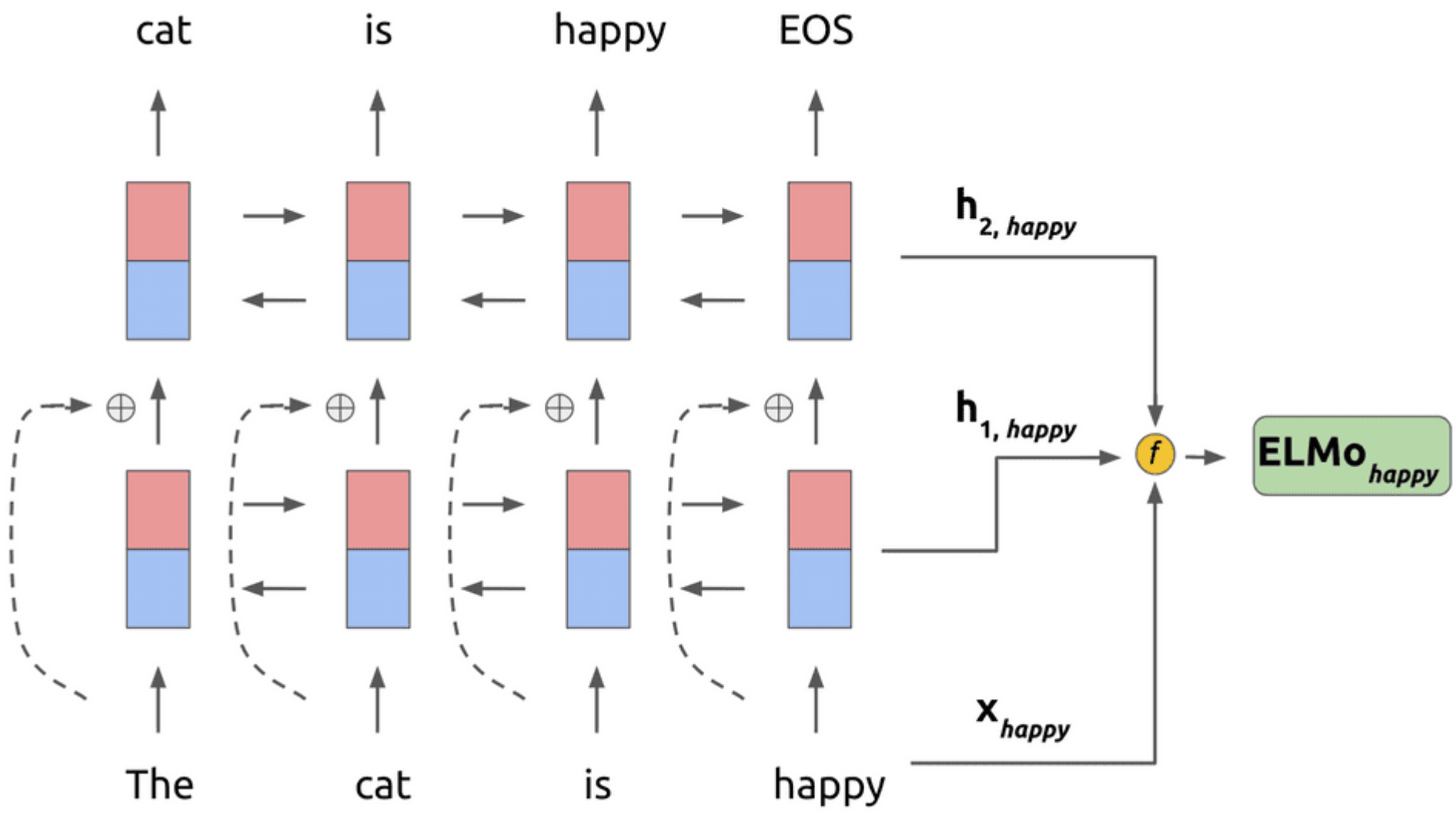
Assignment 4

Report

ELMo Architecture



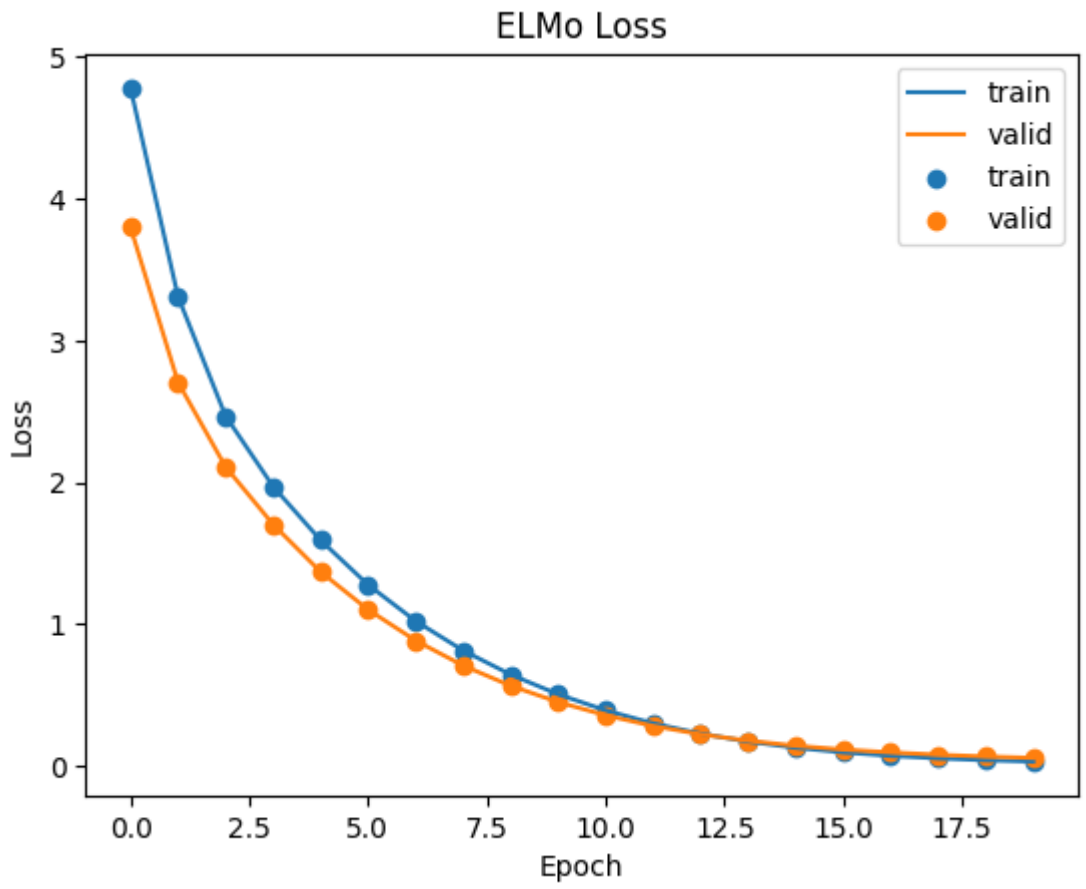
- The model takes in an input tensor of size (`batch_size, sequence_length`) where each element in the tensor is a word index representing a token in the input text.
- The embedding layer looks up the pretrained GloVe embeddings for each word in the input tensor and returns a tensor of size (`batch_size, sequence_length, embedding_dim` where `embedding_dim` is the size of the GloVe embedding vectors.
- The `lstm1` layer is a bidirectional LSTM layer with hidden_dim hidden units, which means it has hidden_dim hidden units in both the forward and backward directions. This layer takes in the output of the embedding layer and returns a tensor of size (`batch_size, sequence_length, hidden_di*2`) because the outputs of the forward and backward LSTMs are concatenated along the last dimension.
- The `lstm2` layer is also a bidirectional LSTM layer with hidden_dim hidden units that takes in the output of lstm1 and returns a tensor of size (`batch_size, sequence_length, hidden_dim*2`) .
- The `linear_out` layer is a linear layer that takes in the output of lstm2 and returns a tensor of size (`batch_size, sequence_length, vocab_size`) where `vocab_size` is the number of output classes (i.e. the size of the output vocabulary).

Overall, the model is designed to take in a sequence of word indices, embed those words using pretrained GloVe embeddings, and then use a bidirectional LSTM to encode the sequence into a fixed-length vector representation that can be used for classification or other downstream tasks.

