**Assignment 3- Time-Series Data**

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Used MSE loss function, Mean Absolute Error (MAE) metric and rmseprop optimizer to learn how different methodologies affect the performance of the models.

I have used MAE over accuracy as MAE is a better statistic than Accuracy for temperature prediction as the goal here is to predict continuous numerical values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Dense Units | Dropout | Loss | Test MAE |
| Basic Machine Learning model | 16 | No | 11.3323 | 2.64 |
| Basic Machine Learning model | 8 | No | 11.7202 | 2.67 |
| Basic Machine Learning model | 32 | No | 11.2124 | 2.64 |
| Basic Machine Learning model | 64 | No | 11.4702 | 2.67 |
| 1D Convolution model | 16 | No | 15.6535 | 3.13 |
| RNN models | | | | |
| LSTM layers | 16 | No | 10.8068 | 2.58 |
| LSTM layers | 16 | Yes | 10.7598 | 2.57 |
| GRU (later replaced with LSTM)- not needed but did for comparison | 16 | Yes | 9.8051 | 2.44 |
| Bidirectional LSTM model | 16 | No | 10.9463 | 2.6 |
| Combination of 1d\_Convent and LSTM model with dropout | | | | |
| Combination | 16 | Yes | 10.5596 | 2.56 |

**Summary:**

* Increasing the number of dense units in the hidden layers doesn't consistently lead to better performance. In some cases, models with fewer units achieve better accuracy.
* When running the basic machine learning model with different dense units of 8, 16, 32 and 64, both 16 and 32 have the best Test MAE. I have considered dense unit 16 to check Test MAE and loss function for 1D Convolution model and other RNN models (LSTM layer, GRU and Bidirectional LSTM model)

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* Configuration 16 attains best MAE of 2.64 with loss of 11.3323 but there is not much difference between all the different combinations.
* Among all the different combinations tried excluding GRU, LSTM model with dropout (0.5) has the best MAE of 2.57 and less loss function of 10.7598

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* Have combined LSTM model with dropout (0.5) with 1d\_convents as it has the best MAE. The combination gave the best MAE among all the models with MAE OF 2.56 and loss function 10.5596.

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**Recommendations:**

* Using MAE (Mean Absolute Error) is appropriate for time-series data, especially when the goal is to predict continuous numerical values like temperature.
* Using dropout can help prevent overfitting, as evidenced by the LSTM model with dropout achieving a lower MAE and loss.
* The 1D Convolution model has higher MAE compared to some of the RNN models, indicating that RNNs might be more suitable for the given time-series data.
* Combining LSTM with dropout and 1D Convolution layers results in the best MAE of 2.56 and a lower loss function of 10.5596, suggesting that this hybrid approach is a strong candidate for temperature prediction.
* There is no consistent improvement in performance when the number of dense units in the hidden layers is increased. Models with fewer units can sometimes attain higher accuracy. Achieving equilibrium and considering the trade-off between model complexity and performance is crucial.

To further improve the accuracy of temperature forecasts, it is advised to concentrate on the LSTM model with dropout and investigate combinations of various architectures, such as LSTM with 1D Convolution. Additionally, MAE is a better statistic than accuracy given the nature of the assignment. Temperature prediction models may do even better with additional experimentation and fine-tuning.