

Multi-Source Transformer Models for Time Series Forecasting

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Introduction

Time series forecasting is a common and widely-used approach to predict the future data points in a time series.



Traditional techniques: AR model, ARMA model, ARIMA model,.....

New Approach: Deep learning models for sequential data(RNN, Transformer,...)

Problem Formulation

- Target time series data: \mathbf{X}_0 , with $\mathbf{X}_0 = (x_{0,1}, x_{0,2}, \dots, x_{0,t})$ observed.
- Other k time series $\mathbf{X}_1, \mathbf{X}_2, \dots, \mathbf{X}_k$, where $\mathbf{X}_i = (x_{i,1}, x_{i,2}, \dots, x_{i,t})$, $i = 0, \dots, k$.
- Main Problem: Forecasting the unobserved future data points $x_{0,t+1}$ of \mathbf{X}_0 .
- Key design: We pile up these time series together as a matrix time series. We denote this $(k+1) \times t$ matrix as \mathbf{D} , where $\mathbf{D} = (\mathbf{X}_0, \mathbf{X}_1, \dots, \mathbf{X}_k)'$. The input is \mathbf{D} and the output is $x_{0,t+1}$.

Transformer

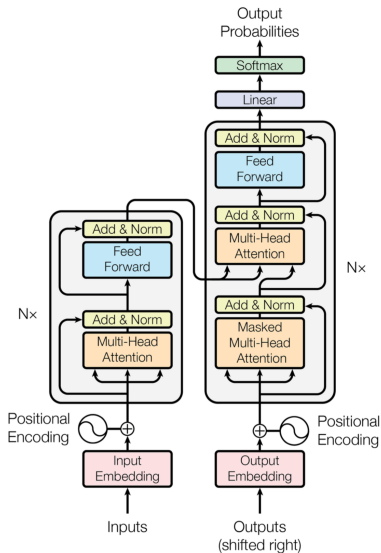
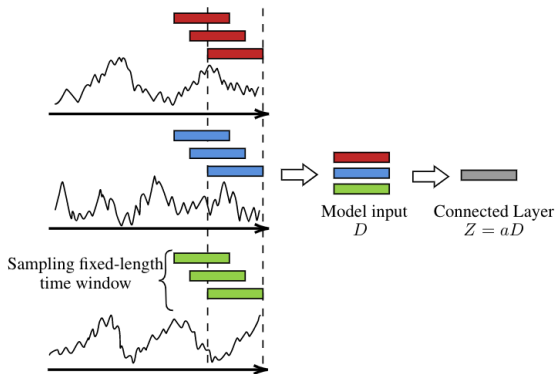


Figure 1: The Transformer - model architecture.

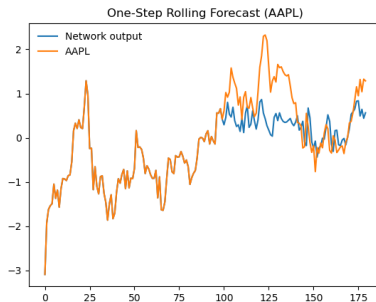
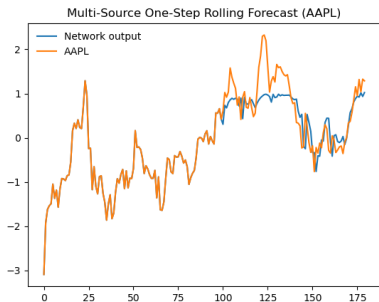
New model based on transformer

We use the similar approach as the transformer model(Encoder, Decoder). The major design is, for the data fed into the transformer, we added another fully connected layer to combine multiple sources.



Results

We ran our algorithm on the stock market data for Apple Inc. The target is the stock value while the additional source is the transaction volume. We also take the existing method (single source) as the baseline.



We could see that our method could make better results on the forecasting accuracy.

Conclusion

Below is the major contribution for the research project:

- We designed a novel framework to make time series forecasting based on multi-sources time series through transformer. From our knowledge, this is the first work which considers time series forecasting from multi-sources by transformer in the deep learning field.
- We further analysed the stock market value prediction through our algorithm. After evaluation, we have shown that our algorithm benefits the prediction accuracy and greatly improve the results compared with previous work.

The End