NLP Assignment:2

POS Tagging

Name: Ajay Ray

Roll:2021102032

1. **POS Tagging using Feed Forward Neural Network**

- **Data Preparation:**

  The dataset is loaded from CoNLL-U formatted files (Universal Dependencies).

  Sentences and corresponding POS tags are extracted from the dataset.

- **Context Size:**

  The model considers a context window of "p" previous tokens and "s" successive tokens. The total context size is defined as "p + s + 1."

- **Model Architecture:**

  The FFNNTagger class defines the neural network model.

  Embedding Layer: Converts word indices into continuous vectors (embedding dimension is 1024).

  First Fully Connected Layer (self.fc1): Output size of 512 with ReLU activation.

  ReLU Activation: Applies the Rectified Linear Unit activation function to introduce non-linearity.

  Second Fully Connected Layer (self.fc2): Produces logits for POS tags based on the output of the ReLU layer.

- **Training:**

  The model is trained using cross-entropy loss and the Adam optimizer.

  The model's state dictionary is saved after each epoch.

- **Hyperparameters:**

Word embedding dimension: 1024.

Context window size: p=2 (previous tokens) and s=2 (successive tokens)

Learning rate: 0.0001

- **FFNN Training losses and Accuracy**

  Epoch 1 LOSS: 4.9685015255818143e-05 Accuracy: 96.81%

  Epoch 2 LOSS: 4.369514135760255e-05 Accuracy: 98.32%

  Epoch 3 LOSS: 2.0322352156654233e-06 Accuracy: 99.21%

  Epoch 4 LOSS: 2.0012352156654233e-06 Accuracy: 99.51%

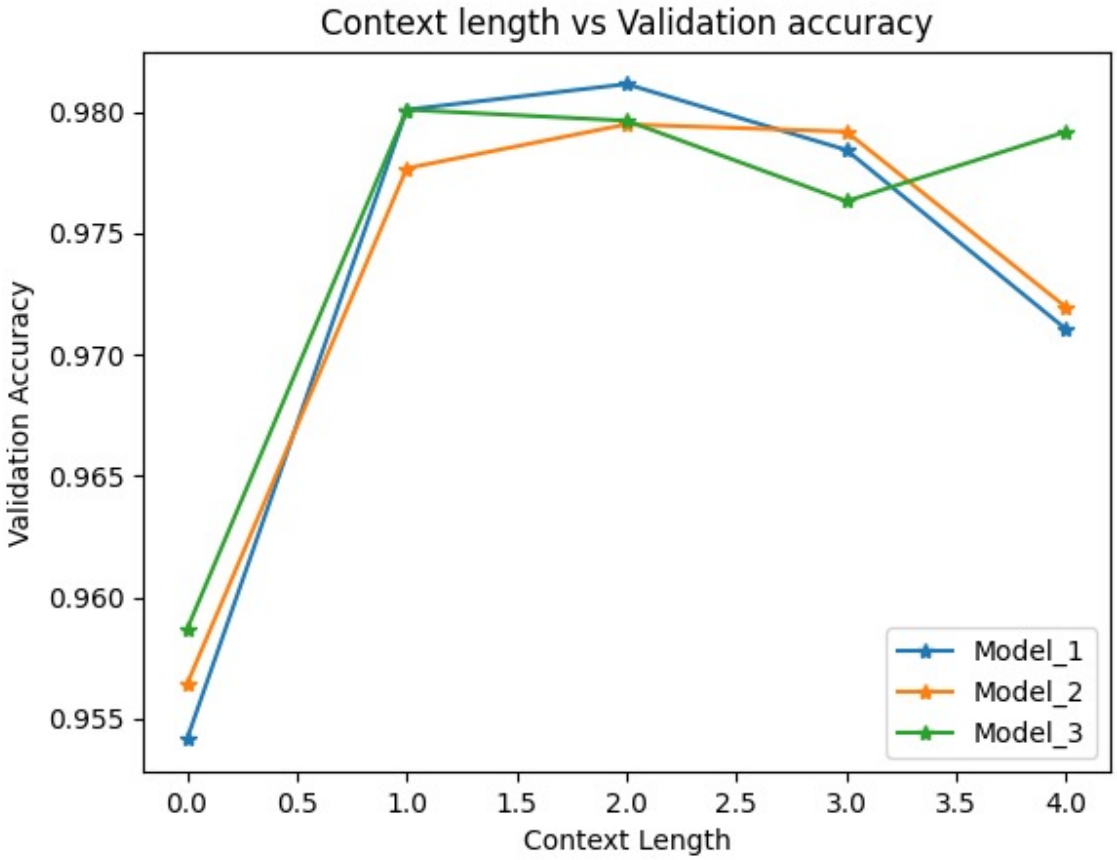
  Epoch 5 LOSS: 0 Accuracy: 99.56%

  Epoch 6 LOSS: 0 Accuracy: 99.56%

  Epoch 7 LOSS: 0 Accuracy: 99.6%

Analysis:

1. Using learning rate 0.0001 mode convergers fastly and also give good accuracies.
2. I used different no of hidden layers . Nothing significance observed in terms of accuracy.Plot is attached below.



