Assignment 3

Group Name: Codefellas
Group Members: Utsav Bheda(224101054)
Anjali Priya (190101012)
Nancy(190101057)

1. Problem Statement

Sarcasm Detection in Hindi-English code-mixed data using Bilingual word embeddings

2. Preprocessing

Different preprocessing used for cleaning data:

- Replaced all @.... with username
- Removed all hashtags
- Removed all hyperlinks
- Removed Rare words

3. Dataset

2 types of dataset needed:
Unlabeled dataset for generating Bi-Lingual embeddings.
Labelled dataset for detecting sarcasm in hindi-english code-mixed language.

4. Model

Embeddings Used:

a) Word2Vec
b) FastText
c) IndicBERT

Models Used for detecting Sarcasm:

a) Series CNN
b) Parallel CNN
c) LSTM
d) Bi- Directional LSTM
e) Bi-Directional LSTM with attention

5. Results

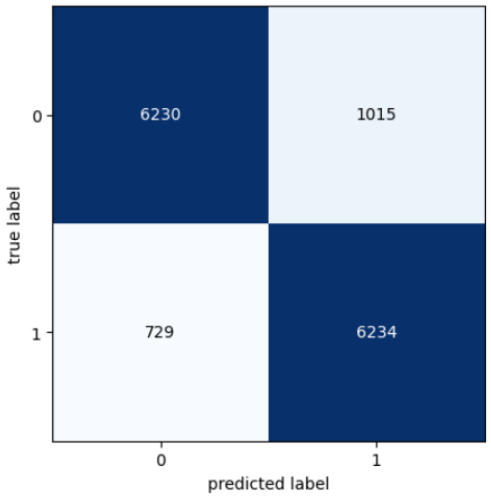
Word2Vec on Hinglish data

Series CNN

```
Test Accuracy:  tensor(0.8766, device='cuda:0')
              precision    recall  f1-score   support

           0       0.90      0.86      0.88      7245
           1       0.86      0.90      0.88      6963

    accuracy                           0.88     14208
   macro avg       0.88      0.88      0.88     14208
weighted avg       0.88      0.88      0.88     14208
```

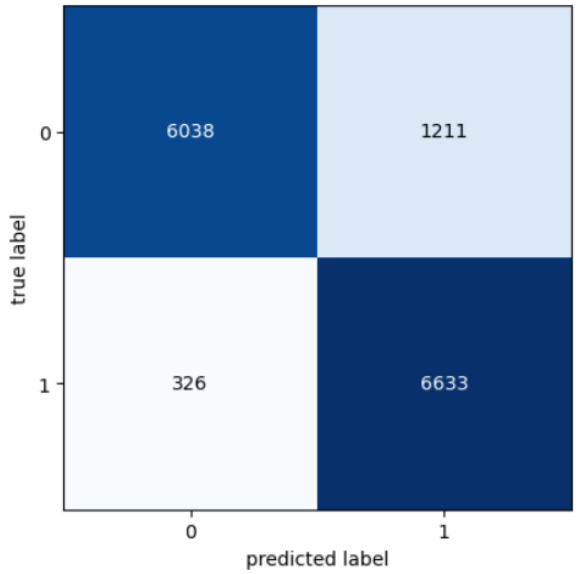


Parallel CNN

```
Test Accuracy:  tensor(0.8911, device='cuda:0')
              precision    recall  f1-score   support

           0       0.95      0.83      0.89      7249
           1       0.85      0.95      0.90      6959

    accuracy                           0.89     14208
   macro avg       0.90      0.89      0.89     14208
weighted avg       0.90      0.89      0.89     14208
```

