

ASSIGNMENT 3

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Sample

POS Tagging with HMM-Viterbi

Accuracy

```
✓ [129] accu(ptags, test_tags)
0s
Accuracy: 0.9602673784846318
```

POS Tagging with MLP and Word2Vec

Accuracy

```
3395/3395 [=====] - 4s 1ms/step - loss: 0.3663 - acc
Test results - Loss: 0.3663422763347626 - Accuracy: 0.8777501583099365%
```

With the best model

```
2173/2173 [=====] - 11s 5ms/step - loss: 0.1980 - accuracy: 0.9292
3395/3395 [=====] - 4s 1ms/step - loss: 0.2585 - accuracy: 0.9143
Test results - Loss: 0.25848084688186646 - Accuracy: 0.9142962098121643%
```

POS tagging with MLP and Glove

Accuracy

```
Test results - Loss: 0.15828320384025574 - Accuracy: 0.9463039636611938%
```

With the Best Model

```
Epoch 28/30
2173/2173 [=====] - 11s 5ms/step - loss: 0.1341 - accuracy: 0.9498
Epoch 29/30
2173/2173 [=====] - 11s 5ms/step - loss: 0.1336 - accuracy: 0.9493
Epoch 30/30
2173/2173 [=====] - 11s 5ms/step - loss: 0.1330 - accuracy: 0.9497
3395/3395 [=====] - 5s 1ms/step - loss: 0.3068 - accuracy: 0.9452
Test results - Loss: 0.3068057894706726 - Accuracy: 0.9451808929443359%
```

We can see that Glove outperforms Word2Vec

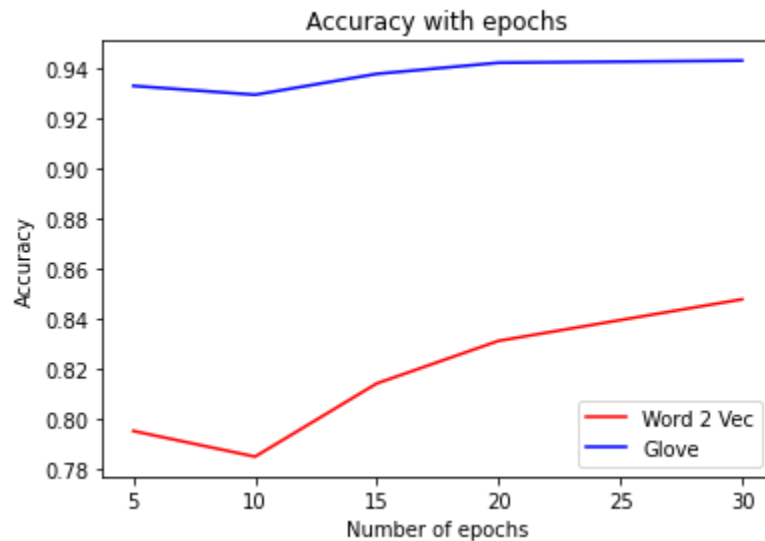
Making the models for MLP.

Comparison

Based on the Number of Epochs

Epochs taken = [5, 10, 15, 20, 30]

Graph of Accuracy of the test set.



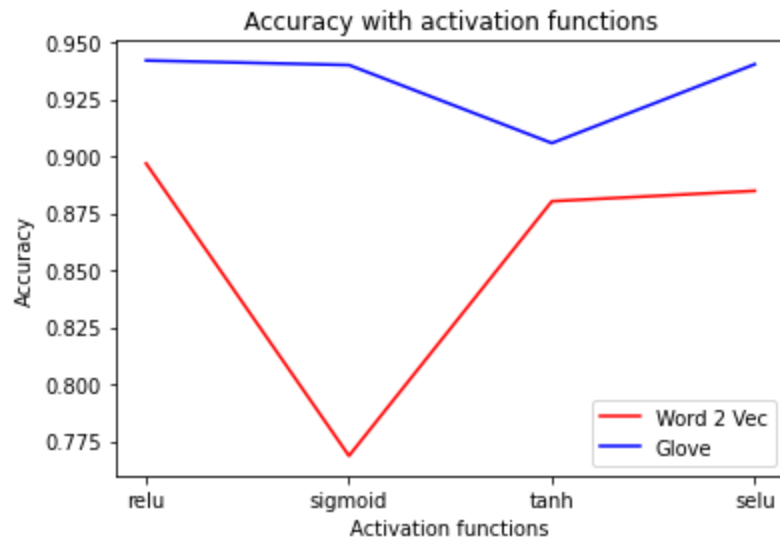
Final = 30

But the next implementation uses 15 to save time.

Based on the Activation Functions

Activation Functions Chosen = ["relu", "sigmoid", "tanh", "selu"]

Graph of Accuracy of the test set.

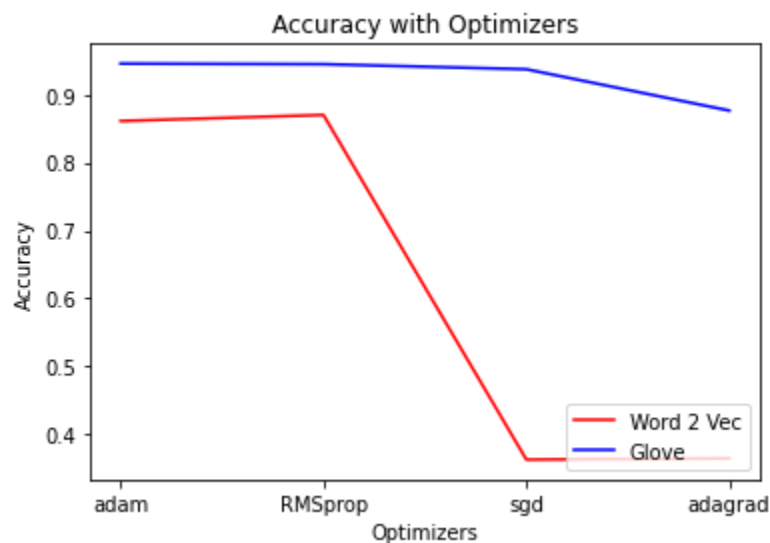


Best: Relu or Selu

Based on the Optimizers

Activation Functions Chosen = ["adam", "RMSprop", "sgd", "adagrad"]

Graph of Accuracy of the test set.