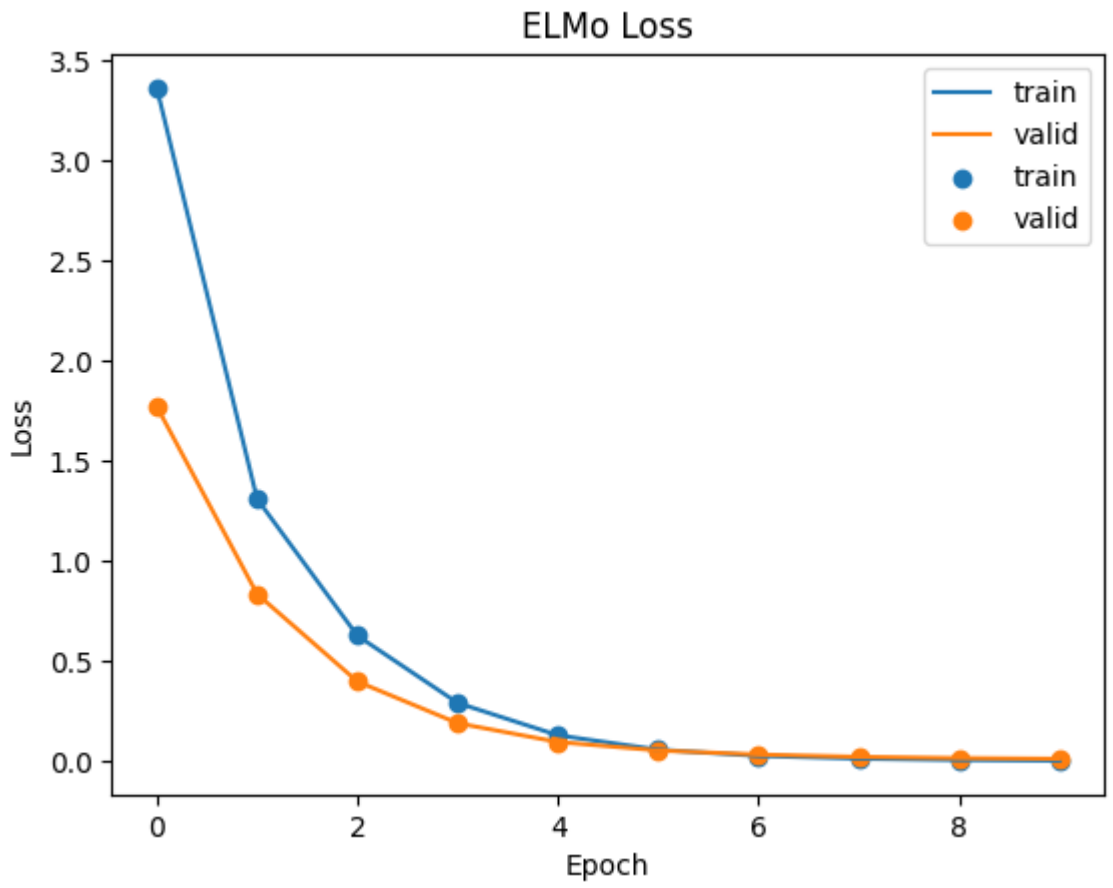
```
ELMo(
  (embedding): Embedding(10394, 300, padding_idx=0)
  (lstm1): LSTM(300, 100, batch_first=True, bidirectional=True)
  (lstm2): LSTM(200, 100, batch_first=True, bidirectional=True)
  (linear_out): Linear(in_features=200, out_features=10394, bias=True)
)
```

The inputs are the the sequence of word indices from 0 to length-1 , and the output is the sequence of word indices from 1 to length .

Dataset : Stanford Sentiment Treebank



Dataset : Multi-Genre NLP corpus



Classification

The architecture consists of the following layers:

