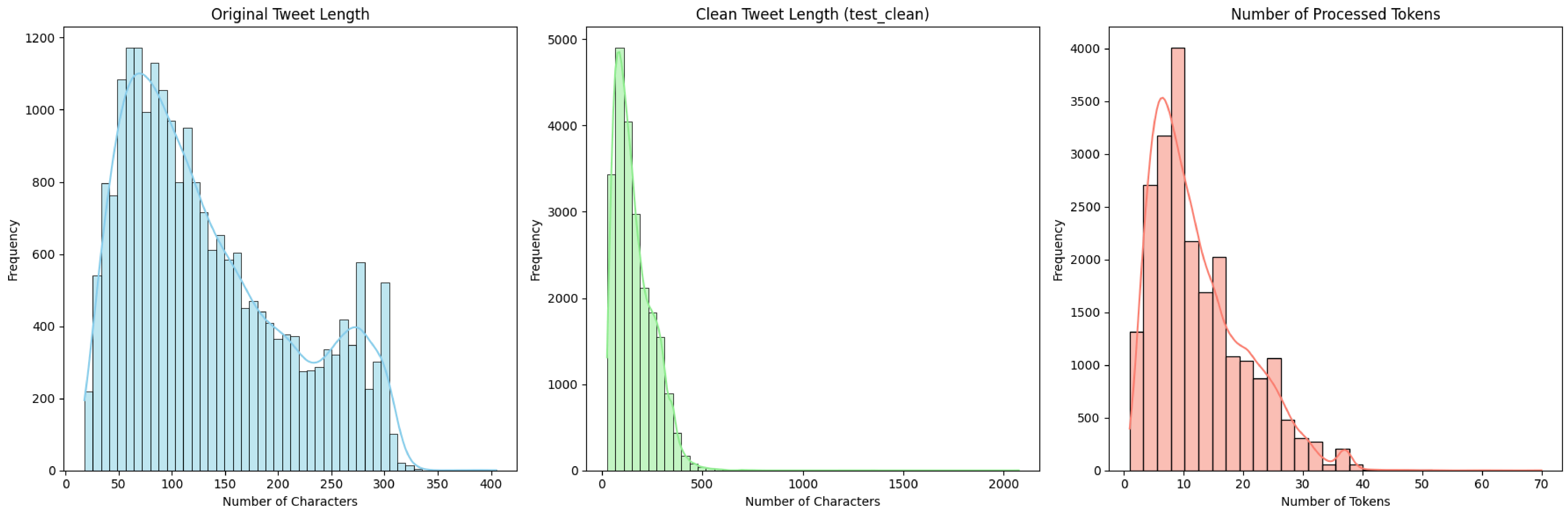
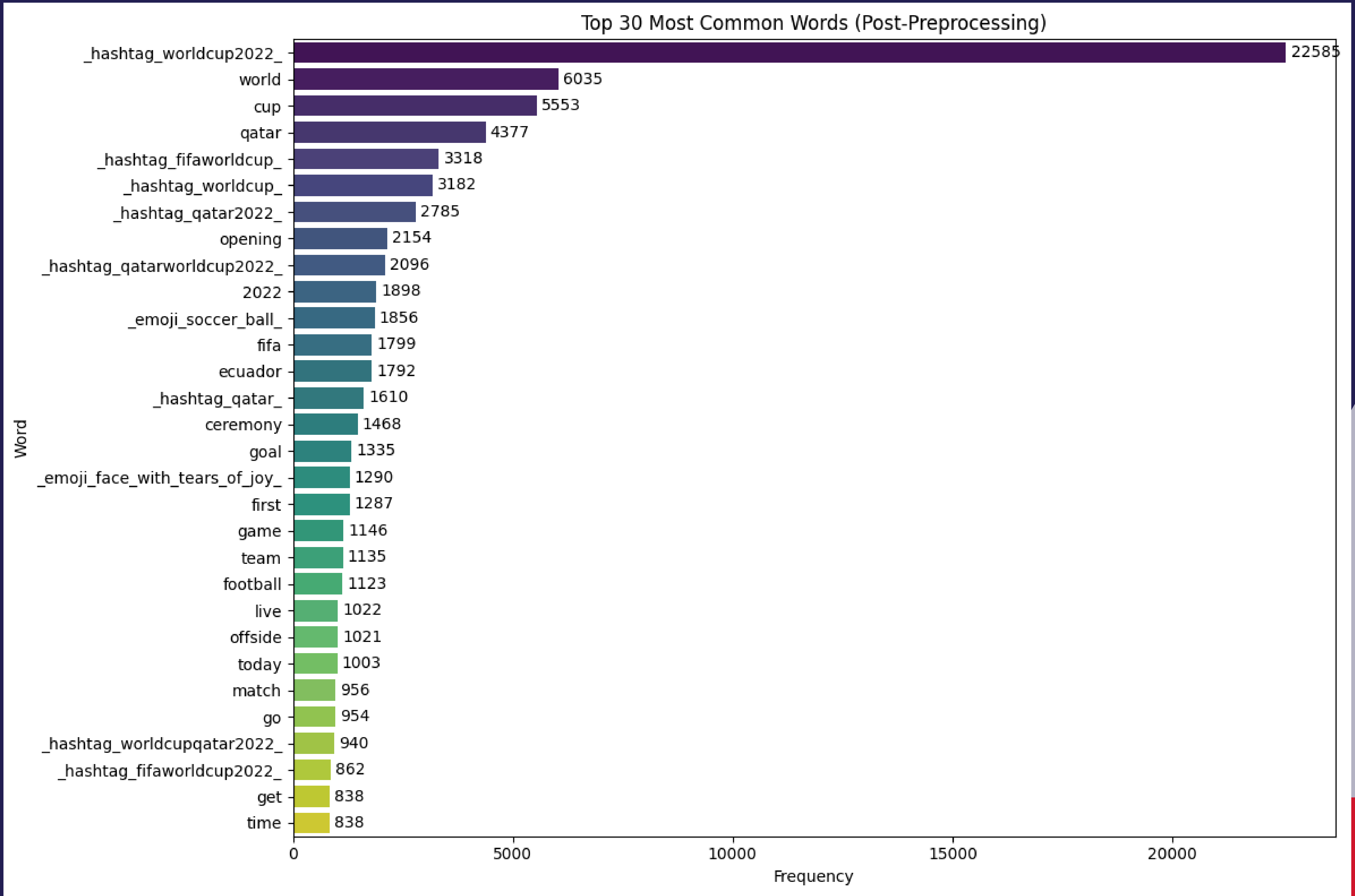
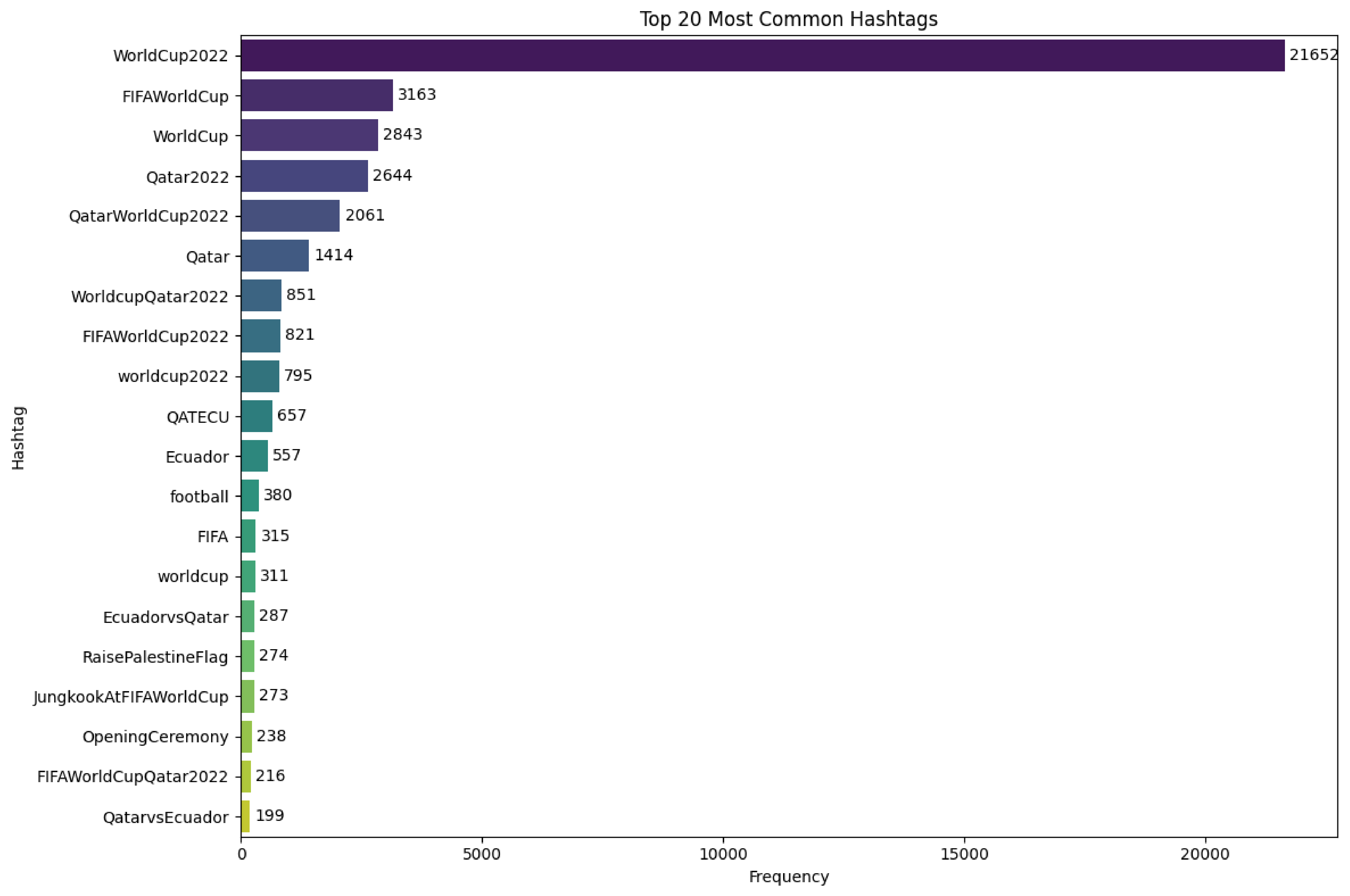
ANALYSIS OF TEXT LENGTH AND NUMBER OF TOKENS:



MOST COMMON WORDS



MOST COMMON HASHTAGS



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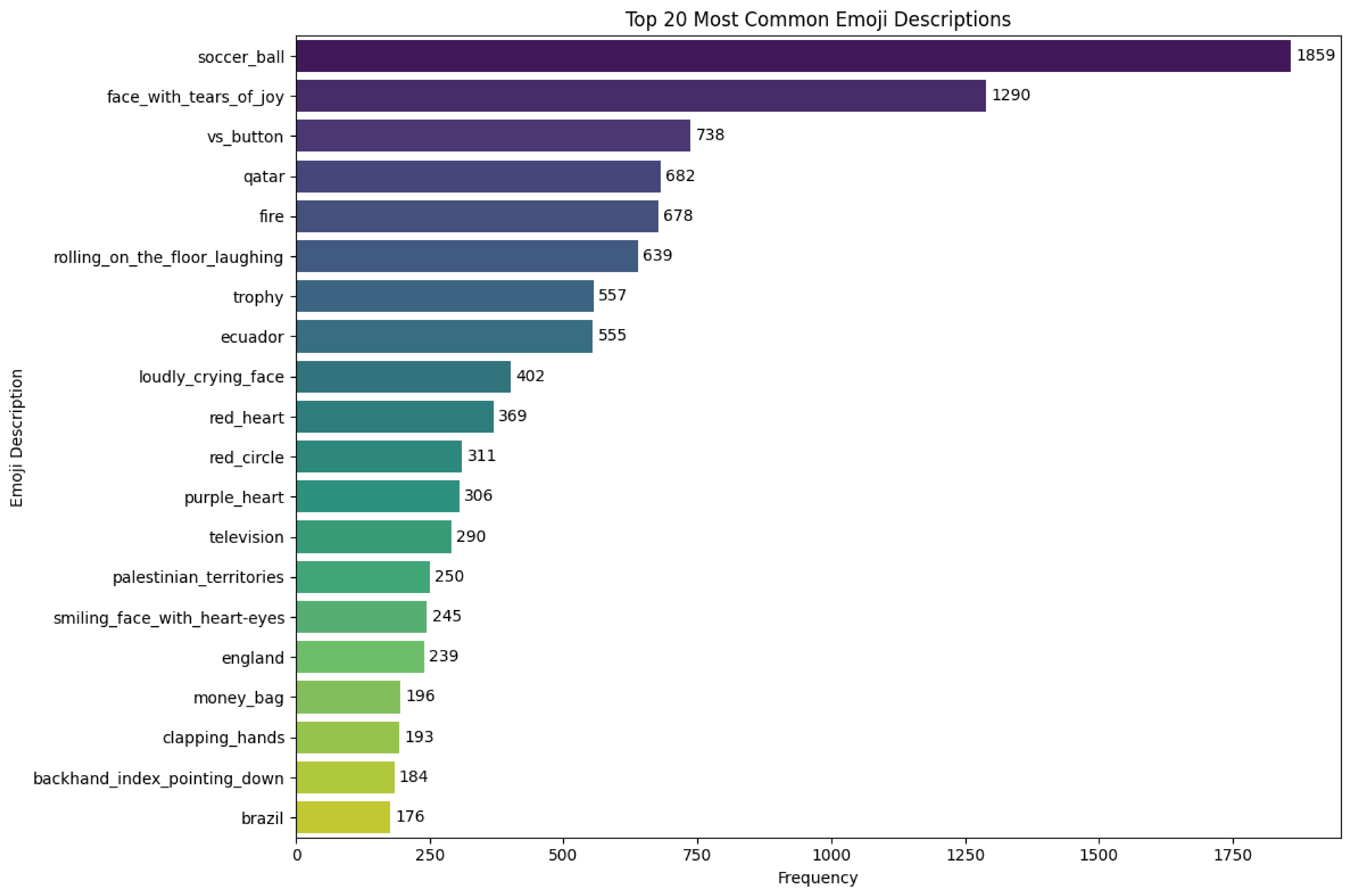
THE MOST COMMON EMOJIS