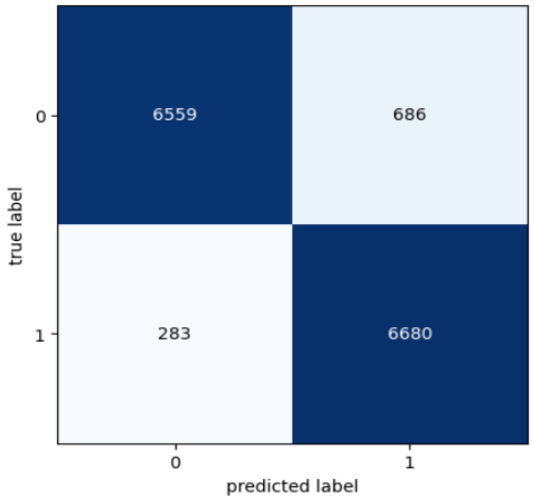


LSTM

```
Test Accuracy:  tensor(0.9311, device='cuda:0')
              precision    recall  f1-score   support

           0       0.96      0.91      0.93      7245
           1       0.91      0.96      0.93      6963

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

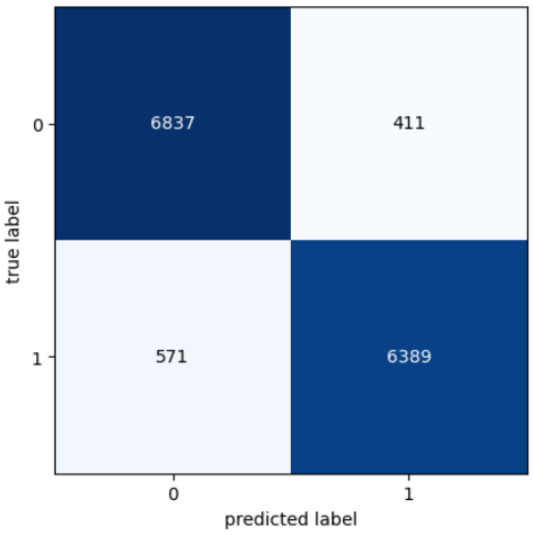


Bi- Directional LSTM

```
Test Accuracy:  tensor(0.9302, device='cuda:0')
              precision    recall  f1-score   support

           0       0.92      0.94      0.93      7248
           1       0.94      0.92      0.93      6960

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

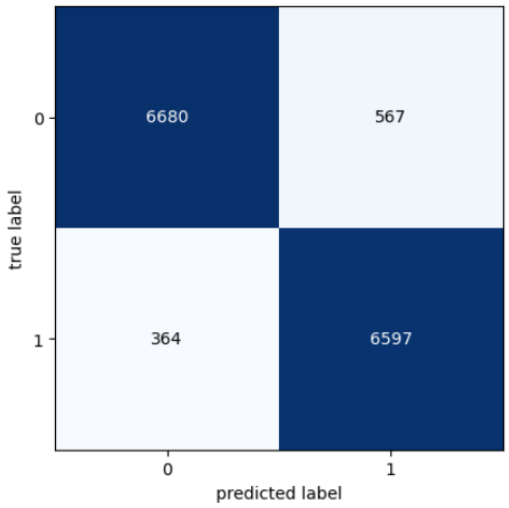


Bi-Directional LSTM with attention

```
Test Accuracy:  tensor(0.9338, device='cuda:0')
              precision    recall  f1-score   support

           0       0.95      0.92      0.93      7247
           1       0.92      0.95      0.93      6961

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```



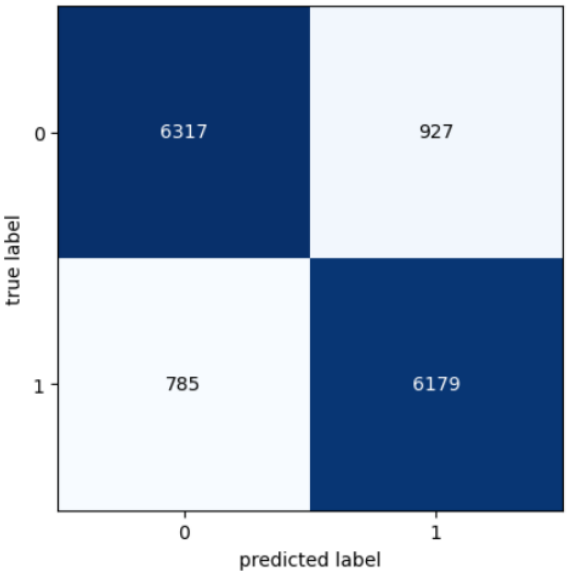
Fasttext on Hinglish data

Series CNN

```
Test Accuracy:  tensor(0.8788, device='cuda:0')
              precision    recall  f1-score   support

           0       0.89      0.87      0.88      7244
           1       0.87      0.89      0.88      6964

    accuracy                           0.88     14208
   macro avg       0.88      0.88      0.88     14208
weighted avg       0.88      0.88      0.88     14208
```

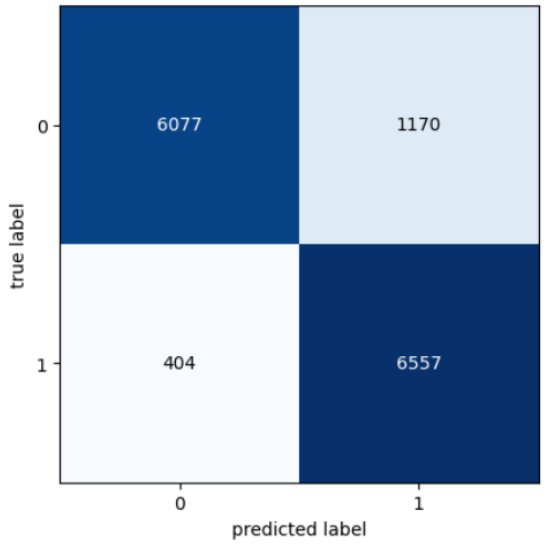


Parallel CNN

