Paper 1 [Oct 12 2022]

**What is it doing?**

It is trying to find the effectiveness of using a Graph theory based Graph Neural Network (GTNN) and a Neighbourhood-based graph neural network (NGNN) effect on the prediction of Rt values (covid spread rate) within US states. All whilst using a LSTM as a base model of comparison. The two graph variants generated used the same model, which was a three hidden layer Graph Convolution layer model, which utilised an apparent (based on image in paper) leaky ReLU and Regularisation function (which was not explained, if existed based on image but not explicitly stated).

**What is the new thing I learnt from the paper?**

The new thing I learnt from the paper is how to develop a Graph theory based GNN. What they did was first take a time series data for Rt (which they calculated based on Case information). They would then use a preprocessing called EMD (empirical mode decomposition) to break down the time series into eight different IMF (intrinsic mode functions).. Then removes the highest frequency IMFs to create a “noise removed” time series. They then did a pearson correlation between each state’s time series, and they added 1 more for the correlation between percentage changes and time series. Which resulted in a Correlation Matrix of size 51x51. They then used a threshold of 0.3 and if the correlation between two states was greater than that a binary edge of 1 was given between the two states to represent it as connected.

**Was there anything that could be improved on?**

One major thing that I saw was that the choice of 0.3 for a threshold to represent a connection was arbitrary and not explained. I believe this hyperparameter could have been trained and then later the best threshold could have been identified. It should be noted that these parameters should be found with the use of a much smaller section of the test data set. Another thing is that they should have a stricter definition for highly oscillating frequencies, as the IMF removal is not well justified. Lastly, a larger portion of their data set should have gone to testing, only 2% does not seem significant enough. Their justification of using the same absolute time of Zheng et al’s paper is not a strong reason.

**What applications of this paper can I think of?**

The most immediate application I can think of is the implementation of the same Graph theory based GNN for my project for predicting the covid cases within Hong Kong. However, I have a weak conceptual understanding of the Rt value, I think with further reading I can learn to accurately calculate it and then proceed with their implementation.

**Does this paper share any ideas/similarities to other concepts/papers I have considered before?**

The only similarity I see is between the behaviour of the preprocessing EMD to time series and Fourier transforms to sound waves. This is because they both aim to decompose a more complicated function to simpler functions, upon which operations are performed to remove noise.

[Below are my personal notations whilst reading the paper, and contains more information that I could not provide whilst answering my preset questions I have given myself]

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