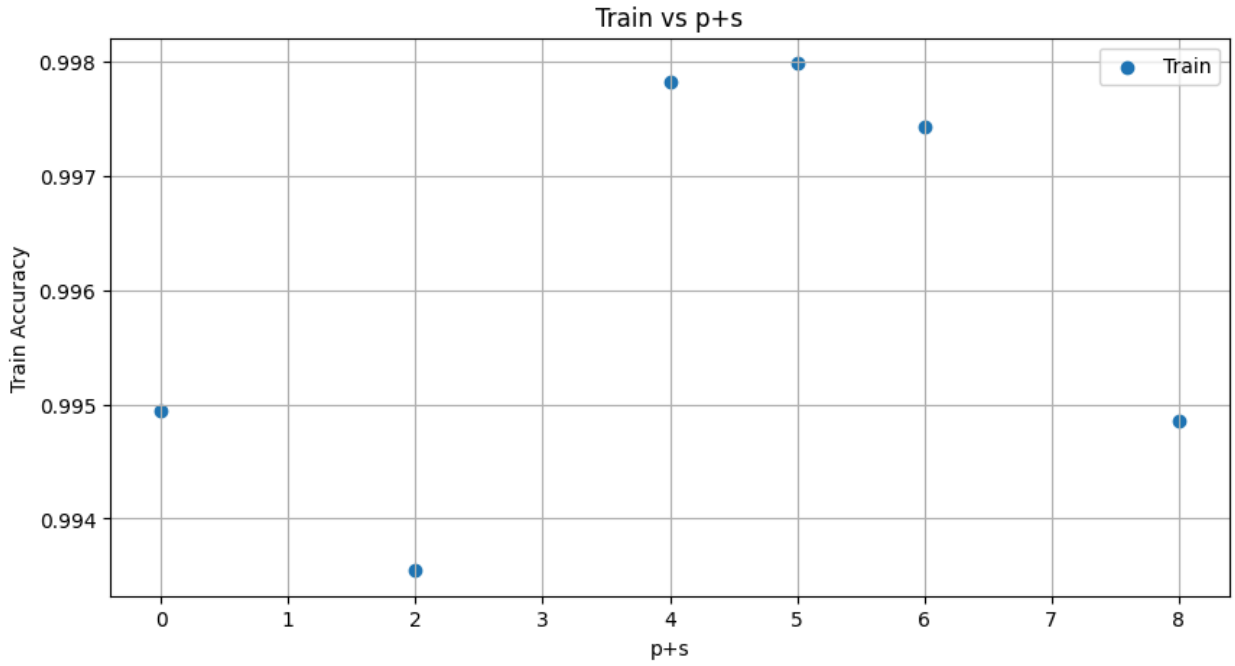
FFNN

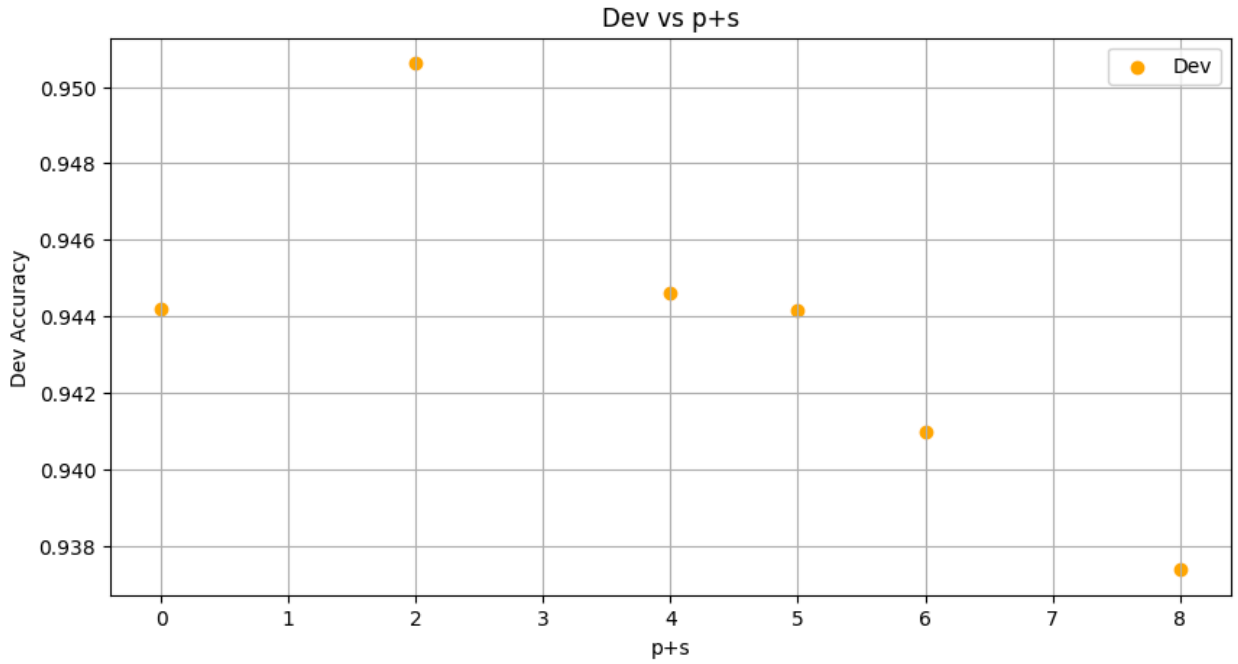
Epochs : 75

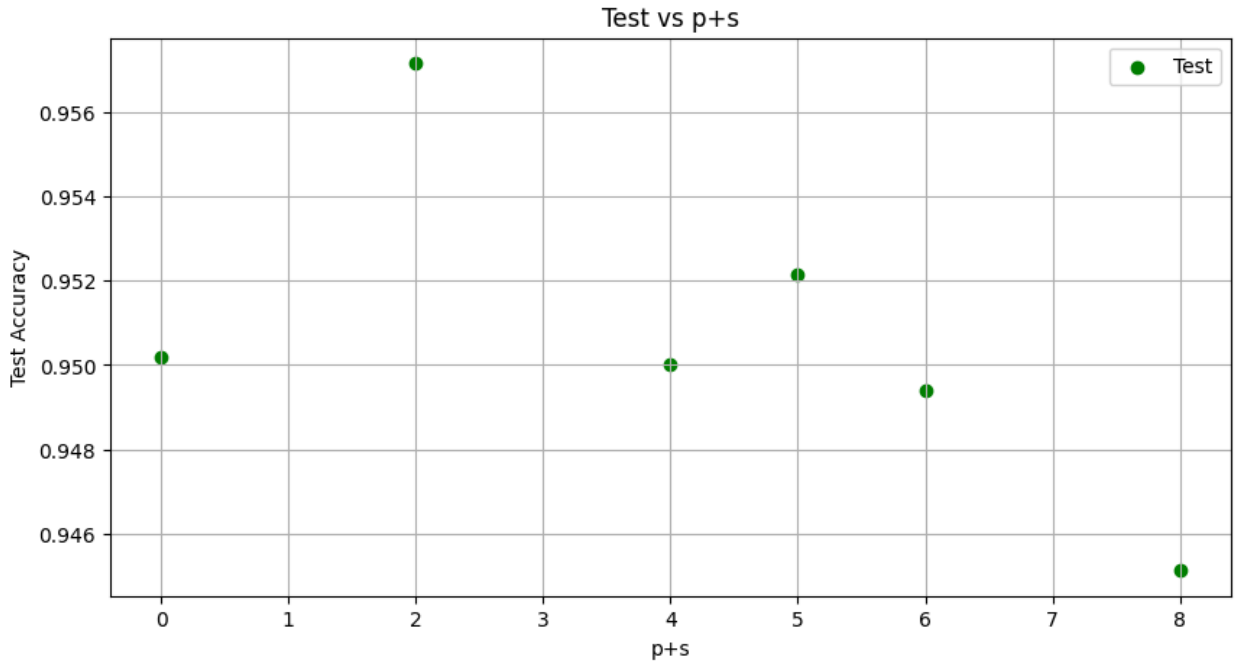
Chosen Model : p = s = 1

{'PART': 0, 'OOV': 1, 'PRON': 2, 'PROPN': 3, 'NUM': 4, 'AUX': 5, 'VERB': 6, 'CCONJ': 7, 'ADJ': 8, 'NOUN': 9, 'ADV': 10, 'INTJ': 11, 'ADP': 12, 'DET': 13}

Index p+s	Train	Dev	Test
0	0.9949439934230809	0.9441990364348087	0.9501975683890578
2	0.9935463981091357	0.9506172839506173	0.9571428571428572
4	0.9978213955400267	0.9445950015055706	0.95
5	0.997985818518138	0.9441433303221921	0.9521276595744681
6	0.9974308909670127	0.9409816320385426	0.9493920972644377
8	0.9948617819340253	0.9373682625715146	0.9451367781155016




Dev vs p+s
Dev
Dev Accuracy
0.950
0.948
0.946
0.944
0.942
0.940
0.938
0
1
2
3
4
5
6
7
8
p+s


Test vs p+s
Test
Test Accuracy
0.956
0.954
0.952
0.950
0.948
0.946
0
1
2
3
4
5
6
7
8
p+s

p=0 s=0

```
Training model...
Epoch 1/75, Loss: 0.8681635394124572
Epoch 2/75, Loss: 0.35202915210193625
Epoch 3/75, Loss: 0.2596902823499092
Epoch 4/75, Loss: 0.20427245551747186
Epoch 5/75, Loss: 0.16957314591487666
Epoch 6/75, Loss: 0.14631193098899725
Epoch 7/75, Loss: 0.1312463967565266
Epoch 8/75, Loss: 0.1203126020260821
Epoch 9/75, Loss: 0.11090921784008262
Epoch 10/75, Loss: 0.10405567658258327
Epoch 11/75, Loss: 0.0965028539062545
Epoch 12/75, Loss: 0.0925034311991344
Epoch 13/75, Loss: 0.08686759843637569
Epoch 14/75, Loss: 0.08153747835024609
Epoch 15/75, Loss: 0.07758819546454748
Epoch 16/75, Loss: 0.07490421935380089
Epoch 17/75, Loss: 0.07130005654339518
Epoch 18/75, Loss: 0.06734352853627916
Epoch 19/75, Loss: 0.06508594227702295
Epoch 20/75, Loss: 0.06297782451222937
Epoch 21/75, Loss: 0.06152307610673245
Epoch 22/75, Loss: 0.056311103722366695
Epoch 23/75, Loss: 0.05814633374795016
Epoch 24/75, Loss: 0.05369755152768187
Epoch 25/75, Loss: 0.05355855770064891
Epoch 26/75, Loss: 0.053604977917400376
Epoch 27/75, Loss: 0.05056259590245443
Epoch 28/75, Loss: 0.051898523207232095
Epoch 29/75, Loss: 0.04586906031170336
Epoch 30/75, Loss: 0.05332299097200227
Epoch 31/75, Loss: 0.042941992431107086
Epoch 32/75, Loss: 0.04688231437844461
Epoch 33/75, Loss: 0.042564824483232296
Epoch 34/75, Loss: 0.042139033942730504
Epoch 35/75, Loss: 0.04402194240849628
Epoch 36/75, Loss: 0.04105270667875729
Epoch 37/75, Loss: 0.04607790806931001
Epoch 38/75, Loss: 0.037554445278483915
Epoch 39/75, Loss: 0.03642117567689612
Epoch 40/75, Loss: 0.040192398745865915
Epoch 41/75, Loss: 0.035657210432148555
Epoch 42/75, Loss: 0.03820701422792562
```

```
Epoch 43/75, Loss: 0.041372663328310494
Epoch 44/75, Loss: 0.0318424846931743
Epoch 45/75, Loss: 0.03427693372870227
Epoch 46/75, Loss: 0.040103445995351
Epoch 47/75, Loss: 0.03020267218690993
Epoch 48/75, Loss: 0.032885601295572525
Epoch 49/75, Loss: 0.029611401603815268
Epoch 50/75, Loss: 0.03190327035162067
Epoch 51/75, Loss: 0.028068236914333012
Epoch 52/75, Loss: 0.03712659505356169
Epoch 53/75, Loss: 0.026550498065685817
Epoch 54/75, Loss: 0.03380538917438229
Epoch 55/75, Loss: 0.025435179396556203
Epoch 56/75, Loss: 0.042681078396663866
Epoch 57/75, Loss: 0.029647464004336852
Epoch 58/75, Loss: 0.030857799802173534
Epoch 59/75, Loss: 0.024247071703986833
Epoch 60/75, Loss: 0.033147514913023646
Epoch 61/75, Loss: 0.02347862614205847
Epoch 62/75, Loss: 0.023366906724897305
Epoch 63/75, Loss: 0.026049193323242445
Epoch 64/75, Loss: 0.023133217696116905
Epoch 65/75, Loss: 0.03149266785512778
Epoch 66/75, Loss: 0.027065620794480966
Epoch 67/75, Loss: 0.023667975118439648
Epoch 68/75, Loss: 0.022158168461175135
Epoch 69/75, Loss: 0.025709881600115978
Epoch 70/75, Loss: 0.02000249942470628
Epoch 71/75, Loss: 0.02035523636468881
Epoch 72/75, Loss: 0.02955523210419542
Epoch 73/75, Loss: 0.019444085144663947
Epoch 74/75, Loss: 0.019488982673491546
Epoch 75/75, Loss: 0.028258233310696733
Saving model...

Loading model...
Metrics of train set:
sk_accuracy_train=0.9949439934230809
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       1.00      0.98      0.99      1577
         ADP       1.00      1.00      1.00     11098
         ADV       0.93      0.95      0.94       371
         AUX       1.00      0.99      1.00      1573
```

CCONJ	1.00	1.00	1.00	742
DET	1.00	1.00	1.00	4511
INTJ	1.00	0.99	0.99	335
NOUN	0.99	0.99	0.99	8786
NUM	0.89	0.96	0.93	785
PRON	1.00	1.00	1.00	2435
PROPN	1.00	1.00	1.00	11403
VERB	1.00	0.99	0.99	5039
accuracy			**0.99**	**48655**
macro avg	**0.98**	**0.99**	**0.99**	**48655**
weighted avg	**1.00**	**0.99**	**0.99**	**48655**

recall_micro_train=0.9949439934230809
recall_macro_train=0.9876571029441347
f1_micro_train=0.9949439934230809
f1_macro_train=0.985654847374831

```
confusion_mat_train =
[[ 1549     0     1     0     0     0     0     5     8     0    10
4]
 [    0 11091     2     0     0     0     0     0     2     0     1
2]
 [    0     0   351     0     0     0     0     2    11     0     2
5]
 [    0     0     5  1565     0     0     0     2     1     0     0
0]
 [    0     0     0     0   742     0     0     0     0     0     0
0]
 [    0     0     0     0     0  4510     0     1     0     0     0
0]
 [    0     0     0     0     0     0   331     0     1     0     0
3]
 [    1     0     3     0     0     0     0  8741    23     0    12
6]
 [    0     0     2     0     0     0     0    14   757     0     8
4]
 [    0     0     0     0     0     0     0     5     0  2428     2
0]
 [    1     1     4     0     0     0     0     9    25     0 11362
1]
 [    0     0     9     0     0     0     0    21    20     0     7
4982]]
```