```
Test Accuracy:  tensor(0.8885, device='cuda:0')
              precision    recall  f1-score   support

           0       0.94      0.84      0.89      7247
           1       0.85      0.94      0.89      6961

    accuracy                           0.89     14208
   macro avg       0.89      0.89      0.89     14208
weighted avg       0.89      0.89      0.89     14208
```

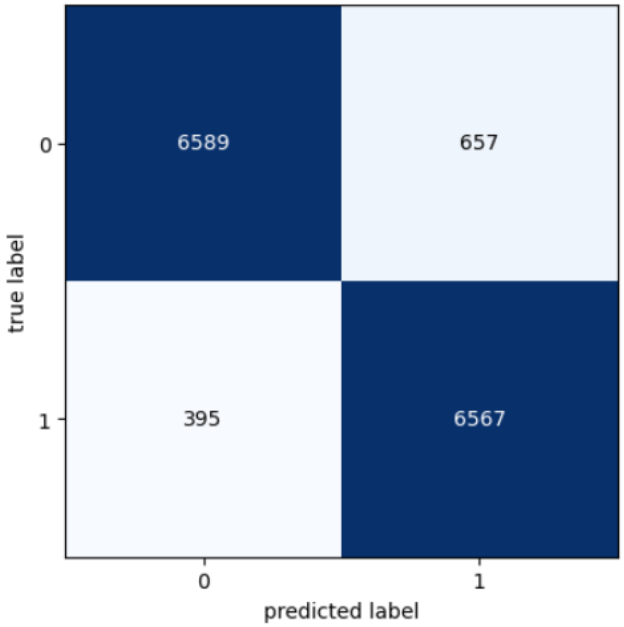


LSTM

```
Test Accuracy:  tensor(0.9252, device='cuda:0')
              precision    recall  f1-score   support

           0       0.94      0.91      0.93      7246
           1       0.91      0.94      0.93      6962

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

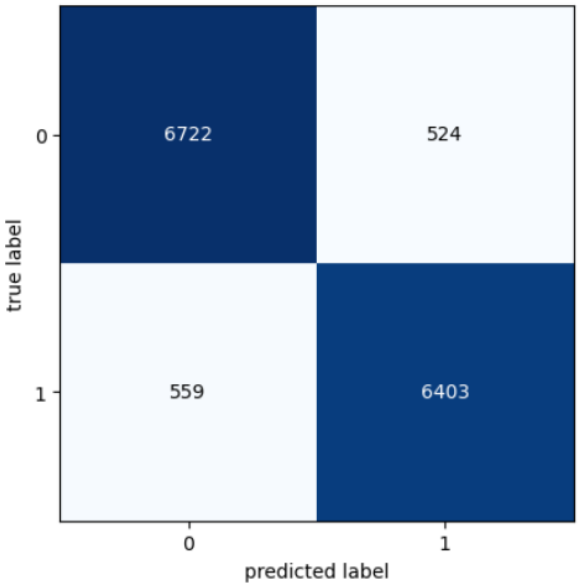


Bi- Directional LSTM

```
Test Accuracy:  tensor(0.9231, device='cuda:0')
              precision    recall  f1-score   support

           0       0.92      0.93      0.93      7246
           1       0.92      0.92      0.92      6962

    accuracy                           0.92     14208
   macro avg       0.92      0.92      0.92     14208
weighted avg       0.92      0.92      0.92     14208
```

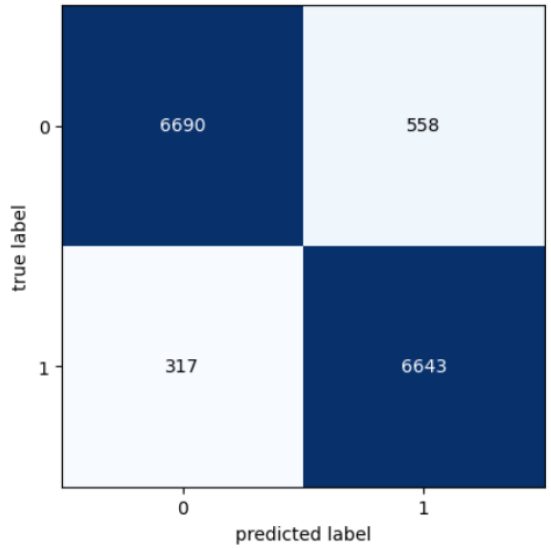


Bi-Directional LSTM with attention

```
Test Accuracy:  tensor(0.9377, device='cuda:0')
              precision    recall  f1-score   support

           0       0.95      0.92      0.94      7248
           1       0.92      0.95      0.94      6960

    accuracy                           0.94     14208
   macro avg       0.94      0.94      0.94     14208
weighted avg       0.94      0.94      0.94     14208
```



