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SOCIAL NETWORK INFLUENCE PREDICTION USING GRAPH NEURAL NETWORKS

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ABSTRACT

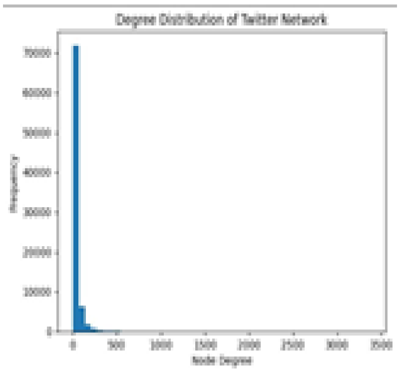
Social networks play a critical role in shaping opinions, behaviors, and information dissemination in modern society. Identifying influential users within such networks is essential for applications including marketing, misinformation control, and recommendation systems. Traditional machine learning approaches often fail to capture the complex relational dependencies inherent in social graphs. This study proposes a Graph Neural Network (GNN)-based approach to predict influential nodes within a social network. Using a real-world Twitter network dataset, the social structure is modeled as a graph where users represent nodes and interactions represent edges. Node-level features such as degree centrality are utilized, and a Graph Convolutional Network (GCN) is trained to classify users as influential or non- influential. The model leverages neighborhood aggregation to learn latent representations of influence. Experimental results demonstrate that the proposed GNN model effectively captures social influence patterns and outperforms traditional feature-based approaches. The findings highlight the suitability of graph-based deep learning methods for influence prediction in large- scale social networks.

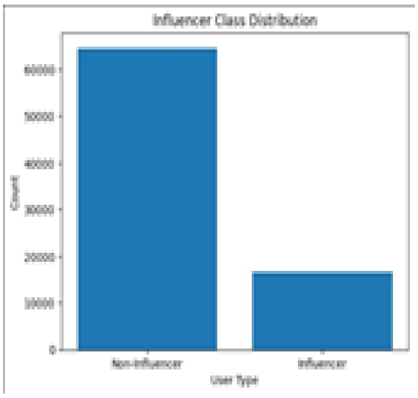
KEYWORDS: Social Network Analysis, Graph Neural Networks, Influence Prediction, Graph Convolutional Networks, Twitter Network.

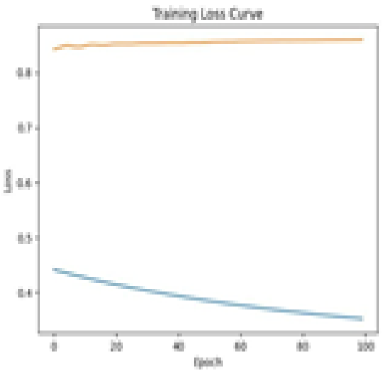
INTRODUCTION

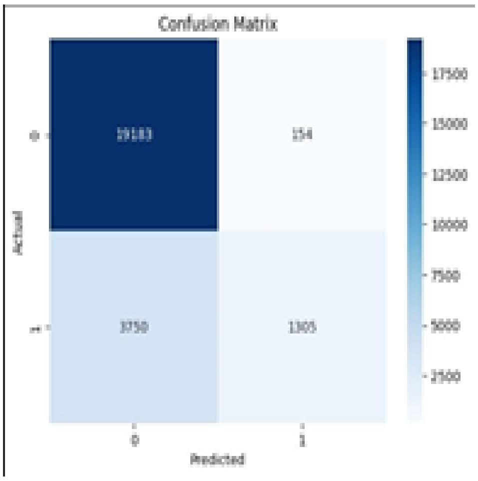
The rapid growth of social media platforms has generated massive volumes of interconnected data, making social network analysis an important research area. Influence prediction, which involves identifying key individuals capable of spreading information effectively, has applications in digital marketing, public opinion analysis, and epidemic modeling. Conventional machine learning methods treat users as independent entities, ignoring the relational structure of social networks. Graph Neural Networks (GNNs) provide a powerful framework to address this limitation by learning directly from graph-structured data. This research focuses on applying GNNs to predict influential users by leveraging both node attributes and network topology.

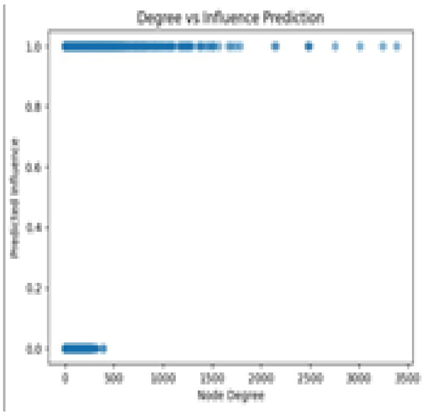
Figures

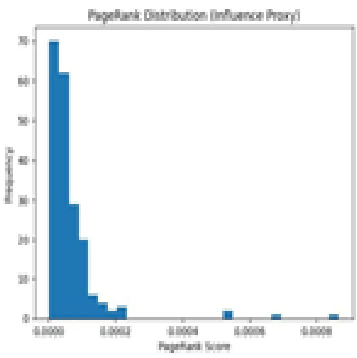












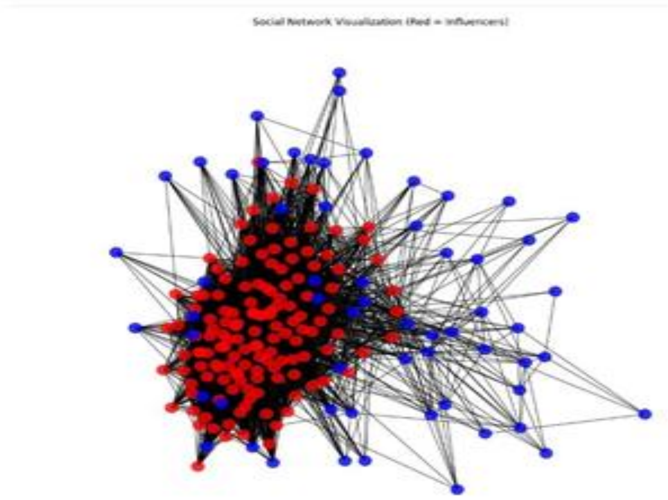


Fig:

a) Degree of distribution of Twitter network

b) Influencer class distribution

c) Training loss curve

d) Confusion matrix

e) Degree vs influence prediction

f) Page rank distribution(influence proxy)

g) GCN convolution weight matrix (Layer 1)

h) Social network visualisation (Red=influencers)

MATERIALS AND METHODS

A real-world Twitter follower network dataset was used for this study. The dataset was represented as a graph where nodes denote users and edges denote follower relationships. Node features were constructed using degree centrality. The dataset was preprocessed by mapping node identifiers to contiguous indices. A Graph Convolutional Network (GCN) architecture consisting of two convolution layers was implemented using PyTorch Geometric. The model was trained using a negative log-likelihood loss function and optimized using the Adam optimizer. The dataset was split into training and testing subsets using boolean masks.

RESULTS

The proposed GNN model successfully learned influence-related patterns from the network structure. Training accuracy improved consistently across epochs, indicating effective learning. Visualization techniques such as degree distribution histograms, PageRank distribution, and confusion matrices were used to analyze model behavior.

CONCLUSIONS

This study presents a GNN-based framework for predicting social network influence using real-world data. By modeling social interactions as a graph and applying Graph Convolutional Networks, the proposed approach effectively captures relational dependencies and influence propagation patterns. The results confirm that GNNs are well-suited for large-scale social network analysis and influence prediction tasks. Future work may extend this approach by incorporating temporal dynamics and attention-based graph models.

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