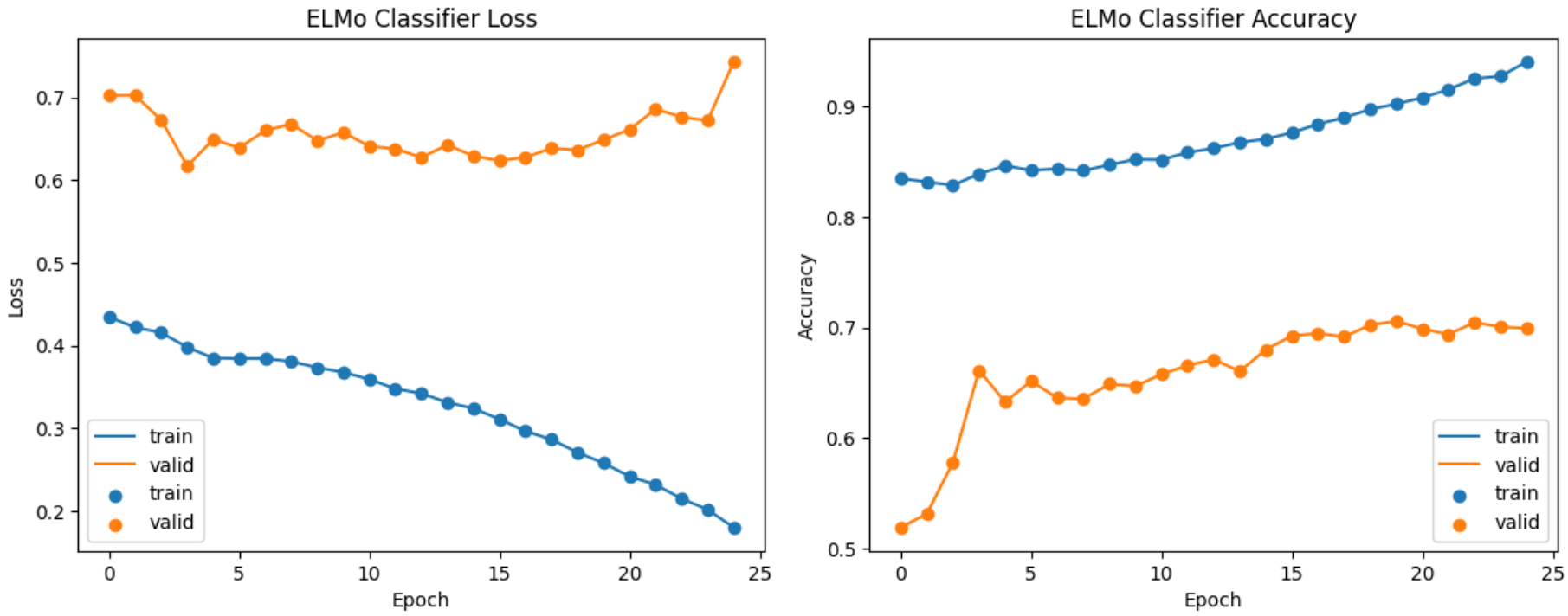
- `nn.Embedding`: The input is first passed through an embedding layer using the pretrained ELMo embedding. nn.Linear : The output from the embedding layer is passed through a linear layer to change the embedding dimension to hidden dimensionx2.
- `nn.LSTM` : The resulting tensor is then passed through two layers of LSTM in a sequential manner. torch.max : After passing through the LSTM layers, the resulting tensor is passed through a max pooling layer.
- `nn.Dropout` : The max pooling output is then passed through a dropout layer with a dropout probability of 0.5.

`nn.Linear` : Finally, the resulting tensor is passed through a linear layer to get the output of the classifier.

This architecture also includes `L2 regularization`.

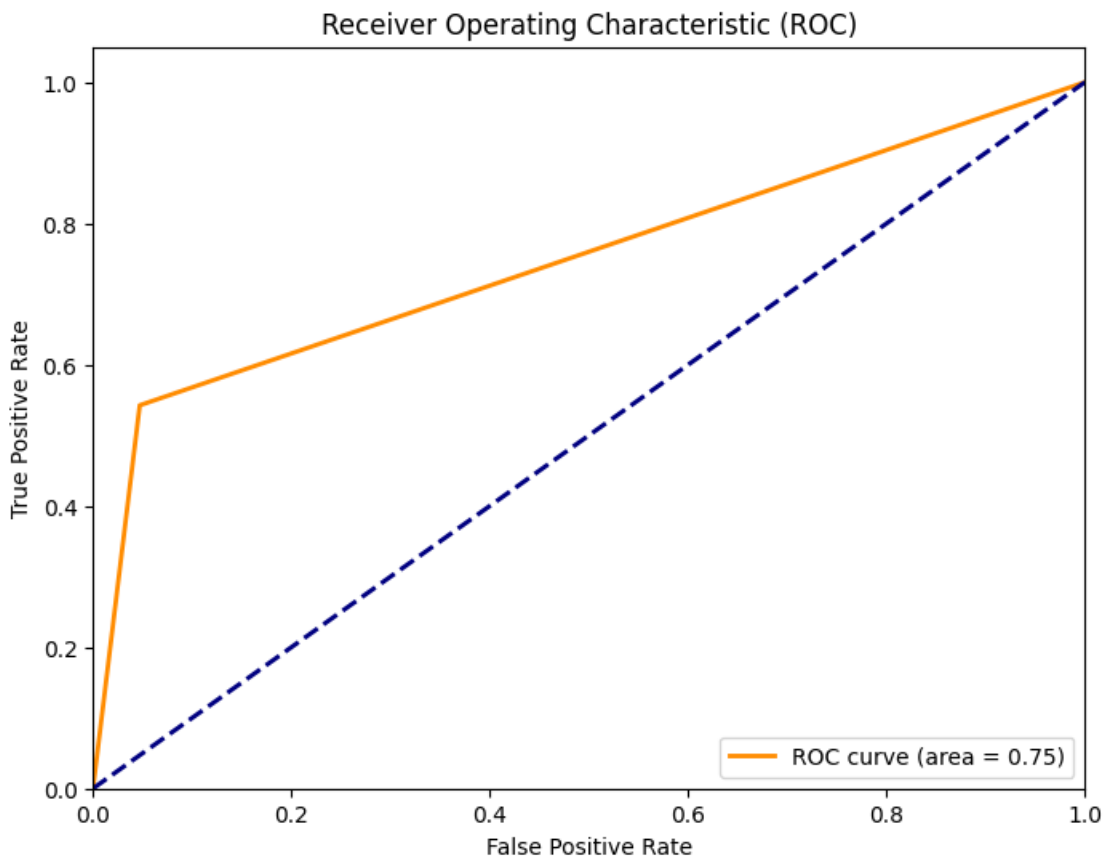
```
scoreClassifier(
(embeddings): Embedding(10394, 300, padding_idx=0)
(lstm1): LSTM(300, 100, batch_first=True, bidirectional=True)
(lstm2): LSTM(200, 100, batch_first=True, bidirectional=True)
(linear1): Linear(in_features=300, out_features=200, bias=True)
(linear_out): Linear(in_features=200, out_features=3, bias=True)
(dropout): Dropout(p=0.5, inplace=False)
)
```