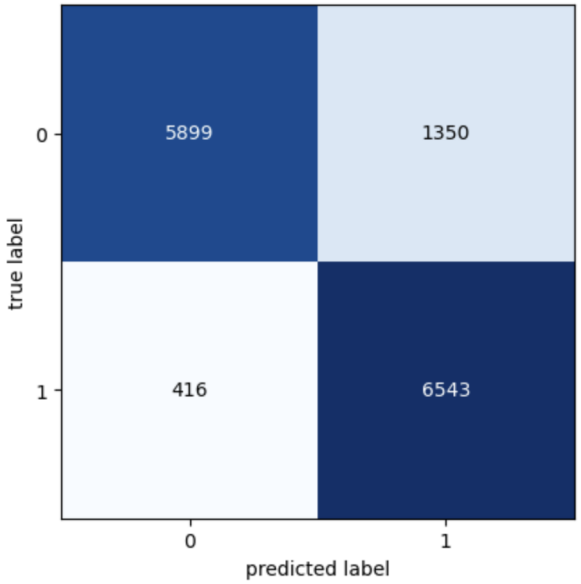
Word2Vec on Hinglish+English Dataset :

Series CNN

```
Test Accuracy:  tensor(0.8750, device='cuda:0')
              precision    recall  f1-score   support

           0       0.93      0.81      0.87      7249
           1       0.83      0.94      0.88      6959

    accuracy                           0.88     14208
   macro avg       0.88      0.88      0.88     14208
weighted avg       0.88      0.88      0.88     14208
```

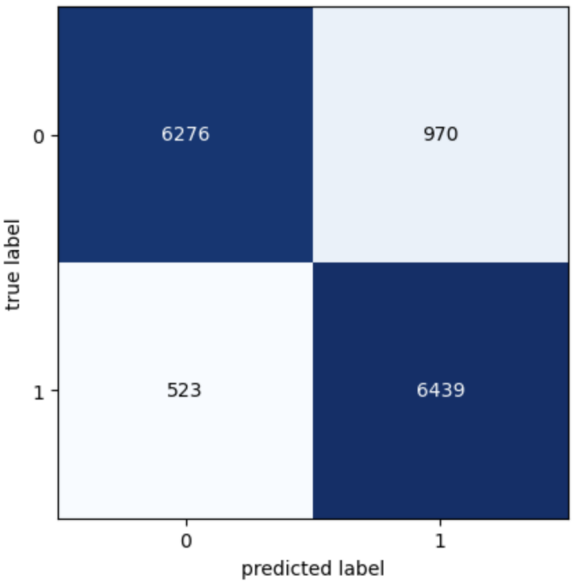


Parallel CNN

```
Test Accuracy:  tensor(0.8942, device='cuda:0')
              precision    recall  f1-score   support

           0       0.92      0.87      0.89      7246
           1       0.87      0.92      0.90      6962

    accuracy                           0.89     14208
   macro avg       0.90      0.90      0.89     14208
weighted avg       0.90      0.89      0.89     14208
```