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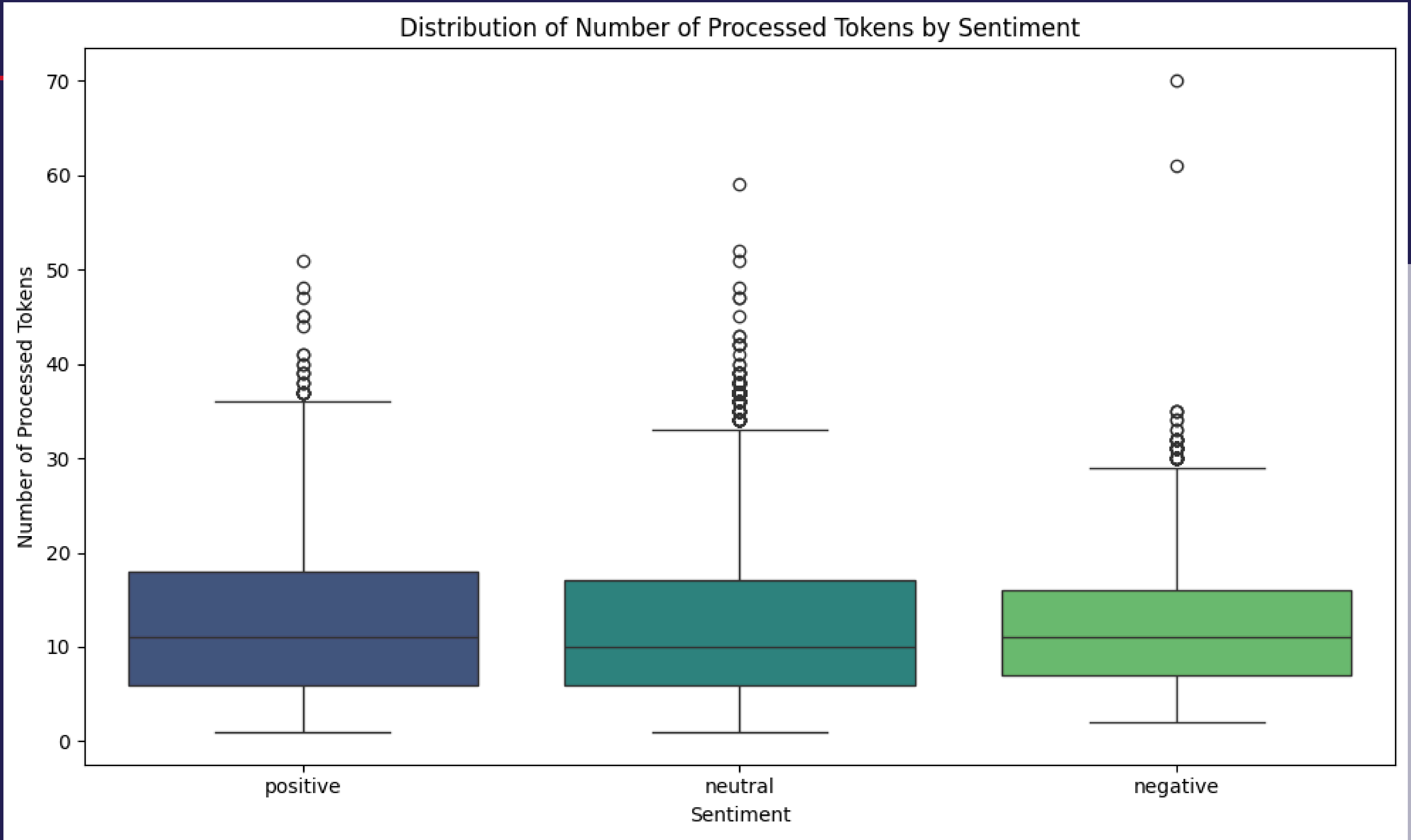
PROCESSED TOKEN LENGTH VS SENTIMENT



WORD CLOUD FOR SENTIMENTS

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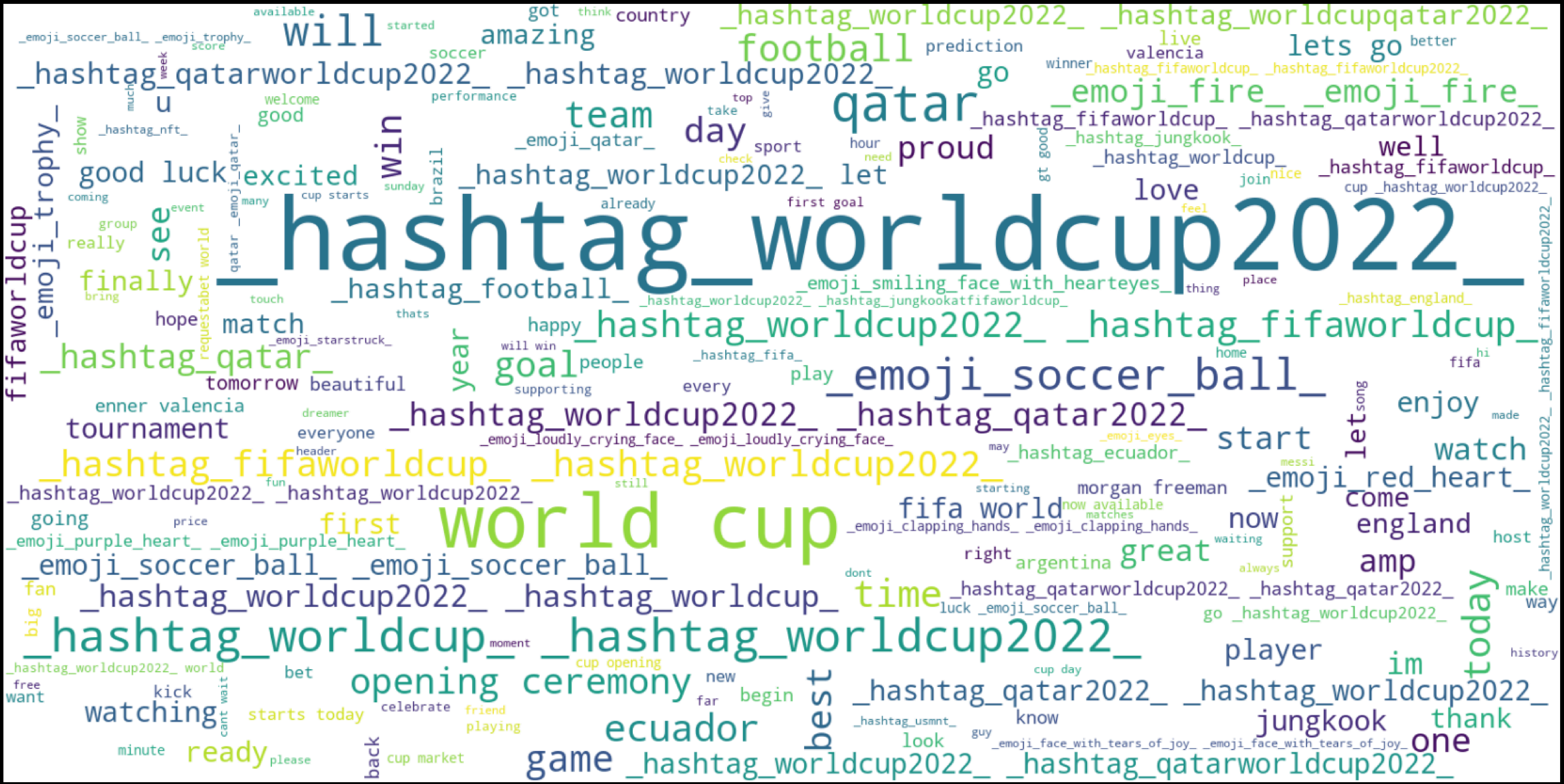
Word Cloud for Sentiment: neutral

Word Cloud for Sentiment: positive



Word Cloud for Sentiment: negative

MODELS AND TRAINING

Dummy Classifier

- Purpose: To provide a minimal performance benchmark.
- Strategy: Simply predicts the most frequent class (as shown in the notebook output). Expected low performance.

Dense Neural Network:

- This is a standard feed-forward network. It includes an Embedding layer to represent words numerically, but then uses pooling or flattening layers which process the input without preserving word order or sequential relationships.

Vanilla Recurrent Neural Network (RNN):

- This model processes text word by word, maintaining a basic 'memory' of previous information. While it can capture simple sequential patterns, it often struggles to remember context over long distances in text.

Long Short-Term Memory (LSTM)

- An advanced RNN that excels at capturing long-term context in text, using specialized gates to manage information. (Mention if you used Bidirectional: "We used a Bidirectional LSTM for enhanced context capture.")