Dataset : Stanford Sentiment Treebank



Visualizations

Training Dataset

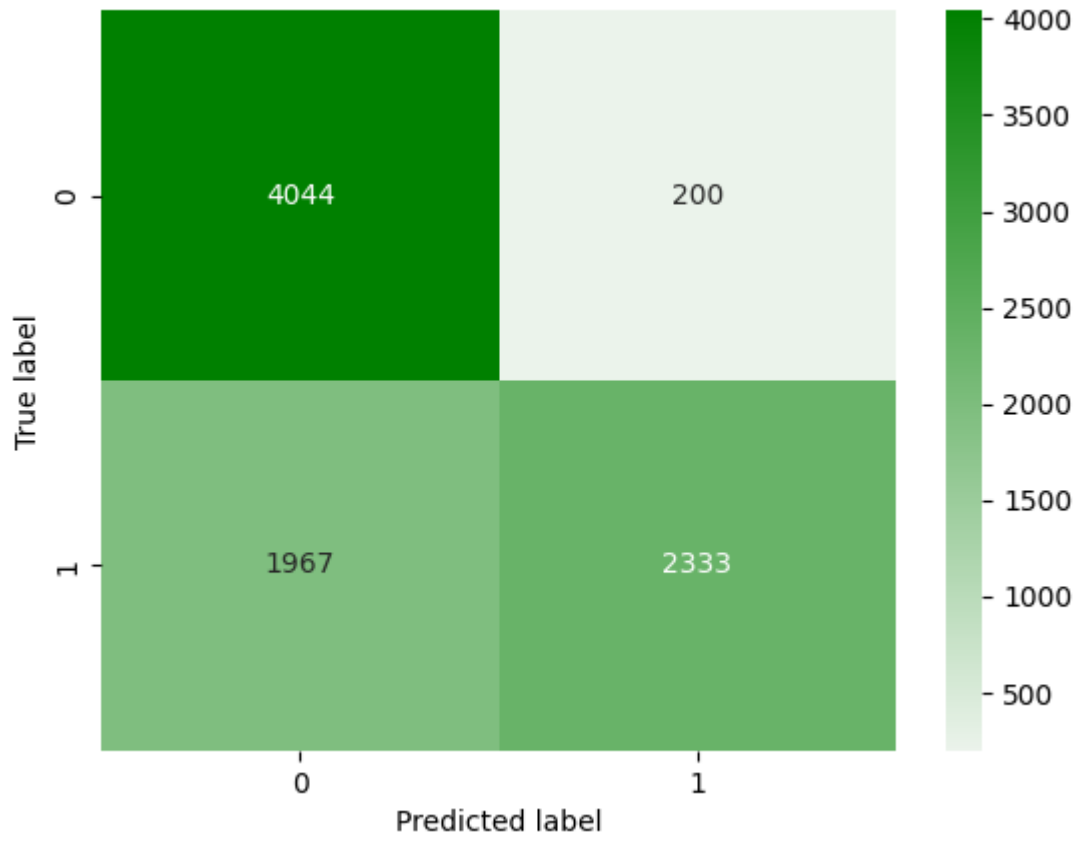


Training Dataset

	precision	recall	f1-score	support
0	0.67	0.95	0.79	4244
1	0.92	0.54	0.68	4300
accuracy			0.75	8544
macro avg	0.80	0.75	0.74	8544
weighted avg	0.80	0.75	0.74	8544