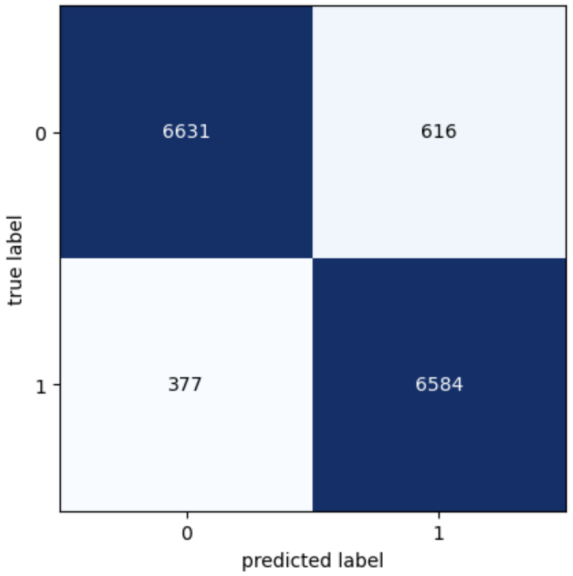


LSTM

```
Test Accuracy:  tensor(0.9294, device='cuda:0')
              precision    recall  f1-score   support

           0       0.95      0.91      0.93      7247
           1       0.91      0.95      0.93      6961

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

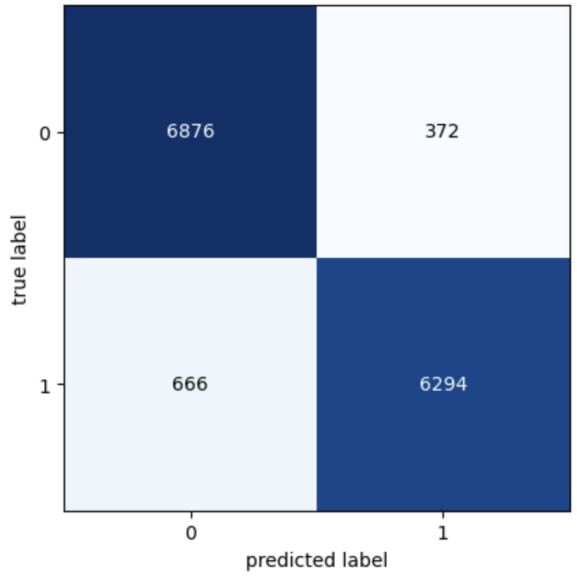


BiLSTM

```
Test Accuracy:  tensor(0.9262, device='cuda:0')
              precision    recall  f1-score   support

           0       0.91      0.95      0.93      7248
           1       0.94      0.90      0.92      6960

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

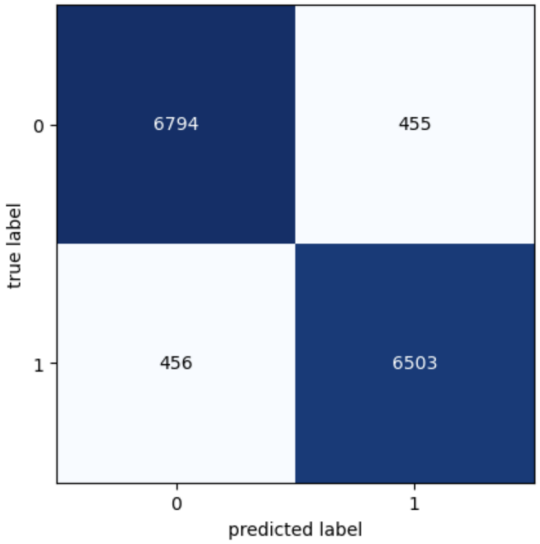


BiLSTM with Attention

```
Test Accuracy:  tensor(0.9352, device='cuda:0')
              precision    recall  f1-score   support

           0       0.94      0.94      0.94      7249
           1       0.93      0.93      0.93      6959

    accuracy                           0.94     14208
   macro avg       0.94      0.94      0.94     14208
weighted avg       0.94      0.94      0.94     14208
```



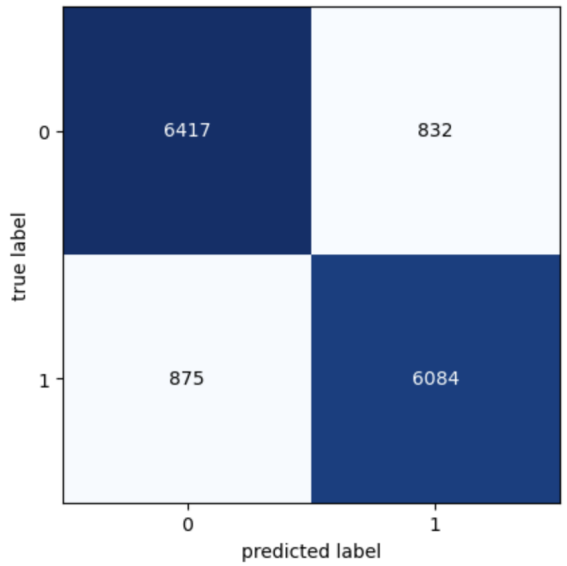
FastText on Hinglish+English dataset:

Series CNN

```
Test Accuracy:  tensor(0.8792, device='cuda:0')
              precision    recall  f1-score   support

           0       0.88      0.89      0.88      7249
           1       0.88      0.87      0.88      6959

    accuracy                           0.88     14208
   macro avg       0.88      0.88      0.88     14208
weighted avg       0.88      0.88      0.88     14208
```

