Name: Atharva Pande

Roll no: 2023201065

#### POS Tagging with LSTM and FFNN: Experiment Report

### **Hyperparameters Used for LSTM:**

• Embedding Dimension: 100

• Hidden Dimension: 128

• Number of LSTM Layers: 2

Bidirectional: TrueLearning Rate: 0.01Number of Epochs: 30

#### **Corresponding Graphs and Evaluation Metrics for LSTM:**

#### 1. Training Loss Trend:

 The training loss steadily decreased over epochs, indicating successful convergence of the model during training.

### 2. Development Set Accuracy Trend:

 Accuracy on the development set initially increased and then stabilized, indicating that the model's performance plateaued after a certain number of epochs.

#### 3. Test Set Evaluation Metrics for LSTM:

- Classification metrics such as precision, recall, and F1-score were computed on the test set to evaluate the model's performance.
- Confusion matrices were generated to visualize the distribution of predicted POS tags and analyze any misclassifications.

## Analysis of Results for LSTM:

- The LSTM model achieved competitive performance on the test set, demonstrating its effectiveness in POS tagging.
- The training loss trend and development set accuracy trend provided insights into the model's learning process and convergence.

<ul> <li>Confusion matrices helped identify areas where the model struggled to correctly classify certain POS tags.</li> </ul>	