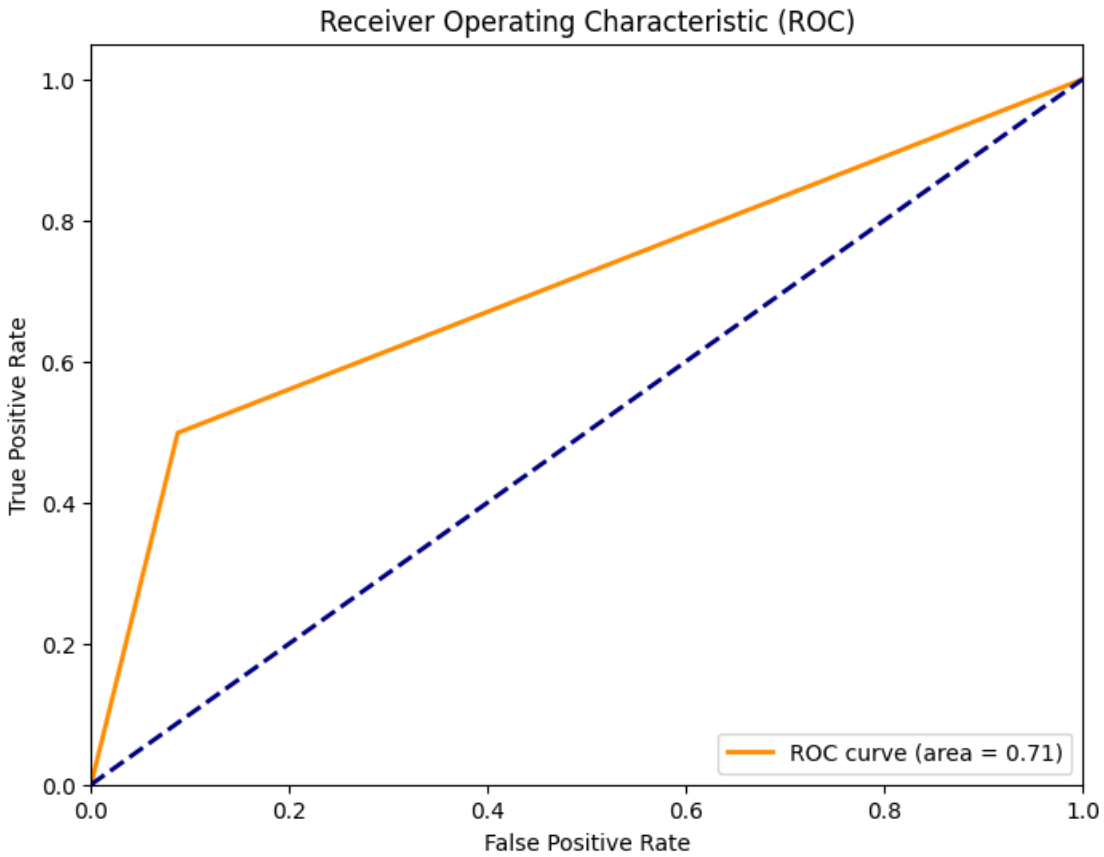
Accuracy: 0.7463717228464419
F1 Score: 0.6828625786623739
Precision: 0.9210422424003158