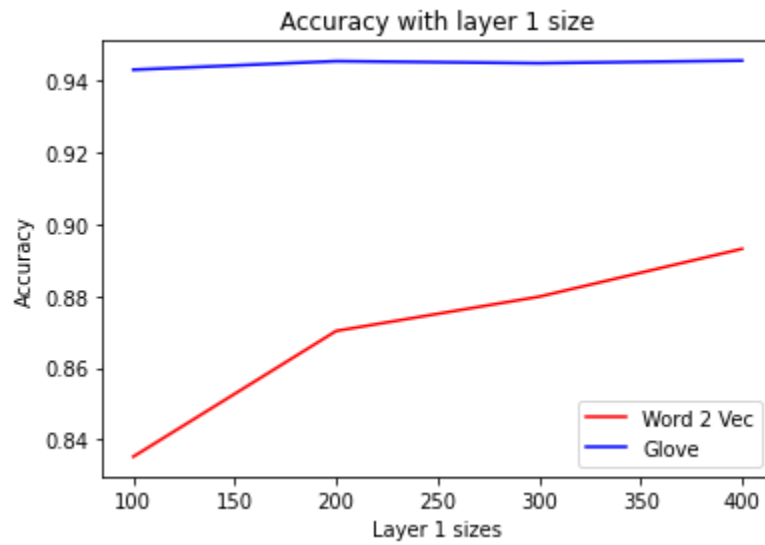


Best: RMSProp

Based on the Length of Hidden Layer 1

Lengths Chosen = [100, 200, 300, 400]

Graph of Accuracy of the test set.



Based on the Label Encoding or Not

Activation Functions Chosen = ["sparse cross entropy", "cross entropy"]

Accuracies

Embeddings	Categorical Cross-Entropy	Sparse Cross-Entropy
Word2Vec	0.877	0.8715
Glove	0.9463	0.9456

Experiment 2

The word types most incorrectly predicted are:

MLP:

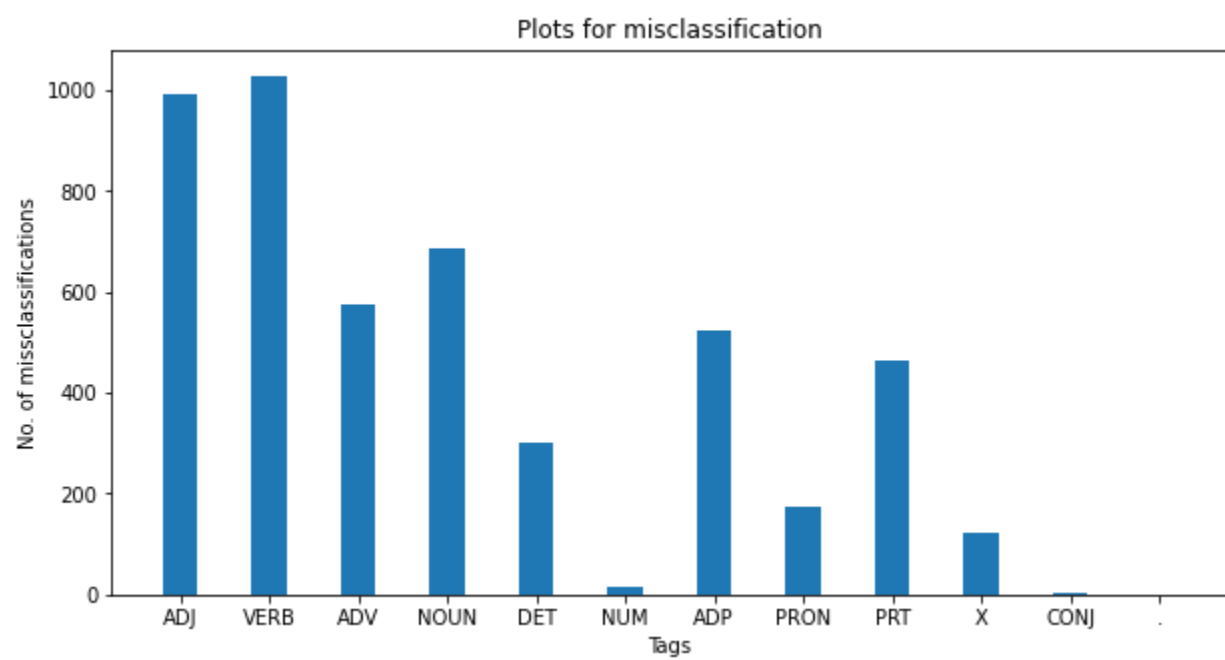
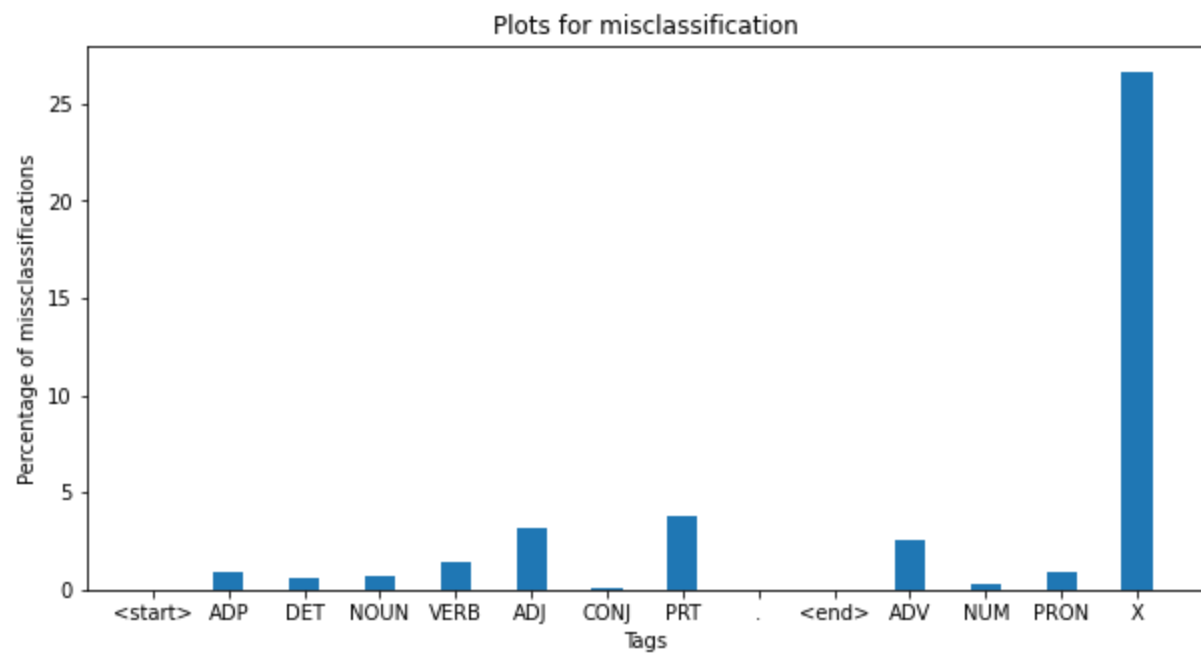
Adverbs and adjectives are misclassified the most. As can be seen from the confusion matrices, that many adverbs are being classified as adpositions and adjectives. This is caused due to the ambiguity of adverbs. Words like “rough” can be both adjectives and adverbs. The same is true for adpositions. Due to using word embeddings that are independent of context, it is possible to misclassify the terms. The same can be seen in the case of Adjectives.