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TRAINING WITHOUT HYPERPARAMETERS

DENSE

--- Evaluación del Modelo: Modelo de Sentimiento ---
141/141 ━━━━━━━━━━━━━━━━━━━━ **0s** 3ms/step

	precision	recall	f1-score	support
negative (0)	0.63	0.88	0.74	1157
neutral (1)	0.72	0.64	0.68	1650
positive (2)	0.85	0.70	0.77	1698
accuracy			0.73	4505
macro avg	0.73	0.74	0.73	4505
weighted avg	0.74	0.73	0.73	4505

Accuracy: 0.7263
Precision: 0.7431
Recall: 0.7263
F1-Score: 0.7261
Cohen's Kappa: 0.5913

RNN

141/141 ━━━━━━━━━━━━━━━━━━━━ 6s 42ms/step
Classification Report:

	precision	recall	f1-score	support
negative	0.65	0.78	0.71	1157
...				
accuracy			0.70	4505
weighted avg	0.70	0.70	0.70	4505

DUMMY

Accuracy: 0.35753908219868885
Precision: 0.11917969406622962
Recall: 0.3333333333333333
F1-score: 0.1755819712729074

Classification Report:

	precision	recall	f1-score	support
negative	0.00	0.00	0.00	600
neutral	0.00	0.00	0.00	674
positive	0.36	1.00	0.53	709
accuracy			0.36	1983
macro avg	0.12	0.33	0.18	1983
weighted avg	0.13	0.36	0.19	1983

LSTM

Accuracy: 0.7376 Precision: 0.7376
Recall: 0.7376 F1-score: 0.7376 Kappa: 0.6015

	precision	recall	f1-score	support
negative	0.72	0.74	0.73	1157
neutral	0.70	0.69	0.69	1650
positive	0.79	0.79	0.79	1698
accuracy			0.74	4505
macro avg	0.74	0.74	0.74	4505
weighted avg	0.74	0.74	0.74	4505

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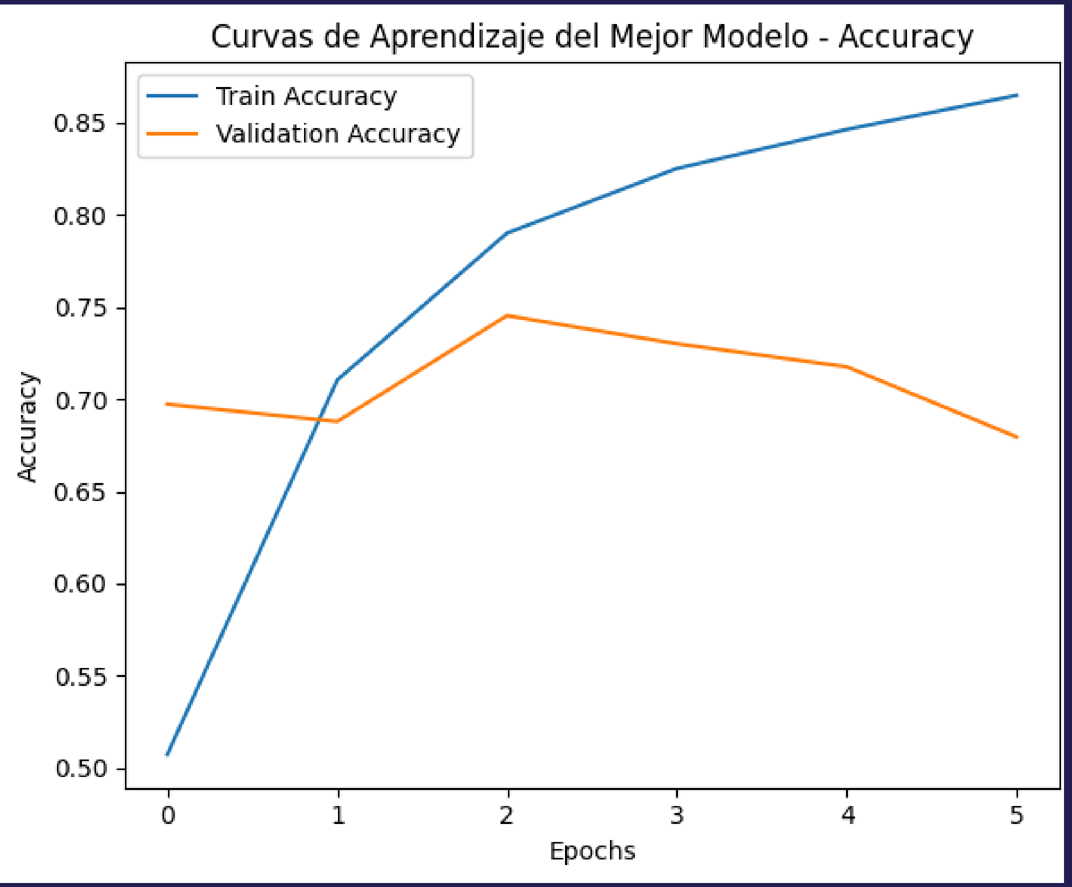
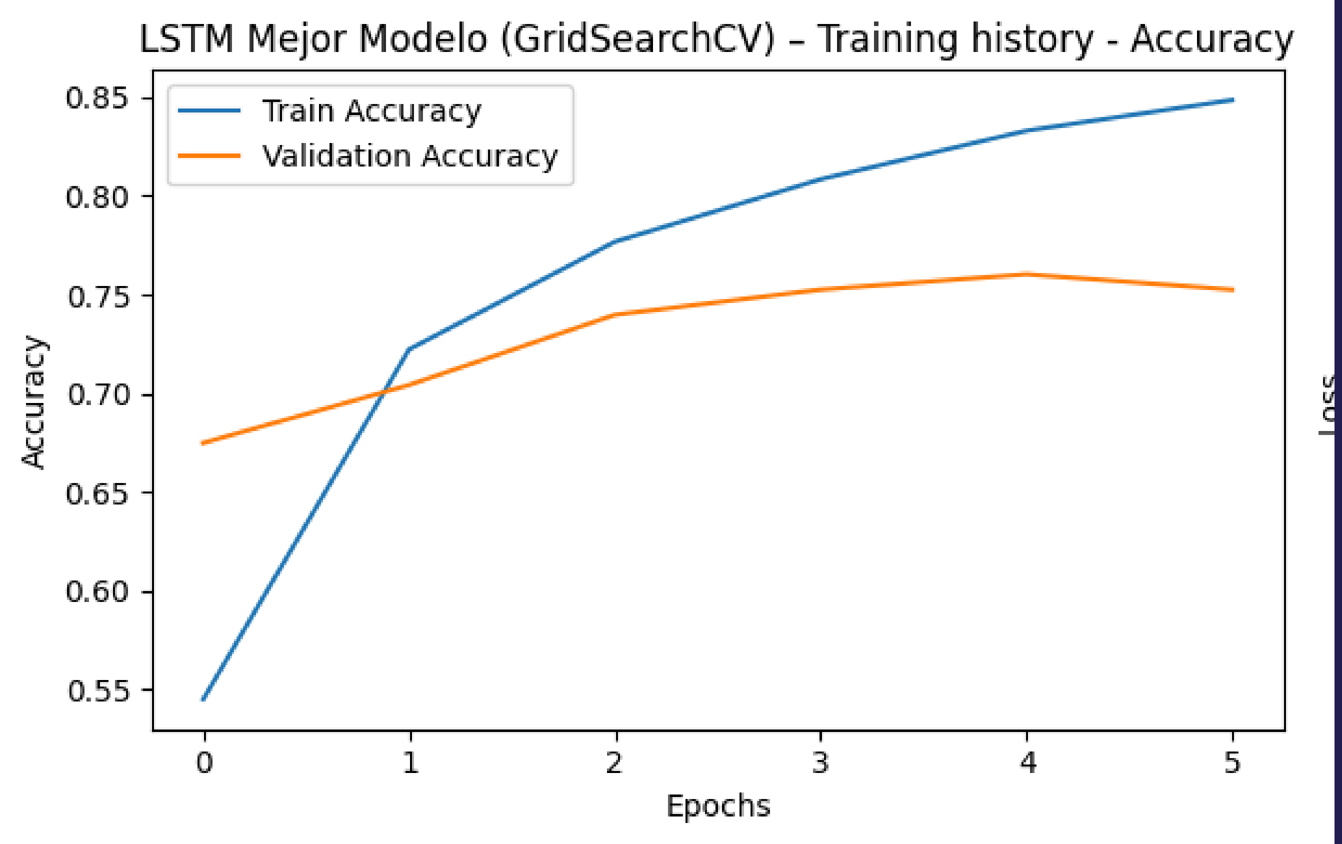
HYPERPARAMETER TUNING