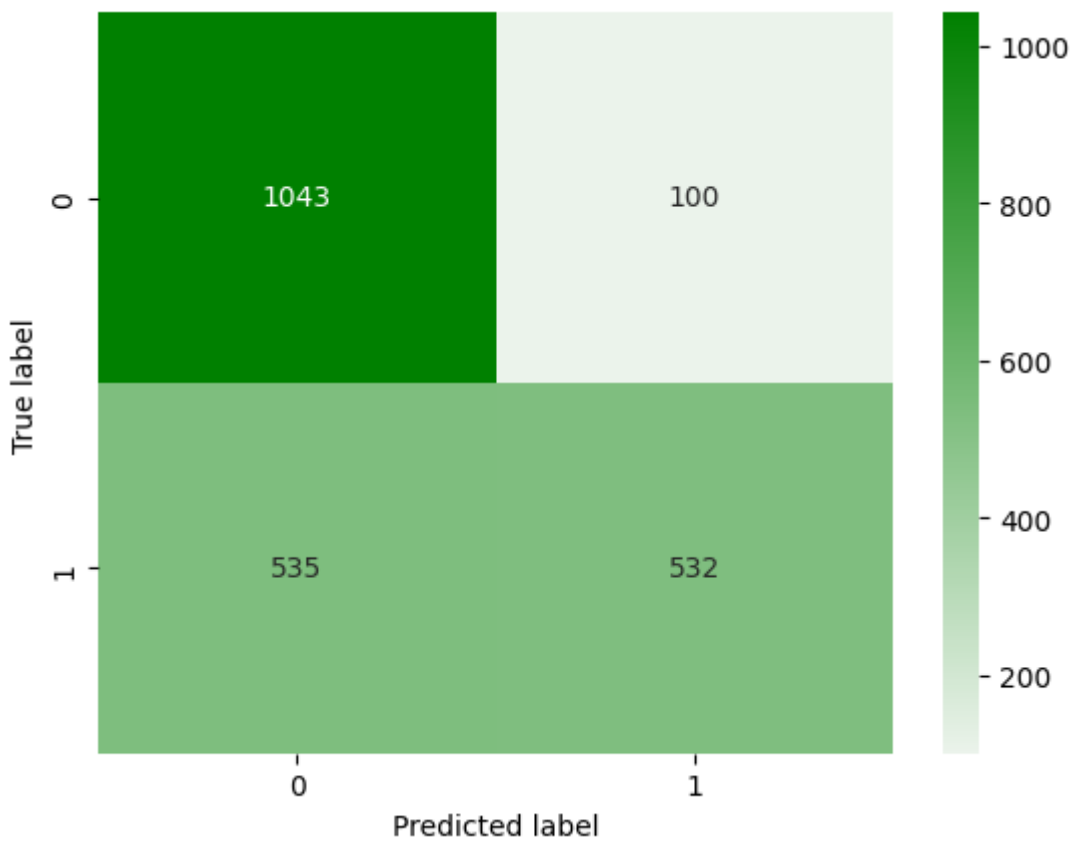
```
Recall: 0.5425581395348837
Confusion Matrix:
[[4044.  200.]
 [1967. 2333.]]
```



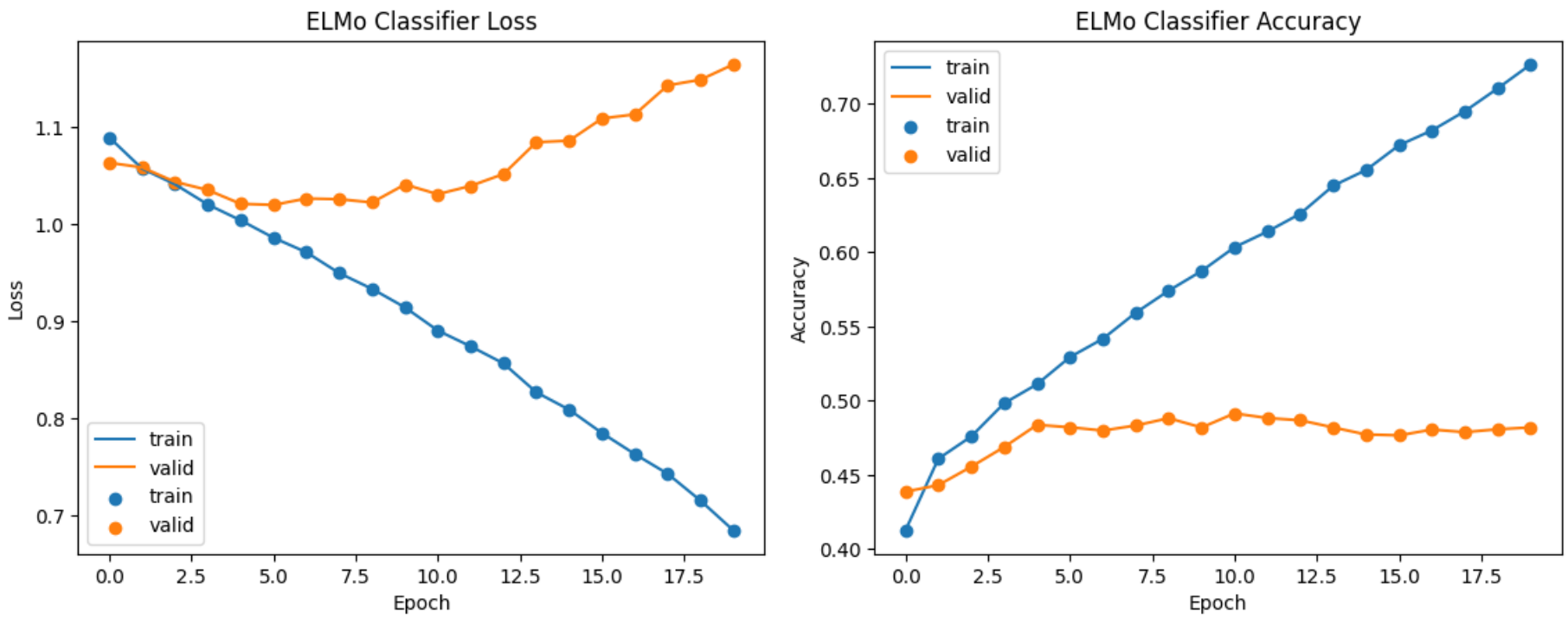
Testing Dataset

```
                precision    recall  f1-score   support

           0       0.66      0.91      0.77      1143
           1       0.84      0.50      0.63      1067

    accuracy                           0.71      2210
   macro avg       0.75      0.71      0.70      2210
weighted avg       0.75      0.71      0.70      2210

Accuracy: 0.7126696832579186
F1 Score: 0.6262507357268982
Precision: 0.8417721518987342
Recall: 0.4985941893158388
Confusion Matrix:
[[1043.  100.]
 [ 535.  532.]]
```





