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Application of ML
Homework 6

Problem 1:

a) AirModel consists of two layers, the first being an LSTM layer which feeds a fully connected linear layer. The input of the LSTM is the input sequence given in airline-passengers.csv. The LSTM is one layer with 50 features which represent the hidden state h. The linear layer then has an output of a single value, the estimated airline passengers. This model is trained using the Adam optimizer and MSE Loss function.

b) Lookback parameter tuning:

Lookback = 4

```
Epoch 1900: train RMSE 21.4035, test RMSE 79.0935
```

Lookback = 5

```
Epoch 1900: train RMSE 18.4333, test RMSE 78.8678
```

Lookback = 6

```
Epoch 1900: train RMSE 17.0207, test RMSE 77.2110
```

Lookback = 7

```
Epoch 1900: train RMSE 16.4082, test RMSE 77.8989
```

Lookback = 8

```
Epoch 1900: train RMSE 14.8903, test RMSE 77.8461
```

Lookback = 10

```
Epoch 1900: train RMSE 14.0684, test RMSE 81.8245
```

Lookback = 20

```
Epoch 1900: train RMSE 9.7112, test RMSE 88.0112
```

Lookback = 30

```
Epoch 1900: train RMSE 8.4731, test RMSE 94.3163
```

Given these results, the best value for the lookback parameter in the data loader is with lookback=6.

Problem 2:

a) The transformer consists of encoder layers, decoder layers, and within these is a feed forward neural network and self-attention calculations. These attributes are established when the transformer is initialized. To start, the embedding is size 512, with the feed forward

network having dimensionality of 512 also. To start with there are two encoder structures and two decoder structures before assessing output probabilities. Note that the first encoder and decoder also use an embedding layer. The transformer uses cross entropy loss and the Adam optimizer for training.

b) Training completed, sentences below:

```
print(translate(transformer, "Eine Gruppe von Menschen steht vor einem Iglu ."))
# A group of people stand in front of an igloo.
print(translate(transformer, "Hallo, mein Name ist Tim Horrell ."))
# Hello my name is Tim Horrell
print(translate(transformer, "Es macht mir Spaß, etwas über Computertechnik zu lernen ."))
# I enjoy learning about computer engineering
print(translate(transformer, "Ich hoffe, dass Sie bei der Benotung dieser Hausaufgabe gnädig sind ."))
# I hope you are merciful in grading this homework
print(translate(transformer, "Ich habe heute zum Frühstück einen Apfel und Haferflocken gegessen ."))
# I ate an apple and oatmeal for breakfast today
```

c) Layers = 2

```
A group of people standing in front of an office .
A football player is fixing the same time .
There is a football player having fun over some sort of wood .
I I I for the goal at the same time .
I I players 's out of an apple , and one is putting on an empty and
```

Layers = 3

```
A group of people stand in front of an empty instrument .
A bunch of dogs are fixing the bubble .
There is a conversation while something on something board .
I I I see the puck with the puck .
I I I see a speech and groom .
```