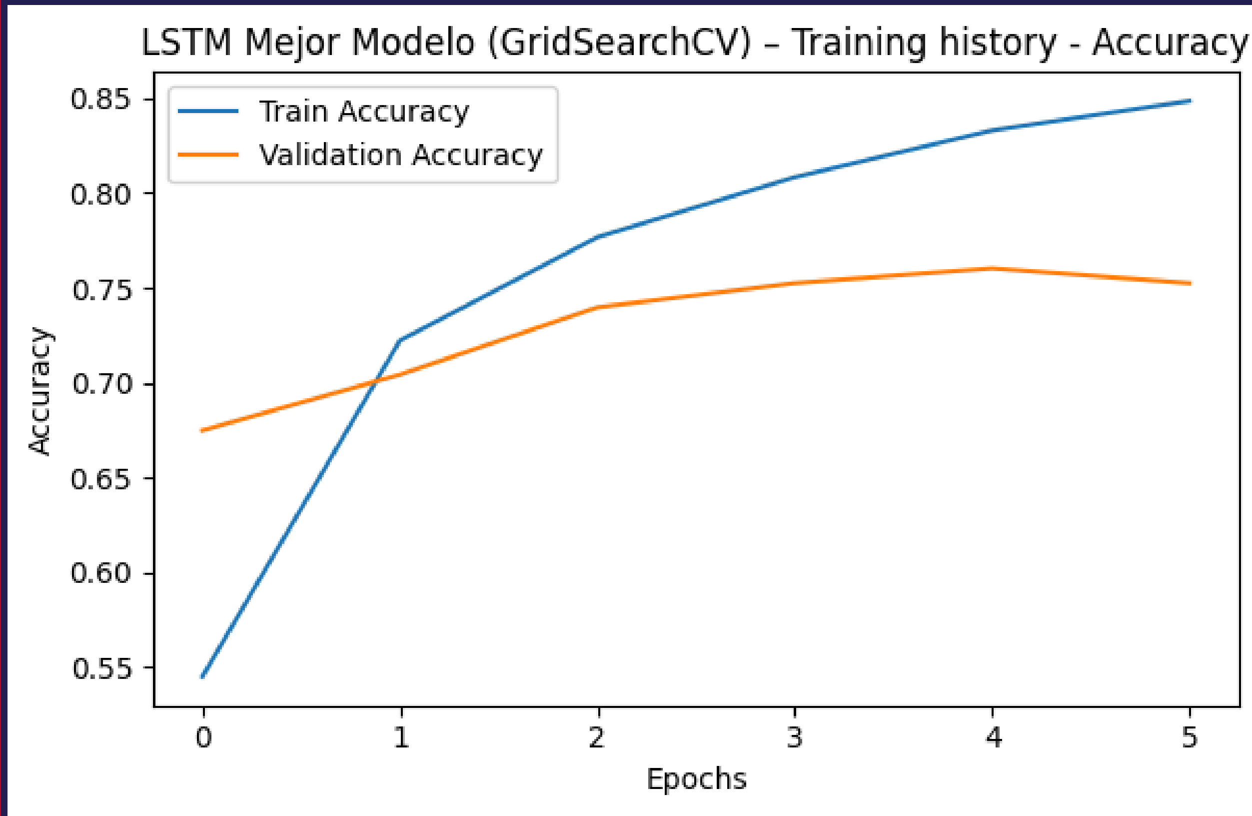
DENSE



RNN



LSTM



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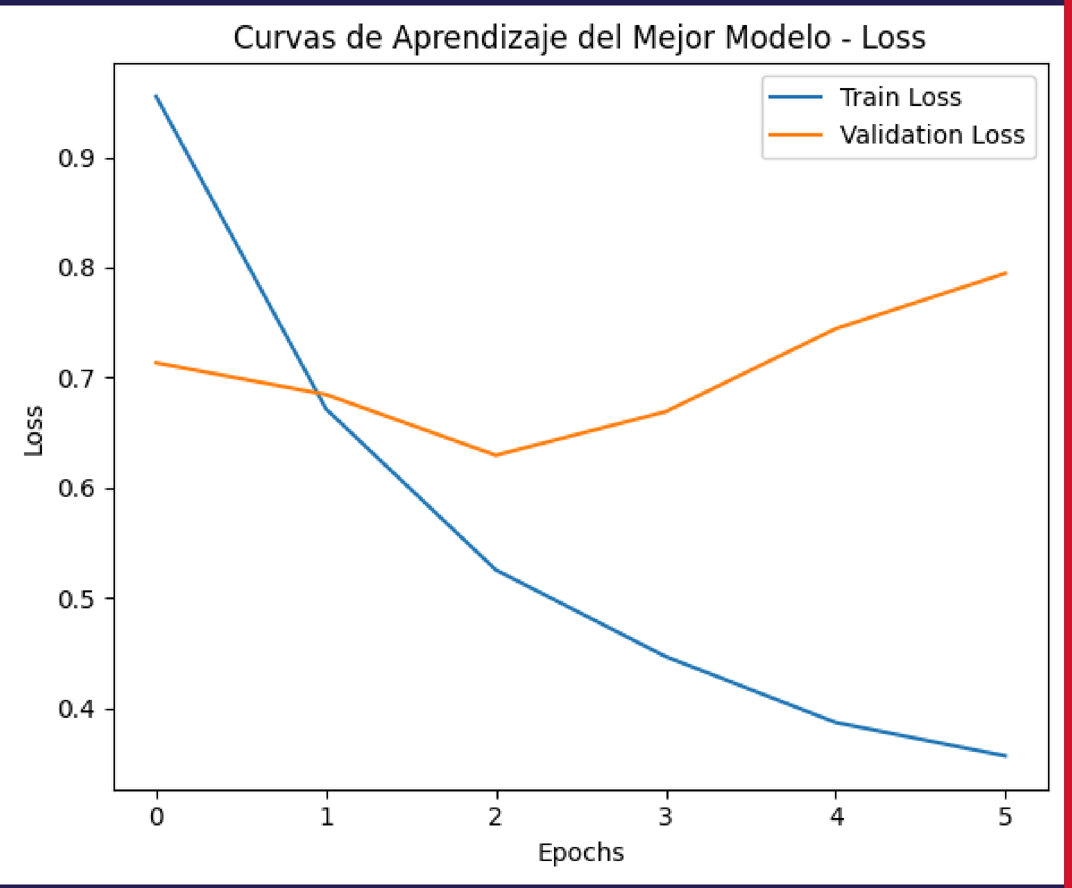
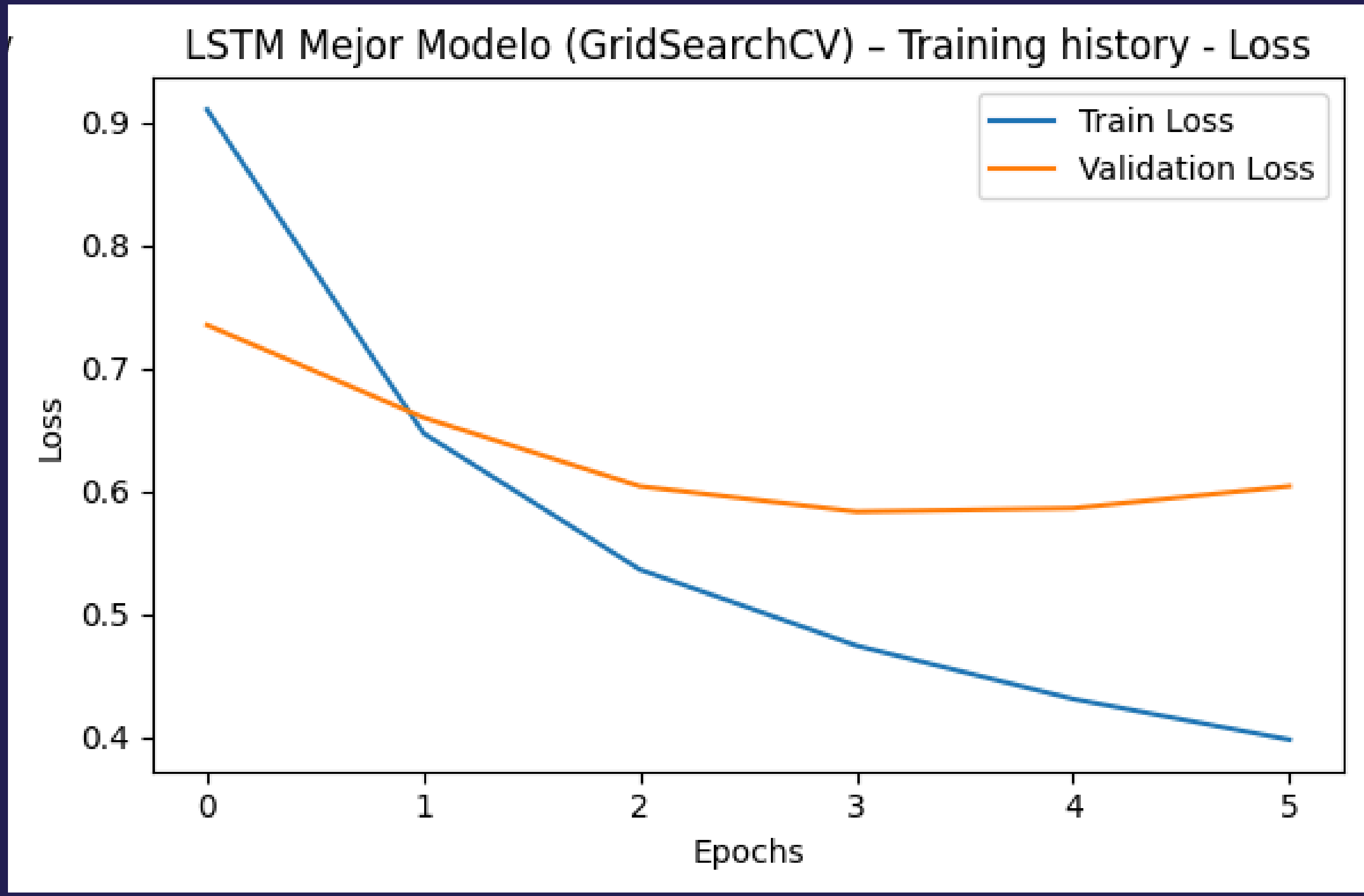
HYPERPARAMETER TUNING

