Journal of Information Systems Engineering and Management
2025, 10(46s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Leveraging the Employees of Organizations Using an Organizational Network Analysis tool based on information Dissemination Tree Model of Information Diffusion

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ARTICLEINFO

Received: 29 Dec 2024

Revised: 15 Feb 2025

Accepted: 24 Feb 2025

ABSTRACT

The organizational social networks are symmetric with that of social networks; both the organizational social networks and the online social networks involve people and their interactions. The analysis of these organizations is trending these days. The research studies on organizational networks can bring new developments in the organizations under study. In this paper we have proposed a Social Networks Analysis (SNA) model, the proposed model is an Information Dissemination Tree (IDT) based cascading model for the detection of prioritization of organization networks users. Initially the method detects the users that can act at the top of their organization using a new degree centrality based on the organization's information diffusion process. The new degree centrality will be based on the netdegree parameter. After the detection of these top users, the proposed model detects the Ultimate Observers of information diffusion in the given organization's social networks using the information dissemination tree based cascading model. The proposed model will output the prioritization of users according to their positions in the detected information dissemination cascades. The proposed model has been developed in Python language using three organization social networks, the experiments reveal that the proposed model is successful on the detection of initial cover of seed users that are acting as the top brasses in the given organizational network and the model gives the exact prioritization of all the users in the given network. Finally, the ultimate observers that are least prioritized users are detected successfully by the proposed method.

Keywords:*Online social networks, organizational social networks, Social Network Analysis (SNA), Organizational Network Analysis (ONA), Information Dissemination Trees (IDTs), cascading model, information cascades.*

INTRODUCTION

Online Social networks are involving the social agents and their interactive communications [1]. The intent of creation and usage of such networks is for having social interactions over these virtual networks called as online social networks [2]. The interactive behavior of these users over these online social networks brings dissemination of huge amounts of data and results into the so called the phenomena information diffusion. The paths that are traversed by this information diffusion over these online social networks are called as informational cascades [3].

Organizational social networks are symmetric to that of social networks, so such networks can be studied using the models of Social Network Analysis (SNA) [4]. These users of organizational social networks are usually the employees of these organizations. The studies of information diffusion can have further implication to handle the information diffusion over these organizational social networks.

The users who are the main sources of information as the seed users are the most important users and need to be more privileged in these organizations. These seed users are the main generators information in the form of

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Research Article

contents and decisions [5]. The users that are much passive over these organizational social networks are called as ultimate observers and are needed to be less prioritized and privileged.

To find these central or seed users in these networks various centrality measures such Degree centrality, Betweenness centrality, Closeness centrality, Eigenvector centrality and the PageRank centrality [6] can be used from these existing centralities have the major limitations and, in this study, we are going to make the application of our newly proposed centrality called as netdegree, which has the benefit of having the independence from explicit or implicit parameter k. This netgdegree centrality takes least number of computational resources. These seed nodes are the central nodes in the organizations and need to be prioritized [6].

Information dissemination trees are the trees that are being traversed by dissemination of this information over these organization networks. The information cascades in these organizational networks can be traversed by information dissemination trees. The most passive users are occurring at the terminal level of of these information dissemination trees. Such users are least prioritized in the given organizations.

The major contribution of This study is to find these seed users of organizational social networks and the ultimate observer users that are least prioritized in these organizational social networks.

The organizational social network is modeled as a graph G(V, E), where V is the nonempty set of nodes representing the users in the organization and E is the set of edges representing the communication/links in the organizational social network [7].

This paper is of five sections, this introduction section is followed by related worksection ,nextsection is proposed model, followed by results and discussion section and the paper is concluded by conclusion and the future work.

RELATED WORK

The importance of Social Networks Analysis (SNA) has been studied by a number of studies and the most relevant studies that have been made in the literature and are related to our work are: Methot et. al. studied the importance of Social Networks Analysis in organizations and how such social network analysis can be applied over the organizational social networks as both the two are very much symmetric [8].Anugerah et. al. studied the importance and performance of utilizing the SNA approaches in studying the business and management research problems [9]. Francis et. al. studied the usage of SNA in bringing improvements in healthcare organizations. [10]. Miller et. al. studied how SNA methods can be used for studying the organization behavior of employees in organizations [11].Boyd et. al. studied the usage of SNA in studying the interactions of educational organizations [12]. These are some of the well-known studies that have been made in the literature and are related to our study.

