

Report - INLP Assignment 2



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Brief Info about the models

All of these insights are related to a LSTM model that was developed for the purpose of POS tagging. The various hyper parameters were modified throughout to test out which one is the best for the given corpus and purpose of executing the task for the assignment.

The LSTM was built using PyTorch.

Various Hyper parameters used and their scores obtained

```
#hyperparameters
```

```
EMBEDDING_DIM = 64  
HIDDEN_DIM = 64  
EPOCHS = 10  
LEARNING_RATE = 0.01  
NUM_LAYERS = 2
```

```
Accuracy: 0.9332324876899561  
Precision: 0.9208403094511413  
Recall: 0.9332324876899561  
F1 Score: 0.9217010749413027
```

```
[227] #hyperparameters
```

```
EMBEDDING_DIM = 32  
HIDDEN_DIM = 32  
EPOCHS = 30  
LEARNING_RATE = 0.01  
NUM_LAYERS = 2
```

```
Accuracy: 0.9482284128213696  
Precision: 0.9416743593516217  
Recall: 0.9482284128213696  
F1 Score: 0.9402486284168468
```

[232] #hyperparameters

```
EMBEDDING_DIM = 32
HIDDEN_DIM = 32
EPOCHS = 20
LEARNING_RATE = 0.01
NUM_LAYERS = 2
```

Accuracy: 0.946796237402346
Precision: 0.9395169700387428
Recall: 0.946796237402346
F1 Score: 0.9385257514571439

[236] #hyperparameters

```
EMBEDDING_DIM = 32
HIDDEN_DIM = 32
EPOCHS = 10
LEARNING_RATE = 0.01
NUM_LAYERS = 2
```

Accuracy: 0.9083079999499416
Precision: 0.8910286238149344
Recall: 0.9083079999499416
F1 Score: 0.8925134187268826

[240] #hyperparameters

```
EMBEDDING_DIM = 128
HIDDEN_DIM = 128
EPOCHS = 10
LEARNING_RATE = 0.01
NUM_LAYERS = 3
```

Accuracy: 0.9181651893897138
Precision: 0.9033718738930718
Recall: 0.9181651893897138
F1 Score: 0.9043694170867665

[244] #hyperparameters

```
EMBEDDING_DIM = 32
HIDDEN_DIM = 32
EPOCHS = 10
LEARNING_RATE = 0.01
NUM_LAYERS = 3
```

Accuracy: 0.8339077756040556
Precision: 0.8078392049585712
Recall: 0.8339077756040556
F1 Score: 0.8098706732239543

[30] #hyperparameters

```
EMBEDDING_DIM = 128
HIDDEN_DIM = 128
EPOCHS = 10
LEARNING_RATE = 0.01
NUM_LAYERS = 2
```

Accuracy: 0.9467025328411389
Precision: 0.9380710198751867
Recall: 0.9467025328411389
F1 Score: 0.9375683302108772

```
[34] #hyperparameters  
  
EMBEDDING_DIM = 64  
HIDDEN_DIM = 64  
EPOCHS = 20  
LEARNING_RATE = 0.01  
NUM_LAYERS = 2
```

```
Accuracy: 0.952530304320399  
Precision: 0.9454432719959998  
Recall: 0.952530304320399  
F1 Score: 0.9446978608149081
```

```
#hyperparameters  
  
EMBEDDING_DIM = 128  
HIDDEN_DIM = 128  
EPOCHS = 20  
LEARNING_RATE = 0.01  
NUM_LAYERS = 2
```

```
Accuracy: 0.9567099267945275  
Precision: 0.9498349803110567  
Recall: 0.9567099267945275  
F1 Score: 0.9493526777623749
```

```
[42] #hyperparameters  
  
EMBEDDING_DIM = 64  
HIDDEN_DIM = 64  
EPOCHS = 10  
LEARNING_RATE = 0.01  
NUM_LAYERS = 3
```

```
Accuracy: 0.8901814035938865  
Precision: 0.8622641584958788  
Recall: 0.8901814035938865  
F1 Score: 0.8678366328020454
```

Analysis and Insights

As we can see when the embedding and hidden dimensions were made 128 and we had 20 epochs for the model, we had the best accuracy scores which would give us the best trained model.

In addition to that, messing around with the numbers gave us insightful results like how increasing the dimension usually leads to an increase in accuracy - atleast that was the trend that we could observe for the increase from 32 to 64 to 128.

However, what we should also note in this case is how increasing the number of layers or adding more hidden layers actually decreased the accuracy of the model.

Also, increasing the epochs also increased the accuracy but usually the models would hit a sort of saturation point after which increasing the epochs didn't really bring about much change in the results that the model would generate.

You can find the notebooks used for the generation of the various models (along with the different important hyperparameters in the given notebooks

1. <https://colab.research.google.com/drive/1uatJWV8XY17-jqBOX4JOp2Jj0YumzJa5?usp=sharing>
2. https://colab.research.google.com/drive/1C5tvWEQX_M-7s_ZDV3fhYm80B5aV5JxL?usp=sharing

These notebooks can give us more insights into the models that were trained and the results obtained from those trainings.

Best Trained Model

Hyperparameters

```
EMBEDDING_DIM = 128
HIDDEN_DIM = 128
EPOCHS = 20
LEARNING_RATE = 0.01
NUM_LAYERS = 2
```

Training Loss Values

```
Starting Training...
Epoch 1      Training Loss: 1.8048821604441525      Validation Loss: 1.5060969511424744
Epoch 2      Training Loss: 1.091363285015789      Validation Loss: 0.8737715017115633
Epoch 3      Training Loss: 0.6322936181512443      Validation Loss: 0.535410837651315
Epoch 4      Training Loss: 0.3856264177470559      Validation Loss: 0.36531748769518274
Epoch 5      Training Loss: 0.26051719477122903      Validation Loss: 0.27663305387636844
Epoch 6      Training Loss: 0.19221946954802677      Validation Loss: 0.22619806121427474
Epoch 7      Training Loss: 0.15078912450476328      Validation Loss: 0.19482802618738634
Epoch 8      Training Loss: 0.12338163430168042      Validation Loss: 0.17389993357225453
Epoch 9      Training Loss: 0.10426746126729614      Validation Loss: 0.15976056379328768
Epoch 10     Training Loss: 0.09059239053899289      Validation Loss: 0.15021958770370844
Epoch 11     Training Loss: 0.08054395009772718      Validation Loss: 0.14365090809170633
Epoch 12     Training Loss: 0.07294818388594804      Validation Loss: 0.13896025639624496
Epoch 13     Training Loss: 0.06704828108792409      Validation Loss: 0.1355180499514616
Epoch 14     Training Loss: 0.062368383704768625      Validation Loss: 0.13292539751227786
Epoch 15     Training Loss: 0.05859409918534385      Validation Loss: 0.13100562664008353
Epoch 16     Training Loss: 0.05550876141976158      Validation Loss: 0.1296393499070908
Epoch 17     Training Loss: 0.052947473300971305      Validation Loss: 0.12866969705598288
Epoch 18     Training Loss: 0.05078520817454655      Validation Loss: 0.1279551641532412
Epoch 19     Training Loss: 0.04893679188223951      Validation Loss: 0.12738905501393383
Epoch 20     Training Loss: 0.04733873602130755      Validation Loss: 0.1269180295392136
```

Scores obtained

```
Accuracy: 0.9567099267945275  
Precision: 0.9498349803110567  
Recall: 0.9567099267945275  
F1 Score: 0.9493526777623749
```