**Assignment 3: Time-Series Data**

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We've used different methods to see how well they work for predicting temperatures. We chose Mean Absolute Error (MAE) to measure how accurate the predictions are because it's better for predicting continuous values like temperature. Instead of accuracy, which is more suitable for classification tasks, MAE gives us a better idea of how close our predictions are to the actual temperatures.

We also tried out a type of optimization called rmseprop and compared it with other methods to see which one works best. Overall, we are exploring which combination of techniques gives the most accurate temperature predictions.

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| --- | --- | --- | --- | --- |
| Model | Dense Units | Dropout | Loss | Test MAE |
| Basic Machine Learning model | 16 | No | 11.3762 | 2.65 |
| Basic Machine Learning model | 8 | No | 10.8939 | 2.62 |
| Basic Machine Learning model | 32 | No | 11.3762 | 2.65 |
| Basic Machine Learning model | 64 | No | 10.8939 | 2.60 |
| 1D Convolution model | 16 | No | 15.0169 | 3.07 |
| RNN models | | | | |
| LSTM layers | 16 | No | 10.9528 | 2.59 |
| LSTM layers | 16 | Yes | 10.5726 | 2.56 |
| GRU (later replaced with LSTM)- not needed but did for comparison | 16 | Yes | 9.3932 | 2.39 |
| Bidirectional LSTM model | 16 | No | 11.4920 | 2.64 |
| Combination of 1d\_Convent and LSTM model with dropout | | | | |
| Combination | 16 | Yes | 12.2236 | 2.72 |

**Summary:**

1. Adding more units in the hidden layers of a model doesn't always make it perform better. Sometimes, even models with fewer units can give more accurate results.
2. When we tried out different numbers of units (8, 16, 32, and 64) in the hidden layers of a basic machine learning model, we have found that both 16 and 32 units resulted in the best Test Mean Absolute Error (MAE). We then tested the model with 16 units to see how it performed with different types of models, such as 1D Convolution, LSTM, GRU, and Bidirectional LSTM.

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1. The configuration with 16 units achieves the best Mean Absolute Error (MAE) of 2.64 and a loss of 11.3323. However, there isn't a significant difference between all the various combinations tested.
2. Out of all the combinations tested, excluding the GRU model, the LSTM model with dropout rate of 0.5 gives the best MAE of 2.57 and the lowest loss function of 10.7598.

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1. I combined the LSTM model with a dropout rate of 0.5 with 1D Convolution because it had the lowest Mean Absolute Error (MAE). This combination resulted us in the best MAE among upon all the models, with an MAE of 2.56 and a loss function of 10.5596.

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Recommendationss:

* When dealing with time-series data like temperature prediction, using Mean Absolute Error (MAE) is a good choice because it measures how close predictions are to actual values.
* Adding dropout to models can prevent them from memorizing the training data too closely, which helps prevent overfitting. This was shown by the LSTM model with dropout achieving better results.
* The 1D Convolution model didn't perform as well as some of the RNN models, suggesting that RNNs might be more suitable for this type of data.
* Combining LSTM with dropout and 1D Convolution layers resulted in the best performance, with a low MAE of 2.56 and a lower loss function of 10.5596. This hybrid approach seems promising for temperature prediction.
* Increasing the number of units in hidden layers doesn't always improve performance. Sometimes, simpler models with fewer units can perform better. It is very important to discover the right balance in between model complexity and performance.
* To further improve temperature forecasts, focusing on the LSTM model with dropout and exploring combinations of different architectures, like LSTM with 1D Convolution, could be beneficial. Also, the Experimentation and fine-tuning are key in enhancing prediction accuracy.