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Advanced Machine Learning (BA-64061-003)

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Assignment 3 Report

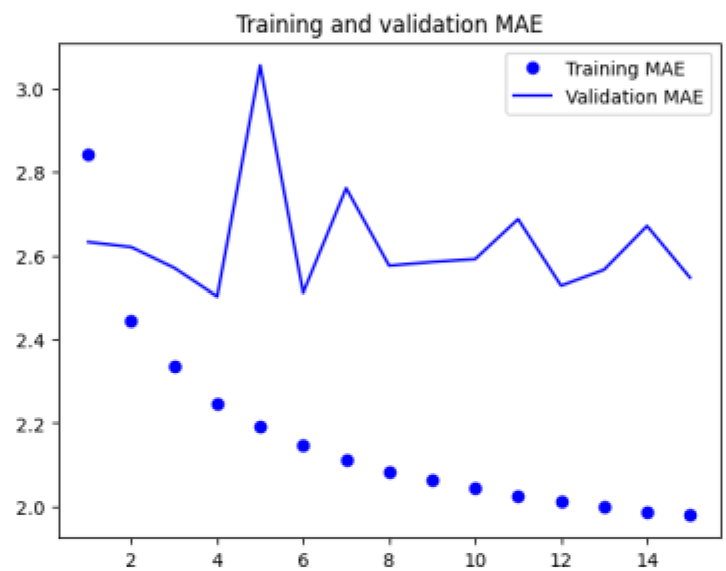
Time-series forecasting plays an important role in many different industries, from Weather predictions to financial forecasting. This is because I must have the ability to understand and predict trends over time to ensure that organizations have the ability to make educated business decisions. In this report, I explore the different machine learning approaches for time-series modeling and evaluate their performance using Mean Absolute Error (MAE) as a metric. "MAE is defined as the average variance between the significant values in the dataset and the projected values in the same dataset" (*Mean Absolute Error - an Overview | ScienceDirect Topics*, n.d.).

In this report, I compared a few different model configurations. First, a basic machine learning example that serves as the baseline. Second, Long Short-Term Memory (LSTM) layering, "LSTM networks are a type of recurrent neural network capable of learning order dependence in sequence prediction problems" (Brownlee, 2017). Thirdly, I used a combination of 1D convolutional layers (1D convnets) and recurrent neural network (RNN) layers, specifically LSTM, to capture spatial and temporal patterns at the same time. Lastly, I adjusted the number of units in each recurrent layer to optimize the model's architecture.

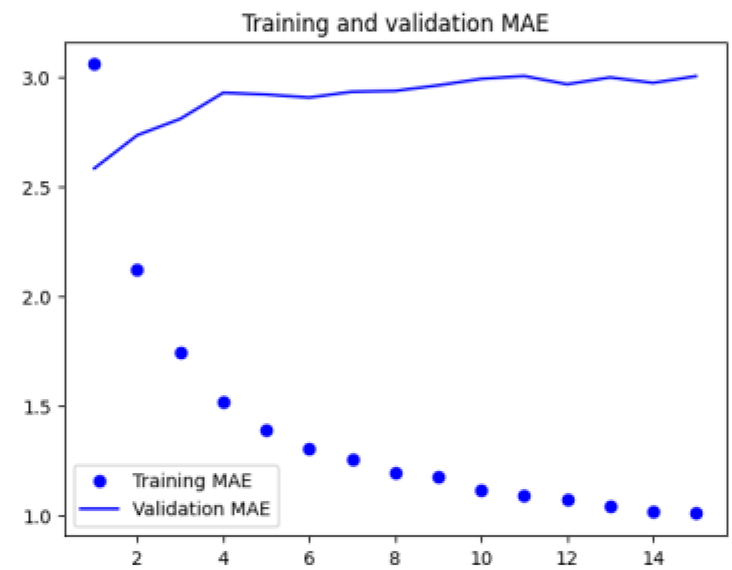
The MAE values obtained from each model configuration are used to assess the effectiveness of these approaches in improving time-series forecasting accuracy. My goal is to identify which techniques and architectures yield the best results for the given time-series data.

