Recurrent Neural Networks with a step-wise activation function

Stage topic Description

Recurrent Neural Networks usually consider sigmoid nodes in their architectures. Other kind of neurons considered are the tanh or the Phi functions. The historical information of the time serie is stored in these hidden neurons thanks to the cyclic connections.

On the other hand, a step-wise function was proposed in the field of outlier detection [1,2]. The step-wise activation function used for the middle hidden layer divides the continuously distributed patterns into a number of discrete valued vectors. Data compression is achieved through this mechanism. The mapping to the discrete categories in the middle hidden layer naturally places the patterns into a number of clusters.

This activation function is specially interesting in the time series modelling. If we are able to get the patterns divided into clusters, we will be able to detect abrupt changes by looking for long steps in these nodes.

The main goal of this stage is the analysis of performance of the step-wise activation function in Recurrent Neural Networks. Taking into consideration the activation function, non-gradient descent algorithms should be considered for training the model. The model proposed will be applied to real financial problems obtained from the Finance Department.

Candidate's tasks

Develop a Recurrent Neural Network considering the step-wise activation function. Determine the potential of the model to detect tipping points. Apply the model to real problems.

The ideal candidate

Knowledge of time series.

Programming skills (Java and/or C/C++).

References

S. Hawkins, H. He, G. Williams, and R. Baxter, “Outlier detection using replicator neural networks,” Data Warehousing and Knowledge Discovery, pp. 113–123, 2002.

R. Hecht-Nielsen, “Replicator neural networks for universal optimal source coding,” Science, vol. 269, no. 5232, pp. 1860–1863, 1995.