

# Task 4: Parts-of-speech tagging using a single hidden layer RNN

**Hyper parameters:** Learning rate - 0.001      Epochs - 20    No. of Layers - 1      No. of nodes - 25

## Experiment and Observations:

- The dataset instance is given below. The sentences split indexed and so are the Parts of speech variables. The vocabulary is stored and 200-dimensional GloVe embeddings are used to embed the text before feeding to the RNN
- The texts are padded and tagged with <SOS> , <EOS> etc.. No other pre-processing were required
- The model is defined and trained over 10 epochs initially which felt like there was more room for improvement.
- So, the epochs were adjusted and finalized as 20. The overall accuracy and accuracy for each tag is determined and plots are generated.

	Sentence	Tags
0	) is for the most part a recondite affair , fo...	. VERB ADP DET ADJ NOUN DET ADJ NOUN . ADP ADV...
1	The \$6,100,000,000 measure , which was passed ...	DET NOUN NOUN . DET VERB VERB ADJ NOUN ADP DET...
2	Now and then he would disappear for several da...	ADV CONJ ADV PRON VERB VERB ADP ADJ NOUN .
3	He'd come alone , without his wife and child .	PRT VERB ADV . ADP DET NOUN CONJ NOUN .
4	An' that could mean trouble with a fella that'...	CONJ PRON VERB VERB NOUN ADP DET NOUN PRT VERB...

## Features and observations:

- **Number of classes identified - 12**
- **Train Loss: 59.6769**
- **Train accuracy: 88.89%**
- **Test accuracy : 87.27%**
- **The tag wise metrics is listed below:**

Label	Precision	Recall	F1-Score	Support
.	1.00	1.00	1.00	3848
<b>VERB</b>	0.90	0.78	0.84	4914
<b>ADP</b>	0.91	0.92	0.91	4043
<b>DET</b>	0.98	0.99	0.98	3812
<b>ADJ</b>	0.75	0.53	0.62	2325
<b>NOUN</b>	0.77	0.93	0.84	7684
<b>ADV</b>	0.82	0.66	0.73	1563
<b>PRON</b>	0.98	0.93	0.96	1231
<b>PRT</b>	0.70	0.75	0.72	767
<b>CONJ</b>	0.98	0.98	0.98	1029
<b>NUM</b>	0.86	0.78	0.82	350
<b>X</b>	0.50	0.06	0.11	16
<b>Accuracy</b>			0.87	31582
<b>Macro Avg</b>	0.85	0.78	0.79	31582
<b>Weighted Avg</b>	0.88	0.87	0.87	31582

## Predictions from Model for an input not from the dataset:

**Sentence:** ['I', 'love', 'natural', 'language', 'processing']

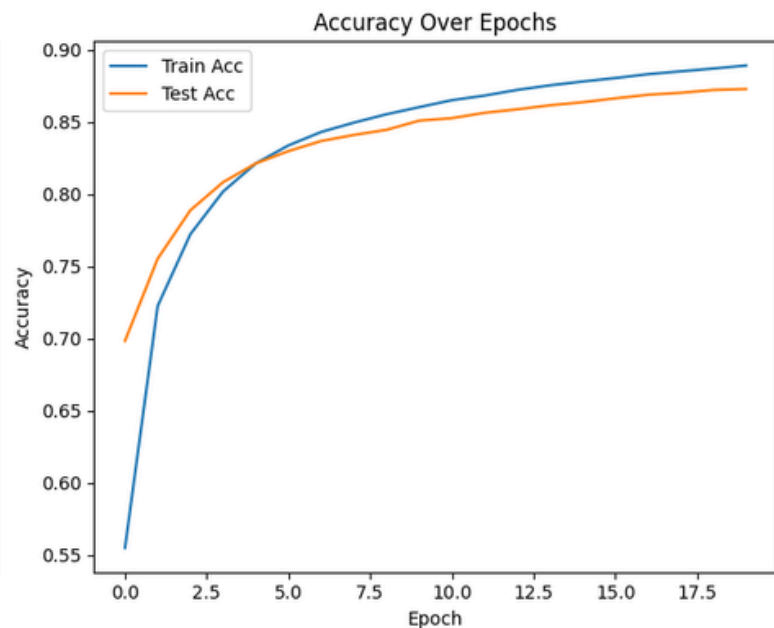
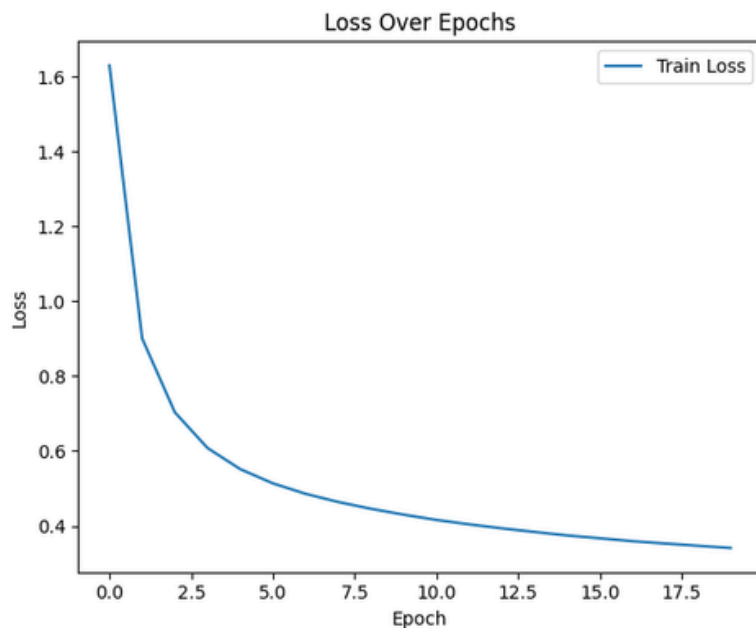
**Predicted Tags:** ['PRON', 'VERB', 'ADJ', 'NOUN', 'NOUN']

**Sentence:** ['The', 'quick', 'brown', 'fox', 'jumps']

**Predicted Tags:** ['DET', 'ADJ', 'NOUN', 'NOUN', 'ADJ']

**Sentence:** ['Data', 'science', 'is', 'fun']

**Predicted Tags:** ['VERB', 'NOUN', 'VERB', 'ADJ']



## Inference:

- The model achieved strong overall performance in parts-of-speech tagging, showing a high level of agreement between predicted and actual tags.
- It performed exceptionally well on common tags like punctuation, determiners, conjunctions, and pronouns, indicating it has effectively learned the dominant patterns in the data.
- Nouns and verbs, being among the most frequent word classes, were tagged with high consistency, though verbs showed slightly lower recall, suggesting some were missed.
- Adjectives and adverbs had moderate performance, which is expected due to their contextual variability and lower representation in the dataset.
- Less frequent tags such as foreign words or miscellaneous symbols were harder for the model to identify, resulting in low precision and recall for those classes.
- The macro average values indicate that while the model handles dominant classes well, there's room for improvement in capturing the less frequent ones.
- The weighted averages reflect the model's strength in handling class imbalance by prioritizing performance on tags that appear more often.
- Overall, the model demonstrates a solid understanding of syntactic structure and is suitable for general POS tagging tasks.