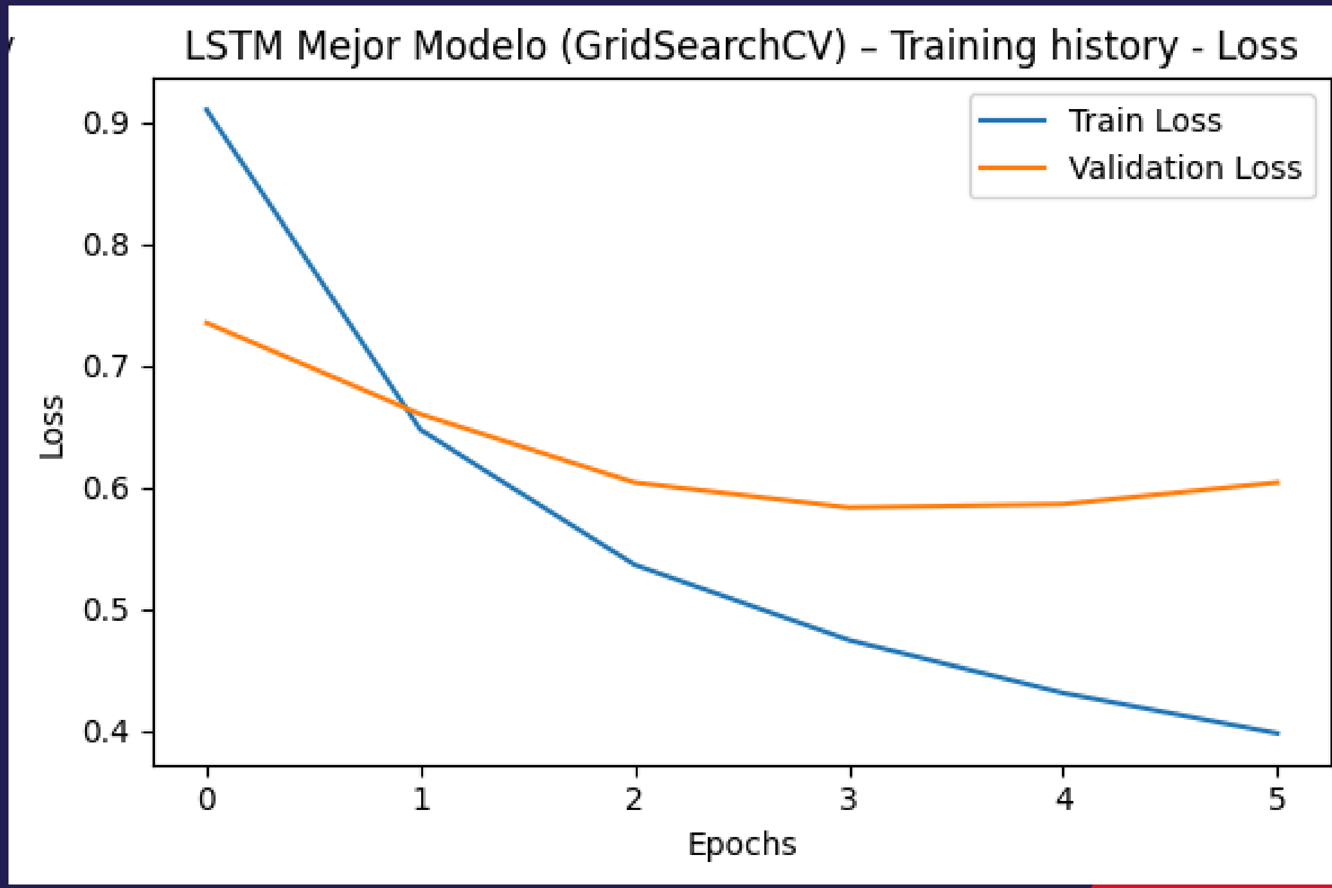
DENSE



RNN



LSTM



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