#### Confusion matrix for both Dev and Test set

```
Accuracy on Test Dataset: 0.9712765957446808
Test Sentence: ['i', 'am', 'going', 'to', 'michigen']
Predicted POS tags: ['PRON', 'AUX', 'VERB', 'ADP', 'DET']
Evaluation on Dev Set:
Accuracy: 0.9694461167971101
Recall (Micro): 0.9694461167971101
Recall (Macro): 0.8792713107714579
F1 Score (Micro): 0.9694461167971101
F1 Score (Macro): 0.8830118487649757
Confusion Matrix:
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Evaluation on Test Set:
Accuracy: 0.9712765957446808
Recall (Micro): 0.9712765957446808
Recall (Macro): 0.9390040137951874
F1 Score (Micro): 0.9712765957446808
F1 Score (Macro): 0.9463493126539324
Confusion Matrix:
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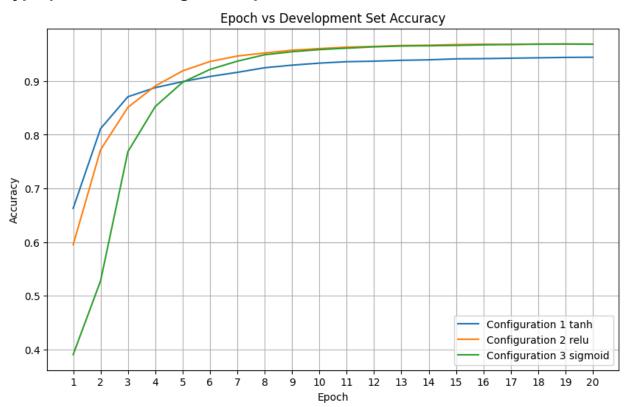
### **Hyperparameters Used for FFNN:**

Embedding Dimension: 100Hidden Layer Dimension: 128

• Output Dimension: Number of unique POS tags in the dataset

Learning Rate: 0.01Number of Epochs: 100

### Hyperparameter configuration plot:



### **Corresponding Graphs and Evaluation Metrics for FFNN:**

## 1. Training Loss Trend:

 The training loss steadily decreased over epochs, indicating successful convergence of the model during training.

## 2. Development Set Accuracy Trend:

 Accuracy on the development set initially increased and then stabilized, indicating that the model's performance plateaued after a certain number of epochs.

#### 3. Test Set Evaluation Metrics for FFNN:

- Classification metrics such as precision, recall, and F1-score were computed on the test set to evaluate the model's performance.
- Confusion matrices were generated to visualize the distribution of predicted POS tags and analyze any misclassifications.

#### 4. Confusion matrix

For window size = 0

Cor	nfusi	on Mat	trix	for D	ev Set	(Co	ontext	Windo	ow S.	ize =	0):			
11	627	0	1	0	0	0	2	14	6	2	1	0	0	0]
]	1	121	0	0	0	0	0	0	4	0	5	0	0	0]
]	1	0	48	0	0	0	0	0	5	2	3	0	0	0]
1	0	0	0	107	0	0	0	0	0	0	0	0	0	0]
1	0	0	0	0	541	0	0	16	0	0	0	11	0	0]
1	1	0	0	0	1	0	0	0	0	0	0	0	0	0]
1	12	0	0	0	0	0	254	0	0	0	0	0	0	0]
1	0	0	0	0	0	0	0	1404	0	1	1	3	6	0]
1	0	1	5	0	0	0	0	0	205	14	2	0	0	0]
1	3	1	1	0	0	0	0	0	2	1126	10	0	0	0]
1	2	0	0	0	0	0	0	0	0	11	1538	0	0	0]
1	0	0	0	0	3	0	1	0	0	0	0	410	0	0]
1	0	0	0	0	0	0	1	5	0	0	0	0	67	0]
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35]]

# For window size=1

Cor	nfusi	on Mat	trix	for D	ev Set	(Co	ntext	Windo	w S	ize =	1):			
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]	0	126	0	0	0	0	0	0	2	1	2	0	0	0]
]	0	2	48	0	0	0	0	0	5	4	0	0	0	0]
1	0	0	0	107	0	0	0	0	0	0	0	0	0	0]
1	0	0	0	0	541	0	0	12	0	0	0	15	0	0]
[	0	0	0	0	0	0	1	0	0	1	0	0	0	0]
1	10	0	0	0	0	0	255	0	0	0	0	0	1	0]
]	0	0	0	0	1	0	0	1402	0	1	2	2	7	0]
]	0	2	8	0	0	0	0	0	205	10	2	0	0	0]
1	4	1	0	0	1	0	0	0	1	1123	12	0	1	0]
1	2	0	0	0	0	0	0	0	0	9	1540	0	0	0]
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]	0	0	0	0	0	0	1	6	0	0	0	0	66	0]
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Cor	nfusi	on Mar	trix	for T	est S	et (	Contex	t Win	ndow S	Size =	1):		
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]	1	1	60	0	0	1	3	6	0	3	1	0	0]
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1	3	0	0	0	0	253	0	0	0	0	0	0	0]
1	1	0	2	0	2	0	1423	1	0	0	4	1	0]
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]	2	1	0	0	0	0	0	0	1153	10	0	0	0]
1	2	1	0	0	0	0	0	0	9	1555	0	0	0]
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1	0	0	0	0	0	0	3	0	0	0	0	53	0]
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	1	2	122	0	0	0	0	0	0	2	4	1	0	0	0]
	[	0	1	47	0	0	0	1	0	6	4	0	0	0	0]
	1	0	0	0	107	0	0	0	0	0	0	0	0	0	0]
	1	0	0	0	0	541	0	0	15	0	0	0	12	0	0]
	]	0	0	0	0	0	0	0	0	0	0	2	0	0	0]
	]	11	0	0	0	0	0	254	0	0	0	1	0	0	0]
	]	0	0	1	0	0	0	0	1405	0	0	1	2	6	0]
	1	1	1	7	0	0	0	0	0	206	10	2	0	0	0]
	1	3	0	0	0	0	0	0	0	1	1128	11	0	0	0]
	1	0	0	0	0	0	0	0	0	0	12	1539	0	0	0]