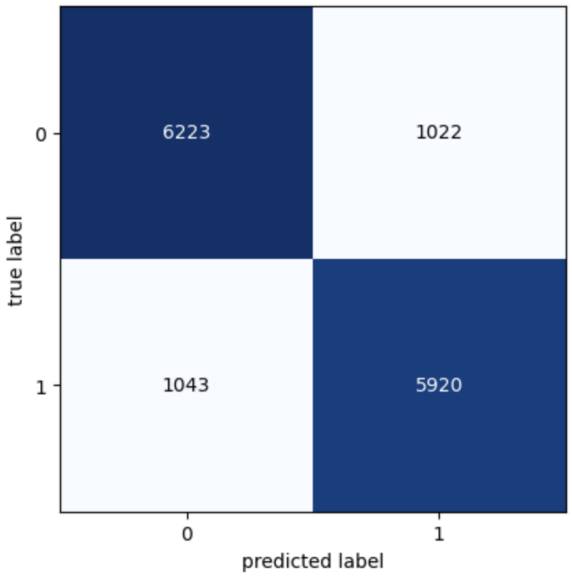


Parallel CNN

```
Test Accuracy:  tensor(0.8540, device='cuda:0')
              precision    recall  f1-score   support

           0       0.86      0.86      0.86      7245
           1       0.85      0.85      0.85      6963

    accuracy                           0.85     14208
   macro avg       0.85      0.85      0.85     14208
weighted avg       0.85      0.85      0.85     14208
```

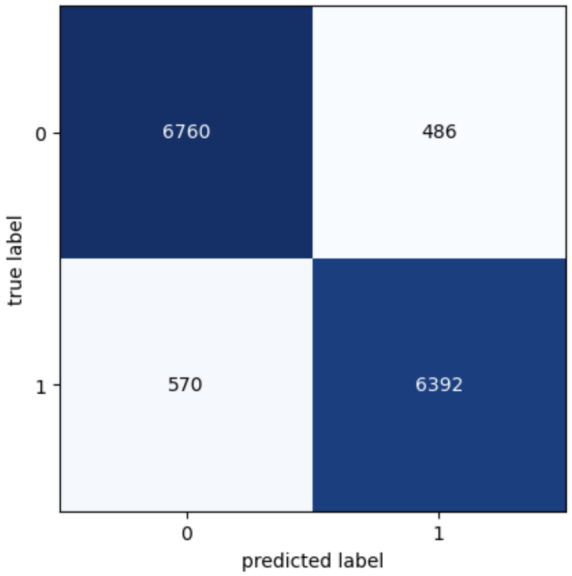


LSTM

```
Test Accuracy:  tensor(0.9250, device='cuda:0')
              precision    recall  f1-score   support

           0       0.92      0.93      0.93      7246
           1       0.93      0.92      0.92      6962

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

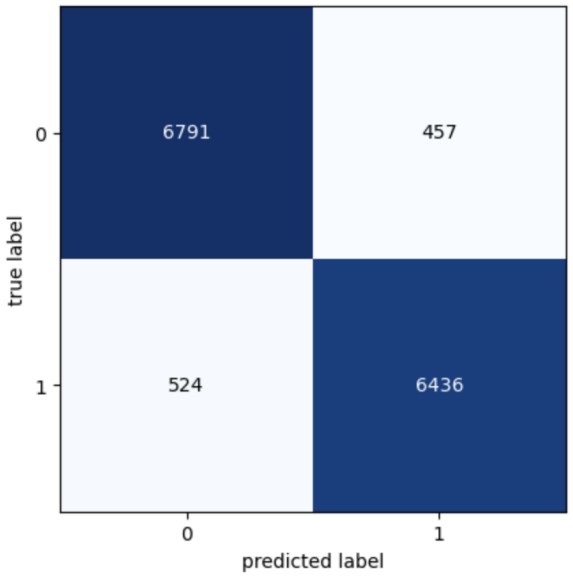


BiLSTM

```
Test Accuracy:  tensor(0.9302, device='cuda:0')
              precision    recall  f1-score   support

           0       0.93      0.94      0.93      7248
           1       0.93      0.92      0.93      6960