But the words in X are being misclassified the most. This is because all other classes of POS tags are being included in X. Hence words in X can be classified as one of the Nouns, Verbs, Adverbs as well.

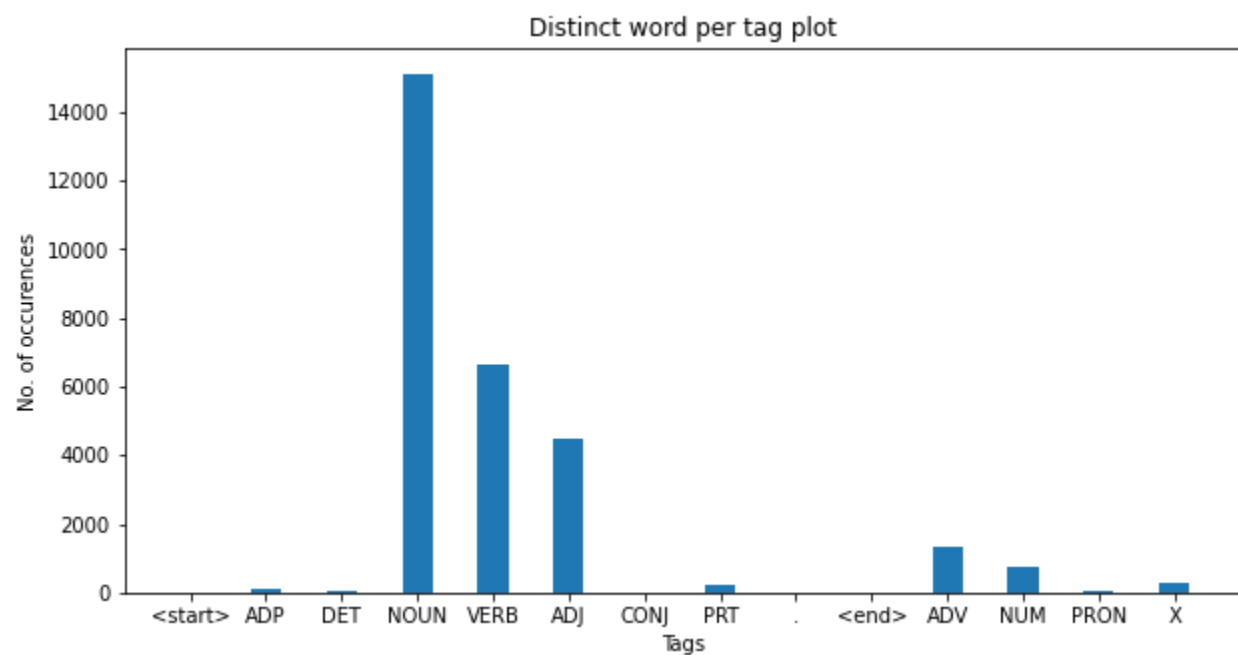
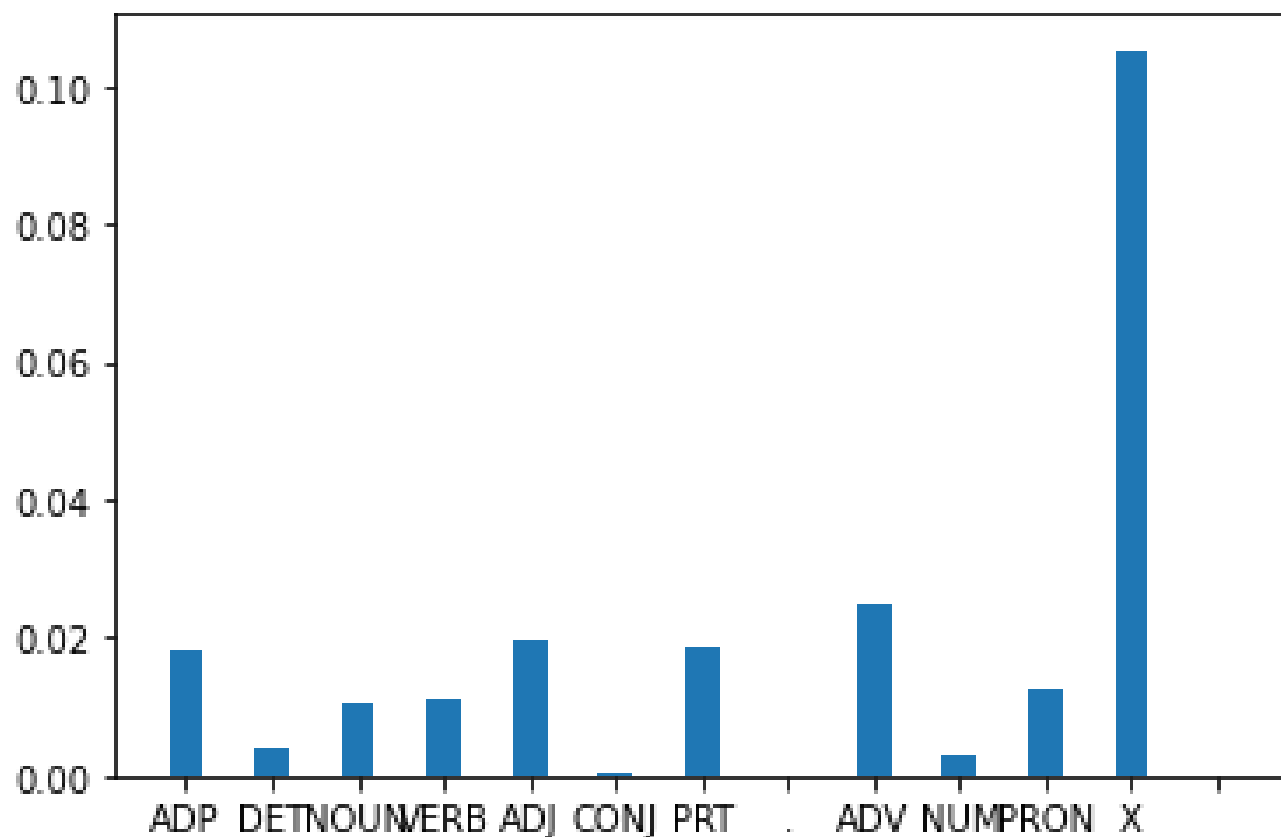
HMM:

Adjectives and prt are being misclassified the most. As can be seen from the confusion matrices, about 10% of adjectives were classified as nouns. This is caused by ambiguity. Sentences like ‘A tennis ball...’ exist in the corpus. The word tennis has been classified as a noun. So we believe sentences like, “She’s playing tennis” must also be existing and the tag given most frequently to tennis is NOUN. Words like “to” are in PRT. “To” can be a preposition or adverb as well.

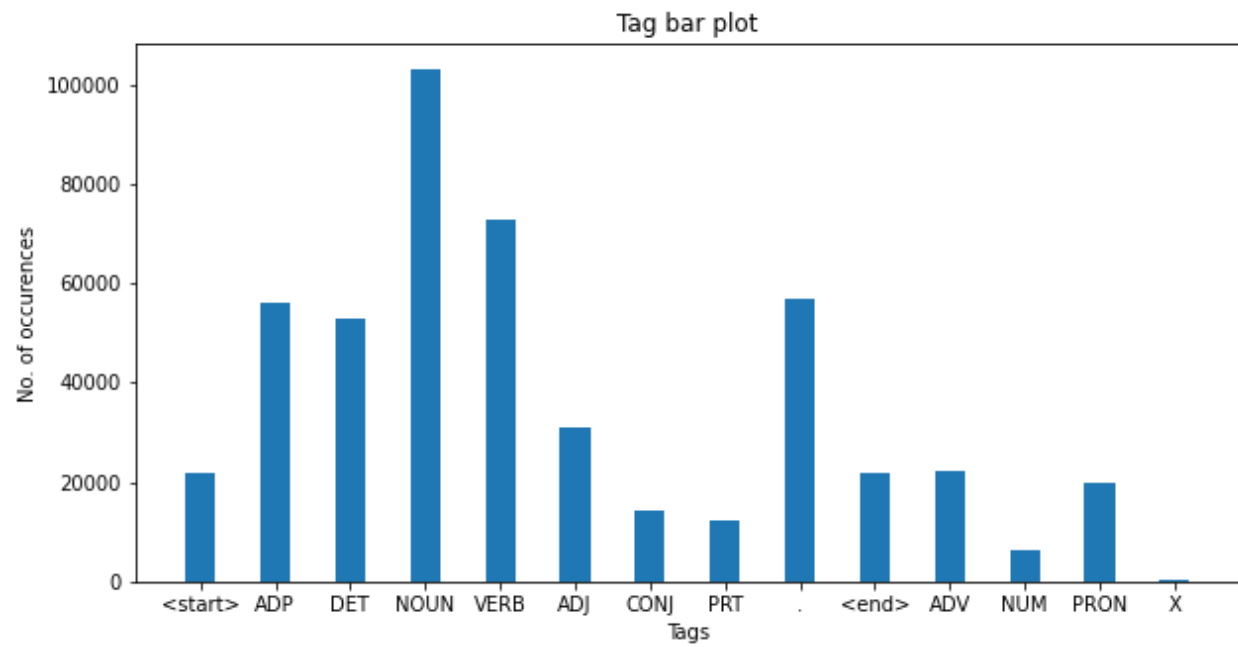
But the words in X are being misclassified the most. This is because all other classes of POS tags are being included in X. Hence words in X can be classified as one of Nouns, Verbs, Adverbs as well.



(MLP with Glove)



Experiment 2.



Experiment 1

3 Cross-Validation for each model.

Table.