2. **POS Tagging using LSTM.**

Model Architecture and Hyperparameters:

The basic architecture is:

Words → Embedding layer → LSTM → fully connected layer → POS Tag

A single layer LSTM was used with hidden dimension = 2.

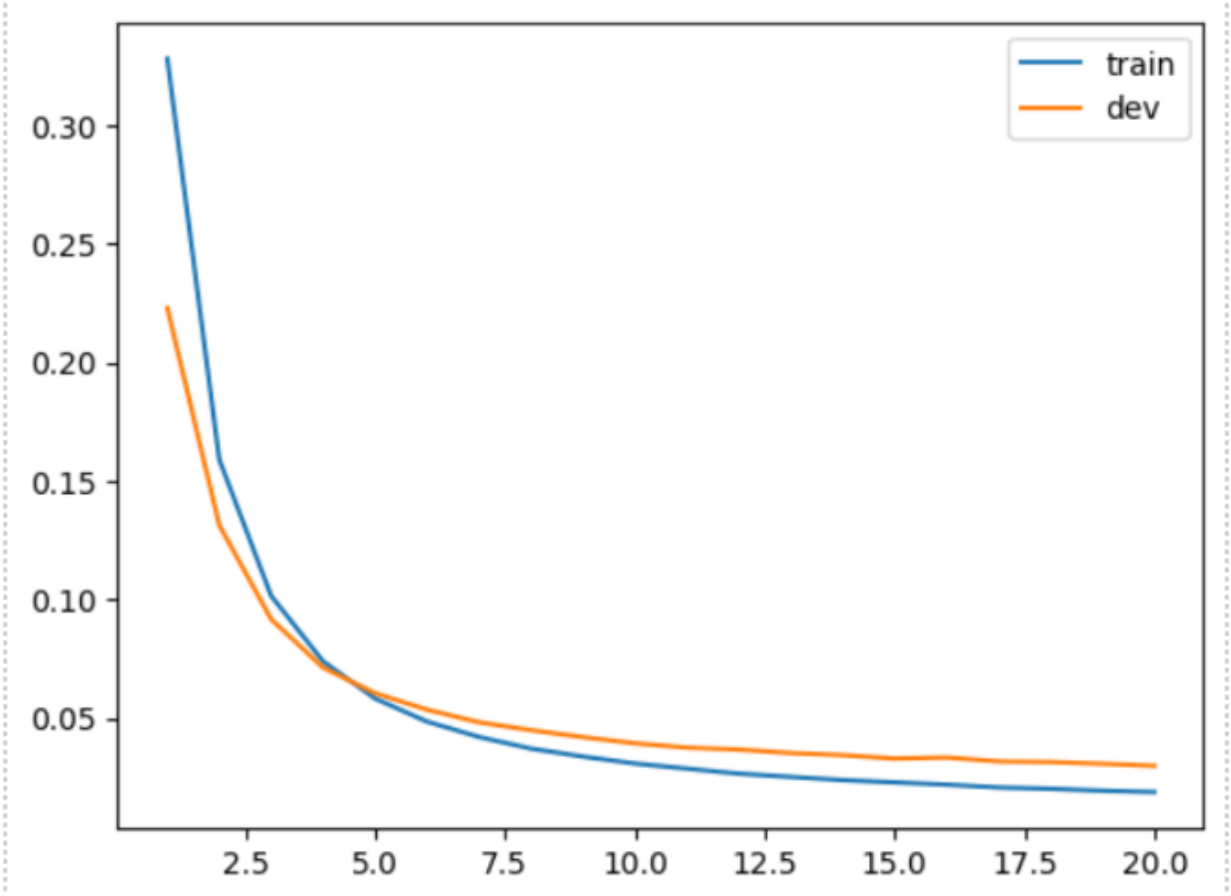
Negative log likelihood is used as loss function.

The output of the LSTM (at each time step) was passed to a fully connected layer (dimention= vocab of POS Tags = 13), and then through a softmax layer to give the POS tag.

Training

Training was done for 20 epochs.

