A review and new research idea towards fairness graph anomaly detection(FairGAD)

Proposal for STATS403-Deep Learning

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Introduction

I am a dedicated computer science student enrolled at Wuhan University, where I have honed my technical skills and developed a strong foundation in the field.

What really drives me is the connection between people and technology. I possess an innate curiosity that transcends disciplinary boundaries, and I actively engage with diverse knowledge domains, with a special emphasis on the intricate interplay between society and technology. This broad-ranging exploration equipped me with a unique perspective on the multifaceted relationship between humans and technology. My motivation stems from a deep desire to harness the potential of this intersection to positively impact human lives. I am resolute in my commitment to advancing technology in ways that truly benefit and enhance our daily experiences

Problem Statement

What is my problem?

Deep learning has proven to be a powerful tool for solving real-world challenges. However, it's not without its pitfalls. One critical aspect that often goes overlooked is fairness. In many machine learning and deep learning tasks, data plays a pivotal role. The quality of the data can significantly impact the outcomes. Within the realm of data processing, anomaly detection is a vital step.

Upon an extensive review of existing research in fairness and anomaly detection, a notable gap becomes apparent. Graph anomaly detection, an area with immense potential for addressing fairness concerns, has received relatively little attention. This is the problem we aim to tackle in our project.

Why is the problem interesting?

Graph Anomaly Detection (GAD) aims to identify anomalous nodes in an input graph whose characteristics are significantly different from those of the rest nodes in the graph financial markets , and cybersecurity, can be naturally represented as graphs, there has been an increasing interest in research on developing GAD methods in recent years . By detecting anomalies in graphs, we can characterize potential threats and harmful content, enabling early warning, timely intervention, and efficient decision-making. With the advance of Graph Neural Networks (GNNs) , GNN-based GAD methods have increasingly attracted attention in the literature.

Considering fairness in GAD research is essential due to the widespread application of GAD methods in high-stakes domains, such as loan approvals and misinformation where biased and unfair anomaly detection outcomes can have adverse effects on various aspects of our lives Fairness in graphs is particularly crucial in anomaly detection areas such as misinformation detection, where decision outcomes can significantly affect individuals.
However, little research focuses on graph anomaly detection from fairness perspective.

Approach

I will approach this project through a structured methodology, which involves :

- **Dataset Selection**: I will begin by identifying an appropriate dataset for Fair Graph Anomaly Detection (FairGAD) and ensuring its suitability for our research.

- **Fairness Evaluation**: My study will encompass a comprehensive analysis of fairness evaluation techniques in the context of deep learning and AI tasks.

- **Existing GAD Methods**: I will review and thoroughly examine existing Graph Anomaly Detection (GAD) methods to understand their strengths and weaknesses.

- **Innovative FairGAD Methods**: One of the main thrusts of the project will be the exploration and development of novel FairGAD methods that incorporate fairness considerations into anomaly detection in graph data.

- **Experimental Validation**: To assess the effectiveness of the proposed methods, I will conduct rigorous experiments to validate their performance in real-world scenarios."

Project Goals

By undertaking this project, I wish to acquire a deeper understanding of the intersection between fairness considerations and graph anomaly detection within the realm of deep learning. Specifically, I aim to learn:

1. A comprehensive understanding of the existing Graph Anomaly Detection (GAD) methods, their strengths, limitations, and how they can be adapted to incorporate fairness principles.

2. The intricacies of fairness evaluation techniques, especially within the context of deep learning and AI tasks, provide insights into the assessment of equitable outcomes in data-driven systems.

3. The innovative techniques required to develop novel FairGAD methods that address fairness challenges in graph anomaly detection, thus contributing to a more equitable application of deep learning.

4. Inforce my understanding of representative learning techniques.