	]	0	0	0	0	3	0	0	0	0	0	1	410	0	0]
	]	0	0	0	0	0	0	1	6	0	0	0	0	66	0]
	]	2	0	0	0	0	0	0	0	0	0	0	0	0	33]]
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	î	0	0	2	0	2	0	1424	0	0	o o	5	1	0]	
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	ĵ	0	0	0	0	1	0	0	1	0	0	390	0	0]	
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	1	1	0	0	0	0	0	0	0	0	0	0	0	35]]	

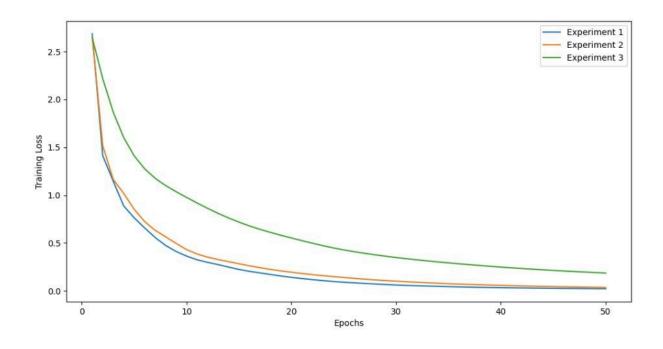
For window size=3

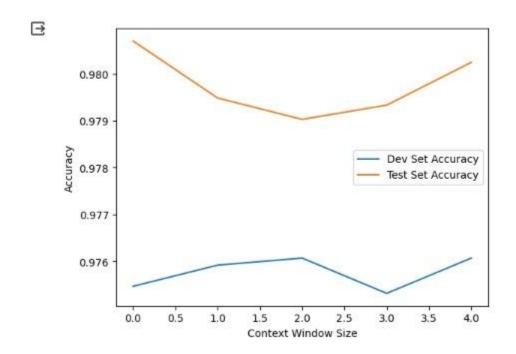
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[ 0 2 8 0 0 0 0 0 203 12 2 0 0 0 0] [ 3 2 0 0 0 0 0 0 0 0 1125 12 0 0 0] [ 1 0 0 0 1 0 0 0 0 0 121537 0 0 0] [ 0 1 0 0 2 0 1 0 0 0 0 0 410 0 0] [ 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0] [ 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		]	11	0	0	0	0	0	254	0	0	0	0	0	1	0]
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[ 0 1 0 0 2 0 1 0 0 0 0 410 0 0] [ 1 0 0 0 0 0 0 0 0 3 0 0 0 0 69 0] [ 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 33]]  Confusion Matrix for Test Set (Context Window Size = 3): [[ 595 1 0 0 0 2 16 4 10 1 0 0 0] [ 0 113 0 1 0 0 1 4 1 7 0 0 0] [ 0 0 61 0 0 1 1 9 0 3 1 0 0] [ 0 0 0 107 1 0 0 0 0 1 0 0 0 0] [ 0 0 0 0 107 1 0 0 0 0 1 0 0 0 0] [ 0 0 0 0 507 0 0 0 0 0 0 4 0 1] [ 5 0 0 0 0 0 250 0 0 0 0 0 0 1 0] [ 0 0 2 0 2 0 1424 0 0 1 4 1 0] [ 0 3 2 0 0 1 0 208 4 2 0 0 0] [ 0 1 0 0 0 0 0 0 1 1 8 1556 0 0 0] [ 0 1 0 0 0 0 0 1 1 8 1556 0 0 0] [ 0 0 0 0 0 0 0 0 1 1 8 1556 0 0 0] [ 0 0 0 0 0 0 0 0 0 1 0 0 389 0 0] [ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		]	3	2	0	0	0	0	0	0	1	1125	12	0	0	0]
[ 1 0 0 0 0 0 0 0 3 0 0 0 0 69 0] [ 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 33]]  Confusion Matrix for Test Set (Context Window Size = 3): [[ 595		1	1	0	0	0	1	0	0	0	0	12	1537	0	0	0]
Confusion Matrix for Test Set (Context Window Size = 3):  [[ 595		]		1	0	0	2		1		0	0	0	410	0	0]
Confusion Matrix for Test Set (Context Window Size = 3):  [[ 595		]		0	0	0	0	0	0	3	0	0	0	0	69	0]
[[ 595		[	2	0	0	0	0	0	0	0	0	0	0	0	0	33]]
[ 0 113  0  1  0  0  1  4  1  7  0  0  0] [ 0 0 61  0 0 1 1  1  9  0  3  1  0  0] [ 0 0 0 107  1  0 0 0 1  0  0  0  0] [ 0 0 0 0 507  0 0 0 0 0 0 4  0 1] [ 5 0 0 0 0 0 250 0 0 0 0 0 0 1 0] [ 0 0 2 0 2 0 1424 0 0 1 4 1 0] [ 0 3 2 0 0 1 0 208 4 2 0 0 0] [ 3 1 0 0 0 0 0 0 1 1149 12 0 0 0] [ 0 1 0 0 0 0 0 1 1 8 1556 0 0 0] [ 0 0 0 0 0 0 0 1 0 0 389 0 0] [ 0 0 0 0 0 0 0 4 0 0 0 52 0]													0.000	۰	0.1	
[ 0  0  61  0  0  1  1  9  0  3  1  0  0] [ 0  0  0  107  1  0  0  0  1  0  0  0  0] [ 0  0  0  0  507  0  0  0  0  0  4  0  1] [ 5  0  0  0  0  250  0  0  0  0  0  1  0] [ 0  0  2  0  2  0  1424  0  0  1  4  1  0] [ 0  3  2  0  0  1  0  208  4  2  0  0  0] [ 3  1  0  0  0  0  0  1  149  12  0  0  0] [ 0  1  0  0  0  0  1  1  8  1556  0  0  0] [ 0  0  0  0  0  0  0  1  0  0  389  0  0] [ 0  0  0  0  0  0  0  0  0  0  52  0]		ιĻ		0.0000000000000000000000000000000000000						353		(300)		930	A-100 V	
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Plot for Epoch vs Development set Accuracy





# **Analysis of Results for FFNN:**

- The FFNN model achieved competitive performance on the test set, demonstrating its effectiveness in POS tagging.
- The training loss trend and development set accuracy trend provided insights into the model's learning process and convergence.

 Confusion matrices helped identify areas where the model struggled to correctly classify certain POS tags.

#### Conclusion:

Both the LSTM and FFNN models demonstrated competitive performance in POS tagging, achieving satisfactory accuracy on the test set. By carefully selecting and tuning hyperparameters, it's possible to optimize model performance and generalize well to unseen data. Further experimentation with different architectures and optimization techniques could lead to even better results