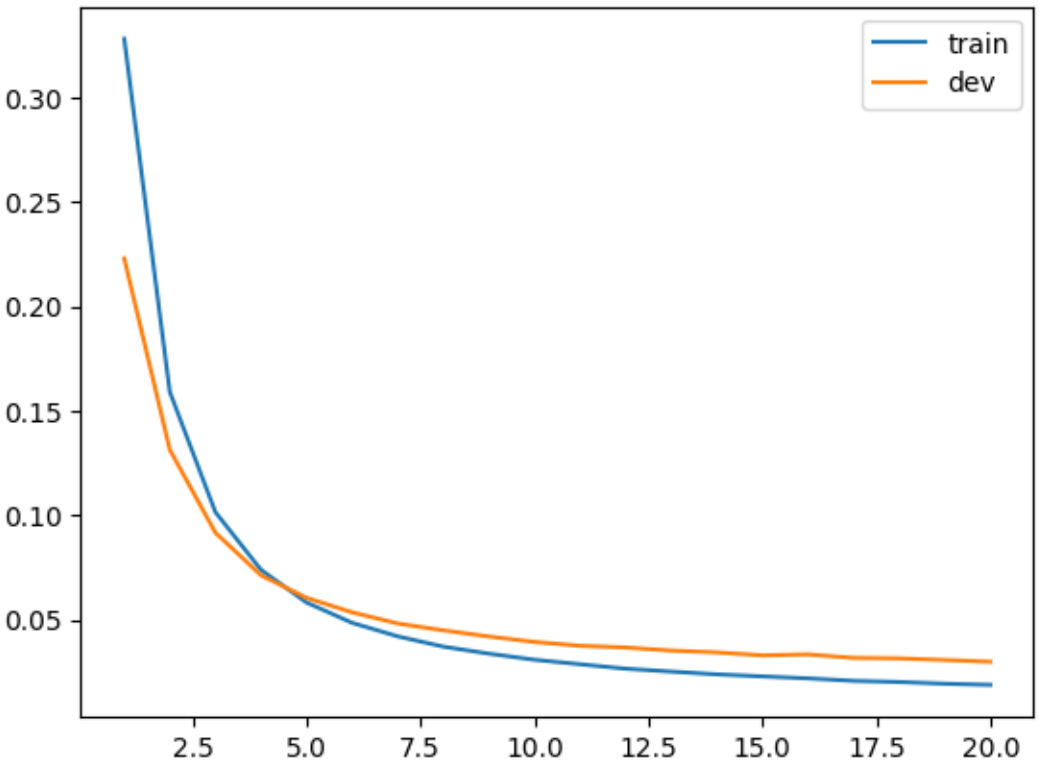
Training loss became less than validation loss at about epoch 4 and kept going down.



Results

1. **Train**:

	precision	recall	f1-score
<PAD>	0	0	0.00E+00
ADJ	0.97	8.70E-01	0.91
ADP	0.96	9.90E-01	0.97
ADV	0.8	8.00E-01	0.8
AUX	0.95	9.40E-01	0.94
CCONJ	1	9.70E-01	0.98
DET	0.9	0.92	0.91
INTJ	0.95	0.98	0.96
NOUN	0.99	0.99	0.99
NUM	0.98	0.98	0.98
PART	0.87	0.97	0.91
PRON	0.91	0.88	0.9
PROPN	0.99	1	1
VERB	0.96	0.91	0.94
	OBJ	OBJ	
accuracy	OBJ	OBJ	0.96
macro avg	0.87	0.87	0.87
weighted avg	0.96	0.96	0.96



1. **DEV**

	precision	recall	f1-score
ADJ	0.96	0.86	0.91
ADP	0.94	0.99	0.96
ADV	0.76	0.76	0.76
AUX	0.98	0.94	0.96
CCONJ	1	0.99	1
DET	0.92	0.92	0.92
INTJ	0.97	1	0.99
NOUN	0.98	0.98	0.98
NUM	0.98	0.9	0.94
PART	0.88	0.89	0.88
PRON	0.91	0.9	0.9
PROPN	0.97	1	0.98

SYM	0	0	0
VERB	0.96	0.87	0.92
accuracy	OBJ	OBJ	0.95
macro avg	0.87	0.86	0.86
weighted avg	0.95	0.95	0.95

1. **TEST**

	precision	recall	f1-score
ADJ	0.95	0.91	0.93
ADP	0.95	0.99	0.97
ADV	0.87	0.7	0.77
AUX	0.94	0.94	0.94
CCONJ	1	0.97	0.99
DET	0.89	0.92	0.91
INTJ	0.97	1	0.99
NOUN	0.99	0.98	0.99
NUM	0.96	0.81	0.88
PART	0.96	0.96	0.96
PRON	0.9	0.88	0.89
PROPN	0.97	1	0.98
VERB	0.96	0.86	0.9
accuracy	OBJ	OBJ	0.95
macro avg	0.95	0.92	0.93
weighted avg	0.95	0.95	0.95