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

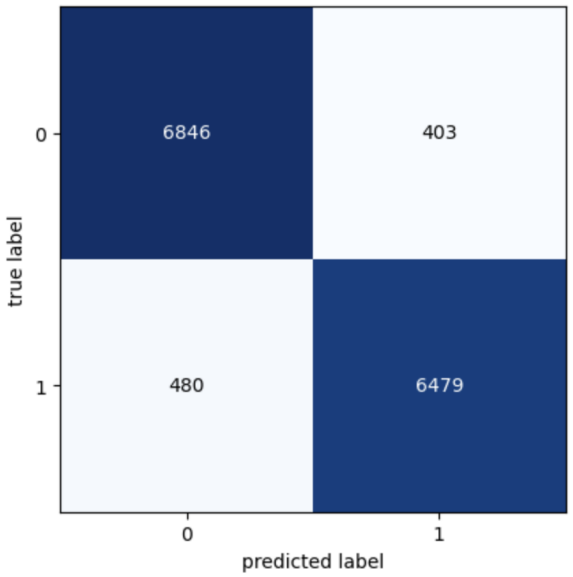


BiLSTM with Attention

```
Test Accuracy:  tensor(0.9371, device='cuda:0')
              precision    recall  f1-score   support

           0       0.93      0.94      0.94      7249
           1       0.94      0.93      0.94      6959

    accuracy                           0.94     14208
   macro avg       0.94      0.94      0.94     14208
weighted avg       0.94      0.94      0.94     14208
```



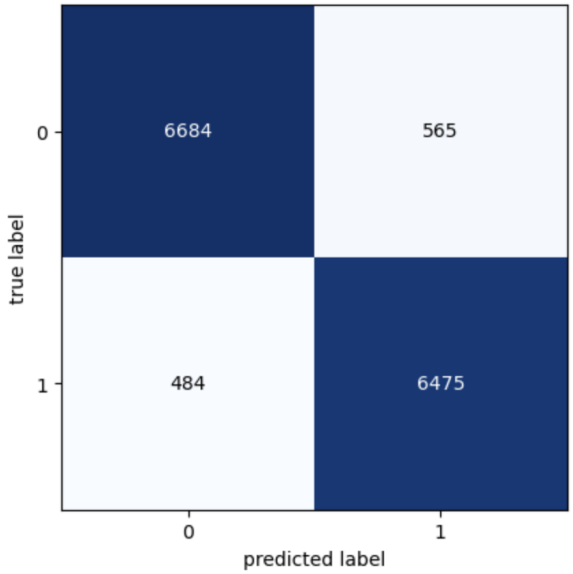
IndicBERT on Hinglish + English Dataset:

Series CNN

```
Test Accuracy:  tensor(0.9255, device='cuda:0')
              precision    recall  f1-score   support

           0       0.93      0.92      0.93      7249
           1       0.92      0.93      0.93      6959

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

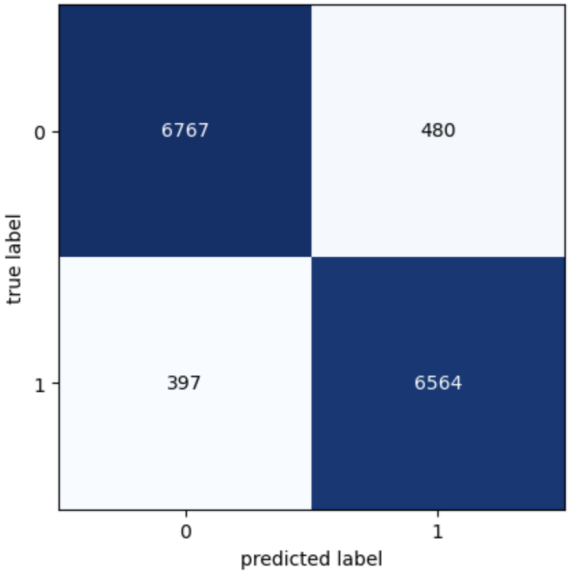


Parallel CNN

```
Test Accuracy:  tensor(0.9375, device='cuda:0')
              precision    recall  f1-score   support

           0       0.94      0.93      0.94      7247
           1       0.93      0.94      0.94      6961

    accuracy                           0.94     14208
   macro avg       0.94      0.94      0.94     14208
weighted avg       0.94      0.94      0.94     14208
```

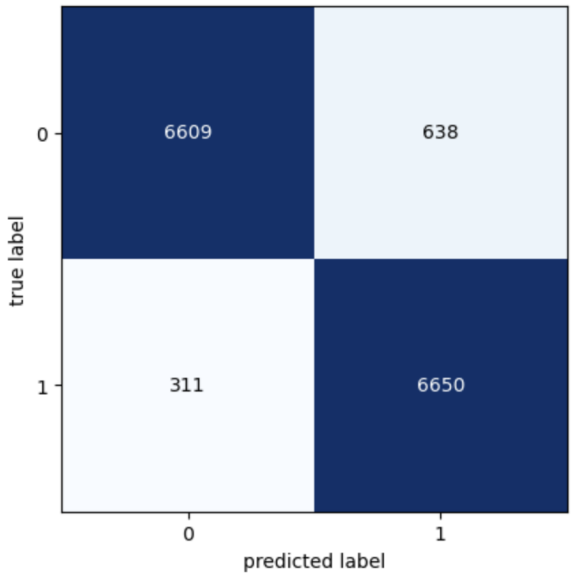


LSTM