Metrics of dev set:
sk_accuracy_dev=0.9441990364348087

```
classification_rep_dev =
              precision    recall  f1-score   support

         ADJ       1.00      0.94      0.97       223
         ADP       0.97      1.00      0.99      1456
         ADV       0.85      0.92      0.89        51
         AUX       0.98      0.77      0.86       296
       CCONJ       1.00      0.99      1.00       107
         DET       1.00      0.94      0.97       697
        INTJ       1.00      1.00      1.00        35
        NOUN       0.93      0.96      0.94      1130
         NUM       0.89      0.82      0.86       131
        PRON       0.95      1.00      0.98       314
       PROPN       0.98      0.96      0.97      1565
        VERB       0.89      0.99      0.94       637

    accuracy                           0.96      6642
   macro avg       0.95      0.94      0.95      6642
weighted avg       0.96      0.96      0.96      6642

recall_micro_dev=0.9591990364348087
recall_macro_dev=0.9405929340283952
f1_micro_dev=0.9591990364348087
f1_macro_dev=0.9458223402421592
confusion_mat_dev =
[[ 209    0    6    0    0    0    0    4    1    0    3    0]
 [   0 1455    0    0    0    0    0    1    0    0    0    0]
 [   0    0   47    0    0    0    0    1    1    0    1    1]
 [   0    0    0  228    0    0    0   17    0    0    0   51]
 [   0    0    0    0  106    1    0    0    0    0    0    0]
 [   0   42    0    0    0  654    0    1    0    0    0    0]
 [   0    0    0    0    0    0   35    0    0    0    0    0]
 [   1    0    0    4    0    0    0 1086    3    0   17   19]
 [   0    0    1    0    0    0    0    0  108   15    5    2]
 [   0    0    0    0    0    0    0    0    0  313    1    0]
 [   0    0    1    0    0    0    0   57    6    0 1500    1]
 [   0    0    0    0    0    0    0    2    2    0    3  630]]

Metrics of test set:
sk_accuracy_test=0.9501975683890578
classification_rep_test =
              precision    recall  f1-score   support

         ADJ       0.90      0.94      0.92       218
         ADP       1.00      1.00      1.00      1491
```

ADV	0.86	0.64	0.74	76
AUX	0.97	0.91	0.94	239
CCONJ	1.00	0.98	0.99	109
DET	1.00	1.00	1.00	618
INTJ	1.00	1.00	1.00	36
NOUN	0.96	0.93	0.94	1240
NUM	0.83	0.80	0.81	128
PRON	0.95	1.00	0.97	286
PROPN	0.98	0.99	0.98	1516
VERB	0.89	0.96	0.93	623
accuracy			**0.97**	**6580**
macro avg	**0.95**	**0.93**	**0.94**	**6580**
weighted avg	**0.97**	**0.97**	**0.96**	**6580**

recall_micro_test=0.9651975683890578
recall_macro_test=0.9286033754720951
f1_micro_test=0.9651975683890578
f1_macro_test=0.9352826361549704

confusion_mat_test =

```
[[ 204    0    3    0    0    0    0    4    2    0    3    2]
 [   1 1489    0    0    0    0    0    0    0    0    0    1]
 [  20    0   49    0    0    0    0    1    1    0    4    1]
 [   0    0    0  218    0    0    0   21    0    0    0    0]
 [   0    0    0    0  107    2    0    0    0    0    0    0]
 [   0    0    0    0    0  616    0    2    0    0    0    0]
 [   0    0    0    0    0    0   36    0    0    0    0    0]
 [   0    0    0    6    0    0    0 1148    4    0   20   62]
 [   0    0    0    0    0    0    0    1  102   15    6    4]
 [   0    0    0    0    0    0    0    0    0  286    0    0]
 [   1    2    2    0    0    0    0    4   11    0 1495    1]
 [   0    0    3    0    0    0    0   16    3    0    0  601]]
```

p=1 s=1

```
Training model...
Epoch 1/75, Loss: 0.6653759327476034
Epoch 2/75, Loss: 0.24612780980540638
Epoch 3/75, Loss: 0.17956529387349995
Epoch 4/75, Loss: 0.14623236873905504
Epoch 5/75, Loss: 0.12734507840755793
Epoch 6/75, Loss: 0.11387971372364404
Epoch 7/75, Loss: 0.10279513666383021
Epoch 8/75, Loss: 0.09631142775563624
Epoch 9/75, Loss: 0.09051683592474218
Epoch 10/75, Loss: 0.08663826996357145
Epoch 11/75, Loss: 0.08059836413600248
Epoch 12/75, Loss: 0.07890300723828014
Epoch 13/75, Loss: 0.07569907029430442
Epoch 14/75, Loss: 0.07206495610263404
Epoch 15/75, Loss: 0.06965854867810013
Epoch 16/75, Loss: 0.06654168398959887
Epoch 17/75, Loss: 0.06776103299773441
Epoch 18/75, Loss: 0.06090503466500975
Epoch 19/75, Loss: 0.05945304968503259
Epoch 20/75, Loss: 0.06136599870236543
Epoch 21/75, Loss: 0.05752311471118298
Epoch 22/75, Loss: 0.05470718825074573
Epoch 23/75, Loss: 0.054227284087902596
Epoch 24/75, Loss: 0.052194644925538686
Epoch 25/75, Loss: 0.05035528555101992
Epoch 26/75, Loss: 0.04776201048969097
Epoch 27/75, Loss: 0.04898391138055789
Epoch 28/75, Loss: 0.044625931757730726
Epoch 29/75, Loss: 0.04492582787284277
Epoch 30/75, Loss: 0.050213452582072396
Epoch 31/75, Loss: 0.03999883194933826
Epoch 32/75, Loss: 0.04095282671103168
Epoch 33/75, Loss: 0.04284383164939349
Epoch 34/75, Loss: 0.040742786326788495
Epoch 35/75, Loss: 0.039360890332946416
Epoch 36/75, Loss: 0.03997906423840919
Epoch 37/75, Loss: 0.03551999892621987
Epoch 38/75, Loss: 0.03639441412826951
Epoch 39/75, Loss: 0.03632051697353788
Epoch 40/75, Loss: 0.03595019084450405
Epoch 41/75, Loss: 0.03698284534946648
Epoch 42/75, Loss: 0.03526530713839465
```

```
Epoch 43/75, Loss: 0.030376939602445554
Epoch 44/75, Loss: 0.030526801138143565
Epoch 45/75, Loss: 0.03196187283669271
Epoch 46/75, Loss: 0.029979200099296607
Epoch 47/75, Loss: 0.03327043062509442
Epoch 48/75, Loss: 0.02913917906094072
Epoch 49/75, Loss: 0.0320390529950514
Epoch 50/75, Loss: 0.027266101460495067
Epoch 51/75, Loss: 0.031791719381291314
Epoch 52/75, Loss: 0.02767385300836391
Epoch 53/75, Loss: 0.02640724379135732
Epoch 54/75, Loss: 0.026867136746667443
Epoch 55/75, Loss: 0.02534136137651716
Epoch 56/75, Loss: 0.02687800109666896
Epoch 57/75, Loss: 0.027402799325904812
Epoch 58/75, Loss: 0.026984180226998864
Epoch 59/75, Loss: 0.025604903653692855
Epoch 60/75, Loss: 0.026800537322496185
Epoch 61/75, Loss: 0.027375409019695457
Epoch 62/75, Loss: 0.020173560801264742
Epoch 63/75, Loss: 0.024542906810541356
Epoch 64/75, Loss: 0.02414080894774021
Epoch 65/75, Loss: 0.024334698399322112
Epoch 66/75, Loss: 0.026745803086403605
Epoch 67/75, Loss: 0.018100517205771667
Epoch 68/75, Loss: 0.019744566950996467
Epoch 69/75, Loss: 0.026176343799496044
Epoch 70/75, Loss: 0.02663622331811998
Epoch 71/75, Loss: 0.017239858343085206
Epoch 72/75, Loss: 0.025306915151201013
Epoch 73/75, Loss: 0.01596333922314148
Epoch 74/75, Loss: 0.02176945554171438
Epoch 75/75, Loss: 0.029869008724830497
Saving model...

Loading model...
Metrics of train set:
sk_accuracy_train=0.9935463981091357
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       0.97      0.98      0.98      1577
         ADP       1.00      1.00      1.00     11098
         ADV       0.95      0.93      0.94       371
         AUX       1.00      1.00      1.00      1573
```

CCONJ	1.00	1.00	1.00	742
DET	1.00	1.00	1.00	4511
INTJ	1.00	0.98	0.99	335
NOUN	0.98	0.99	0.99	8786
NUM	0.95	0.98	0.96	785
PRON	1.00	1.00	1.00	2435
PROPN	1.00	1.00	1.00	11403
VERB	1.00	0.98	0.99	5039
accuracy			**0.99**	**48655**
macro avg	**0.99**	**0.99**	**0.99**	**48655**
weighted avg	**0.99**	**0.99**	**0.99**	**48655**

recall_micro_train=0.9935463981091357
recall_macro_train=0.9854504974831704
f1_micro_train=0.9935463981091357
f1_macro_train=0.9863229343901038
confusion_mat_train =

```
[[ 1544     2     0     0     0     0     0    15     6     0    10
0]
 [    3 11090     2     0     0     0     0     1     1     0     1
0]
 [    1     1   345     0     0     0     0     8     6     1     8
1]
 [    3     0     0  1567     0     0     0     1     2     0     0
0]
 [    0     0     0     0   742     0     0     0     0     0     0
0]
 [    7     2     1     0     0  4490     0     8     0     0     2
1]
 [    0     0     3     0     0     0   328     0     0     0     0
4]
 [   17     1     0     0     0     0     0  8736    13     0    18
1]
 [    2     0     1     0     0     0     0    10   767     0     4
1]
 [    1     0     0     0     0     0     0     1     0  2433     0
0]
 [    4     0     0     0     0     0     0    32     3     0 11364
0]
 [    6     9    12     0     0     0     0    59     9     0     9
4935]]
```

Metrics of dev set:
sk_accuracy_dev=0.9506172839506173

```
classification_rep_dev =
              precision    recall  f1-score   support

         ADJ       0.94      0.93      0.93       223
         ADP       0.97      1.00      0.98      1456
         ADV       0.77      0.80      0.79        51
         AUX       0.97      0.76      0.85       296
       CCONJ       1.00      0.99      1.00       107
         DET       1.00      0.93      0.96       697
        INTJ       1.00      0.97      0.99        35
        NOUN       0.91      0.95      0.93      1130
         NUM       0.90      0.85      0.87       131
        PRON       0.95      0.99      0.97       314
       PROPN       0.98      0.95      0.97      1565
        VERB       0.89      0.96      0.92       637

    accuracy                           0.95      6642
   macro avg       0.94      0.92      0.93      6642
weighted avg       0.95      0.95      0.95      6642

recall_micro_dev=0.9506172839506173
recall_macro_dev=0.9238191977339062
f1_micro_dev=0.9506172839506173
f1_macro_dev=0.9298615697541335
confusion_mat_dev =
[[ 207    1    7    0    0    0    0    5    1    0    1    1]
 [   1 1449    1    1    0    0    0    3    0    0    1    0]
 [   2    0   41    1    0    0    0    5    0    0    1    1]
 [   1    1    0  224    0    0    0   17    0    0    2   51]
 [   0    1    0    0  106    0    0    0    0    0    0    0]
 [   2   44    0    0    0  648    0    1    1    0    0    1]
 [   0    0    0    0    0    0   34    0    0    0    0    1]
 [   4    0    3    4    0    0    0 1074    3    0   22   20]
 [   1    0    0    0    0    0    0    2  111   15    2    0]
 [   0    0    0    0    0    0    0    1    0  312    1    0]
 [   2    1    0    0    0    0    0   61    5    0 1494    2]
 [   1    3    1    2    0    0    0   10    3    1    2  614]]

Metrics of test set:
sk_accuracy_test=0.9571428571428572
classification_rep_test =
              precision    recall  f1-score   support

         ADJ       0.85      0.94      0.89       218
         ADP       0.99      1.00      0.99      1491
```

ADV	0.85	0.59	0.70	76
AUX	0.96	0.91	0.93	239
CCONJ	0.99	0.97	0.98	109
DET	1.00	0.98	0.99	618
INTJ	0.97	1.00	0.99	36
NOUN	0.94	0.91	0.93	1240
NUM	0.87	0.80	0.83	128
PRON	0.95	0.99	0.97	286
PROPN	0.97	0.99	0.98	1516
VERB	0.90	0.94	0.92	623
accuracy			**0.96**	**6580**
macro avg	**0.94**	**0.92**	**0.93**	**6580**
weighted avg	**0.96**	**0.96**	**0.96**	**6580**

recall_micro_test=0.9571428571428572
recall_macro_test=0.9186666817258099
f1_micro_test=0.9571428571428572
f1_macro_test=0.9250386356217705

confusion_mat_test =

```
[[ 204    1    4    0    0    0    0    5    4    0    0    0]
 [   1 1484    0    1    0    1    0    1    0    0    1    2]
 [  21    0   45    1    0    0    0    4    1    0    4    0]
 [   0    0    0  218    0    0    0   21    0    0    0    0]
 [   0    0    0    0  106    0    0    1    0    0    2    0]
 [   2    0    0    1    0  607    0    5    0    0    3    0]
 [   0    0    0    0    0    0   36    0    0    0    0    0]
 [   4    1    0    7    1    0    0 1131    2    0   29   65]
 [   1    0    2    0    0    0    0    2  103   16    4    0]
 [   0    0    0    0    0    0    0    2    0  284    0    0]
 [   1    4    1    0    0    0    0    8    6    0 1496    0]
 [   5    2    1    0    0    2    1   18    3    0    7  584]]
```

p=2 s=2

```
Training model...
Epoch 1/75, Loss: 0.6669412596976083
Epoch 2/75, Loss: 0.23950119581166532
Epoch 3/75, Loss: 0.17561681083135514
Epoch 4/75, Loss: 0.14639532106283576
Epoch 5/75, Loss: 0.1245593965951838
Epoch 6/75, Loss: 0.11139748842790771
Epoch 7/75, Loss: 0.0986522575886247
Epoch 8/75, Loss: 0.09120297909271567
Epoch 9/75, Loss: 0.08413295384341025
Epoch 10/75, Loss: 0.07834551974065705
Epoch 11/75, Loss: 0.07611020553505854
Epoch 12/75, Loss: 0.06790540271356663
Epoch 13/75, Loss: 0.06560826117815187
Epoch 14/75, Loss: 0.06278679532990375
Epoch 15/75, Loss: 0.05956481083791942
Epoch 16/75, Loss: 0.055731257978532046
Epoch 17/75, Loss: 0.05453096036832907
Epoch 18/75, Loss: 0.0532482283777859
Epoch 19/75, Loss: 0.04892798243376577
Epoch 20/75, Loss: 0.047698379530514874
Epoch 21/75, Loss: 0.04262518438098062
Epoch 22/75, Loss: 0.04187127529498071
Epoch 23/75, Loss: 0.043483608516886624
Epoch 24/75, Loss: 0.03786127808232445
Epoch 25/75, Loss: 0.03751578032158504
Epoch 26/75, Loss: 0.039012994108956034
Epoch 27/75, Loss: 0.032980726797286995
Epoch 28/75, Loss: 0.036319219190098805
Epoch 29/75, Loss: 0.030915478442877762
Epoch 30/75, Loss: 0.030771825520483825
Epoch 31/75, Loss: 0.03091167194502119
Epoch 32/75, Loss: 0.027442443065213575
Epoch 33/75, Loss: 0.0267454694849118
Epoch 34/75, Loss: 0.03180381721686755
Epoch 35/75, Loss: 0.025704050450629526
Epoch 36/75, Loss: 0.02538777613393421
Epoch 37/75, Loss: 0.029070953044625574
Epoch 38/75, Loss: 0.022571083300139683
Epoch 39/75, Loss: 0.026267587507243402
Epoch 40/75, Loss: 0.020667055550925115
Epoch 41/75, Loss: 0.028094953834608468
Epoch 42/75, Loss: 0.021779593421269075
```

```
Epoch 43/75, Loss: 0.021487854677080743
Epoch 44/75, Loss: 0.02135819606964459
Epoch 45/75, Loss: 0.023956931393654166
Epoch 46/75, Loss: 0.02171284635889645
Epoch 47/75, Loss: 0.021565944876335286
Epoch 48/75, Loss: 0.021704151510148078
Epoch 49/75, Loss: 0.01769023550826999
Epoch 50/75, Loss: 0.015553645015377409
Epoch 51/75, Loss: 0.02123445989517687
Epoch 52/75, Loss: 0.018470431407131723
Epoch 53/75, Loss: 0.023528578550442363
Epoch 54/75, Loss: 0.017549729169839212
Epoch 55/75, Loss: 0.020739572657214662
Epoch 56/75, Loss: 0.019251615818965527
Epoch 57/75, Loss: 0.014290918878349962
Epoch 58/75, Loss: 0.02569019970423699
Epoch 59/75, Loss: 0.013361575072304229
Epoch 60/75, Loss: 0.017239952922943027
Epoch 61/75, Loss: 0.015290537125674512
Epoch 62/75, Loss: 0.018410970048088858
Epoch 63/75, Loss: 0.01790050916941143
Epoch 64/75, Loss: 0.010703432608934253
Epoch 65/75, Loss: 0.021755999071883646
Epoch 66/75, Loss: 0.01278015168899959
Epoch 67/75, Loss: 0.021185490611762146
Epoch 68/75, Loss: 0.010793651018968667
Epoch 69/75, Loss: 0.014587920354463782
Epoch 70/75, Loss: 0.015520555621741814
Epoch 71/75, Loss: 0.016898193668220072
Epoch 72/75, Loss: 0.012560404137468686
Epoch 73/75, Loss: 0.013122266575809612
Epoch 74/75, Loss: 0.016777434418168237
Epoch 75/75, Loss: 0.013163483590862165
Saving model...

Loading model...
```
Metrics of train set:
sk_accuracy_train=0.9978213955400267
```
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       0.99      0.99      0.99      1577
         ADP       1.00      1.00      1.00     11098
         ADV       0.98      0.98      0.98       371
         AUX       1.00      1.00      1.00      1573
```