The employees who are highly influential over these organizational social networks can be identified as seed users and there are number of attempts in the literature for finding these seed influential people over these networks, some of the attempts in the literature that are related to our work are: Kumar et al studied the process of uncovering the seed influential nodes using the different centralities measures such as Degree centrality, Closeness centrality, Eigenvector centrality, and PageRank centrality [13].Dey et al. used the multiple centralities for uncovering of seed users in large scale social networks[14].

Information diffusion in online social networks has become the hotspot for social media researchers and the topic has evolved from simple epidemic models to the well-known cascading models of the day. Some of the well-known attempts that have been proposed and are related to our study are: Kempe et al. used the Independent Cascades (IC) model to study the process of information diffusion in online social networks [15]. Granovetter has researched the dissemination of information using the General Threshold model [16]. The Independent Cascade (IC) and Linear Threshold models have been expanded in numerous other studies by adding various elements including time decay and user profile [17]. Topic sensitive models have been proposed as an extension to the cascading model [18]. Anh et al. handled the information cascades using the asynchronous Independent Cascade (IC) model [19]. Using the pattern of heat diffusion Bao et al. explored to predict the information diffusion in online social networks [20]. Using ordinary differential equations, Tu et al. modeled the dissemination of information in online social networks [21]. The information diffusion in online social networks has been a well known learning process that has made its attempt in disseminating knowledge from known to unknown ones,so the researchers have tried to study information diffusion in online social networks as learning models that predict or explain the dissemination of information in online social networks. Some known leaning-based attempts that are related to our study are: Xuan et al. proposed a self-learning-based model for studying information diffusion in online social networks [22].

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Research Article

Hoang et al developed a learning-based model that predicts the information diffusion in twitter online social network [23]. Qiang et al. proposed a learning-based model that can tackle the person-to-person influence-flow in online social networks [24]. Cheng et al. used the deep learning-based method to study the information diffusion in online social networks by learning user habits [25]. Lobel et al. studied the process of information diffusion in online social networks using social learning [26]. All these existing approaches are opening the gates for new research approaches; so, in this paper we propose a new information dissemination tree based cascading model for prioritizing the users in organizational social networks.

PROPOSED MODEL

Initially our proposed mode will select a node in random from a given organizational network graph G(V,E) and calculate the indegree and outdegree and the netdegree of the selected node. Then other nodes in the networks will be selected by using Breadth First search(BFS) search strategy. After traversing all the reachable nodes, the output will a set of seed nodes that have been detected using the equation given below:

netdegree(node)=outdegree(node)-indegree(node) b (1)

if (netdegree(node))>0,node is a seed user otherwise nonseed user.

the pseudocode for detecting these seed users is given the Algorithm 1 below:

Input: Directed organizational social graph G(V,E)
Output:seed_user_set
1 :**begin**
2 : select node i, randomly from V
3 : calculate indegree and outdegree for i
4 : calculate
netdegree(i)=(outdegree(i)-indegree(i))
5 :**if** (netdegree(i)>=1)
6 : add i to seed_user_set
7 :**else**
8 : add i to nonseed_user _set
9 :**endif**
10: select next node using BFS and put it in i
11: **if**(i==null)
12: **return** seed_node_set
13: **else**
14: goto step3
15: **endif**
16: **end**

The flowchart for the proposed model is given below in figure Fig.1 below:

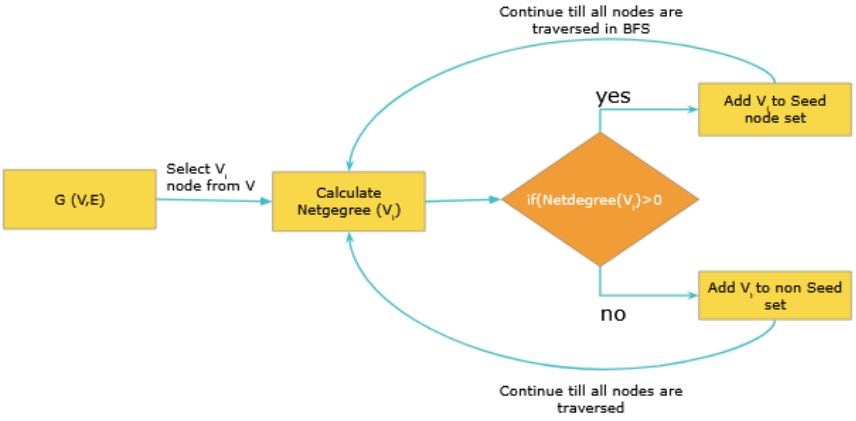

Fig 1: Flowchart for the proposed model.