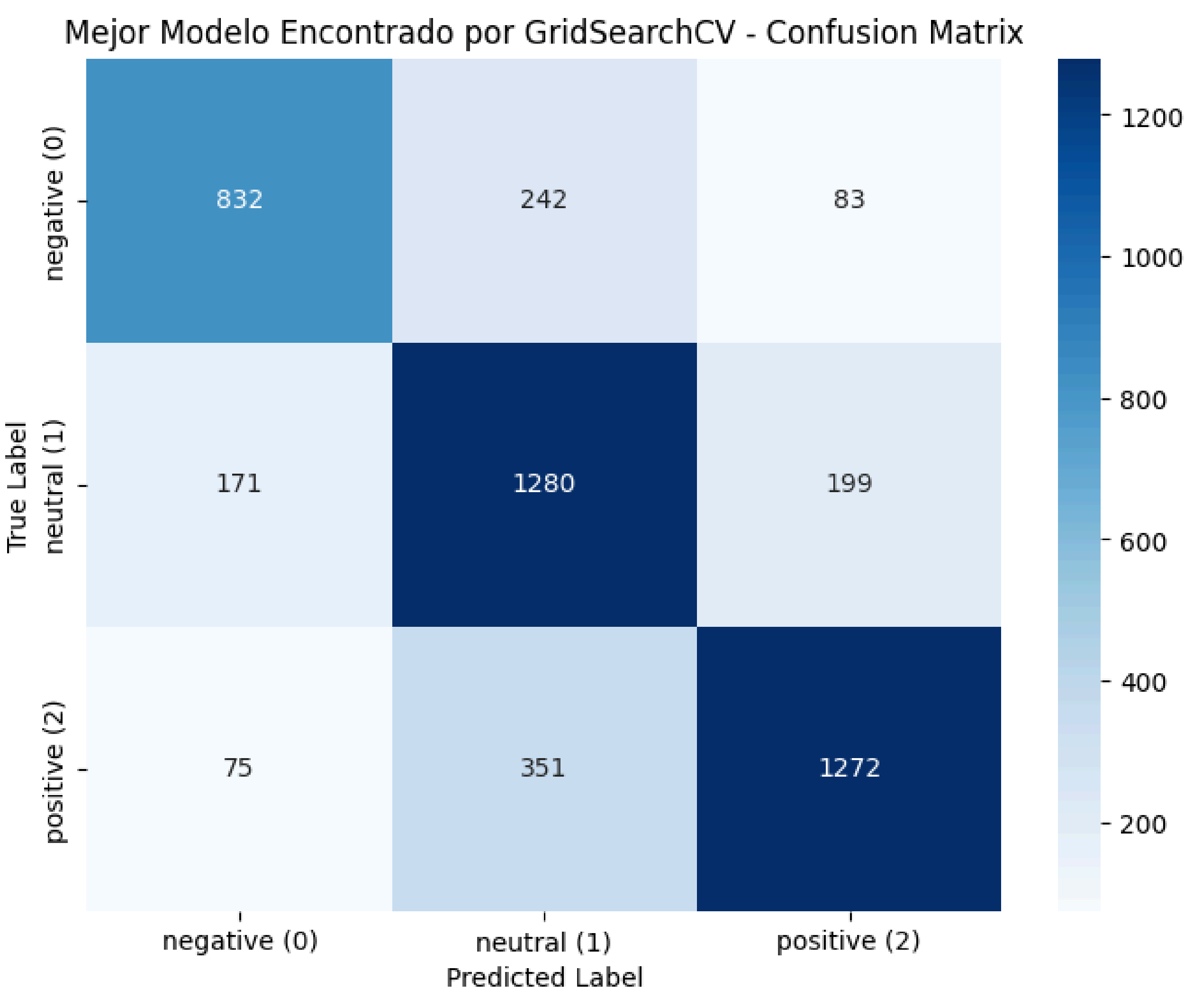
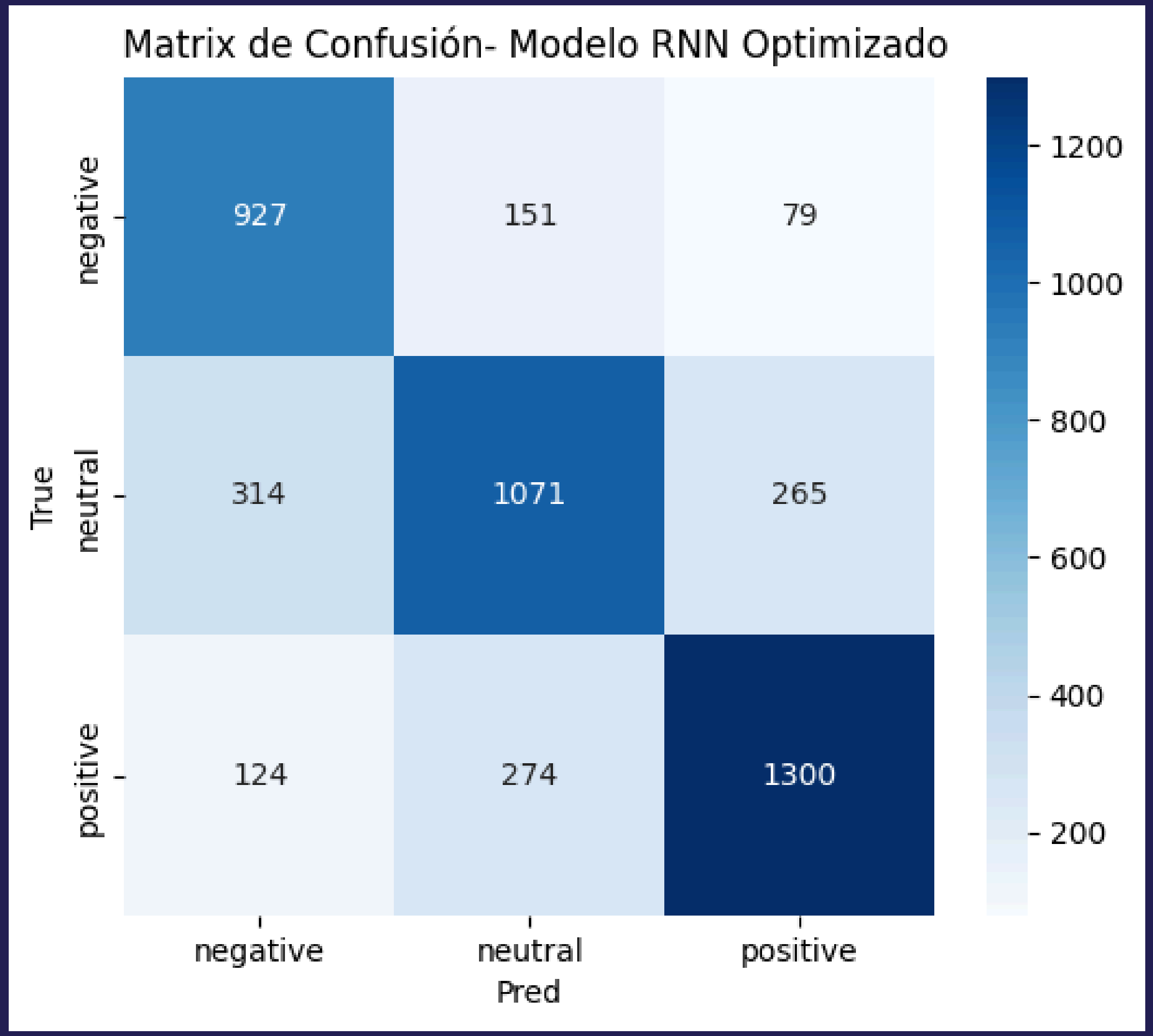
HYPERPARAMETER TUNING