	MLP + Word2Vec	MLP + Glove	HMM and Viterbi
Precision	86.33, 89.14, 89.33	94.50, 94.27, 94.38	95.92, 95.94, 96.03
Recall	84.47, 85.58, 88.14	94.46, 94.07, 94.35	95.86, 95.89, 95.98
F1- Score	84.58, 86.20, 88.28	94.39, 94.03, 94.29	95.84, 95.87, 95.95

Statistics of tag set

There are total 29017 words in the vocab

There are total 12 tags in the vocab

The average length of sentences is 19.76

The minimum length of sentences is 0

The maximum length of sentences is 386

There aren't any words with more than 1 tag

HMM with Viterbi

Tag-wise confusion matrices

<start>	PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	<end>
10997	0	0	0	0	0	0	0	0	0	0	0	0	0
0	10695	0	257	91	0	8	0	1	0	0	0	0	0
0	1	33423	39	2	78	2351	2	28	1	3	8	1	0
0	32	23	25278	128	15	16	7	372	23	0	310	0	0
0	230	0	114	24830	0	7	0	38	6	0	0	1	0
0	2	77	13	6	12374	1549	3	468	0	2	59	0	0
0	23	531	6	55	423	46758	14	44	2	11	20	82	0
0	0	0	0	0	0	0	28579	0	0	5	0	0	0
0	2	7	310	36	358	316	1	9889	13	1	200	0	0
0	0	0	5	16	0	0	0	19	7104	0	0	0	0
0	2	2	3	3	2	166	7	0	0	62	0	0	0
0	9	3	481	2	5	97	0	60	0	1	5577	0	0
0	1	0	0	1	2	234	0	1	0	0	1	2333	0
0	0	0	0	0	0	0	0	0	0	0	0	0	10997

<start>	PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	<end>
8247	0	0	0	0	0	0	0	0	0	0	0	0	0
0	7875	0	181	66	0	3	0	2	0	0	2	0	0
0	3	25252	32	1	50	1647	0	19	0	5	8	0	0
0	30	14	19057	103	17	14	10	303	19	0	296	0	0
0	200	0	75	18729	0	4	0	27	3	0	0	1	0
0	0	53	7	5	9430	1076	4	332	0	1	26	0	0
0	13	392	5	27	332	35216	7	44	2	7	21	52	0
0	0	0	0	0	0	2	21300	0	0	2	0	0	0
0	1	3	222	18	289	230	1	7274	8	0	140	0	0
0	0	0	2	13	0	0	0	19	5255	0	0	0	0
0	1	0	4	0	2	101	8	0	0	53	0	1	0
0	3	1	370	0	1	59	1	52	0	0	4233	0	0
0	1	0	2	3	2	186	1	3	0	0	0	1833	0
0	0	0	0	0	0	0	0	0	0	0	0	0	8247

<start>	PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	<end>
8248	0	0	0	0	0	0	0	0	0	0	0	0	0
0	7802	0	180	61	0	4	0	1	0	0	0	0	0
0	3	25079	40	2	65	1592	2	26	0	1	2	0	0
0	34	17	19024	110	12	14	2	305	21	5	250	0	0
0	173	0	55	18639	0	2	0	26	4	0	0	0	0
0	3	59	8	2	9501	1060	0	313	0	1	30	2	0
0	13	420	11	36	265	35802	5	39	1	17	15	59	0
0	0	0	0	0	0	0	21665	0	0	2	0	0	0
0	4	3	238	24	292	205	0	7449	11	0	138	0	0
0	0	0	3	9	0	1	0	16	5317	0	0	0	0
0	0	3	2	0	2	113	6	0	0	47	0	0	0
0	4	11	329	2	6	79	1	68	0	2	4165	0	0
0	0	0	2	0	0	194	1	0	0	1	1	1861	0
0	0	0	0	0	0	0	0	0	0	0	0	0	8248

For Fold 1:

Precision of tag PRON is:

0.97

Precision of tag VERB is:

0.93
Precision of tag ADP is:
0.96
Precision of tag DET is:
0.98
Precision of tag ADJ is:
0.85
Precision of tag NOUN is:
0.97
Precision of tag . is:
1.0
Precision of tag ADV is:
0.89
Precision of tag CONJ is:
0.99
Precision of tag X is:
0.25
Precision of tag PRT is:
0.89
Precision of tag NUM is:
0.91
Precision of tag <end> is:
1.0
Recall of tag <start> is:
1.0
Recall of tag PRON is:
0.97
Recall of tag VERB is:
0.93
Recall of tag ADP is:
0.96
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.85
Recall of tag NOUN is:
0.97
Recall of tag . is:
1.0
Recall of tag ADV is:
0.89
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.25
Recall of tag PRT is:
0.89

Recall of tag NUM is:
0.91
Recall of tag <end> is:
1.0
F1 score of tag <start> is:
1.0
F1 score of tag PRON is:
0.97
F1 score of tag VERB is:
0.93
F1 score of tag ADP is:
0.96
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.85
F1 score of tag NOUN is:
0.97
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.89
F1 score of tag CONJ is:
0.99
F1 score of tag X is:
0.25
F1 score of tag PRT is:
0.89
F1 score of tag NUM is:
0.91
F1 score of tag <end> is:
1.0

For Fold 2:

Precision of tag <start> is:
1.0
Precision of tag PRON is:
0.97
Precision of tag VERB is:
0.93
Precision of tag ADP is:
0.96
Precision of tag DET is:
0.98
Precision of tag ADJ is:
0.86
Precision of tag NOUN is:

0.98
Precision of tag . is:
1.0
Precision of tag ADV is:
0.89
Precision of tag CONJ is:
0.99
Precision of tag X is:
0.31
Precision of tag PRT is:
0.9
Precision of tag NUM is:
0.9
Precision of tag <end> is:
1.0
Recall of tag <start> is:
1.0
Recall of tag PRON is:
0.97
Recall of tag VERB is:
0.93
Recall of tag ADP is:
0.96
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.86
Recall of tag NOUN is:
0.98
Recall of tag . is:
1.0
Recall of tag ADV is:
0.89
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.31
Recall of tag PRT is:
0.9
Recall of tag NUM is:
0.9
Recall of tag <end> is:
1.0
F1 score of tag <start> is:
1.0
F1 score of tag PRON is:
0.97

F1 score of tag VERB is:
0.93
F1 score of tag ADP is:
0.96
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.8599999999999999
F1 score of tag NOUN is:
0.98
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.89
F1 score of tag CONJ is:
0.99
F1 score of tag X is:
0.31
F1 score of tag PRT is:
0.9
F1 score of tag NUM is:
0.9
F1 score of tag <end> is:
1.0