Journal of Information Systems Engineering and Management
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Research Article

The output nodes are the source or seed nodes in the given organizational social network. The strategy of finding seed nodes with this proposed approach takes noe more than O(|V|+|E|) operations.

After the detection of these seed/top users we are going to detect the ultimate observers of information diffusion by using algorithm Algorithm 2 given below:

Algorithm 2: Ultimate_obervers_detection
Input: Organizational Social graph G(V,E), the seed node set Seed_set[]
Output: Ultimate_observer_list[][]
1:**Begin**
2:**While** (Seed_set[i]!=null)
3: take node i as root node of information dissemination tree
4: generate all the information dissemination tree using BFS propagation
5: Ultimate_observer_list[i][]=all the last leaf level nodes of detected information dissemination tree on i
6: i=next index of seed in seed_set[]
7:**End While**
8:**End**

Algorithm 2 will give us ultimate observers/least priority of a given organizational social network.

These top and least prioritized users are the users in the given organizational social networks that need to take into consideration for successful growth of given organizations.

RESULTS AND DISCUSSIONS

We have done all the experimentation on three real organizational social networks using the Python language on Google Collab. The three datasets used in this study are taken from pajek dataset repository and are as:

(1) Student Government Dataset [27,28,29]: Student government representatives from the University of Jubljana in Solvenna are discussed in this dataset. The students were asked to name the fellow with whom they preferred to speak about issues pertaining to university administration.

(2) Galesburg Network [30,31]:This dataset comes from a Columbia University's pharmacological trial. The doctor's connections and conversational interactions are included in the dataset

(3) Strike Network [32,33]: Strike network dataset comes from a factory that processes wood. Workers went on strike after they

were provided with new compensation packages; the management then opted for discussions and negotiations through various negotiators.

the structural properties of these three organizational social networks are shown given below in table Table 1:

Table 1: Structural properties Organizational social networks

Dataset	No of Vertices (|V|)	No of Edges (|E|)	Nature of Edges
Student Government	11	41	Directed

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Research Article

[27,28,29]			
Galesburg Network [30,31]	17	35	Directed
Strike Network [32,33]	24	38	Directed

On running the Algorithm1 on these datasets we have got the following results as shown in the figures Fig. 2 to Fig. 4 below.

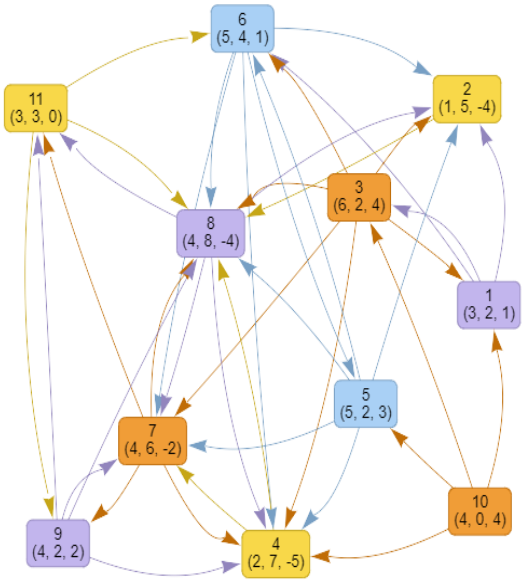

Fig 2: Results of on Student Government Network

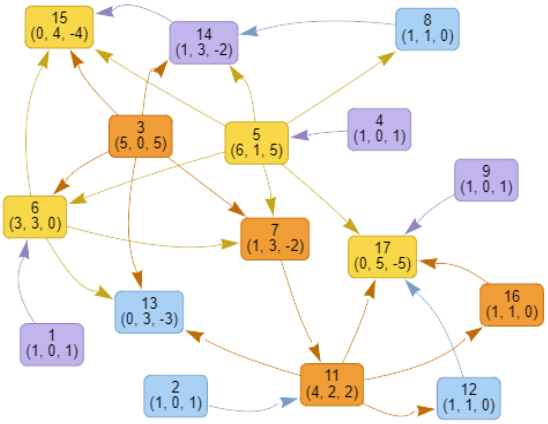

Fig 3: Results of on Galesburg Network

Journal of Information Systems Engineering and Management
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e-ISSN: 2468-4376
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Research Article

