Hate Speech Classification Task Using Word2Vec + NN, RNN & Transformer (BERT)

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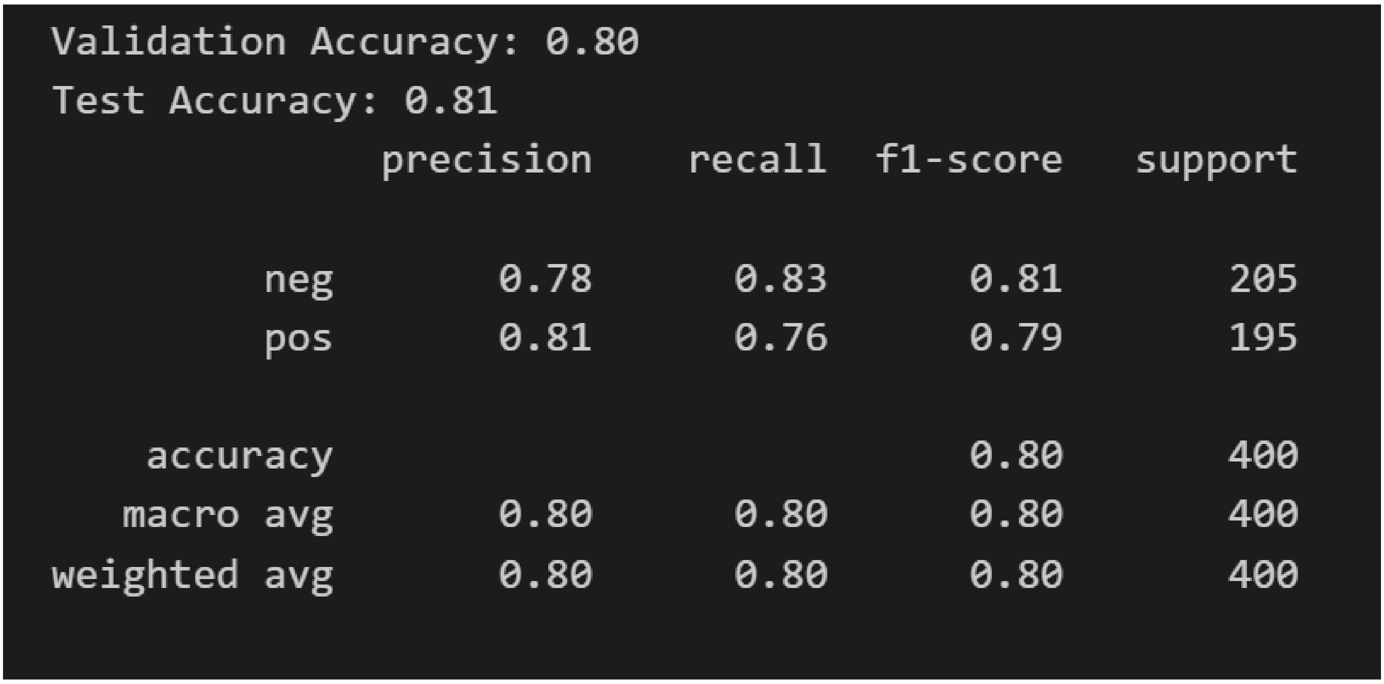
Code: https://github.com/swapnik-iitkgp/NLP-Course-Project

Task 1: Using Neural Network Classifier:

- In Task 1, a Part-of-Speech (POS) tagger was implemented from scratch using the NLTK library and the Treebank corpus.
- The Treebank corpus was used for training data, which consists of sentences with words and their corresponding POS tags.
- Transition and emission probabilities were calculated based on the training data, which are essential for the Viterbi Algorithm used in POS tagging.
- A custom POS tagger was created to tag words in sentences, assigning each word a POS tag based on the probabilities learned from the training data.

Task 2: Using Recurrent Neural Network Classifier:

- In Task 2, a baseline sentiment analyser was built using the movie_reviews corpus, which contains movie reviews labelled as 'positive' or 'negative.'
- TF-IDF vectorization was used to convert the reviews into numerical feature vectors.
- A Multinomial Naive Bayes classifier was trained on these TF-IDF features to classify the sentiment of movie reviews into 'positive' or 'negative.'
- The performance of this baseline model was evaluated using metrics like accuracy and a classification report.



```
Validation Accuracy: 0.80
Test Accuracy: 0.81
              precision    recall  f1-score   support

         neg       0.78      0.83      0.81       205
         pos       0.81      0.76      0.79       195

    accuracy                           0.80       400
   macro avg       0.80      0.80      0.80       400
weighted avg       0.80      0.80      0.80       400
```

- **Results of Vanilla Sentiment Analyser on movie_reviews corpus**

Task 3: Using BERT Classifier:

Step 1: POS Tagging with Task 1's POS Tagger:

- Used the POS Tagger I have implemented in Task 1 to tag the words in the movie_reviews dataset. Each word in a review will be associated with its POS tag.

