
Detecting Anomalous Business Ownership with Graph Convolutional Neural Networks

Project Proposal

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Introduction

Background

In October of 2021, The International Consortium of Investigative Journalists (ICIJ) revealed the findings of their Pandora Papers investigation, implicating hundreds of politicians, public officials, and businesses in efforts to conceal the true ownership of companies and assets around the world (ICIJ 2021). The intentions behind this secrecy range from legitimate privacy concerns to criminal activities, including money laundering, tax evasion, and fraud (European Union Agency for Law Enforcement Cooperation 2021). According to a study by the European Commission, an estimated total of USD 7.8 trillion was held offshore in 2016. The share of this attributed to the European Union (EU) was USD 1.6 trillion, which corresponds to an estimated tax revenue loss to the EU of EUR 46 billion (European Commission. Directorate General for Taxation and Customs Union. 2019).

Few countries have implemented beneficial ownership registers that require declaration of a company's beneficiaries. This makes uncovering true company ownership a difficult exercise, placing strain on the resources of law enforcement agencies and responsible financial institutions (Steven M. 2019). Processing and flagging high risk entities is made difficult by the interconnected nature of businesses and individuals, as well as the ingenuity of criminals in masking illicit activity behind layers of seemingly legitimate business.

In order to model a complex global business network, it is necessary to represent companies, people, and their relationships in a graph structure. With the data in this format, it is possible to not only consider the features of a particular entity when making a decision, but also those of their close connections and local community. Anomaly detection algorithms that can operate on graph structures remain at the frontier of machine learning research. A review of the current state of anomaly detection in graphs is presented in the subsequent literature review.

Project Title

The proposed title for this project is “Detecting Anomalous Business Ownership with Graph Convolutional Neural Networks”.

Aims, Objectives and Research Questions

NOTES

- reasons for study

- existing studies do not test GCN on business ownership graphs
- important for detecting fraud, specifically money laundering
- traditional methods do not take into account contextual data

Aims

The aim of this project is to assess the performance of Graph Convolutional Neural Network (GCN) models in identifying anomalous entities in a business ownership graph.

Literature Review

Methods

NOTES

- split graph into weakly connected components (define term)
- select random node(s) from outside of the connected component as target
- impossible for traditional methods to identify as anomalous as features are indistinguishable from others
- can attempt traditional anomaly detection techniques on individual connected component as a baseline
 - random forest
 - gradient boosted tree
 - K Nearest Neighbours
 - logistic regression
 - GraphGym
 - Tuned GCN (Optuna or similar)

Data

Research Instruments and Tools

Ethical Considerations

Anticipated Outcomes

Project Plan

Roadmap

- Data acquisition
- Data understanding
- Data preparation
- Feature engineering
- Preprocessing
- Modeling
- Evaluation

Data Acquisition

Risks and Challenges

References

- European Commission. Directorate General for Taxation and Customs Union. 2019. *Estimating International Tax Evasion by Individuals*. LU: Publications Office. <https://data.europa.eu/doi/10.2778/300732>.
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Steven M., D'Antuono. 2019. "Combating Illicit Financing by Anonymous Shell Companies — FBI." Testimony. <https://www.fbi.gov/news/testimony/combating-illicit-financing-by-anonymous-shell-companies>.