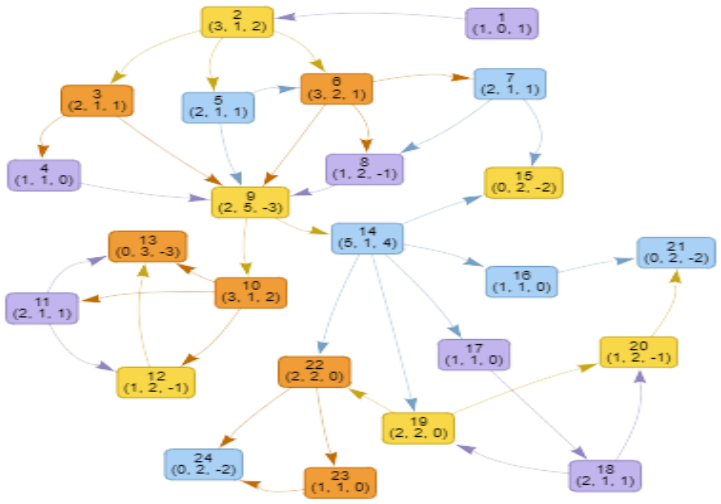

Fig 4: Results of on Strike Network

The seed users/top priority users we have found on these three datasets is shown below in the figures Fig. 5 to Fig. 7 below.

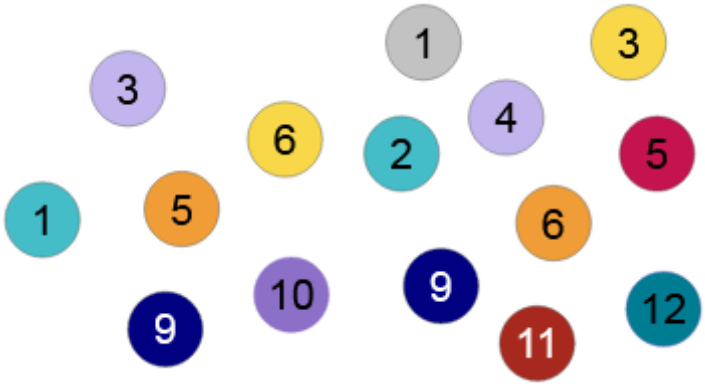

Fig 5: Results on Student Government Network

Fig 6 : Results of on Galesburg Network

Fig 7: Results of on Strike Network

Journal of Information Systems Engineering and Management
2025, 10(46s)
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Research Article

Once these seed users have been detected, Algorithm 2 finds the ultimate observers using the proposed methodology and the results for the same are shown in the figures below.

the least prioritized users of these three organizational social networks have been found using the Algorithm 2 and the results for all the three networks is given below:

Table 2: Least priority users in Student Government organizational network

Seed Node	Ultimate Observer Nodes
1	9,11
3	5,9,11
5	9,11
6	9,11
9	2
10	9,11

Table 3: Least priority users in the Galesburg Network organization.

Seed Node	Ultimate Observer Nodes
1	12,16,17
2	12,13,16,17
3	12,16,17
4	12,16
5	9,16
6	12,16,17
9	17
11	12,13,16,17
12	17

Journal of Information Systems Engineering and Management
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https://www.jisem-journal.com/

Research Article

Table 4: Least priority users in Strike organizational network

Seed Node	Ultimate Observer Nodes
1	18,21,23,24
2	18,20,21,23,24
3	18,20,21,23,24
5	18,20,21,23,24
6	18,20,21,23,24
10	11,12,13
11	12,13
14	18,20,21,23,24
18	23,24

The ultimate observer users are such users that are least prioritized in the given organization social network. Such users deserve to be positioned at the lower level in the given organizations.

The proposed model has been tested on the real organizational networks from pajek datasets repository and the results show that the proposed model can be purposefully used as an analysis model in prioritization of the organization employees for the organization to be a goal-oriented organization.

CONCLUSION AND FUTURE STUDY

In this paper we have studied the application of newly proposed netdegree centrality to uncover the top priority employees in the given organizations. In this paper we have used our newly proposed information dissemination Tree based model for uncover the least priority users in the given organizations. The newly developed tools will be deployed to different organizations to leverage their employees.

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