For fold 3:

Precision of tag <start> is:
1.0
Precision of tag PRON is:
0.97
Precision of tag VERB is:
0.94
Precision of tag ADP is:
0.96
Precision of tag DET is:
0.99
Precision of tag ADJ is:
0.87
Precision of tag NOUN is:
0.98
Precision of tag . is:
1.0
Precision of tag ADV is:
0.89
Precision of tag CONJ is:
0.99
Precision of tag X is:

0.27
Precision of tag PRT is:
0.89
Precision of tag NUM is:
0.9
Precision of tag <end> is:
1.0
Recall of tag <start> is:
1.0
Recall of tag PRON is:
0.97
Recall of tag VERB is:
0.94
Recall of tag ADP is:
0.96
Recall of tag DET is:
0.99
Recall of tag ADJ is:
0.87
Recall of tag NOUN is:
0.98
Recall of tag . is:
1.0
Recall of tag ADV is:
0.89
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.27
Recall of tag PRT is:
0.89
Recall of tag NUM is:
0.9
Recall of tag <end> is:
1.0
F1 score of tag <start> is:
1.0
F1 score of tag PRON is:
0.97
F1 score of tag VERB is:
0.94
F1 score of tag ADP is:
0.96
F1 score of tag DET is:
0.99
F1 score of tag ADJ is:
0.87

F1 score of tag NOUN is:
0.98
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.89
F1 score of tag CONJ is:
0.99
F1 score of tag X is:
0.27
F1 score of tag PRT is:
0.89
F1 score of tag NUM is:
0.9
F1 score of tag <end> is:
1.0

Tag Wise Precision, Recall, and F1 Score For MLP with Glove

For Fold 1

Confusion Matrix

	PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	
PRON	8522	0	238	318	0	8	0	0	0	0	3	0	0
VERB	0	28272	45	0	151	1416	0	45	0	3	12	0	0
ADP	0	16	19613	1	30	10	3	206	22	2	1908	0	0
DET	2	0	394	20589	0	3	0	0	19	0	1	1	0
ADJ	0	106	24	0	10965	596	4	323	0	11	8	5	0
NOUN	3	857	23	28	744	38252	1	67	0	40	120	169	0
.	0	0	0	0	0	0	24105	0	0	0	0	0	0
ADV	0	33	451	62	633	68	0	7762	15	0	174	0	0
CONJ	0	0	0	8	0	1	0	8	5895	1	0	0	0
X	0	3	4	0	4	94	8	0	0	71	1	2	0
PRT	7	7	279	1	44	40	0	57	0	0	4780	0	0
NUM	0	4	0	0	4	29	0	1	1	0	0	2194	0
	0	0	0	0	0	0	0	0	0	0	0	0	0

The tag wise precision, recall and F1 Score

The precision score is

Precision of tag PRON is:

0.94

Precision of tag VERB is:

0.94

Precision of tag ADP is:

0.9

Precision of tag DET is:

0.98

Precision of tag ADJ is:

0.91

Precision of tag NOUN is:

0.95

Precision of tag . is:

1.0

Precision of tag ADV is:

0.84

Precision of tag CONJ is:

1.0

Precision of tag X is:

0.38

Precision of tag PRT is:

0.92

Precision of tag NUM is:

0.98

Precision of tag is:

0
The recall score is
Recall of tag PRON is:
0.94
Recall of tag VERB is:
0.94
Recall of tag ADP is:
0.9
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.91
Recall of tag NOUN is:
0.95
Recall of tag . is:
1.0
Recall of tag ADV is:
0.84
Recall of tag CONJ is:
1.0
Recall of tag X is:
0.38
Recall of tag PRT is:
0.92
Recall of tag NUM is:
0.98
Recall of tag is:
0
The F1-score is
F1 score of tag PRON is:
0.94
F1 score of tag VERB is:
0.94
F1 score of tag ADP is:
0.9
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.91
F1 score of tag NOUN is:
0.9500000000000001
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.8399999999999999
F1 score of tag CONJ is:
1.0

F1 score of tag X is:

0.38

F1 score of tag PRT is:

0.92

F1 score of tag NUM is:

0.98

F1 score of tag is:

0

Total precision recall and F1 score is

(0.9450715177259689, 0.9446009389671362, 0.9439520272912658, None)

For Fold 2

PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	
8547	0	0	510	0	1	0	2	0	0	4	0	0
0	28306	46	0	157	1381	0	60	0	5	12	2	0
0	8	18699	939	27	22	8	378	21	0	1928	0	0
2	0	1	20943	0	2	0	0	10	0	0	0	0
0	90	25	0	10740	815	0	542	0	8	14	9	0
6	889	24	30	586	38255	1	98	0	51	38	157	0
0	0	0	0	0	0	23863	0	0	0	0	0	0
0	13	367	143	329	65	0	8104	7	1	294	1	0
0	0	0	23	0	0	0	13	5933	0	0	0	0
0	2	3	2	3	102	8	1	0	78	1	0	0
0	7	270	1	66	58	0	9	0	0	4662	0	0
0	1	0	0	3	32	0	0	0	1	0	2185	0
0	0	0	0	0	0	0	0	0	0	0	0	0

The precision score is

Precision of tag PRON is:

0.94

Precision of tag VERB is:

0.94

Precision of tag ADP is:

0.85

Precision of tag DET is:

1.0

Precision of tag ADJ is:

0.88

Precision of tag NOUN is:

0.95

Precision of tag . is:

1.0

Precision of tag ADV is:

0.87

Precision of tag CONJ is:

0.99
Precision of tag X is:
0.39
Precision of tag PRT is:
0.92
Precision of tag NUM is:
0.98
Precision of tag is:
0
The recall score is
Recall of tag PRON is:
0.94
Recall of tag VERB is:
0.94
Recall of tag ADP is:
0.85
Recall of tag DET is:
1.0
Recall of tag ADJ is:
0.88
Recall of tag NOUN is:
0.95
Recall of tag . is:
1.0
Recall of tag ADV is:
0.87
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.39
Recall of tag PRT is:
0.92
Recall of tag NUM is:
0.98
Recall of tag is:
0
The F1-score is
F1 score of tag PRON is:
0.94
F1 score of tag VERB is:
0.94
F1 score of tag ADP is:
0.85
F1 score of tag DET is:
1.0
F1 score of tag ADJ is:
0.88

