Multistep Air Quality Forecasting Report

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Problem Description

The dataset contains air quality of four different cities B,G,S,T. We have to prepare a deep learning architecture to forecast/predict air quality of these cities for Multiple days (i.e. step size). We have to train the model for each city independently of each other that is the model should handle multiple units of independent dataset. To predict the air quality (PM25 Concentration), we have to use all the attributes for example weather, temperature etc.

Model Architecture

- Before performing training process, the categorical attributes need to be converted to numerical entry, if any found. After this, there is a need to scale the input data so that model works stable on every data. So we scaled it to 0-1 using MinMaxScaler.
- We also implemented the early stopping mechanism so that the model doesn't get overfit due to large training process.
- The model consists of two LSTM layers with ReLU activation functions, a Dense layer with a linear activation function using the Adam optimizer with a specified learning rate 0.0001. The loss function used for training is Mean Squared Error (MSE), and the model's performance is evaluated using Mean Squared Error as a metric.

Layer 1: LSTM
- Number of Units: 50
- Activation Function: ReLU

Layer 2: LSTM
- Number of Units: 50
- Activation Function: ReLU

Layer 3: Dense
- Number of Units: n_steps_out

Layer 4: Activation
- Activation Function: Linear

Optimizer: Adam
- Learning Rate: 0.0001

Loss Function: Mean Squared Error (MSE)
Metrics: Mean Squared Error (MSE)

Training Process

Before training, we splitted the data into 80:20 ratio. We used 20% for the data for the validation purpose. Then the model is optimized using the Adam optimizer and the training is performed using the mean squared error as the loss function for 500 epochs. The training progress is monitored using the mean squared error metric, and the training and validation data are specified for the training process. At each epoch, we took a window of 128 days to predict the air quality of next 30 days. In this way, we trained the model on the dataset.

Testing Process

Similar to training process, there is a need for data pre-processing before we test it on the model. Firstly, the data needs to be scaled down to 0-1 values. Also, Change the categorical values to numerical values if found any. Then we send the model for the prediction. To compare with the original data, we need to reconstruct the value or transform it to original form. After that, we can compare and get the results in form of MSE and MAE.

Evaluation Results

After testing the data on test_datasets provided, following results are achieved:

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City B:
Mean Squared Error (MSE): 0.002714649574552171
Mean Absolute Error (MAE): 0.037899698505754746
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City G:
Mean Squared Error (MSE): 0.0037706239547818502
Mean Absolute Error (MAE): 0.04572688940876896

City S:
Mean Squared Error (MSE): 0.006804956263485068
Mean Absolute Error (MAE): 0.06208550218273405

City T:
Mean Squared Error (MSE): 0.0028759463480074097
Mean Absolute Error (MAE): 0.038998570219962864
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