Adversarial Training for Crime Forecasting

Crime forecasting techniques can hinder crime occurrences, especially in areas under possible threat. The recent development of machine learning has motivated research toward designing crime forecasting-based applications in a temporal, spatial, or combined spatiotemporal context. The crime forecasting problem aims to predict different types of crimes for each geographical region (like a neighborhood or censor tract) in the near future. Since nearby regions usually have similar socioeconomic characteristics, which indicate similar crime patterns, recent state-of-the-art solutions constructed a distance-based region graph and utilized Graph Neural Network (GNN) techniques for crime forecasting because the GNN techniques could effectively exploit the latent relationships between the neighboring region nodes in the graph if the edges reveal high dependency or correlation[1]. In this thesis, we will propose a novel negative-sampling technique to optimize the existing crime prediction models to predict crime patterns precisely. The unobserved examples, e.g., a crime has not occurred at a specific location yet, are a mixture of real negative examples (e.g., the region has never reported a specific crime at a particular time) and potential positive examples (e.g., the region might report the crime at a specific time in the future). It is incredibly challenging to identify real representative negative examples. Using reinforcement learning, we will implement a popularity-biased negative sampling technique [2] and adversarial neural networks, to improve existing crime prediction frameworks.

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Technical Requirements:

- Familiarity with Python libraries, Pytorch Geometric, Transformer, etc.

References:

- 1: Chenyu Wang, Zongyu Lin, Xiaochen Yang, Jiao Sun, Mingxuan Yue, and Cyrus Shahabi. **Hagen: Homophily-aware graph convolutional recurrent network for crime forecasting**. In AAAI Conference on Artificial Intelligence, Vol. 36. 2022. 4193–4200.
- Hongzhi Yin, Hongxu Chen, Xiaoshuai Sun, Hao Wang, Yang Wang, and Quoc Viet Hung Nguyen. **SPTF: a scalable probabilistic tensor factorization model for semanticaware behavior prediction**. In IEEE International Conference on Data Mining (ICDM). 2017, 585–594.