CCONJ	1.00	1.00	1.00	742
DET	1.00	1.00	1.00	4511
INTJ	1.00	0.98	0.99	335
NOUN	1.00	0.99	1.00	8786
NUM	0.98	1.00	0.99	785
PRON	1.00	1.00	1.00	2435
PROPN	1.00	1.00	1.00	11403
VERB	1.00	1.00	1.00	5039
accuracy			**1.00**	**48655**
macro avg	**1.00**	**1.00**	**1.00**	**48655**
weighted avg	**1.00**	**1.00**	**1.00**	**48655**

recall_micro_train=0.9978213955400267
recall_macro_train=0.9952450385389895
f1_micro_train=0.9978213955400267
f1_macro_train=0.9952303008786357

confusion_mat_train =

```
[[ 1561     0     0     0     0     1     0     3     2     0     3
7]
 [    0 11091     0     0     0     0     0     2     0     0     4
1]
 [    1     0   365     0     0     0     0     0     1     0     4
0]
 [    0     0     0  1573     0     0     0     0     0     0     0
0]
 [    0     0     0     0   742     0     0     0     0     0     0
0]
 [    0     0     0     0     0  4510     0     0     0     0     1
0]
 [    0     0     6     0     0     0   329     0     0     0     0
0]
 [   11     0     0     2     0     1     0  8737    10     0    23
2]
 [    0     0     0     0     0     0     0     1   783     0     0
1]
 [    2     0     0     0     0     0     0     1     0  2432     0
0]
 [    0     0     0     0     0     0     0     3     2     0 11398
0]
 [    1     0     0     0     0     1     0     1     3     0     5
5028]]
```

Metrics of dev set:
sk_accuracy_dev=0.9445950015055706

```
classification_rep_dev =
              precision    recall  f1-score   support

         ADJ       0.94      0.88      0.91       223
         ADP       0.97      0.99      0.98      1456
         ADV       0.76      0.73      0.74        51
         AUX       0.96      0.75      0.84       296
       CCONJ       1.00      0.99      1.00       107
         DET       0.99      0.93      0.96       697
        INTJ       1.00      0.91      0.96        35
        NOUN       0.91      0.94      0.92      1130
         NUM       0.87      0.83      0.85       131
        PRON       0.95      0.99      0.97       314
       PROPN       0.97      0.95      0.96      1565
        VERB       0.87      0.97      0.92       637

    accuracy                           0.94      6642
   macro avg       0.93      0.91      0.92      6642
weighted avg       0.95      0.94      0.94      6642

recall_micro_dev=0.9445950015055706
recall_macro_dev=0.9055198059501973
f1_micro_dev=0.9445950015055706
f1_macro_dev=0.917055619794931
confusion_mat_dev =
[[ 196    1    3    0    0    1    0   12    5    0    2    3]
 [   0 1439    1    1    0    2    0    3    0    0    4    6]
 [   0    1   37    1    0    1    0    5    0    0    4    2]
 [   0    0    1  222    0    0    0   17    0    0    2   54]
 [   0    0    0    0  106    0    0    0    0    0    0    1]
 [   1   42    0    1    0  649    0    1    0    0    2    1]
 [   0    0    2    0    0    0   32    0    0    0    0    1]
 [   8    1    1    4    0    1    0 1063    4    0   26   22]
 [   0    0    0    0    0    0    0    3  109   15    4    0]
 [   0    0    0    1    0    0    0    0    0  312    1    0]
 [   1    1    1    0    0    1    0   62    4    0 1493    2]
 [   2    1    3    2    0    1    0    4    3    0    5  616]]

Metrics of test set:
sk_accuracy_test=0.95
classification_rep_test =
              precision    recall  f1-score   support

         ADJ       0.84      0.88      0.86       218
         ADP       1.00      0.99      0.99      1491
```

ADV	0.80	0.53	0.63	76
AUX	0.95	0.90	0.93	239
CCONJ	0.99	0.96	0.98	109
DET	0.99	0.99	0.99	618
INTJ	0.97	0.97	0.97	36
NOUN	0.94	0.90	0.92	1240
NUM	0.79	0.77	0.78	128
PRON	0.94	1.00	0.97	286
PROPN	0.96	0.98	0.97	1516
VERB	0.87	0.94	0.90	623
accuracy			**0.95**	**6580**
macro avg	**0.92**	**0.90**	**0.91**	**6580**
weighted avg	**0.95**	**0.95**	**0.95**	**6580**

recall_micro_test=0.95
recall_macro_test=0.9011578223882216
f1_micro_test=0.9500000000000001
f1_macro_test=0.9083186329604063
confusion_mat_test =

```
[[ 192    0    2    0    0    0    0   11    4    0    5    4]
 [   2 1476    2    2    1    2    0    2    1    0    2    1]
 [  19    0   40    2    0    0    1    3    0    0    5    6]
 [   0    0    0  216    0    0    0   21    0    0    2    0]
 [   1    0    0    0  105    1    0    0    0    0    2    0]
 [   1    0    1    0    0  609    0    3    0    0    3    1]
 [   0    0    0    0    0    0   35    0    0    0    0    1]
 [   5    0    1    7    0    0    0 1118    8    0   34   67]
 [   3    0    2    0    0    0    0    4   99   15    3    2]
 [   0    0    0    0    0    1    0    0    0  285    0    0]
 [   2    0    1    0    0    1    0    6    9    1 1493    3]
 [   3    3    1    1    0    2    0   17    4    1    8  583]]
```

p=2 s=3

```
Training model...
Epoch 1/75, Loss: 0.6066811263619992
Epoch 2/75, Loss: 0.22933205328734882
Epoch 3/75, Loss: 0.17128477451170007
Epoch 4/75, Loss: 0.13629795124316185
Epoch 5/75, Loss: 0.11856527653315965
Epoch 6/75, Loss: 0.10581943224173201
Epoch 7/75, Loss: 0.09537249560231148
Epoch 8/75, Loss: 0.08646029437575171
Epoch 9/75, Loss: 0.08122710557272059
Epoch 10/75, Loss: 0.07334742390944742
Epoch 11/75, Loss: 0.0698228381132357
Epoch 12/75, Loss: 0.06510573317836504
Epoch 13/75, Loss: 0.06014025303823983
Epoch 14/75, Loss: 0.058310281188391225
Epoch 15/75, Loss: 0.05704072710093289
Epoch 16/75, Loss: 0.053776597283286764
Epoch 17/75, Loss: 0.04991354832319242
Epoch 18/75, Loss: 0.04713122321289517
Epoch 19/75, Loss: 0.04218561193977689
Epoch 20/75, Loss: 0.04510606291058356
Epoch 21/75, Loss: 0.038483053487894214
Epoch 22/75, Loss: 0.0379830002536333
Epoch 23/75, Loss: 0.04013793948985319
Epoch 24/75, Loss: 0.03216634290323837
Epoch 25/75, Loss: 0.03753336011208
Epoch 26/75, Loss: 0.03412311541538566
Epoch 27/75, Loss: 0.02824934760778069
Epoch 28/75, Loss: 0.03275061313618508
Epoch 29/75, Loss: 0.033253448247863575
Epoch 30/75, Loss: 0.02543197648778956
Epoch 31/75, Loss: 0.025191040590637072
Epoch 32/75, Loss: 0.03222002559424767
Epoch 33/75, Loss: 0.030199145966179865
Epoch 34/75, Loss: 0.02118405998950569
Epoch 35/75, Loss: 0.022600579856360242
Epoch 36/75, Loss: 0.02308721250918954
Epoch 37/75, Loss: 0.020994994436135006
Epoch 38/75, Loss: 0.026191695994982212
Epoch 39/75, Loss: 0.02287128277579596
Epoch 40/75, Loss: 0.02048208353646305
Epoch 41/75, Loss: 0.02066043517036689
Epoch 42/75, Loss: 0.01853551409434247
```

```
Epoch 43/75, Loss: 0.024111261559951896
Epoch 44/75, Loss: 0.019578372295762408
Epoch 45/75, Loss: 0.017679350775969934
Epoch 46/75, Loss: 0.0215711614083332
Epoch 47/75, Loss: 0.01713939163038143
Epoch 48/75, Loss: 0.017011324452206728
Epoch 49/75, Loss: 0.018371516570437785
Epoch 50/75, Loss: 0.01911885707345314
Epoch 51/75, Loss: 0.01736232925555088
Epoch 52/75, Loss: 0.01692050680433803
Epoch 53/75, Loss: 0.018151474712912
Epoch 54/75, Loss: 0.011723280555726547
Epoch 55/75, Loss: 0.01913941790003311
Epoch 56/75, Loss: 0.019848266462664643
Epoch 57/75, Loss: 0.012695891056716143
Epoch 58/75, Loss: 0.008338540084068818
Epoch 59/75, Loss: 0.019329817401498584
Epoch 60/75, Loss: 0.022936138921599583
Epoch 61/75, Loss: 0.01015816558886662
Epoch 62/75, Loss: 0.0131897474774696
Epoch 63/75, Loss: 0.02279871449152917
Epoch 64/75, Loss: 0.011174469034143786
Epoch 65/75, Loss: 0.017684894482143613
Epoch 66/75, Loss: 0.01443913824708327
Epoch 67/75, Loss: 0.014213146331462043
Epoch 68/75, Loss: 0.01043119764159893
Epoch 69/75, Loss: 0.01746341197240412
Epoch 70/75, Loss: 0.011987612876596334
Epoch 71/75, Loss: 0.01284054764689252
Epoch 72/75, Loss: 0.01015789966021862
Epoch 73/75, Loss: 0.018313447507931718
Epoch 74/75, Loss: 0.014498993806539563
Epoch 75/75, Loss: 0.007623427357451297
Saving model...

Loading model...
Metrics of train set:
sk_accuracy_train=0.997985818518138
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       0.99      0.99      0.99      1577
         ADP       1.00      1.00      1.00     11098
         ADV       1.00      0.99      0.99       371
         AUX       1.00      1.00      1.00      1573
```

```
       CCONJ       1.00      1.00      1.00       742
         DET       1.00      1.00      1.00      4511
        INTJ       1.00      1.00      1.00       335
        NOUN       1.00      1.00      1.00      8786
         NUM       0.97      1.00      0.98       785
        PRON       1.00      1.00      1.00      2435
       PROPN       1.00      1.00      1.00     11403
        VERB       1.00      1.00      1.00      5039

    accuracy                           1.00     48655
   macro avg       1.00      1.00      1.00     48655
weighted avg       1.00      1.00      1.00     48655
```

recall_micro_train=0.997985818518138
recall_macro_train=0.9971744746310826
f1_micro_train=0.997985818518138
f1_macro_train=0.9967612133829397

```
confusion_mat_train =
[[ 1568     0     0     0     0     0     0     5     3     0     0
1]
 [    0 11093     0     0     0     0     0     2     0     0     0
3]
 [    0     0   367     0     0     0     0     3     0     0     1
0]
 [    0     0     0  1573     0     0     0     0     0     0     0
0]
 [    0     0     0     0   742     0     0     0     0     0     0
0]
 [    0     0     0     0     0  4510     0     1     0     0     0
0]
 [    0     0     0     0     0     0   334     1     0     0     0
0]
 [   10     0     0     1     0     0     0  8746    10     0    12
7]
 [    0     0     0     0     0     0     0     2   782     0     0
1]
 [    0     0     0     0     0     0     0     1     0  2434     0
0]
 [    2     0     0     0     0     0     0     7     6     0 11387
1]
 [    0     0     0     0     0     0     0    13     3     0     2
5021]]
```

Metrics of dev set:
sk_accuracy_dev=0.9441433303221921

```
classification_rep_dev =
              precision    recall  f1-score   support

         ADJ       0.93      0.84      0.88       223
         ADP       0.97      0.99      0.98      1456
         ADV       0.75      0.75      0.75        51
         AUX       0.96      0.74      0.84       296
       CCONJ       0.97      0.99      0.98       107
         DET       0.99      0.93      0.96       697
        INTJ       1.00      1.00      1.00        35
        NOUN       0.90      0.95      0.92      1130
         NUM       0.91      0.85      0.88       131
        PRON       0.95      1.00      0.97       314
       PROPN       0.98      0.95      0.96      1565
        VERB       0.86      0.96      0.91       637

    accuracy                           0.94      6642
   macro avg       0.93      0.91      0.92      6642
weighted avg       0.95      0.94      0.94      6642

recall_micro_dev=0.9441433303221921
recall_macro_dev=0.9120591242485095
f1_micro_dev=0.9441433303221921
f1_macro_dev=0.9195467230921373
confusion_mat_dev =
[[ 187    1    8    0    1    2    0   14    1    1    4    4]
 [   2 1443    1    0    1    0    0    4    0    0    0    5]
 [   1    0   38    2    0    0    0    5    0    0    3    2]
 [   1    1    0  220    0    2    0   18    0    0    1   53]
 [   0    0    0    0  106    0    0    0    0    0    0    1]
 [   2   41    0    1    0  649    0    1    0    0    0    3]
 [   0    0    0    0    0    0   35    0    0    0    0    0]
 [   6    0    0    5    0    0    0 1068    3    0   22   26]
 [   1    0    0    0    0    0    0    2  111   15    2    0]
 [   0    0    0    0    0    0    0    0    0  314    0    0]
 [   1    2    0    0    0    1    0   67    4    0 1487    3]
 [   0    0    4    0    1    0    0   10    3    1    5  613]]

Metrics of test set:
sk_accuracy_test=0.9521276595744681
classification_rep_test =
              precision    recall  f1-score   support

         ADJ       0.82      0.88      0.85       218
         ADP       0.99      0.99      0.99      1491
```

