Statement of purpose

Graph Neural Networks in Epidemic modelling

Aim :

The aim of this project is to predict the behaviour of infectious diseases using ***Graph Neural Network*** which will help to mitigate the infectious diseases.

Motivation :

- In the world Infectious diseases that significantly endangers the health of people in a short period of time.
- In olden days many scientists proposed several mechanistic models to incorporate more sophisticated contagion mechanisms and they have provided deep understanding about how infectious diseases spread but forecasts of most mechanistic models lack quantitative accuracy [2].
- So they proposed a new kind of approach called deep learning based prediction method to forecast infectious diseases [3].Here we analyse the actual day-to-day data using a dataset and by using deep learning algorithms such as ***Graph neural network*** to predict [1].
- And also by examining the properties of this learned mechanics beyond the training data from any successful project could also be used to construct a variety of deep learning models that will be helpful to design many other dynamical models in real life such as ***weather forecasting, people's interests on lifestyles, Financial time series data analysis*** [2].

Implementation :

- Here we use a deep learning algorithm called Graph neural network which is used for structure learning.GNNs are neural networks that can be directly applied to graphs, and provide an easy way to do node-level, edge-level, and graph-level prediction tasks [1].
- So these can also be used to model contagion dynamics on complex networks and help to build data-driven dynamical models on networks.
- We use these mechanisms for epidemic spreading for simplicity and they predict the aggregate statistics of the human population [1],[2].

Method :

1. We design a training procedure and an appropriate GNN architecture which is capable of representing a wide range of dynamics with very few assumptions [2].
   (COVID-19 dataset is used in this paper)
2. We demonstrate the validity of our approach using various contagion dynamics of increasing complexity on networks of different natures, as well as real epidemiological data [2].
3. So that we can provide predictions for previously unseen network structures[2].

- **Example :**
  - Learning the future predictions in Spain in covid-19 endangered padamic between January 2020 and March 2021 using ***COVID-19*** dataset [2].

Goal of my work :

- To understand and predict the behaviour of contagion dynamics using Graph neural network on real-world contagion dynamics data sets.

References :

[1] Murphy, Charles, Edward Laurence, and Antoine Allard. "Deep learning of contagion dynamics on complex networks." *Nature Communications* 12.1 (2021): 1-11.

[2] Kumar, R. L., Khan, F., Din, S., Band, S. S., Mosavi, A., & Ibeke, E. (2021). Recurrent neural network and reinforcement learning model for COVID-19 prediction. *Frontiers in public health*, *9*.

[3] Tomy, Abhishek, et al. "Estimating the state of epidemics spreading with graph neural networks." *Nonlinear Dynamics* (2022): 1-15.

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