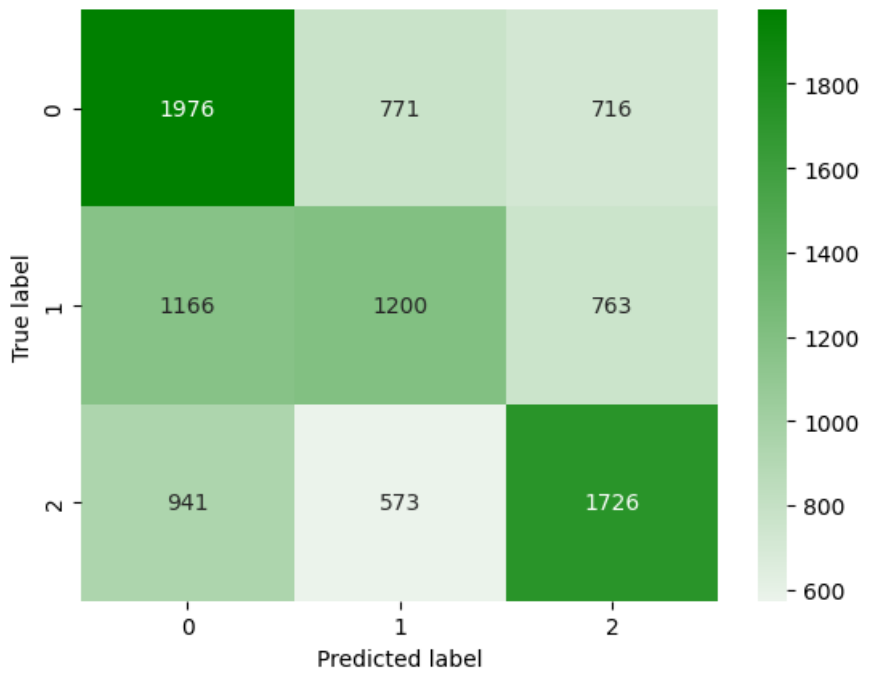
Dataset : Multi-Genre NLP corpus



Results:

Testing

```
                precision    recall  f1-score   support

    negative       0.48      0.57      0.52      3463
     neutral       0.47      0.38      0.42      3129
    positive       0.54      0.53      0.54      3240

    accuracy                           0.50      9832
   macro avg       0.50      0.50      0.49      9832
weighted avg       0.50      0.50      0.50      9832

Accuracy: 0.49857607811228644
Confusion Matrix:
[[1976.  771.  716.]
 [1166. 1200.  763.]
 [ 941.  573. 1726.]]
```



Training

```
                precision    recall  f1-score   support

    negative       0.78      0.87      0.82      8565
     neutral       0.85      0.77      0.81      7525
    positive       0.85      0.83      0.84      9134

    accuracy                           0.82     25224
   macro avg       0.83      0.82      0.82     25224
weighted avg       0.83      0.82      0.82     25224

Accuracy: 0.8242150333016175
Confusion Matrix:
[[7418.  550.  597.]
 [ 990. 5784.  751.]
 [1057.  489. 7588.]]
```