ADV	0.87	0.61	0.71	76
AUX	0.94	0.90	0.92	239
CCONJ	1.00	0.97	0.99	109
DET	0.99	0.98	0.99	618
INTJ	0.95	0.97	0.96	36
NOUN	0.94	0.91	0.92	1240
NUM	0.80	0.77	0.79	128
PRON	0.95	0.99	0.97	286
PROPN	0.97	0.98	0.98	1516
VERB	0.88	0.95	0.91	623
accuracy			**0.95**	**6580**
macro avg	**0.93**	**0.91**	**0.91**	**6580**
weighted avg	**0.95**	**0.95**	**0.95**	**6580**

recall_micro_test=0.9521276595744681
recall_macro_test=0.9084664736197056
f1_micro_test=0.9521276595744681
f1_macro_test=0.9146494786148335

```
confusion_mat_test =
[[ 191    2    2    0    0    1    0   11    5    0    3    3]
 [   4 1481    1    0    0    1    0    2    1    0    0    1]
 [  17    1   46    1    0    0    1    2    0    1    4    3]
 [   0    0    0  215    0    0    0   21    0    0    1    2]
 [   0    0    0    0  106    0    0    2    0    0    0    1]
 [   3    0    1    1    0  605    1    4    0    0    3    0]
 [   0    0    0    0    0    0   35    0    0    0    0    1]
 [   7    3    1   10    0    0    0 1128    5    0   22   64]
 [   4    0    0    1    0    0    0    4   99   15    3    2]
 [   0    0    0    0    0    2    0    0    0  284    0    0]
 [   4    1    2    0    0    1    0   13    9    0 1484    2]
 [   3    2    0    0    0    0    0   19    4    0    4  591]]
```

p=3 s=3

```
Training model...
Epoch 1/75, Loss: 0.6136231879543381
Epoch 2/75, Loss: 0.23109073894840032
Epoch 3/75, Loss: 0.17369523159205014
Epoch 4/75, Loss: 0.14257437405733298
Epoch 5/75, Loss: 0.12236861573867548
Epoch 6/75, Loss: 0.10924358293169353
Epoch 7/75, Loss: 0.09828827280250443
Epoch 8/75, Loss: 0.089253970347351
Epoch 9/75, Loss: 0.07971711097287905
Epoch 10/75, Loss: 0.077430327652688
Epoch 11/75, Loss: 0.06843705482887405
Epoch 12/75, Loss: 0.06674183667781206
Epoch 13/75, Loss: 0.06004759395429583
Epoch 14/75, Loss: 0.05781155366379184
Epoch 15/75, Loss: 0.05604326767724867
Epoch 16/75, Loss: 0.04937365675293357
Epoch 17/75, Loss: 0.0486428805256878
Epoch 18/75, Loss: 0.042729378669892445
Epoch 19/75, Loss: 0.042962512109836634
Epoch 20/75, Loss: 0.039832713588680686
Epoch 21/75, Loss: 0.03901295537335678
Epoch 22/75, Loss: 0.034946161869283225
Epoch 23/75, Loss: 0.0350869149795677
Epoch 24/75, Loss: 0.02928802635264728
Epoch 25/75, Loss: 0.03548459676486643
Epoch 26/75, Loss: 0.02774214527897789
Epoch 27/75, Loss: 0.02906649150464114
Epoch 28/75, Loss: 0.032239798807433245
Epoch 29/75, Loss: 0.025808440042114297
Epoch 30/75, Loss: 0.02532763664652002
Epoch 31/75, Loss: 0.02836155713044914
Epoch 32/75, Loss: 0.025846273821412875
Epoch 33/75, Loss: 0.02419761915481963
Epoch 34/75, Loss: 0.023974995278144416
Epoch 35/75, Loss: 0.020739304348079787
Epoch 36/75, Loss: 0.02409619288076659
Epoch 37/75, Loss: 0.023893752229001208
Epoch 38/75, Loss: 0.017369652433574842
Epoch 39/75, Loss: 0.021500226730614854
Epoch 40/75, Loss: 0.025041418425960933
Epoch 41/75, Loss: 0.01666209857973236
Epoch 42/75, Loss: 0.017225050536275908
```

```
Epoch 43/75, Loss: 0.017854187815707342
Epoch 44/75, Loss: 0.021187122239319043
Epoch 45/75, Loss: 0.022711282643601925
Epoch 46/75, Loss: 0.013168443667398966
Epoch 47/75, Loss: 0.026872589642840984
Epoch 48/75, Loss: 0.017059267377236842
Epoch 49/75, Loss: 0.012087913963095736
Epoch 50/75, Loss: 0.017103950323258305
Epoch 51/75, Loss: 0.017553822486073296
Epoch 52/75, Loss: 0.017402153708078984
Epoch 53/75, Loss: 0.018220528052628183
Epoch 54/75, Loss: 0.01992841178551755
Epoch 55/75, Loss: 0.01091572596809779
Epoch 56/75, Loss: 0.01529875124308467
Epoch 57/75, Loss: 0.015908462319284142
Epoch 58/75, Loss: 0.016718878429690068
Epoch 59/75, Loss: 0.014323895355564581
Epoch 60/75, Loss: 0.016232970950852632
Epoch 61/75, Loss: 0.011443299988896864
Epoch 62/75, Loss: 0.015495828033144306
Epoch 63/75, Loss: 0.01215549170464137
Epoch 64/75, Loss: 0.012961527832133708
Epoch 65/75, Loss: 0.014078445021157926
Epoch 66/75, Loss: 0.013271559616253006
Epoch 67/75, Loss: 0.012557289755295778
Epoch 68/75, Loss: 0.01706889579733555
Epoch 69/75, Loss: 0.009507583748596928
Epoch 70/75, Loss: 0.015332845086418323
Epoch 71/75, Loss: 0.011060372136469168
Epoch 72/75, Loss: 0.015503776062231647
Epoch 73/75, Loss: 0.009370110531024465
Epoch 74/75, Loss: 0.014439139431303268
Epoch 75/75, Loss: 0.013925257731443338
Saving model...

Loading model...
Metrics of train set:
sk_accuracy_train=0.9974308909670127
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       0.99      0.99      0.99      1577
         ADP       1.00      1.00      1.00     11098
         ADV       0.99      0.99      0.99       371
         AUX       1.00      1.00      1.00      1573
```

CCONJ	0.99	1.00	1.00	742
DET	1.00	1.00	1.00	4511
INTJ	0.99	1.00	0.99	335
NOUN	0.99	1.00	1.00	8786
NUM	0.99	0.99	0.99	785
PRON	1.00	1.00	1.00	2435
PROPN	1.00	1.00	1.00	11403
VERB	0.99	1.00	1.00	5039
accuracy			**1.00**	**48655**
macro avg	**1.00**	**1.00**	**1.00**	**48655**
weighted avg	**1.00**	**1.00**	**1.00**	**48655**

recall_micro_train=0.9974308909670127
recall_macro_train=0.9961855185173517
f1_micro_train=0.9974308909670127
f1_macro_train=0.9958864246054083

```
confusion_mat_train =
[[ 1563     0     0     0     2     0     0     9     1     0     1
1]
 [    0 11094     0     0     0     1     0     0     0     0     1
2]
 [    1     0   366     0     0     0     0     3     0     0     1
0]
 [    0     0     0  1570     0     0     3     0     0     0     0
0]
 [    0     0     0     0   742     0     0     0     0     0     0
0]
 [    1     0     0     0     0  4502     0     4     0     0     2
2]
 [    0     0     0     0     0     0   335     0     0     0     0
0]
 [    9     0     1     1     1     2     1  8752     2     0     8
9]
 [    0     0     0     0     1     0     0     4   777     0     0
3]
 [    0     0     0     0     0     0     0     0     0  2435     0
0]
 [    4     0     0     0     0     0     0    21     2     0 11363
13]
 [    1     0     1     0     0     0     0     5     0     0     1
5031]]
```

Metrics of dev set:
sk_accuracy_dev=0.9409816320385426

classification_rep_dev =

	precision	recall	f1-score	support
ADJ	0.89	0.86	0.88	223
ADP	0.97	0.99	0.98	1456
ADV	0.71	0.76	0.74	51
AUX	0.95	0.73	0.83	296
CCONJ	0.98	0.98	0.98	107
DET	0.99	0.93	0.96	697
INTJ	0.92	1.00	0.96	35
NOUN	0.90	0.93	0.92	1130
NUM	0.89	0.83	0.86	131
PRON	0.95	0.99	0.97	314
PROPN	0.98	0.95	0.96	1565
VERB	0.86	0.97	0.91	637
accuracy			**0.94**	**6642**
macro avg	**0.92**	**0.91**	**0.91**	**6642**
weighted avg	**0.94**	**0.94**	**0.94**	**6642**

recall_micro_dev=0.9409816320385426
recall_macro_dev=0.9107010930927868
f1_micro_dev=0.9409816320385426
f1_macro_dev=0.911280603976841
confusion_mat_dev =

```
[[ 192    1    5    0    1    2    0   11    2    1    3    5]
 [   2 1440    2    0    0    1    0    4    0    1    2    4]
 [   0    1   39    0    0    0    0    4    1    1    5    0]
 [   0    1    2  216    0    0    3   17    0    0    2   55]
 [   0    0    0    0  105    0    0    1    0    0    0    1]
 [   2   43    1    1    0  648    0    1    0    0    1    0]
 [   0    0    0    0    0    0   35    0    0    0    0    0]
 [  15    1    3    8    0    2    0 1051    3    0   18   29]
 [   0    0    1    0    0    1    0    3  109   15    0    2]
 [   0    0    0    0    0    0    0    2    0  312    0    0]
 [   2    1    0    0    0    0    0   63    6    0 1487    6]
 [   2    2    2    2    1    0    0    5    1    0    6  616]]
```

Metrics of test set:
sk_accuracy_test=0.9493920972644377
classification_rep_test =

	precision	recall	f1-score	support
ADJ	0.86	0.90	0.88	218
ADP	0.99	0.99	0.99	1491

ADV	0.77	0.62	0.69	76
AUX	0.95	0.90	0.92	239
CCONJ	0.97	0.95	0.96	109
DET	0.99	0.98	0.99	618
INTJ	0.88	1.00	0.94	36
NOUN	0.93	0.90	0.91	1240
NUM	0.86	0.78	0.82	128
PRON	0.93	1.00	0.96	286
PROPN	0.97	0.98	0.97	1516
VERB	0.87	0.94	0.91	623
accuracy			**0.95**	**6580**
macro avg	**0.91**	**0.91**	**0.91**	**6580**
weighted avg	**0.95**	**0.95**	**0.95**	**6580**

recall_micro_test=0.9493920972644377
recall_macro_test=0.9114722790171058
f1_micro_test=0.9493920972644377
f1_macro_test=0.9116387925449995

confusion_mat_test =

```
[[ 196    0    2    1    2    0    1    9    1    0    1    5]
 [   3 1477    2    0    0    1    0    2    0    2    3    1]
 [  18    1   47    0    0    0    1    2    0    2    4    1]
 [   0    0    0  215    0    0    0   21    0    0    3    0]
 [   1    0    1    0  104    0    0    1    0    0    1    1]
 [   1    1    2    0    0  606    1    5    0    0    1    1]
 [   0    0    0    0    0    0   36    0    0    0    0    0]
 [   5    2    2   10    1    0    2 1112    7    0   28   71]
 [   0    1    1    1    0    0    0    6  100   15    2    2]
 [   0    0    0    0    0    1    0    0    0  285    0    0]
 [   3    1    1    0    0    0    0   20    5    0 1481    5]
 [   2    3    3    0    0    2    0   17    3    1    4  588]]
```

p=4 s=4

```
Training model...
Epoch 1/75, Loss: 0.5626572770080022
Epoch 2/75, Loss: 0.2403129536594887
Epoch 3/75, Loss: 0.1800828152990921
Epoch 4/75, Loss: 0.14544266758121932
Epoch 5/75, Loss: 0.1225804647723881
Epoch 6/75, Loss: 0.1045258568120085
Epoch 7/75, Loss: 0.09632886438257258
Epoch 8/75, Loss: 0.08519852415781068
Epoch 9/75, Loss: 0.0800808182352745
Epoch 10/75, Loss: 0.06707518164077027
Epoch 11/75, Loss: 0.0677103447174389
Epoch 12/75, Loss: 0.05915198307322233
Epoch 13/75, Loss: 0.05316585168582369
Epoch 14/75, Loss: 0.056287070114094256
Epoch 15/75, Loss: 0.04695392495950405
Epoch 16/75, Loss: 0.042428462784315134
Epoch 17/75, Loss: 0.043212575500961956
Epoch 18/75, Loss: 0.039572288750267144
Epoch 19/75, Loss: 0.03665015791859987
Epoch 20/75, Loss: 0.033491335093213476
Epoch 21/75, Loss: 0.032417380729817244
Epoch 22/75, Loss: 0.03388855144511248
Epoch 23/75, Loss: 0.029515575875814836
Epoch 24/75, Loss: 0.03163067653659947
Epoch 25/75, Loss: 0.025529922403853184
Epoch 26/75, Loss: 0.02666165327787373
Epoch 27/75, Loss: 0.026357483060923385
Epoch 28/75, Loss: 0.027122807513322057
Epoch 29/75, Loss: 0.0235691475522315
Epoch 30/75, Loss: 0.022750605183666773
Epoch 31/75, Loss: 0.025448588501646833
Epoch 32/75, Loss: 0.019111906016084663
Epoch 33/75, Loss: 0.018333248247331187
Epoch 34/75, Loss: 0.02039696650104175
Epoch 35/75, Loss: 0.019292128794703642
Epoch 36/75, Loss: 0.021136131047686628
Epoch 37/75, Loss: 0.018126870784858622
Epoch 38/75, Loss: 0.022344241623556558
Epoch 39/75, Loss: 0.01484474513560519
Epoch 40/75, Loss: 0.021732423168113524
Epoch 41/75, Loss: 0.014885076386801827
Epoch 42/75, Loss: 0.019266160734490386
```

```
Epoch 43/75, Loss: 0.016178489500446716
Epoch 44/75, Loss: 0.013748834753043995
Epoch 45/75, Loss: 0.02307849664436166
Epoch 46/75, Loss: 0.014427895025172385
Epoch 47/75, Loss: 0.010091405794061372
Epoch 48/75, Loss: 0.02134290929735452
Epoch 49/75, Loss: 0.016990455804844054
Epoch 50/75, Loss: 0.016353955074374597
Epoch 51/75, Loss: 0.01394435920713485
Epoch 52/75, Loss: 0.016922478951877314
Epoch 53/75, Loss: 0.013722538957351973
Epoch 54/75, Loss: 0.010712827724988862
Epoch 55/75, Loss: 0.01313519796878119
Epoch 56/75, Loss: 0.01596668890022546
Epoch 57/75, Loss: 0.019857267397363623
Epoch 58/75, Loss: 0.008543637250920883
Epoch 59/75, Loss: 0.01624863701838281
Epoch 60/75, Loss: 0.010221772269053558
Epoch 61/75, Loss: 0.015544409213794949
Epoch 62/75, Loss: 0.012159392875231524
Epoch 63/75, Loss: 0.014255131743927167
Epoch 64/75, Loss: 0.00638195187964159
Epoch 65/75, Loss: 0.012012925659419195
Epoch 66/75, Loss: 0.018569944874697288
Epoch 67/75, Loss: 0.012050978502651303
Epoch 68/75, Loss: 0.012550602032640315
Epoch 69/75, Loss: 0.008885750291539964
Epoch 70/75, Loss: 0.015780557215214427
Epoch 71/75, Loss: 0.011134464023758204
Epoch 72/75, Loss: 0.0070732269813792315
Epoch 73/75, Loss: 0.015522285835747664
Epoch 74/75, Loss: 0.01502310316802834
Epoch 75/75, Loss: 0.009570330699243
Saving model...

Loading model...
Metrics of train set:
sk_accuracy_train=0.9948617819340253
classification_rep_train =
              precision    recall  f1-score   support

         ADJ       1.00      0.94      0.97      1577
         ADP       1.00      1.00      1.00     11098
         ADV       0.98      0.93      0.95       371
         AUX       0.99      1.00      1.00      1573
```