Step 2: Sentence Embeddings

- For sentence embeddings, we can use techniques like TF-IDF, Word2Vec, or Doc2Vec to represent the text as numerical vectors. Since I've already used TF-IDF in Task 2, I continued with that for consistency.

Step 3: Integration of POS Tags and Sentence Embeddings

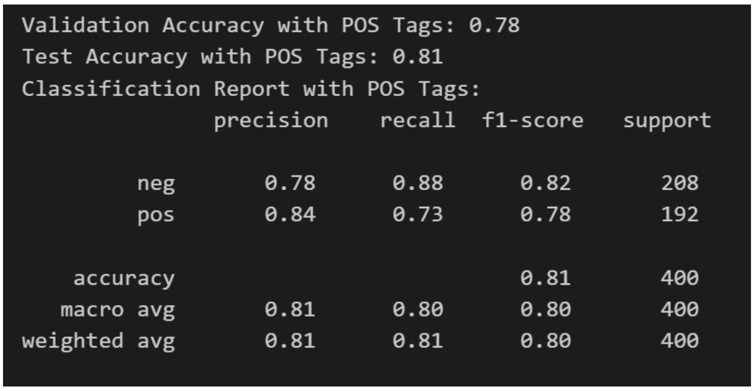
Integrated POS tag features with sentence embeddings, I used the following strategy:

- Concatenated the POS tag embeddings with the sentence embeddings. This resulted in a longer feature vector that includes both the word-level POS tag information and the sentence-level information.
- For example, if the sentence embedding has 100 dimensions and we have a POS tag vocabulary of 50 tags, we will have a final feature vector of 150 dimensions.

This approach reduces the dimensionality of the POS tag information to match the dimensionality of the sentence embeddings.

Step 4: Classifier Training

- Trained the same classifier that I used in Task 2 (e.g., Multinomial Naive Bayes or another classifier of your choice) on the integrated feature vectors. The features will now be a combination of sentence embeddings and POS tag embeddings.

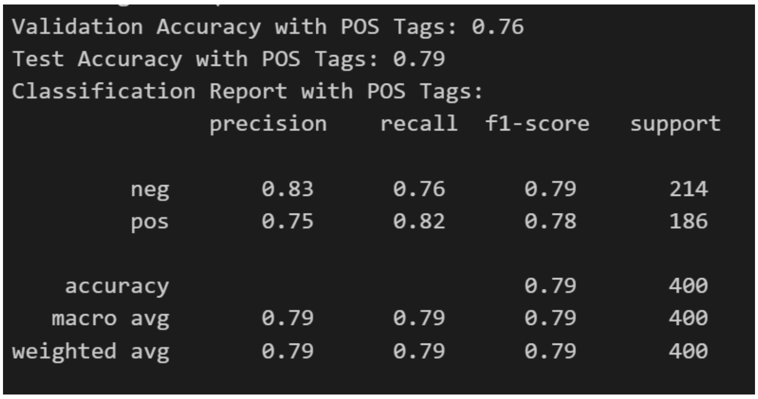


```
Validation Accuracy with POS Tags: 0.78
Test Accuracy with POS Tags: 0.81
Classification Report with POS Tags:
              precision    recall  f1-score   support

         neg       0.78      0.88      0.82       208
         pos       0.84      0.73      0.78       192

    accuracy                           0.81       400
   macro avg       0.81      0.80      0.80       400
weighted avg       0.81      0.81      0.80       400
```

Results of Improved Sentiment Analyser using nltk POS tagger on movie_reviews corpus with an execution time of approx. 90 seconds



```
Validation Accuracy with POS Tags: 0.76
Test Accuracy with POS Tags: 0.79
Classification Report with POS Tags:
              precision    recall  f1-score   support

         neg       0.83      0.76      0.79       214
         pos       0.75      0.82      0.78       186

    accuracy                           0.79       400
   macro avg       0.79      0.79      0.79       400
weighted avg       0.79      0.79      0.79       400
```

Results of Improved Sentiment Analyser using Viterbi POS tagger on movie_reviews corpus with an execution time of approx. 40 minutes