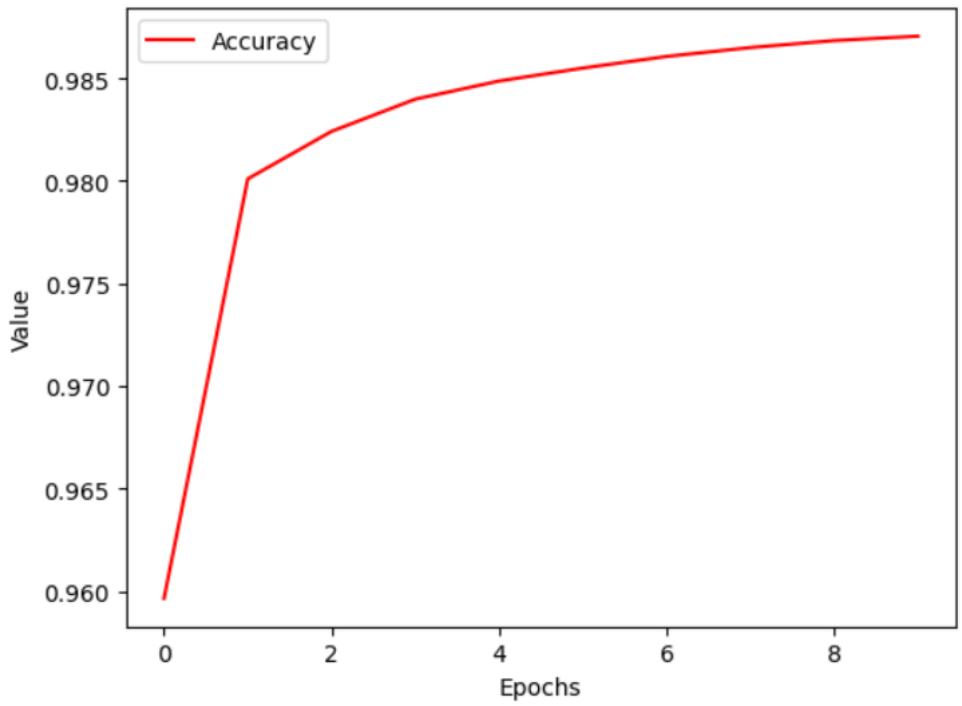
Analysis

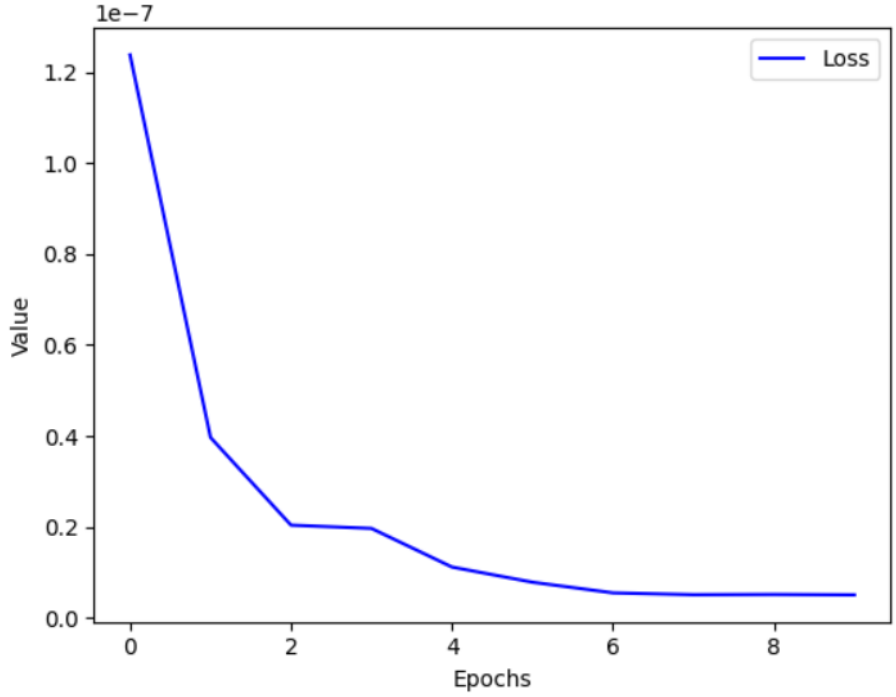
1. Accuracy for train set is 96% whereas for dev and test set is 95% . This suggests that the model has generalized well with high accuracy.

2. F1 score of adverbs is low all through train, dev and test set. This may be due to less data for that class.

model performance with different no of epochs:

```
Epoch 10 Completed,     Loss 2.4353743244276416e-08     Accuracy: 0.9823045313358307
```





ouput tags:

```
Enter the sentence: my name is ajay ray
my      DET

name    NOUN

is      AUX

ajay    PROPN

ray     PROPN
```