CCONJ	1.00	1.00	1.00	742
DET	1.00	1.00	1.00	4511
INTJ	0.97	1.00	0.99	335
NOUN	0.99	1.00	0.99	8786
NUM	0.97	0.98	0.98	785
PRON	1.00	1.00	1.00	2435
PROPN	1.00	1.00	1.00	11403
VERB	0.99	1.00	0.99	5039
accuracy			**0.99**	**48655**
macro avg	**0.99**	**0.99**	**0.99**	**48655**
weighted avg	**0.99**	**0.99**	**0.99**	**48655**

recall_micro_train=0.9948617819340253
recall_macro_train=0.986216971029593
f1_micro_train=0.9948617819340253
f1_macro_train=0.9882420468176026

```
confusion_mat_train =
[[ 1482     3     7     1     0     0     1    58     8     0     4
13]
 [    0 11092     0     1     0     0     1     3     0     0     0
1]
 [    0     0   344     0     0     0     8    11     0     0     1
7]
 [    0     0     0  1572     0     0     0     0     0     0     0
1]
 [    0     0     0     0   739     0     0     0     0     0     0
3]
 [    1     8     0     0     0  4500     0     0     0     0     0
2]
 [    0     0     0     0     0     0   335     0     0     0     0
0]
 [    2     0     0     3     0     0     0  8748     6     0    12
15]
 [    0     0     1     0     0     0     0     5   773     0     0
6]
 [    0     0     0     0     0     0     0     0     0  2435     0
0]
 [    0     2     0     4     0     2     0    28     7     1 11347
12]
 [    0     1     0     0     0     0     0     0     0     0     0
5038]]
```

Metrics of dev set:
sk_accuracy_dev=0.9373682625715146

```
classification_rep_dev =
              precision    recall  f1-score   support

         ADJ       0.97      0.79      0.87       223
         ADP       0.97      0.99      0.98      1456
         ADV       0.79      0.65      0.71        51
         AUX       0.95      0.74      0.83       296
       CCONJ       0.99      0.99      0.99       107
         DET       0.99      0.93      0.96       697
        INTJ       0.92      1.00      0.96        35
        NOUN       0.88      0.94      0.91      1130
         NUM       0.86      0.76      0.80       131
        PRON       0.95      0.99      0.97       314
       PROPN       0.98      0.94      0.96      1565
        VERB       0.84      0.97      0.90       637

    accuracy                           0.94      6642
   macro avg       0.92      0.89      0.90      6642
weighted avg       0.94      0.94      0.94      6642

recall_micro_dev=0.9373682625715146
recall_macro_dev=0.8913191734410507
f1_micro_dev=0.9373682625715146
f1_macro_dev=0.9038903907478538
confusion_mat_dev =
[[ 177    0    3    0    0    1    0   26    4    0    4    8]
 [   1 1445    0    1    0    2    0    1    0    0    0    6]
 [   0    0   33    1    0    0    2    4    2    0    4    5]
 [   0    1    1  220    0    0    0   19    0    0    1   54]
 [   0    0    0    0  106    0    0    0    0    0    0    1]
 [   1   45    0    1    0  645    0    3    0    1    1    0]
 [   0    0    0    0    0    0   35    0    0    0    0    0]
 [   2    2    2    6    0    2    0 1063    6    0   20   27]
 [   0    0    0    0    0    1    0   10   99   15    0    6]
 [   0    0    0    0    0    0    0    1    0  312    0    1]
 [   0    1    3    1    1    1    0   74    3    0 1471   10]
 [   2    1    0    2    0    0    1    7    1    0    3  620]]

Metrics of test set:
sk_accuracy_test=0.9451367781155016
classification_rep_test =
              precision    recall  f1-score   support

         ADJ       0.89      0.79      0.84       218
         ADP       0.99      0.99      0.99      1491
```

ADV	0.85	0.54	0.66	76
AUX	0.93	0.90	0.91	239
CCONJ	1.00	0.94	0.97	109
DET	0.99	0.98	0.98	618
INTJ	0.88	0.97	0.92	36
NOUN	0.92	0.90	0.91	1240
NUM	0.76	0.71	0.73	128
PRON	0.95	0.99	0.97	286
PROPN	0.97	0.98	0.97	1516
VERB	0.86	0.96	0.91	623
accuracy			**0.95**	**6580**
macro avg	**0.91**	**0.89**	**0.90**	**6580**
weighted avg	**0.95**	**0.95**	**0.94**	**6580**

recall_micro_test=0.9451367781155016
recall_macro_test=0.8878807760439787
f1_micro_test=0.9451367781155016
f1_macro_test=0.8975692535220482

confusion_mat_test =

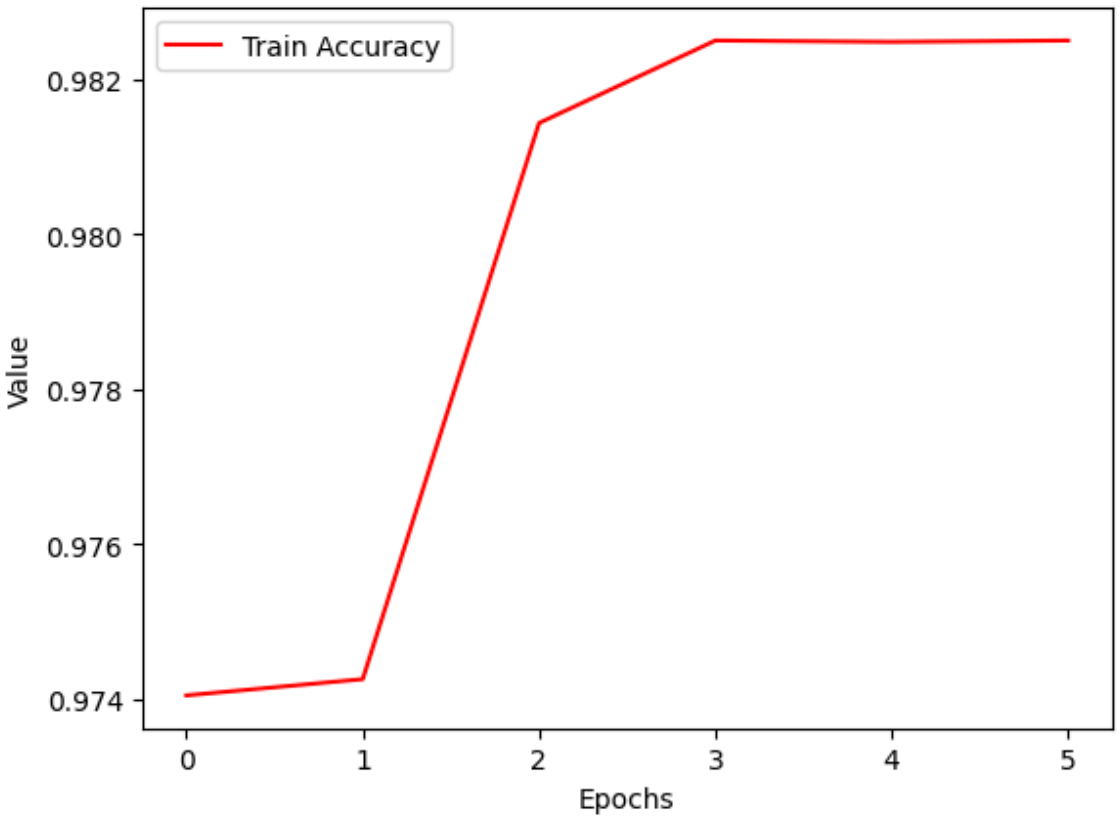
```
[[ 173    1    4    0    0    1    0   17    7    0    5   10]
 [   0 1481    0    2    0    1    0    1    2    0    2    2]
 [  16    0   41    1    0    0    4    6    3    1    2    2]
 [   1    2    0  214    0    0    0   21    0    0    1    0]
 [   0    0    0    0  103    0    0    1    0    0    1    4]
 [   0    4    1    1    0  603    1    7    1    0    0    0]
 [   0    0    0    0    0    0   35    0    0    0    0    1]
 [   2    2    2   10    0    0    0 1115    9    0   29   71]
 [   2    0    0    0    0    0    0   15   91   14    2    4]
 [   0    0    0    0    0    1    0    1    0  284    0    0]
 [   0    2    0    3    0    1    0   17    6    0 1481    6]
 [   0    3    0    0    0    2    0   16    1    0    3  598]]
```

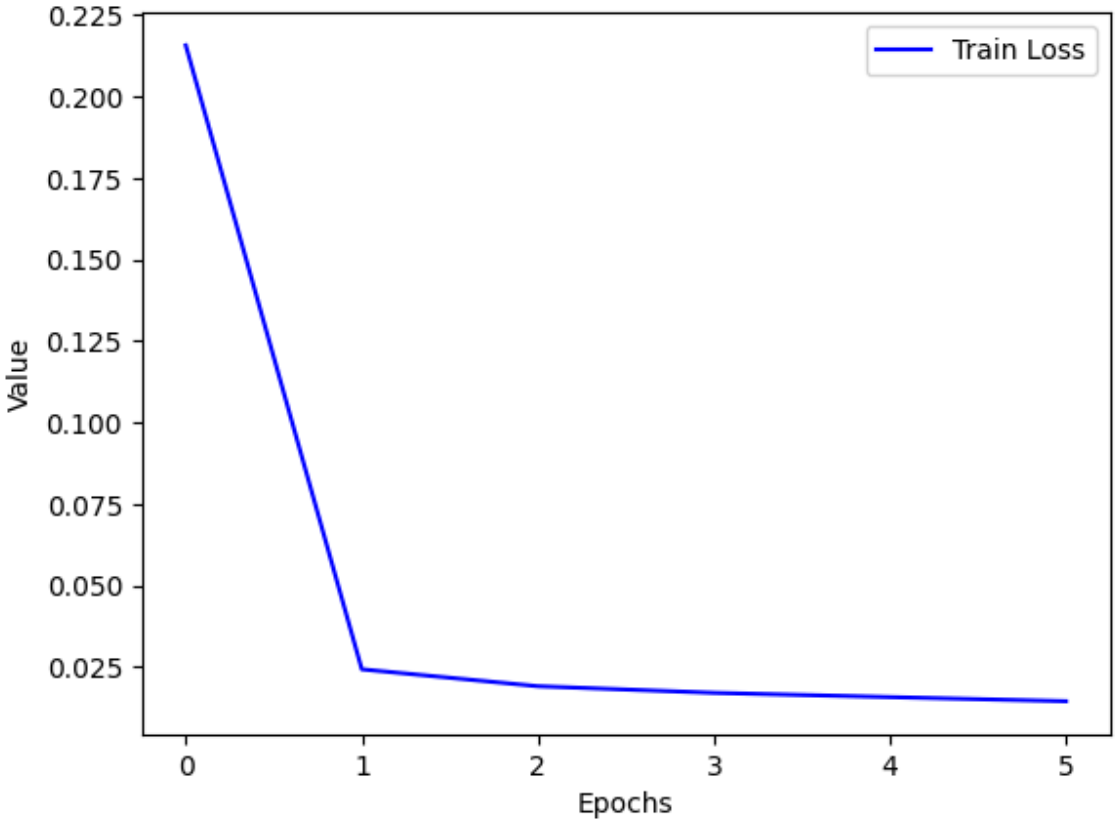
LSTM

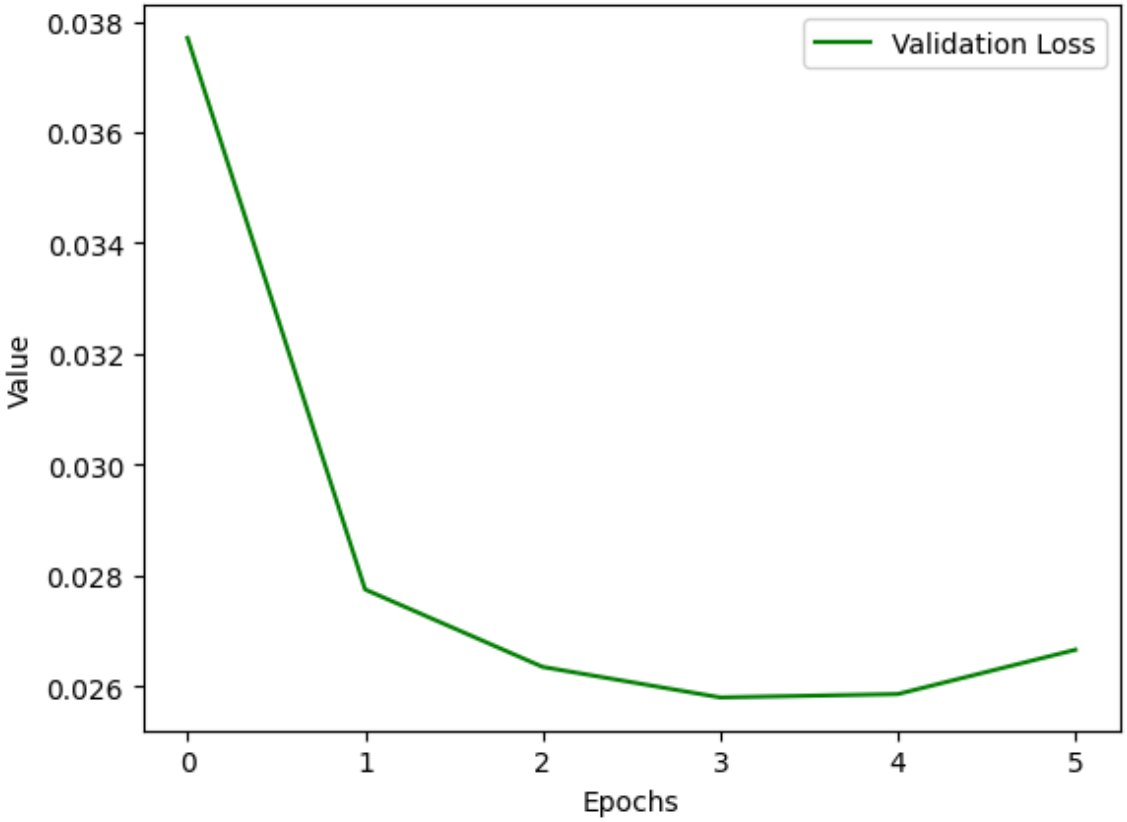
"red"="Train Accuracy"
"blue"="Train Loss"
"green"="Validation Loss"
"yellow"="Validation Accuracy"
Chosen Best Model : lstm_model_1.pt

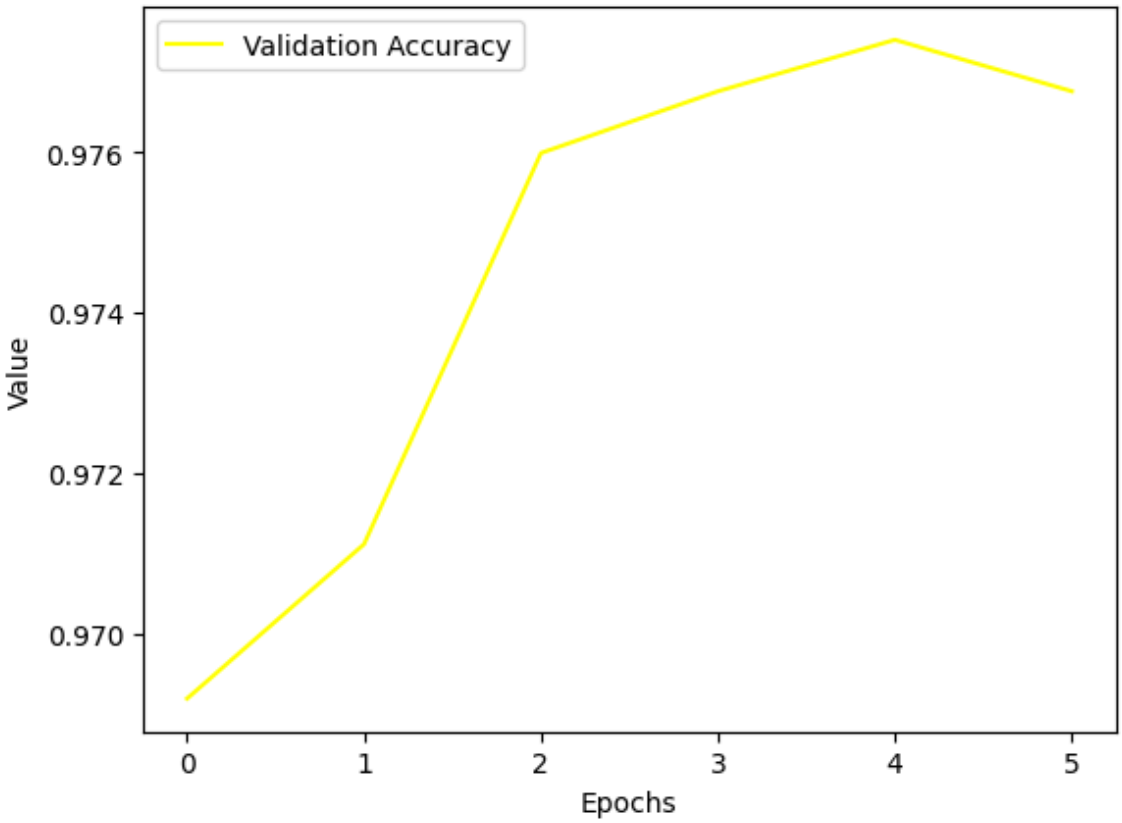
Model : lstm_model_1.pt
Parameters:
model = LSTM(64, 64, 1, len(trainData.vocab), len(trainData.tagVocab))
optimizer = torch.optim.Adam(model.parameters(), lr=0.01)
train_loss_list, valid_loss_list, train_accuracy_list,
valid_accuracy_list = train(model, trainData, optimizer, criterion,
valData, 1, "Test1")

```
Training model...
Validation loss: 0.0377047061920166
Epoch 1 loss: 0.21563559322993256
Validation loss: 0.027747202664613724
Epoch 2 loss: 0.024322354617014305
Validation loss: 0.02634860761463642
Epoch 3 loss: 0.019135417632147003
Validation loss: 0.025797950103878975
Epoch 4 loss: 0.017105293588768413
Validation loss: 0.025858696550130844
Validation loss increased
Epoch 5 loss: 0.015801586294129713
Validation loss: 0.026658661663532257
Validation loss increased
Early stopping
Epoch 6 loss: 0.014542925633740291
```