F1 score of tag NOUN is:

0.9500000000000001

F1 score of tag . is:

1.0

F1 score of tag ADV is:

0.87

F1 score of tag CONJ is:

0.99

F1 score of tag X is:

0.39

F1 score of tag PRT is:

0.92

F1 score of tag NUM is:

0.98

F1 score of tag is:

0

Total precision recall and F1 score is

(0.9427183855434818, 0.9407069870201602, 0.9403154240569194, None)

For Fold 3

	PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	
	8566	0	228	275	0	3	0	2	0	0	2	0	0
1	28375	42	0	181	1207	0	42	0	3	2	0	0	
0	7	19980	0	8	12	9	111	25	0	1868	0	0	
1	0	427	20748	0	5	0	1	14	0	0	1	0	
0	120	48	0	11110	501	2	385	0	6	3	6	0	
15	1131	38	25	1044	37790	1	65	1	47	16	158	0	
0	0	0	0	0	2	23585	0	0	0	0	0	0	
0	34	522	69	549	68	0	7731	12	1	174	1	0	
0	0	8	5	0	0	0	11	5873	0	0	0	0	
0	2	5	0	5	115	8	0	0	65	0	3	0	
2	9	317	0	70	52	0	42	0	1	4841	0	0	
0	3	0	0	8	38	0	3	0	0	0	2157	0	
0	0	0	0	0	1	0	0	0	0	0	0	0	

The precision score is

The precision score is

Precision of tag PRON is:

0.94

Precision of tag VERB is:

0.95

Precision of tag ADP is:

0.91

Precision of tag DET is:

0.98

Precision of tag ADJ is:

0.91

Precision of tag NOUN is:
0.94
Precision of tag . is:
1.0
Precision of tag ADV is:
0.84
Precision of tag CONJ is:
1.0
Precision of tag X is:
0.32
Precision of tag PRT is:
0.91
Precision of tag NUM is:
0.98
Precision of tag is:
0.0
The recall score is
Recall of tag PRON is:
0.94
Recall of tag VERB is:
0.95
Recall of tag ADP is:
0.91
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.91
Recall of tag NOUN is:
0.94
Recall of tag . is:
1.0
Recall of tag ADV is:
0.84
Recall of tag CONJ is:
1.0
Recall of tag X is:
0.32
Recall of tag PRT is:
0.91
Recall of tag NUM is:
0.98
Recall of tag is:
0.0
The F1-score is
F1 score of tag PRON is:
0.94
F1 score of tag VERB is:

0.9500000000000001
F1 score of tag ADP is:
0.91
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.91
F1 score of tag NOUN is:
0.94
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.8399999999999999
F1 score of tag CONJ is:
1.0
F1 score of tag X is:
0.32
F1 score of tag PRT is:
0.91
F1 score of tag NUM is:
0.98
F1 score of tag is:
0
Total precision-recall and F1 score is
(0.943868210881703, 0.9435017950842308, 0.942955860760185, None)

For MLP with Word2Vec

For Fold 1


```

for Fold Number 1
{'PRON': 0, 'VERB': 1, 'ADP': 2, 'DET': 3, 'ADJ': 4, 'NOUN': 5, '.': 6, 'ADV': 7, 'CONJ': 8,
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| PRON | VERB | ADP | DET | ADJ | NOUN | . | ADV | CONJ | X | PRT | NUM |  |  |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 8504 | 0 | 232 | 312 | 1 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 21036 | 86 | 0 | 317 | 8373 | 0 | 142 | 3 | 0 | 27 | 0 | 0 | 0 |
| 0 | 14 | 21604 | 0 | 29 | 129 | 8 | 112 | 17 | 0 | 188 | 0 | 0 | 0 |
| 3 | 0 | 390 | 20616 | 0 | 8 | 0 | 0 | 14 | 0 | 0 | 2 | 0 | 0 |
| 10 | 378 | 59 | 7 | 5544 | 5415 | 2 | 530 | 1 | 0 | 166 | 0 | 0 | 0 |
| 18 | 1069 | 92 | 31 | 519 | 37949 | 2 | 230 | 4 | 0 | 41 | 112 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 23799 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 101 | 545 | 72 | 523 | 1626 | 0 | 6135 | 14 | 0 | 189 | 2 | 0 | 0 |
| 0 | 0 | 1 | 3 | 0 | 5 | 0 | 12 | 5919 | 0 | 0 | 0 | 0 | 0 |
| 1 | 6 | 3 | 0 | 6 | 188 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 12 | 2572 | 2 | 31 | 186 | 0 | 57 | 0 | 0 | 2384 | 1 | 0 | 0 |
| 3 | 47 | 0 | 0 | 84 | 624 | 0 | 12 | 0 | 0 | 9 | 1463 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
The precision score is

```

```

The precision score is
Precision of tag PRON is:
0.93
Precision of tag VERB is:
0.7
Precision of tag ADP is:
0.98
Precision of tag DET is:
0.98
Precision of tag ADJ is:
0.46
Precision of tag NOUN is:
0.95
Precision of tag . is:
1.0
Precision of tag ADV is:
0.67
Precision of tag CONJ is:
1.0
Precision of tag X is:
0.0
Precision of tag PRT is:
0.45
Precision of tag NUM is:
0.65
Precision of tag  is:
0.0
The recall score is
Recall of tag PRON is:
0.93
Recall of tag VERB is:

