

LSTM-based Windspeed Prediction

January 12, 2018

Problem Setting and Preprocessing

Objective:

- Predict windspeed every 15 minutes, based on information from previous m time steps:

$$x_t = f(x_{t-m}, x_{t-m+1}, \dots, x_{t-1} \mid \theta).$$

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Preprocessing steps:

- History data are observed at irregular intervals. Linear interpolation is used to generate ground truth with an acceptable variance.
- No significant correlation is found among windspeed, temperature and pressure from data visualization.
- Forecast data are discarded due to poor accuracy and insufficient predictive power.

Basic LSTM Model

LSTM is adopted to discover the temporal pattern and long-term data dependencies from serial data.

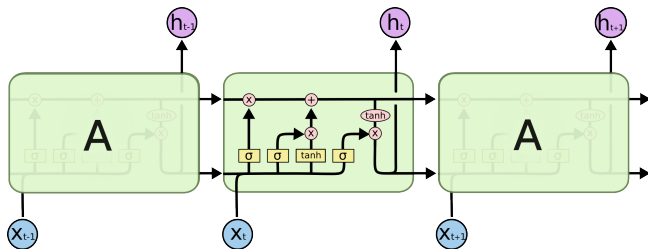
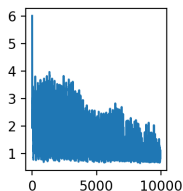


Figure: Classical LSTM structure

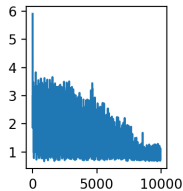
Experiment Results

Settings:

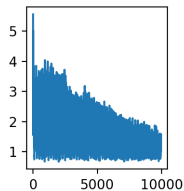
- maximum BP truncated length $m = 60$
- hyperparameter: hidden state size h , learning rate η
- L_2 regularization
- loss: mean absolute error
- gradient clipping to prevent explosion



(a) $h = 50, \eta = 0.1$



(b) $h = 100, \eta = 0.1$



(c) $h = 100, \eta = 0.3$

Figure: Test error with respect to number of iterations

Prospect: Hierarchical LSTM

Windspeed patterns on different time scales modeled by different hierarchies.

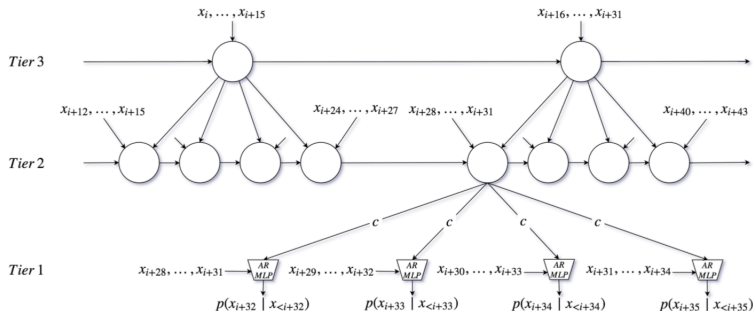


Figure: Hierarchical LSTM

Y. Bengio, et al. SampleRNN: An Unconditional End-to-end Neural Audio Generation Model. ICLR 2017 Conference Paper.