Train Accuracy
0.982
0.980
0.978
0.976
0.974
Value
0
1
2
3
4
5
Epochs


Train Loss
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
Value
0
1
2
3
4
5
Epochs


Validation Loss
0.038
0.036
0.034
0.032
0.030
0.028
0.026
Value
0
1
2
3
4
5
Epochs


Validation Accuracy
0.976
0.974
0.972
0.970
Value
0
1
2
3
4
5
Epochs

Loading model...
Training Accuracy: 0.9825021413463387
Metrics of val set:
valData_sk_accuracy=0.9767591165896251
valData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	573
<SOT>	1.00	1.00	1.00	573
adj	0.96	0.89	0.93	227
adp	0.99	0.99	0.99	1415
adv	0.81	0.81	0.81	59
aux	0.97	0.97	0.97	266
cconj	1.00	1.00	1.00	107
det	0.99	0.86	0.92	568
intj	1.00	1.00	1.00	35
noun	0.98	0.99	0.98	1143
num	0.94	0.99	0.96	131
part	0.90	0.89	0.90	73
pron	0.86	0.99	0.92	414
propn	0.99	0.99	0.99	1551
verb	0.98	0.98	0.98	653
accuracy			**0.98**	**7788**
macro avg	**0.96**	**0.96**	**0.96**	**7788**
weighted avg	**0.98**	**0.98**	**0.98**	**7788**

valData_recall_micro=0.9767591165896251
valData_recall_macro=0.9577204100124747
valData_f1_micro=0.9767591165896251
valData_f1_macro=0.9573463444351754
valData_confusion_mat =

```
[[ 573    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  573    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  203    0    7    0    0    0    0   11    3    0    0
2
     1]
 [   0    0    0 1407    0    0    0    0    0    1    0    6    1
0
     0]
```

```
 [   0    0    5    0   48    1    0    0    0    2    1    0    0
0
     2]
 [   0    0    0    0    0  258    0    0    0    0    0    0    0
0
     8]
 [   0    0    0    0    0    0  107    0    0    0    0    0    0
0
     0]
 [   0    0    0   10    0    0    0  491    0    0    1    0   66
0
     0]
 [   0    0    0    0    0    0    0    0   35    0    0    0    0
0
     0]
 [   0    0    3    0    0    0    0    0    0 1130    1    0    0
9
     0]
 [   0    0    0    1    0    0    0    0    0    0  130    0    0
0
     0]
 [   0    0    0    8    0    0    0    0    0    0    0   65    0
0
     0]
 [   0    0    0    0    0    0    0    4    0    1    0    1  408
0
     0]
 [   0    0    0    0    1    0    0    0    0    7    2    0    0
1539
     2]
 [   0    0    0    0    3    6    0    0    0    2    1    0    0
1
   640]]
```

Metrics of test set:

testData_sk_accuracy=0.9770381836945304

testData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	586
<SOT>	1.00	1.00	1.00	586
adj	0.91	0.95	0.93	220
adp	1.00	1.00	1.00	1434
adv	0.82	0.67	0.74	76
aux	0.95	1.00	0.97	256

cconj	1.00	1.00	1.00	109
det	0.99	0.87	0.92	512
intj	1.00	1.00	1.00	36
noun	0.99	0.99	0.99	1166
num	0.88	0.96	0.92	127
part	0.98	0.96	0.97	56
pron	0.85	0.98	0.91	392
propn	0.99	0.99	0.99	1567
verb	0.99	0.96	0.97	629
accuracy			**0.98**	**7752**
macro avg	**0.96**	**0.96**	**0.95**	**7752**
weighted avg	**0.98**	**0.98**	**0.98**	**7752**

testData_recall_micro=0.9770381836945304
testData_recall_macro=0.9553220963694653
testData_f1_micro=0.9770381836945304
testData_f1_macro=0.954684369349297

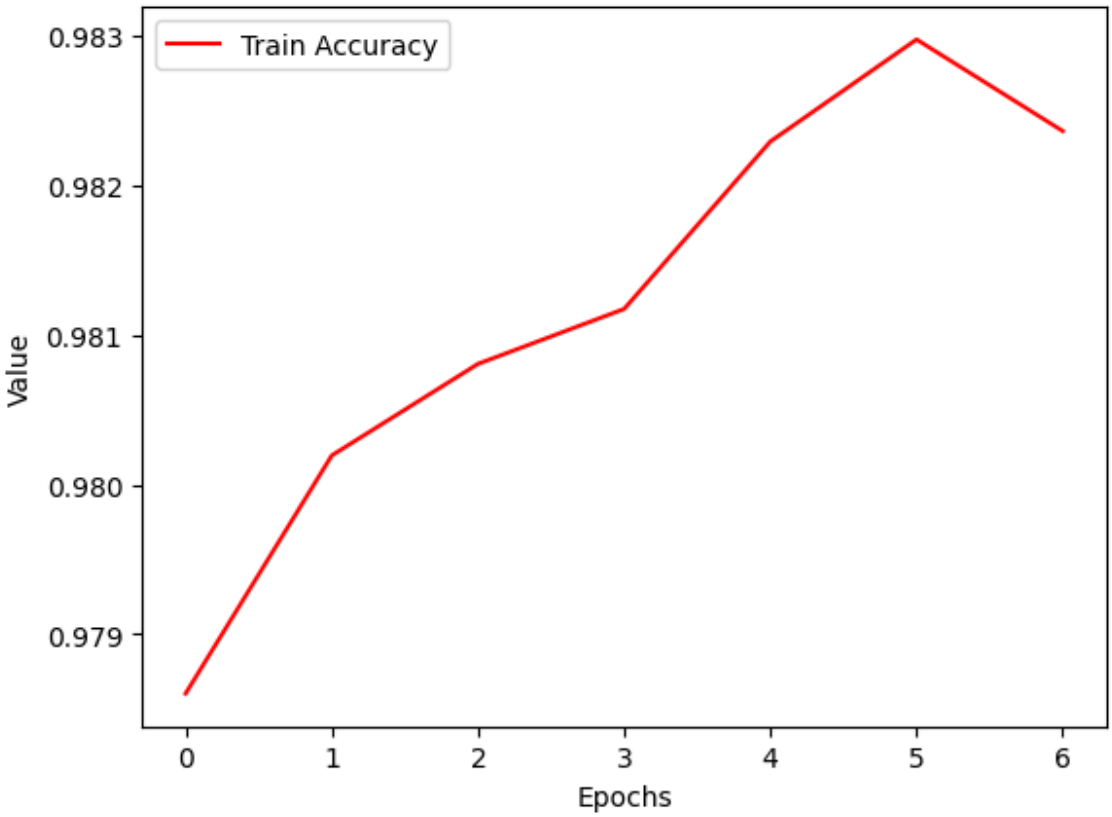
testData_confusion_mat =

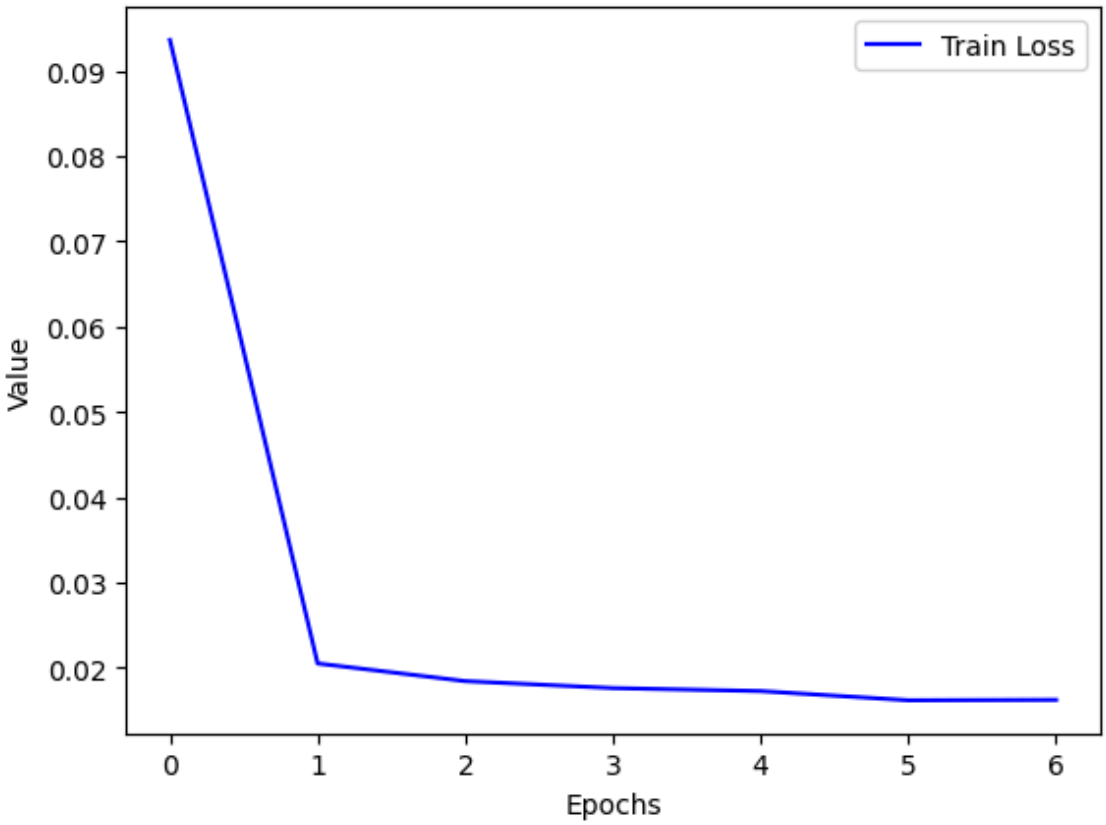
```
[[ 586    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  586    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  210    0    3    0    0    0    0    1    0    0    0
4
     2]
 [   0    0    1 1429    0    0    0    0    0    1    0    1    2
0
     0]
 [   0    0   15    2   51    1    0    0    0    1    2    0    0
3
     1]
 [   0    0    0    0    0  255    0    0    0    0    0    0    0
0
     1]
 [   0    0    0    0    0    0  109    0    0    0    0    0    0
0
     0]
 [   0    0    0    1    1    0    0  443    0    1    0    0   65
1
     0]
 [   0    0    0    0    0    0    0    0   36    0    0    0    0
0
```

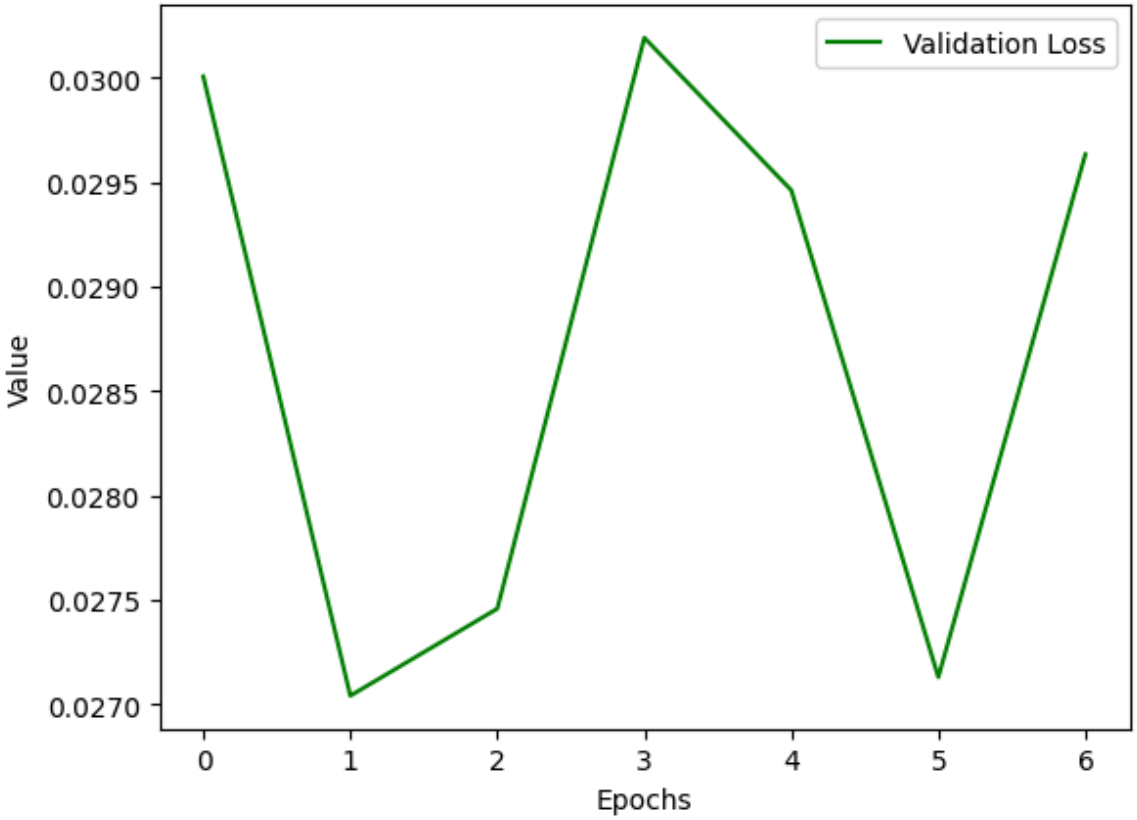
```
      0]
 [    0     0     1     0     1     0     0     0     0 1155     3     0     0
5
      1]
 [    0     0     1     0     0     2     0     0     0     0   122     0     0
1
      1]
 [    0     0     0     2     0     0     0     0     0     0     0    54     0
0
      0]
 [    0     0     0     0     0     0     0     6     0     0     1     0   385
0
      0]
 [    0     0     2     0     1     0     0     0     0     8     6     0     0
1549
      1]
 [    0     0     1     1     5    10     0     0     0     4     4     0     0
0
    604]]
```