```

0.7
Recall of tag ADP is:
0.98
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.46
Recall of tag NOUN is:
0.95
Recall of tag . is:
1.0
Recall of tag ADV is:
0.67
Recall of tag CONJ is:
1.0
Recall of tag X is:
0.0
Recall of tag PRT is:
0.45
Recall of tag NUM is:
0.65
Recall of tag is:
0.0
The F1-score is
F1 score of tag PRON is:
0.93
F1 score of tag VERB is:
0.7
F1 score of tag ADP is:
0.98
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.46
F1 score of tag NOUN is:
0.9500000000000001
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.67
F1 score of tag CONJ is:
1.0
F1 score of tag X is:
0
F1 score of tag PRT is:
0.45
F1 score of tag NUM is:

0.65

F1 score of tag is:

0

Total precision recall and F1 score is

(0.8914547200568967, 0.855857497928749, 0.8620471267785825, None)

For Fold 2

{ PRON : 0, VERB : 1, ADP : 2, DET : 3, ADJ : 4, NOUN : 5, . : 6, ADV : 7, CONJ : 8,													
PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM		
8564	13	217	287	11	13	0	0	0	0	2	0	0	0
3	23142	52	0	325	6271	0	84	0	0	2	10	0	0
0	26	19545	0	59	53	4	272	22	0	1860	0	0	0
0	1	440	20710	1	2	0	0	20	0	0	0	0	0
3	583	30	0	7245	3854	0	434	0	0	3	2	0	0
11	1627	35	35	716	37675	0	139	0	0	14	116	0	0
0	0	0	0	0	0	23762	0	0	0	0	0	0	0
0	250	418	70	588	844	0	6862	11	0	180	17	0	0
0	4	0	7	0	7	0	14	5869	0	0	0	0	0
0	16	6	2	13	136	6	0	0	0	1	1	0	0
0	27	285	0	94	130	0	58	0	0	4624	2	0	0
0	145	1	0	70	397	1	12	0	0	1	1586	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
The precision score is													

The precision score is

Precision of tag PRON is:

0.94

Precision of tag VERB is:

0.77

Precision of tag ADP is:

0.89

Precision of tag DET is:

0.98

Precision of tag ADJ is:

0.6

Precision of tag NOUN is:

0.93

Precision of tag . is:

1.0

Precision of tag ADV is:

0.74

Precision of tag CONJ is:

0.99

Precision of tag X is:

0.0

Precision of tag PRT is:

0.89

Precision of tag NUM is:

0.72
Precision of tag is:
0
The recall score is
Recall of tag PRON is:
0.94
Recall of tag VERB is:
0.77
Recall of tag ADP is:
0.89
Recall of tag DET is:
0.98
Recall of tag ADJ is:
0.6
Recall of tag NOUN is:
0.93
Recall of tag . is:
1.0
Recall of tag ADV is:
0.74
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.0
Recall of tag PRT is:
0.89
Recall of tag NUM is:
0.72
Recall of tag is:
0
The F1-score is
F1 score of tag PRON is:
0.94
F1 score of tag VERB is:
0.7699999999999999
F1 score of tag ADP is:
0.89
F1 score of tag DET is:
0.98
F1 score of tag ADJ is:
0.6
F1 score of tag NOUN is:
0.93
F1 score of tag . is:
1.0
F1 score of tag ADV is:
0.74

F1 score of tag CONJ is:

0.99

F1 score of tag X is:

0

F1 score of tag PRT is:

0.89

F1 score of tag NUM is:

0.72

F1 score of tag is:

0

Total precision recall and F1 score is

(0.8933507153260539, 0.8814360673847004, 0.8828582382572852, None)

For Fold 3

PRON	VERB	ADP	DET	ADJ	NOUN	.	ADV	CONJ	X	PRT	NUM	
8446	33	0	521	3	15	0	0	0	0	0	0	0
8	27110	48	7	331	2295	0	68	0	0	21	0	0
0	97	18566	931	26	37	8	146	19	0	2089	0	0
2	3	0	20932	0	3	0	0	9	0	8	0	0
1	3025	19	0	6672	2026	1	425	0	0	20	11	0
20	9526	35	35	1160	29138	3	204	1	0	86	127	0
0	1	0	0	0	1	23992	0	0	0	0	0	0
0	1148	478	73	633	539	0	6182	10	0	173	0	0
0	9	0	2	0	0	0	7	5907	0	13	0	0
0	93	2	0	14	78	12	1	0	0	0	0	0
0	135	248	0	73	76	0	37	0	0	4587	0	0
0	468	0	0	54	250	0	6	0	0	15	1416	0
0	0	0	0	0	0	0	0	0	0	0	0	0

The precision score is

The precision score is

Precision of tag PRON is:

0.94

Precision of tag VERB is:

0.91

Precision of tag ADP is:

0.85

Precision of tag DET is:

1.0

Precision of tag ADJ is:

0.55

Precision of tag NOUN is:

0.72

Precision of tag . is:

1.0

Precision of tag ADV is:

0.67
Precision of tag CONJ is:
0.99
Precision of tag X is:
0.0
Precision of tag PRT is:
0.89
Precision of tag NUM is:
0.64
Precision of tag is:
0
The recall score is
Recall of tag PRON is:
0.94
Recall of tag VERB is:
0.91
Recall of tag ADP is:
0.85
Recall of tag DET is:
1.0
Recall of tag ADJ is:
0.55
Recall of tag NOUN is:
0.72
Recall of tag . is:
1.0
Recall of tag ADV is:
0.67
Recall of tag CONJ is:
0.99
Recall of tag X is:
0.0
Recall of tag PRT is:
0.89
Recall of tag NUM is:
0.64
Recall of tag is:
0
The F1-score is
F1 score of tag PRON is:
0.94
F1 score of tag VERB is:
0.91
F1 score of tag ADP is:
0.85
F1 score of tag DET is:
1.0

F1 score of tag ADJ is:

0.55

F1 score of tag NOUN is:

0.72

F1 score of tag . is:

1.0

F1 score of tag ADV is:

0.67

F1 score of tag CONJ is:

0.99

F1 score of tag X is:

0

F1 score of tag PRT is:

0.89

F1 score of tag NUM is:

0.64

F1 score of tag is:

0

Total precision recall and F1 score is

(0.8633785997112126, 0.8447832090582712, 0.8455894230840885, None)