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A Hybrid Filtered Based Probabilistic Community Detection and Link Prediction on Facebook Social Networking Data

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ABSTRACT

Online social networks consist of vast interconnected systems that illustrate the relationships among millions of social nodes. Traditional approaches primarily rely on contextual similarity measures to identify relationships but often use limited network structures and non-central node-based predictions. This work introduces a hybrid community detection and link prediction method designed for complex networks. A new community detection measure is established to forecast links among numerous nodes, focusing on central nodes within the network for the prediction process. The developed method combines the new measure with traditional approaches to enhance the hybrid link detection procedure. Experimental results demonstrate that this central node-based link prediction approach outperforms conventional models, highlighting improvements in node prediction rates, error rates, and runtime efficiency. This innovative methodology establishes a more effective framework for understanding and predicting connections in large social networks.

Keywords: Community detection, link prediction, similarity measures, social networking data

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INTRODUCTION

An online social network is characterized as ‘a network of social nodes and the interactions between these nodes’ (Wu et al., 2017). This concept illustrates the structural connections between social entities, which can include both individuals and organizations. The networks aim to

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increase connectivity, which enhances the utility of the services and accelerates information dissemination. In the context of security systems, link prediction can analyse terrorist networks to predict potential future associations among terrorists (Pandey et al., 2019). This assists government agencies in tracking suspects and averting possible attacks. Another example lies in biological networks, where link prediction helps infer new protein-protein interactions based on existing networks (Bastami et al., 2019). Additionally in social networks include tasks as automatic hyperlink prediction and the development of recommendation systems (Aghabozorgi & Khayyambashi, 2018). Various similar measurement methods have been proposed in earlier research,to enhance link prediction accuracy yet it remains a persistant challenge. These models were rigorously tested on multiple ego networks extracted from the Facebook dataset available in the SNAP repository (Berahmand et al., 2022).

PROBLEM STATEMENT OF FILTERED BASED ONLINE SOCIAL NETWORKING FEATURES EXTRACTION AND NODE LINK PREDICTION APPROACH

In this work, a graph filter-based features extraction and link predictionwas developed on the online social networking datasets. Initially, input datawas filtered and visualized using the adjacent nodes shortest path approach. Let G be the digraph with node vertex set as V and node edges list as E for link prediction process. In the first phase, input data was visualized in Digraph format to find the missing adjacent nodes for link prediction process. In the second phase, different features were evaluated for the training data preparation. Finally, in the last phase, a hybrid link prediction approach was developed to predict the link on the given input training data.

ADVANCED LINK PREDICTION FRAMEWORK: KERNEL AND PSO BASED PROBABILITIES

Inputs:

- Filtered dataset *D*
- Test samples for evaluation
- Features and their associated conditional distributions

RESULTS

In this work, Precision, recall, Accuracy and error rate were evaluated on the social networking datasets. Figure 1 shows the proposed statistical accuracy on the opinion dataset using the proposed link prediction model to the conventional models.

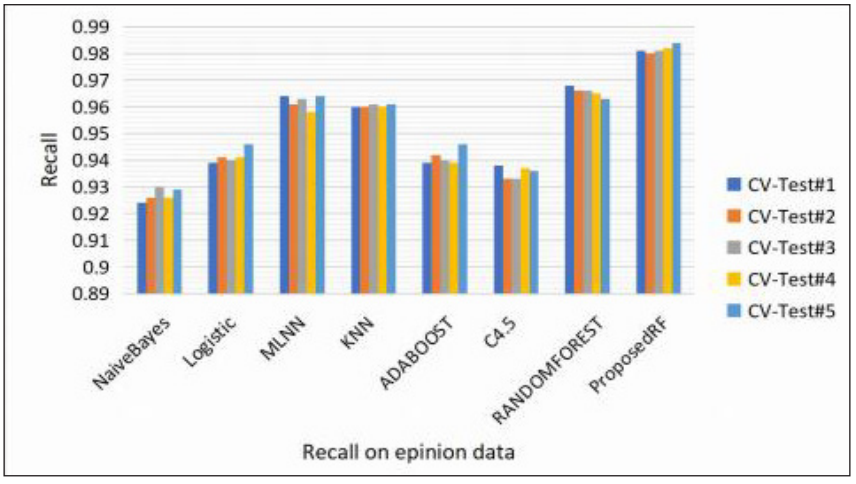

Figure 1. Proposed statistical accuracy on the opinion dataset using the proposed link prediction model to the conventional models

CONCLUSIONS

In this paper, a hybrid filtering based link prediction approach was developed on the online social networking datasets. Since, most of the conventional link prediction models were independent of central node connectivity due to missing edges and links. Also, these models were difficult to handle complex online social networking databases. In this work, hybrid node features were evaluated using the probabilistic source ranking and destination ranking measures. Finally, the link between the source nodes to destination nodes was predicted using the proposed link prediction approach on the social networking datasets. Experimental results showed that the present model had better link prediction efficiency.

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