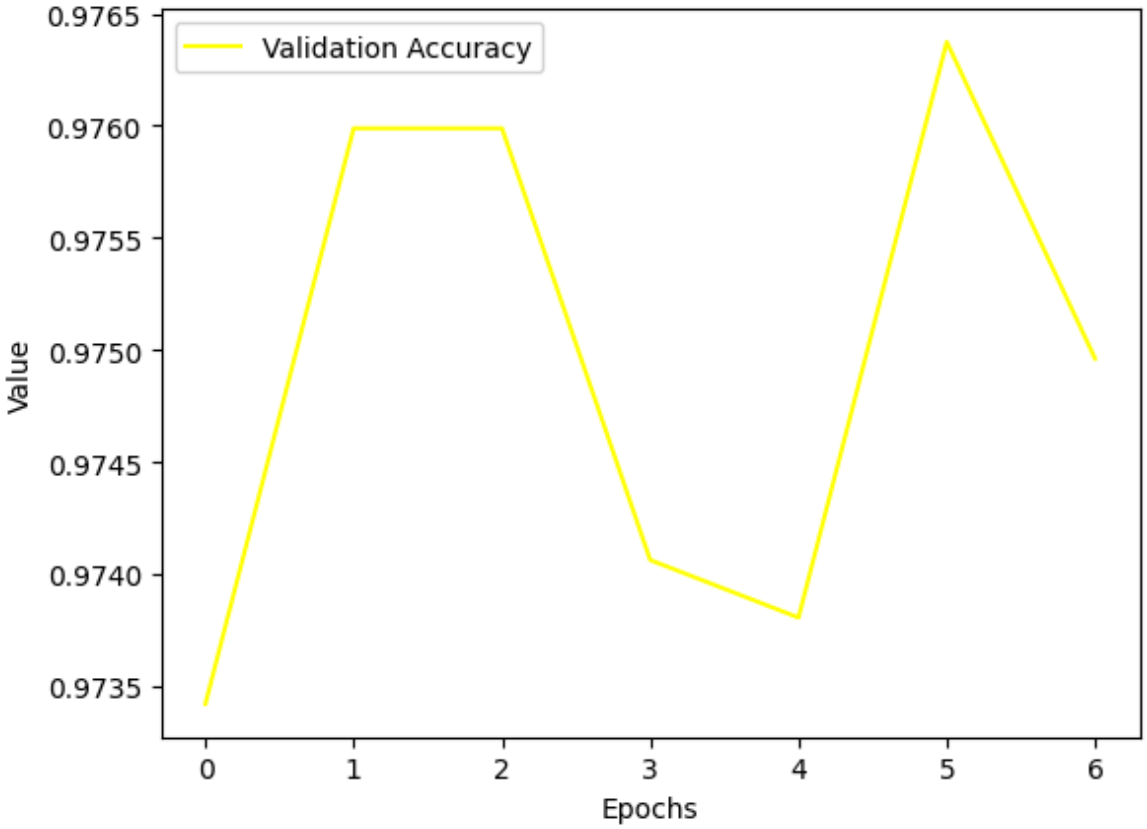
Model : lstm_model_2.pt
Parameters:
model = LSTM(128, 128, 1, len(trainData.vocab),
len(trainData.tagVocab))
optimizer = torch.optim.Adam(model.parameters(), lr=0.025)
train_loss_list, valid_loss_list, train_accuracy_list,
valid_accuracy_list = train(model, trainData, optimizer, criterion,
valData, 4, "Test2")

```
Training model...
Validation loss: 0.03000626340508461
Epoch 1 loss: 0.09359400103619295
Validation loss: 0.027040695771574974
Epoch 2 loss: 0.020520129703235492
Validation loss: 0.027457769960165024
Validation loss increased
Epoch 3 loss: 0.01844894391164851
Validation loss: 0.030191484838724136
Validation loss increased
Epoch 4 loss: 0.017633233306262253
Validation loss: 0.029461102560162544
Epoch 5 loss: 0.017281378668024025
Validation loss: 0.0271297600120306
Epoch 6 loss: 0.016205696170148786
Validation loss: 0.02963349223136902
Validation loss increased
Epoch 7 loss: 0.016253406140230485
```


Train Accuracy
0.983
0.982
0.981
0.980
0.979
Value
0
1
2
3
4
5
6
Epochs


Train Loss
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
Value
0
1
2
3
4
5
6
Epochs


Validation Loss
0.0300
0.0295
0.0290
0.0285
0.0280
0.0275
0.0270
Value
0
1
2
3
4
5
6
Epochs


Validation Accuracy
0.9765
0.9760
0.9755
0.9750
0.9745
0.9740
0.9735
Value
0
1
2
3
4
5
6
Epochs

Loading model...
Training Accuracy: 0.9823622983201357
Metrics of val set:
valData_sk_accuracy=0.9749614791987673
valData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	573
<SOT>	1.00	1.00	1.00	573
adj	0.98	0.88	0.93	227
adp	0.98	1.00	0.99	1415
adv	0.82	0.85	0.83	59
aux	0.97	0.96	0.96	266
cconj	1.00	1.00	1.00	107
det	1.00	0.85	0.92	568
intj	1.00	1.00	1.00	35
noun	0.98	0.98	0.98	1143
num	0.96	0.99	0.97	131
part	0.92	0.79	0.85	73
pron	0.86	0.99	0.92	414
propn	0.99	0.99	0.99	1551
verb	0.96	0.98	0.97	653
accuracy			**0.97**	**7788**
macro avg	**0.96**	**0.95**	**0.96**	**7788**
weighted avg	**0.98**	**0.97**	**0.97**	**7788**

valData_recall_micro=0.9749614791987673
valData_recall_macro=0.9514734869262078
valData_f1_micro=0.9749614791987673
valData_f1_macro=0.9550053318960793
valData_confusion_mat =

```
[[ 573    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  573    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  199    0   10    0    0    0    0   13    1    0    0
3
     1]
 [   0    0    1 1409    0    0    0    0    0    0    0    5    0
0
     0]
```

```
 [   0    0    3    0   50    1    0    0    0    2    1    0    0
0
     2]
 [   0    0    0    0    0  255    0    0    0    0    0    0    0
0
    11]
 [   0    0    0    0    0    0  107    0    0    0    0    0    0
0
     0]
 [   0    0    0   15    0    0    0  485    0    1    0    0   67
0
     0]
 [   0    0    0    0    0    0    0    0   35    0    0    0    0
0
     0]
 [   0    0    0    0    1    1    0    0    0 1125    2    0    0
7
     7]
 [   0    0    0    0    0    0    0    0    0    0  130    0    0
1
     0]
 [   0    0    0   14    0    1    0    0    0    0    0   58    0
0
     0]
 [   0    0    0    1    0    0    0    1    0    0    1    0  411
0
     0]
 [   0    0    0    0    0    0    0    0    0    5    0    0    0
1542
     4]
 [   0    0    0    3    0    5    0    0    0    3    1    0    0
0
   641]]
```

Metrics of test set:

testData_sk_accuracy=0.9788441692466461

testData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	586
<SOT>	1.00	1.00	1.00	586
adj	0.93	0.95	0.94	220
adp	0.99	1.00	1.00	1434
adv	0.87	0.70	0.77	76
aux	0.97	1.00	0.98	256

cconj	1.00	0.99	1.00	109
det	0.99	0.86	0.92	512
intj	1.00	1.00	1.00	36
noun	0.99	0.99	0.99	1166
num	0.94	0.98	0.96	127
part	0.98	0.95	0.96	56
pron	0.85	0.98	0.91	392
propn	0.99	0.99	0.99	1567
verb	0.99	0.97	0.98	629
accuracy			**0.98**	**7752**
macro avg	**0.97**	**0.96**	**0.96**	**7752**
weighted avg	**0.98**	**0.98**	**0.98**	**7752**

testData_recall_micro=0.9788441692466461
testData_recall_macro=0.9565420087002782
testData_f1_micro=0.9788441692466461
testData_f1_macro=0.9595992246174666

testData_confusion_mat =

```
[[ 586    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  586    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  208    0    4    0    0    0    0    3    1    0    0
3
     1]
 [   0    0    0 1430    0    0    0    0    0    0    0    1    2
0
     1]
 [   0    0   14    1   53    1    0    0    0    2    0    0    0
5
     0]
 [   0    0    0    0    0  255    0    0    0    0    0    0    0
0
     1]
 [   0    0    0    0    0    0  108    1    0    0    0    0    0
0
     0]
 [   0    0    0    1    0    0    0  441    0    0    0    0   68
1
     1]
 [   0    0    0    0    0    0    0    0   36    0    0    0    0
0
```

```
      0]
 [    0     0     0     2     2     0     0     0     0 1152     1     0     0
6
      3]
 [    0     0     0     0     0     1     0     0     0     0   124     0     0
1
      1]
 [    0     0     0     3     0     0     0     0     0     0     0    53     0
0
      0]
 [    0     0     0     2     0     0     0     5     0     0     1     0   384
0
      0]
 [    0     0     1     0     0     0     0     0     0     4     2     0     0
1559
      1]
 [    0     0     0     0     2     7     0     0     0     3     3     0     0
1
    613]]
```

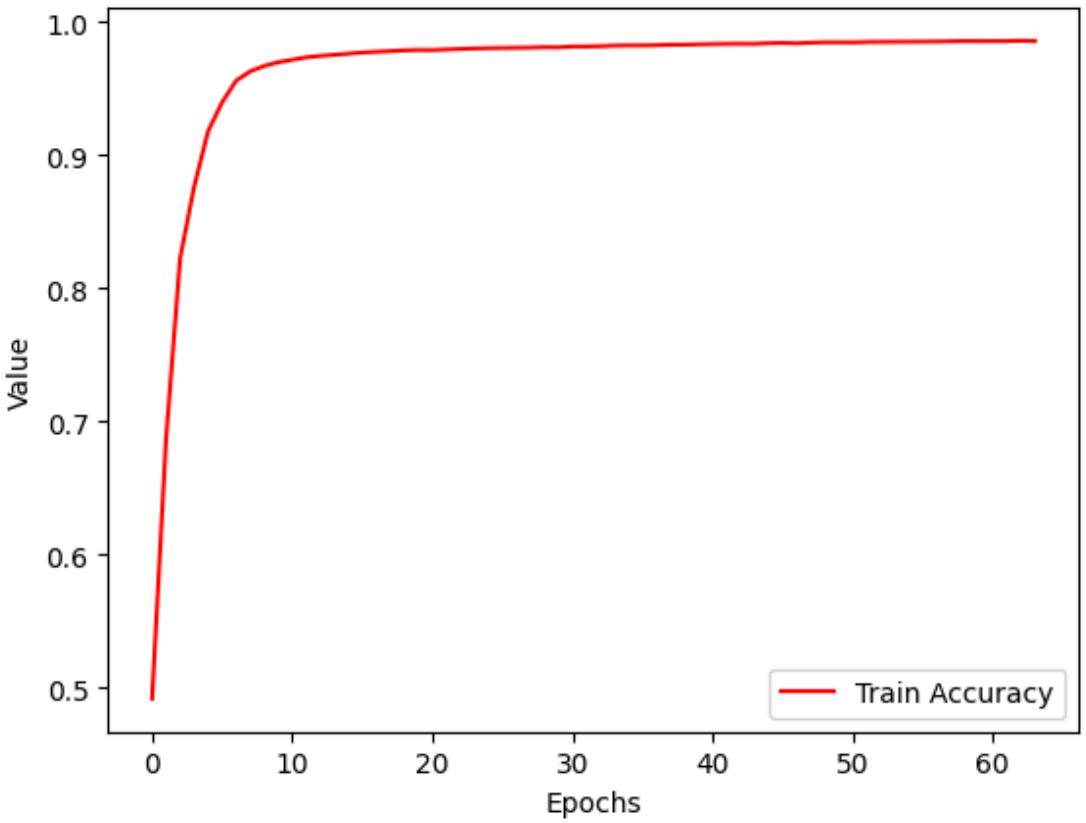
Model : lstm_model_3.pt
Parameters:
model = LSTM(32, 32, 1, len(trainData.vocab), len(trainData.tagVocab))
optimizer = torch.optim.Adam(model.parameters(), lr=0.001)
train_loss_list, valid_loss_list, train_accuracy_list,
valid_accuracy_list = train(model, trainData, optimizer, criterion,
valData, 4, "Test3")

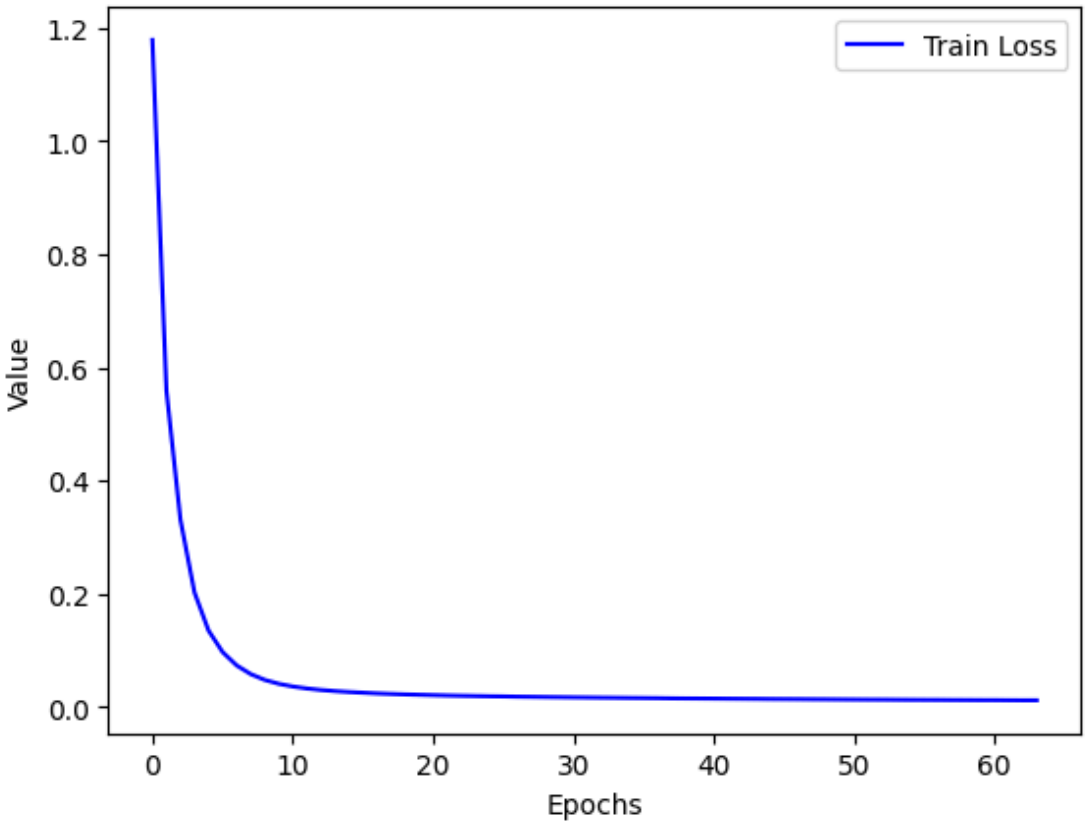
```
Training model...
Validation loss: 0.8267819881439209
Epoch 1 loss: 1.1788430547536308
Validation loss: 0.4886995553970337
Epoch 2 loss: 0.5591191226866707
Validation loss: 0.295136034488678
Epoch 3 loss: 0.33042034795924796
Validation loss: 0.18995629251003265
Epoch 4 loss: 0.20208776341890222
Validation loss: 0.13233111798763275
Epoch 5 loss: 0.1347428599733915
Validation loss: 0.09854885190725327
Epoch 6 loss: 0.09672956324335355
Validation loss: 0.0768512487411499
Epoch 7 loss: 0.07314069457908175
Validation loss: 0.06284667551517487
Epoch 8 loss: 0.057820455560377286
Validation loss: 0.05355506390333176
Epoch 9 loss: 0.047502332408703975
Validation loss: 0.0473376139998436
Epoch 10 loss: 0.04061129728137557
Validation loss: 0.042440060526132584
Epoch 11 loss: 0.03583047377751834
Validation loss: 0.0392436683177948
Epoch 12 loss: 0.032324917211350224
Validation loss: 0.03660435602068901
Epoch 13 loss: 0.029683746890957232
Validation loss: 0.03498818352818489
Epoch 14 loss: 0.027686630625889372
Validation loss: 0.033405497670173645
Epoch 15 loss: 0.02606684780582341
Validation loss: 0.031818464398384094
Epoch 16 loss: 0.02479759951942225
Validation loss: 0.03159680590033531
Epoch 17 loss: 0.023608263442987828
Validation loss: 0.030357791110873222
Epoch 18 loss: 0.022679021283150164
```