```
Test Accuracy:  tensor(0.9325, device='cuda:0')
              precision    recall  f1-score   support

           0       0.96      0.91      0.93      7247
           1       0.91      0.96      0.93      6961

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

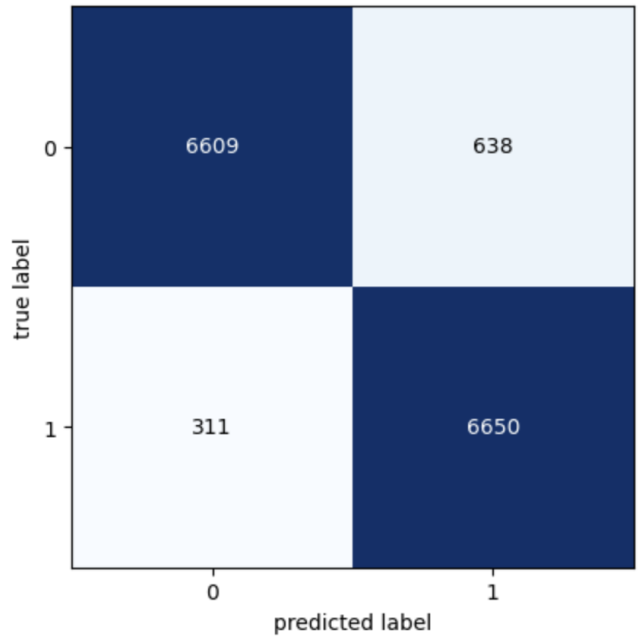


BiLSTM

```
Test Accuracy:  tensor(0.9325, device='cuda:0')
              precision    recall  f1-score   support

           0       0.96      0.91      0.93      7247
           1       0.91      0.96      0.93      6961

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```

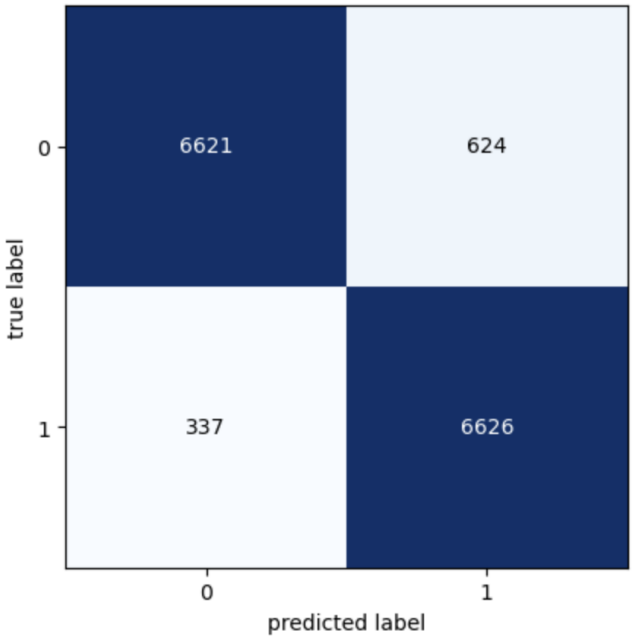


BiLSTM with Attention

```
Test Accuracy:  tensor(0.9316, device='cuda:0')
              precision    recall  f1-score   support

           0       0.95      0.91      0.93      7245
           1       0.91      0.95      0.93      6963

    accuracy                           0.93     14208
   macro avg       0.93      0.93      0.93     14208
weighted avg       0.93      0.93      0.93     14208
```



6. Results and Discussion

DL Models	Hinglish		Hinglish+English		
	Word2Vec	**FastText**	**Word2Vec**	**FastText**	**IndicBERT**
Series CNN	87.66	87.88	87.50	87.92	92.55
Parallel CNN	89.11	88.85	89.42	85.40	93.75
LSTM	93.11	92.52	92.94	92.50	93.25
Bi-LSTM	93.02	92.31	92.62	93.02	93.25
Attention	93.38	93.77	93.52	93.71	93.16

7. Observation

Using fine tuned IndicBERT embeddings improves performance of Series CNN and Parallel CNN significantly but not much improvement on other models.

8. Conclusion

Multilingual Embeddings like IndicBERT gives better embedding compared to FastText and Word2Vec.