The superiority of Echo State Nets in Time Series Forecasting

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For this project, we will compare a Long Short Term Memory (LSTM), an echo-state network, and an Elman network. Time series forecasting is used extensively and has many applications including economic forecasting, stock market analysis, yield projections, process and quality control. People use and experiment with different algorithms for forecasting. We want to compare these models across a range of benchmarks to determine which is the most effective in practice.
To determine which of these models is most effective, we will compare three supervised learning methods for time series forecasting across the standard benchmark datasets - Mackey-Glass time series, Sante Fe Fir Laser Emission series, and the dataset from the M3 Competition as well as a real-world time series like the Dow Jones Industrial Average. In addition, we will use the “Human Activity Recognition Using Smartphones Data Set” and the “Pseudo Periodic Synthetic Time Series Data Set” from UCI Machine Learning repository for training data.
For this project, our implementation language will be python, and we will use scikit-learn and/or pytorch to implement the machine learning models.

Hypothesis: Echo State Networks will perform the best on a majority of the benchmarks due to the power of reservoir computing.

Stretch goal - Implement a “Dual-Stage Attention-Based Recurrent Neural Network”, we will swap the Elman network with this model if the implementation goes smoothly. In Attention based networks, the Attention mechanism performs feature selection in a dynamic way so that the model can keep only the most useful information at each temporal stage.

Some preliminary reference:

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