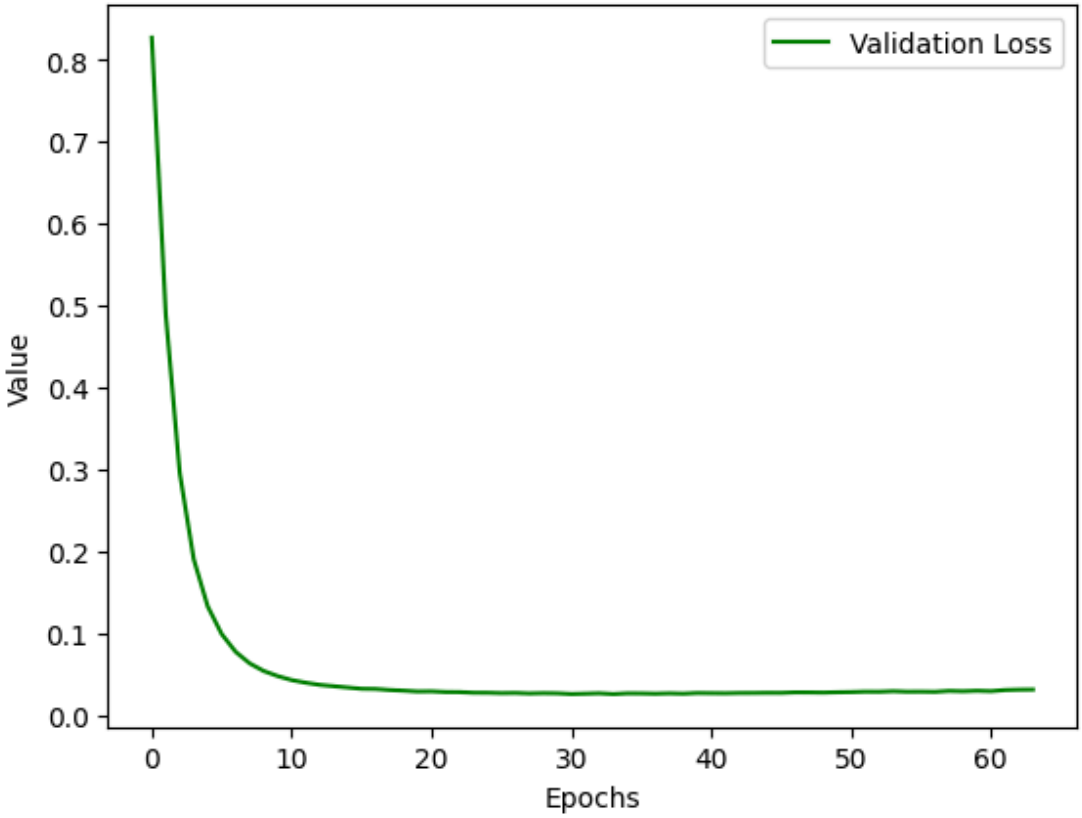
```
Validation loss: 0.029563358053565025
Epoch 19 loss: 0.021862877296534047
Validation loss: 0.028543829917907715
Epoch 20 loss: 0.021176391802450168
Validation loss: 0.02871806174516678
Validation loss increased
Epoch 21 loss: 0.020534275016233103
Validation loss: 0.02789631485939026
Epoch 22 loss: 0.01991789512781065
Validation loss: 0.027775801718235016
Epoch 23 loss: 0.01943285186747228
Validation loss: 0.02702191285789013
Epoch 24 loss: 0.01901908071517055
Validation loss: 0.026976900175213814
Epoch 25 loss: 0.018581606315643484
Validation loss: 0.026539985090494156
Epoch 26 loss: 0.018295775654155817
Validation loss: 0.026751255616545677
Validation loss increased
Epoch 27 loss: 0.01782489790747971
Validation loss: 0.02613043412566185
Epoch 28 loss: 0.01753297629557661
Validation loss: 0.02650010585784912
Validation loss increased
Epoch 29 loss: 0.017196768502107086
Validation loss: 0.02629624679684639
Epoch 30 loss: 0.016911642952585845
Validation loss: 0.025424018502235413
Epoch 31 loss: 0.016631542743225373
Validation loss: 0.025847498327493668
Validation loss increased
Epoch 32 loss: 0.016386105230689715
Validation loss: 0.026316218078136444
Validation loss increased
Epoch 33 loss: 0.016109455529767187
Validation loss: 0.025360288098454475
Epoch 34 loss: 0.015895636696646464
Validation loss: 0.026251591742038727
Validation loss increased
Epoch 35 loss: 0.015636823199161175
Validation loss: 0.026158278807997704
Epoch 36 loss: 0.015469984599708844
Validation loss: 0.025815628468990326
Epoch 37 loss: 0.015253929355279056
Validation loss: 0.026259060949087143
```

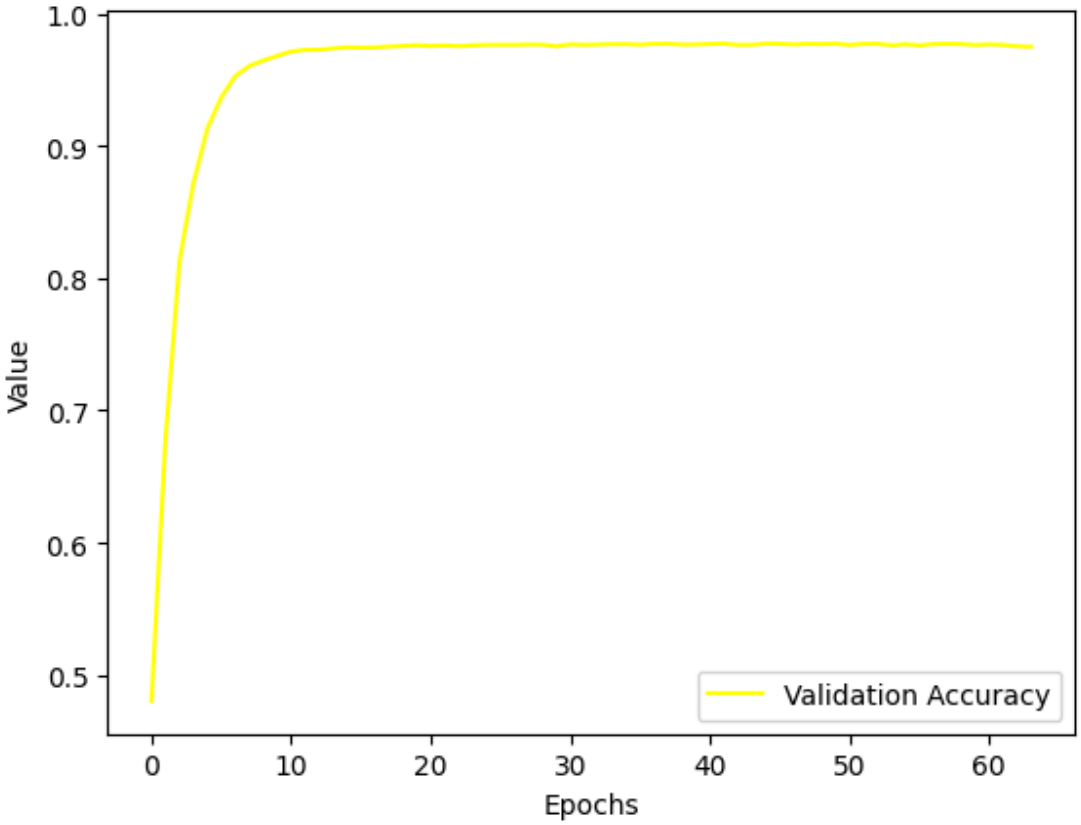
```
Validation loss increased
Epoch 38 loss: 0.014901455112997054
Validation loss: 0.025864901021122932
Epoch 39 loss: 0.014717084185373205
Validation loss: 0.02665800228714943
Validation loss increased
Epoch 40 loss: 0.014591307945744092
Validation loss: 0.02648916095495224
Epoch 41 loss: 0.014425085544752986
Validation loss: 0.02635684609413147
Epoch 42 loss: 0.014228231284016771
Validation loss: 0.02668827772140503
Validation loss increased
Epoch 43 loss: 0.014047954471281437
Validation loss: 0.026729028671979904
Validation loss increased
Epoch 44 loss: 0.013908561180109408
Validation loss: 0.02691001445055008
Validation loss increased
Epoch 45 loss: 0.013688542278928321
Validation loss: 0.026850424706935883
Epoch 46 loss: 0.013564047125626855
Validation loss: 0.027451658621430397
Validation loss increased
Epoch 47 loss: 0.01344645422980634
Validation loss: 0.02739724889397621
Epoch 48 loss: 0.013257850755575989
Validation loss: 0.02720111981034279
Epoch 49 loss: 0.013149918404532902
Validation loss: 0.02758977562189102
Validation loss increased
Epoch 50 loss: 0.012963550099269
Validation loss: 0.027819911018013954
Validation loss increased
Epoch 51 loss: 0.012824700655304451
Validation loss: 0.028300490230321884
Validation loss increased
Epoch 52 loss: 0.012696115143680528
Validation loss: 0.028203044086694717
Epoch 53 loss: 0.012611193947299426
Validation loss: 0.0288703516125679
Validation loss increased
Epoch 54 loss: 0.012467601381714887
Validation loss: 0.028275655582547188
Epoch 55 loss: 0.012309835083893876
```

```
Validation loss: 0.028335047885775566
Validation loss increased
Epoch 56 loss: 0.012215626040306776
Validation loss: 0.028130531311035156
Epoch 57 loss: 0.012145123837182104
Validation loss: 0.02924933098256588
Validation loss increased
Epoch 58 loss: 0.012005117603702776
Validation loss: 0.028833895921707153
Epoch 59 loss: 0.011917717761791019
Validation loss: 0.029429219663143158
Validation loss increased
Epoch 60 loss: 0.011805665036385407
Validation loss: 0.02893529273569584
Epoch 61 loss: 0.011763814669936451
Validation loss: 0.030299536883831024
Validation loss increased
Epoch 62 loss: 0.011619369621013306
Validation loss: 0.030742354691028595
Validation loss increased
Epoch 63 loss: 0.01147879188908125
Validation loss: 0.030897025018930435
Validation loss increased
Epoch 64 loss: 0.011484069381354016
```


1.0
0.9
0.8
0.7
0.6
0.5
Value
Train Accuracy
0
10
20
30
40
50
60
Epochs


1.2
1.0
0.8
0.6
0.4
0.2
0.0
Value
Train Loss
0
10
20
30
40
50
60
Epochs


Validation Loss
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Value
0
10
20
30
40
50
60
Epochs


1.0
0.9
0.8
0.7
0.6
0.5
Value
Validation Accuracy
0
10
20
30
40
50
60
Epochs

Loading model...
Training Accuracy: 0.985910815110039
Metrics of val set:
valData_sk_accuracy=0.9748330765279918
valData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	573
<SOT>	1.00	1.00	1.00	573
adj	0.98	0.89	0.93	227
adp	0.98	0.99	0.99	1415
adv	0.87	0.81	0.84	59
aux	0.99	0.94	0.96	266
cconj	1.00	1.00	1.00	107
det	0.99	0.87	0.93	568
intj	1.00	0.97	0.99	35
noun	0.98	0.99	0.98	1143
num	0.95	0.96	0.96	131
part	0.92	0.90	0.91	73
pron	0.86	0.99	0.92	414
propn	0.99	0.99	0.99	1551
verb	0.95	0.98	0.97	653
accuracy			**0.97**	**7788**
macro avg	**0.96**	**0.95**	**0.96**	**7788**
weighted avg	**0.98**	**0.97**	**0.97**	**7788**

valData_recall_micro=0.9748330765279918
valData_recall_macro=0.9523248095715787
valData_f1_micro=0.9748330765279918
valData_f1_macro=0.9574733859194965
valData_confusion_mat =

```
[[ 573    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  573    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  202    0    6    0    0    0    0   14    0    0    0
3
     2]
 [   0    0    0 1404    0    0    0    1    0    0    0    6    3
0
     1]
```

```
 [   0    0    4    1   48    0    0    0    0    1    1    0    1
0
     3]
 [   0    0    0    0    0  249    0    0    0    0    0    0    0
0
    17]
 [   0    0    0    0    0    0  107    0    0    0    0    0    0
0
     0]
 [   0    0    0   13    0    0    0  494    0    0    1    0   60
0
     0]
 [   0    0    0    0    0    0    0    0   34    0    0    0    0
0
     1]
 [   0    0    0    0    1    0    0    0    0 1127    2    0    0
9
     4]
 [   0    0    0    0    0    0    0    0    0    2  126    0    0
2
     1]
 [   0    0    0    7    0    0    0    0    0    0    0   66    0
0
     0]
 [   0    0    0    1    0    0    0    4    0    1    0    0  408
0
     0]
 [   0    0    1    0    0    0    0    0    0    6    1    0    0
1540
     3]
 [   0    0    0    3    0    3    0    0    0    3    1    0    0
2
   641]]
```

Metrics of test set:

testData_sk_accuracy=0.9780701754385965

testData_classification_rep =

	precision	recall	f1-score	support
<EOT>	1.00	1.00	1.00	586
<SOT>	1.00	1.00	1.00	586
adj	0.92	0.95	0.93	220
adp	1.00	1.00	1.00	1434
adv	0.87	0.70	0.77	76
aux	0.99	0.97	0.98	256

cconj	1.00	1.00	1.00	109
det	0.98	0.87	0.92	512
intj	1.00	1.00	1.00	36
noun	0.99	0.99	0.99	1166
num	0.97	0.93	0.95	127
part	0.98	0.98	0.98	56
pron	0.85	0.97	0.91	392
propn	0.99	0.99	0.99	1567
verb	0.96	0.99	0.98	629
accuracy			**0.98**	**7752**
macro avg	**0.97**	**0.96**	**0.96**	**7752**
weighted avg	**0.98**	**0.98**	**0.98**	**7752**

testData_recall_micro=0.9780701754385965
testData_recall_macro=0.9557698626049818
testData_f1_micro=0.9780701754385965
testData_f1_macro=0.9600307956029778

testData_confusion_mat =

```
[[ 586    0    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0  586    0    0    0    0    0    0    0    0    0    0    0
0
     0]
 [   0    0  209    0    3    0    0    0    0    4    0    0    0
2
     2]
 [   0    0    0 1430    0    0    0    0    0    0    0    1    2
0
     1]
 [   0    0   15    1   53    1    0    0    0    2    0    0    0
3
     1]
 [   0    0    0    0    0  249    0    0    0    0    0    0    0
0
     7]
 [   0    0    0    0    0    0  109    0    0    0    0    0    0
0
     0]
 [   0    0    0    2    0    0    0  445    0    0    0    0   63
1
     1]
 [   0    0    0    0    0    0    0    0   36    0    0    0    0
0
```

```
      0]
 [    0     0     2     0     2     0     0     0     0 1149     0     0     0
8
      5]
 [    0     0     0     0     0     0     0     0     0     2   118     0     0
3
      4]
 [    0     0     0     1     0     0     0     0     0     0     0    55     0
0
      0]
 [    0     0     0     2     0     0     0     7     0     0     1     0   382
0
      0]
 [    0     0     1     0     1     0     0     0     0     7     2     0     0
1554
      2]
 [    0     0     1     1     2     1     0     0     0     2     1     0     0
0
    621]]
```