Review on A hybrid method of link prediction in directed graphs [1]

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1 Introduction

Link prediction is the common method of predicting links between nodes which have common neighbour and the first problem with these previous approaches is if two nodes doesn't have common neighbour then they cannot have zero possibility of link between them . Second problem is the problem of direction in neighbours means it often neglect the connection direction for directed graphs.
motivation comes from the real world that in real system it might happen that friendship can be formed in future with no common friends.
To solve these problems, This paper propose a novel semi-local measures for the link prediction in supervised and unsupervised modes. Motivation:

There is number of previous measure for link prediction like

1. Local measure which include Common neighbors, Jaccard coefficient,Adamic Adar,Resource allocation,Preferential Attachment,Resource Allocation Based on Neighbor interaction(RA-CNI),Sorensen,Hub Promoted Index(HPI),Hub Depressed Index(HDI),Local Leicht-Holme-Newman Index (LLHN),Salton Index (SA),Mutual Information(MI),CAR-Based Indices (CAR),
Similarity Weight (FSW),Individual Attraction Index (IA),Local Na¨ıve Bayes (LNB),Common neighbors degree penalization
2. Global measures includes Random walks with restart (RWR),SimRank
3. Quasi-local measures
4. Similarity measures based on in-degree and out-degree (neighborhood direction) includes Common neighbor out (CNO), Common neighbor in (CNI), Common neighbor in out (CNIO).
5. Similarity measures based on network motifs
6. Representation learning on graphs

All these local and global measures gives zero probability of forming link in future between non common neighbor nodes. To resolve this issue This paper proposed a novel semi-local measures which is describing below.

2 Approach/Methodology

They have used hub, authority and direction of the connection with information along with the information of the common neighbor.

The proposed method considers the information on the common neighbors and information on the direction of the connectivity through their hub-ness and authority-ness. Here are three similarity measures based on this information.

2.1 Common neighbors hub authority (CN-HA)

The similarity between two nodes x and y based on both common neighbors and information on hub-ness and authority-ness is defined as: $CNHA(xy) = \left(\sum_{z(x)O(y)O} Auth(z)\right) + (Hub(x) + Hub(y))$

where Auth(z) is the authority of the set of common neighbors, and Hub(x) indicates the hub-ness of node x.

2.2 Common neighbors authority hub (CN-AH)

This measure is defined as follows. $CNAH(xy) = (\sum z(x)i(y)iHub(z)) + (Auth(x) + Auth(y))$

2.3 Sum of common neighbors with hub and authority (SCNHA)

This measure is a combination of the above two similarity metrics, defined as follows $CNHA(xy) = CNHA(xy) + CNAH(xy)$ On that basis, the similarity score of the pair of nodes x and y for the graph in Fig. 4 is calculated as follows. $SCNHA(xy) = 0.4066$ $CN - HA(xy) = 1.1510 - 14$ $CN - AH(xy) = 0.4066$ The proposed measures resolve the limitations of earlier methods by considering neighborhood direction and considering possibility of link creation between two nodes without common neighbors.

References

[1] X. Zhao, X. Ji, S. Liu, and Z. He. Link prediction based on information preference connection for directed network. In *2020 IEEE International Conference on Smart Internet of Things (SmartIoT)*, pages 183–189, 2020. doi: 10.1109/SmartIoT49966.2020.00035.