# Abstract

Selecting the most influential users (Seed nodes) in the networks has attracted attention due to their ability to influence and spread information. Seed nodes are essential to understanding the spreading and controlling of the information dynamics of the networks. Selecting influential nodes is predominant in single layer networks. After the advancement and widespread usage of social networks, finding influential nodes in multilayer networks is gaining popularity and attention. It is a challenging and yet an unexplored task.

This dissertation investigates the various methods to find the most influential nodes from the multilayer networks. It argues that, many users actively engage in multiple social networks to share their ideas and information. Identifying influential nodes to propagate in multi layer networks is a challenging and alluring topic. Motivated by this observation, we propose several algorithms to identify in this dissertation. This thesis proposes a novel algorithm CIM, clique-based heuristic for finding influential nodes in multilayer networks. CIM finds the seed nodes using a clique-based structure. It finds all the maximal cliques in the multilayer networks. After that, seed nodes are selected from these generated cliques. For finding the seed nodes, CIM proposes the seed selection process; the selection process consists of four cases, and the seed nodes will be identified based on these cases. In addition to this, we also propose ignoring *noted nodes* for influence spread.

One of the disadvantages of CIM is, its insensitivity to the community structure. This thesis proposes SIM, Similarity-based community influence maximization. SIM overcomes the disadvantages of CIM. SIM is an incremental community-based algorithm for influence maximization. Generally, individuals in a community interact frequently and are more likely to influence each other. This algorithm uses the community structure to find the most influential nodes in the multilayer networks. In this work, we propose weighting index (WI), which is used in SIM for detecting the initial communities (DIC). Then SIM consolidates some small communities using cut similarity metric to form the final community set. Then SIM selects the seed nodes from the communities using a quota-based approach.

One of the disadvantages of SIM is the lack of quality communities and seed nodes. This thesis proposes CBIM, community-based influence maximization in multilayer networks. CBIM is another community-based influence maximization algorithm to find much influential nodes for information spreading. CBIM overcomes the disadvantages of SIM. CBIM also finds the most influential nodes and it also uses community structure to find seed nodes. CBIM algorithm has two stages: The first is for community detection, and the second is for seed node

selection. In the first stage, CBIM finds the initial communities. CBIM uses the degree of a node and the dice similarity index for finding initial communities. CBIM merges some initial communities to form the final community set. We propose merging index (MI) as criteria to merge some of the small communities. MI calculates based on community scale and community conductance. In the second stage, this thesis proposes edge weight sum (EWS), which is similar to weighting index (WI). CBIM computes EWS for each node in all the generated communities and ranks the nodes based on EWS. CBIM uses the a quota-based approach to select the seed node set from the communities based on the nodes' EWS ranks.

SIM and CBIM takes more processing time for detecting communities and seed node selection. This thesis proposes K++-Shell decomposition algorithm. It reduces the time complexity and improves the performance in influence spreading than previous algorithms. The K++-Shell decomposition algorithm, which aims to find the most influential nodes in multilayer networks. K++-Shell decomposition is improved version of K-Shell decomposition algorithm. Generally, K-Shell decomposition algorithm prunes the nodes based on degree and places the pruned nodes in the appropriate buckets. But it ignores the critical aspect, i.e., all the nodes in the highest bucket may not be influential, and some nodes in the lower bucket may be much more influential as they may have rich neighbors. To address this problem, K++ Shell decomposition algorithm rewards one point to each neighbor of a pruned node. Before K++ Shell decomposition, we find the communities using label propagation algorithm in multilayer network. We observe that, our proposed algorithms are efficient and maximize the influence spread.

This study is significant as it finds the influential nodes in multilayer networks for viral marketing. In this dissertation, we compare the performance of all the proposed algorithm with the state-of-the-art algorithms and the results are impressive.

*Keywords:* influence maximization, viral marketing, multilayer network, community detection, maximal cliques.