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Improve office air quality prediction performance with Transformer and GRU/LSTM

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This work presents an air quality prediction in the office environment using deep neural networks. The experiment was conducted and the proposed approach showed that it gives good performance at the present time. The deep learning model is used with a combination of Transformer and GRU/LSTM models. Multivariate combination solutions, quantitative regression, and feature selection are researched and used.

Keywords: Machine learning, Time-series forecasting, Transfomer, GRU, LSTM

Introduction: Time series forecasting is an important task in modeling time series data and an important area of machine learning. Currently, with climate change, taking care of health is a top concern. Office air quality directly affects our health, as well as affects work performance. In this paper, we develop a machine learning model based on Transformer and GRU/LSTM that take advantage of the self-attention mechanism to learn complex patterns and dynamics from time series data. Furthermore, it can be applied to univariate and multivariable time series. Forecasting based on data on temperature and humidity in the office, we get good results with low error compared to previous traditional time series forecasting models such as multistage LSTM/GRU, RNN....

Office air quality data is obtained from sensors such as DHT-22 and MHZ-19B… Data is preprocessed with median values every 1 min.

Main content: Given a time series containing N data points $X_{t-N+1}, \dots X_{t-1}, X_t$ for the first M prediction steps.

The input X of the supervised machine learning model is $X_{t-N+1}, \dots X_{t-M}$ and the output Y is $X_{t-M+1}, X_{t-M+2}, \dots, X_t$.

Each data point X_i can be a scalar or a vector of multiple features.

Using Gating mechanisms to ignore unused components, they provide adaptive depth and complexity of the network to accommodate different input variables. The Variable selection network to select relevant input variables at each time step based on Gated Linear Unit or Long Short-term Memory architecture. The static covariance coding model will integrate static features into the network, derive 4 different context vectors to help select time variables, localize temporal objects, and enrich objects with information static…

Take advantage of the self-attention, the model processes objects over time, learning both long- and short-term temporal relationships from known and observable time-varying inputs. A sequence-to-sequence layer will be used for local processing while long-term dependencies are handled by Multi-head attention blocks.

Multipath prediction using quantization output to determine the target value range of possibilities that occur at each prediction step.

Conclusion: Transformer architecture provides longer time series learning ability than traditional architectures such as LSTM, GRU, RNN. The model learns more information thanks to the input static transforms which helps to achieve low error prediction values at longer time step making the air quality control more accurate than using previous machine learning models

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