Report Structure:

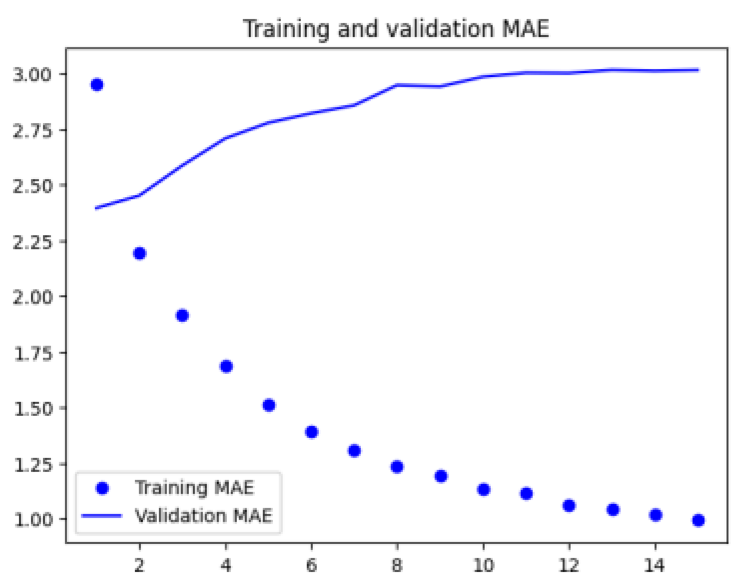
- Basic Machine Learning Example:
  - On the test dataset I received an MAE result of 8.85.
  - This model was used to provide a baseline for my additional attempts at the time-series forecasting assignment without using advanced techniques specific to sequential data. The relatively high MAE appears to suggest that the model may not capture the temporal patterns and dependencies effectively.



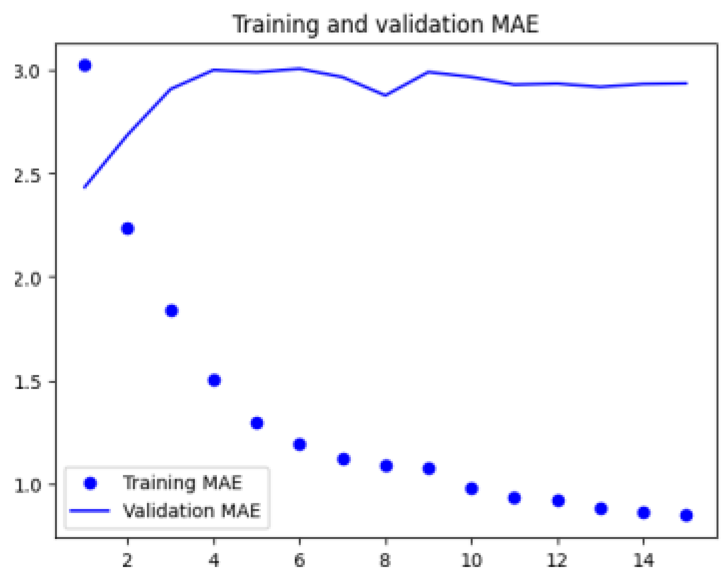
- LSTM Layering:
  - On the test dataset I received an MAE result of 3.12
  - By using a stacked setup of LSTM layers, the models show a considerable improvement compared to the basic machine learning approach. The use of LSTM layers allowed the model to better capture long-term dependencies in the time-series data, resulting in a lower MAE.



- Combination of 1D Convnets & RNN:
  - On the test dataset I received an MAE result of 3.11
  - In this model I combined 1D convolutional layers (1D convnets) with recurrent neural networks (RNN) layers, specifically LSTM. The combination of these layers likely helps in capturing both spatial and temporal patterns in the data. Leading to a similar MAE as the stacked LSTM approach.



- Adjusting the number of units in each recurrent layer:
    - On the test dataset I received an MAE result of 3.08
    - In this model I was able to achieve the lowest MAE among the test models, by adjusting the number of units in each recurrent layer in a stacked LSTM setup. This would suggest that tuning the architecture, particularly the number of units, can have a positive impact on model performance.



In conclusion, the results demonstrate the effectiveness of utilizing advanced techniques such as LSTM layering, combining 1D convnets with RNN, and fine-tuning the model's architecture in improving the accuracy of time-series models. The approach of adjusting the number of units in each recurrent layer shows the most significant improvement, indicating the importance of model structure in designing effective models for time-series data. Overall, the models using LSTM layers and combinations of convolutional and recurrent layers outperform the basic machine learning examples. Which highlights the importance of leveraging advanced architectures for sequential data analysis.

References:

Mean Absolute Error—An overview | ScienceDirect Topics. (n.d.). Retrieved April 4, 2024, from https://www.sciencedirect.com/topics/engineering/mean-absolute-error

Brownlee, J. (2017, May 23). A Gentle Introduction to Long Short-Term Memory Networks by the Experts. *MachineLearningMastery.Com*. https://machinelearningmastery.com/gentle-introduction-long-short-term-memory-networks-experts/