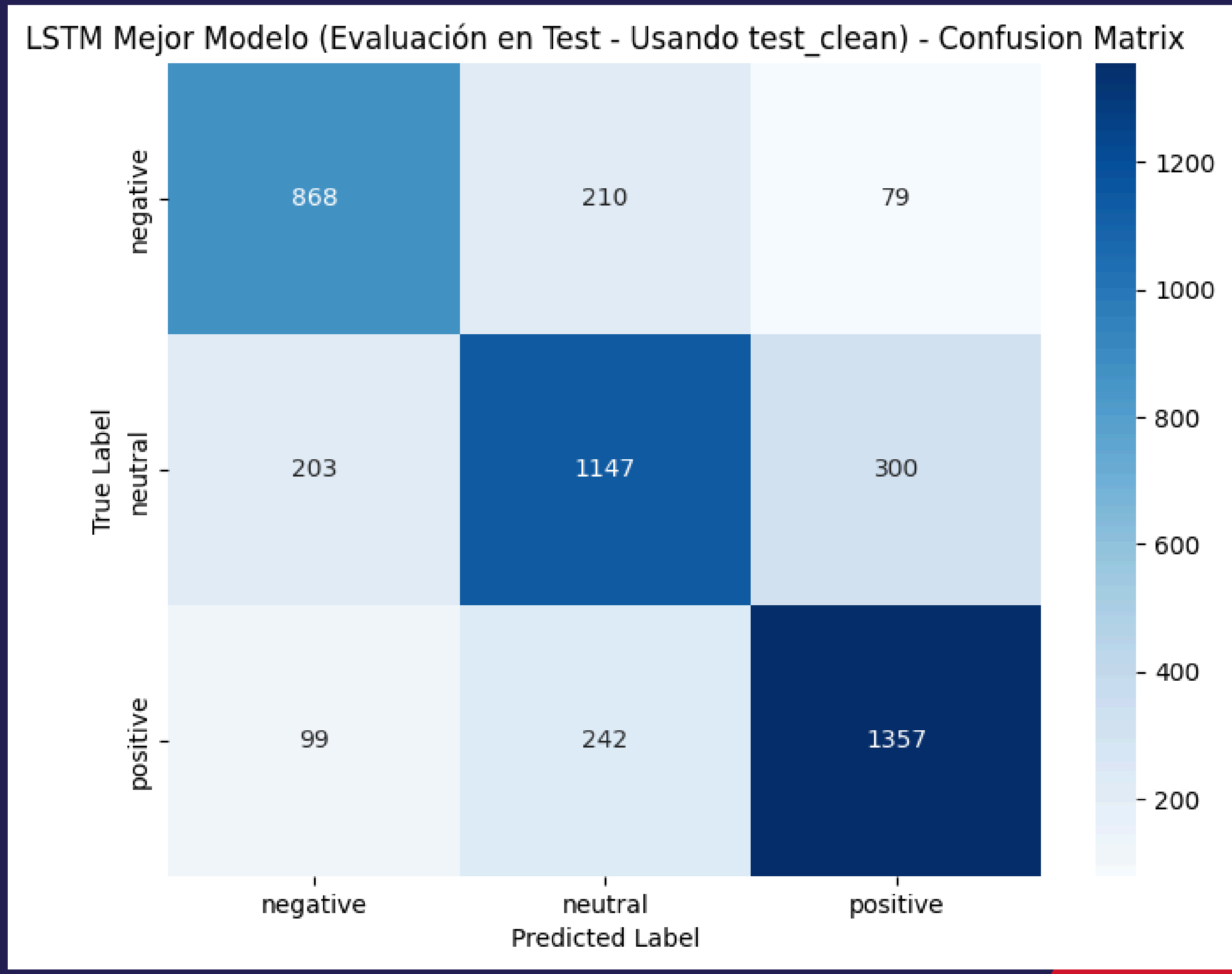
DENSE



RNN



LSTM



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HYPERPARAMETER TUNING

DENSE

```
Precisión (Accuracy): 0.7412
Precisión (Precision - Weighted): 0.7570
Exhaustividad (Recall - Weighted): 0.7512
Puntuación F1 (F1-score - Weighted): 0.7522
Kappa de Cohen: 0.6208

Reporte Detallado de Clasificación:
              precision    recall  f1-score   support

negative (0)       0.77      0.72      0.74      1157
 neutral (1)       0.68      0.78      0.73      1650
positive (2)       0.82      0.75      0.78      1698

    accuracy                           0.75      4505
   macro avg       0.76      0.75      0.75      4505
weighted avg       0.76      0.75      0.75      4505
```

RNN

```
Accuracy: 0.7258   Precision: 0.72
Recall:   0.71   F1-score:  0.715   Kappa: 0.68

              precision    recall  f1-score   support

    negative       0.67      0.80      0.72      1157
     neutral       0.72      0.65      0.68      1650
    positive       0.79      0.77      0.78      1698

    accuracy                           0.72      4505
   macro avg       0.72      0.73      0.72      4505
weighted avg       0.72      0.72      0.72      4505
```

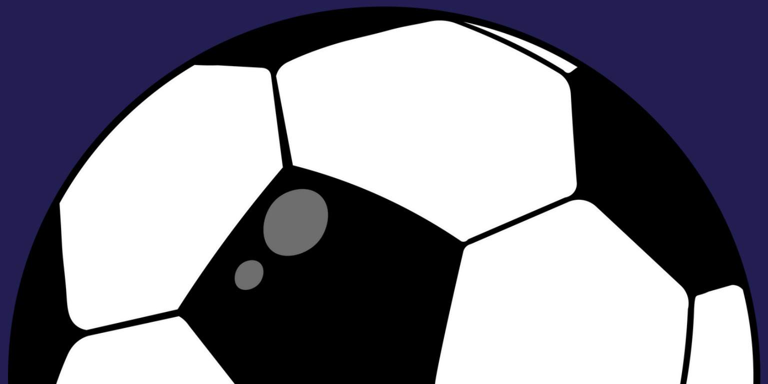
LSTM

```
Precisión (Accuracy): 0.7485
Precisión (Precision - Weighted): 0.7479
Exhaustividad (Recall - Weighted): 0.7485
Puntuación F1 (F1-score - Weighted): 0.7481
Kappa de Cohen: 0.6178

Reporte Detallado de Clasificación:
              precision    recall  f1-score   support

    negative       0.74      0.75      0.75      1157
     neutral       0.72      0.70      0.71      1650
    positive       0.78      0.80      0.79      1698

    accuracy                           0.75      4505
   macro avg       0.75      0.75      0.75      4505
weighted avg       0.75      0.75      0.75      4505
```


COMPARATIVE ANALYSIS &
KEY INSIGHTS

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HYPERPARAMETER TUNING

DENSE

- The Dense NN's performance improvement over the Dummy is expected, as it learns patterns, but its inability to capture word order limits its effectiveness for text.

RNN

- The sequential models (RNN and LSTM) significantly outperformed the Dense NN, demonstrating the critical importance of considering the context and sequence of words in text data.

LSTM

- The LSTM generally performed better than the Vanilla RNN, which aligns with its design to handle longer-range dependencies more effectively.

RNN

The Dummy Classifier's low score confirms that sentiment analysis is a non-trivial task requiring learning.


CONCLUSION
&
QUESTIONS

Conclusion

- Our project successfully implemented and compared different Neural Network architectures for classifying the sentiment of FIFA World Cup tweets.
- The results clearly demonstrate that models designed to process sequential data, like the Vanilla RNN and especially the LSTM, significantly outperform the baseline (Dummy) and a non-sequential Dense network.

- The LSTM model achieved the best performance across key metrics, highlighting its effectiveness in capturing the contextual nuances within tweet text.

Questions ?

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THANK YOU