Chapter 7

Conclusions and Future Works

This chapter provides the overall conclusion of the thesis by analysing the findings of the considered objectives of the thesis. We also provide the future research directions that emerge along with the findings of this thesis.

7.1 Conclusions

Link prediction and influence maximization in dynamic networks are gaining a lot of attention as network science research in recent decades. Various real-time applications of link prediction and influence maximization are attracting researchers and business organizations to work in this field of research. We addressed some of the issues in link prediction and influence maximization in dynamic social networks and proposed suitable models to solve the considered issues in this thesis. Specifically, we consider three objectives for this thesis: link prediction-based influence maximization, multifeature analysis-based link prediction, and context-aware influence maximization in dynamic social networks. The respective conclusions for each objective and final conclusion of this thesis are given in this section.

A link prediction-based influential node tracking method is presented as the solution of our first objective, which finds seed nodes for information spread in the dynamic social

network. We use the ctRBM based deep learning technique for link prediction to predict the next snapshot of the graph. We then find the seed set in the predicted snapshot using the EXCHANGE algorithm. This seed set is used for actual influence spread in the real snapshot of the graph. This method improves the influence spread in terms of the number of influenced nodes in highly dynamic social networks. Extensive experiments on four real social networks demonstrate that our method outperforms the baselines in terms of influence coverage and influence spread time.

A multifeature analysis-based link prediction model PILHNB is proposed as the solution to our second objective, which predicts links among users of the dynamic social networks by utilizing the user behaviour and the network structure change pattern of the evolving network. We used the LDA topic model for user behaviour pattern discovery and to infer the user interest distribution. To reduce the adverse impact of interest distribution, the LDA is improved by the Gaussian weighting technique. Then the HNB algorithm is used to analyze the overall effect of all the considered controlling elements responsible for the prediction of links in the networks. The performance of link prediction is improved in our proposed model by considering and combining both the behavioural and structural evolution patterns of the nodes. We used six real-world datasets for our experiments. The experimental results validate that the proposed model PILHNB gives better performance in terms of precision, recall, F1-Measure, and AUROC on almost all the considered datasets compared with other considered baseline methods. By using our proposed model, we can effectively predict links among users of social networks. We can learn the user behaviour pattern, which changes over time, and also the pattern of structural changes in the networks.

A context-aware influence maximization technique in dynamic social networks is proposed as the solution to our third objective in which the influence spread depends on multiple features, and seed nodes are discovered according to the topic of interest of users and message/product. We propose a novel multifeature based diffusion model, CIC, which is a modified version of the IC diffusion technique. The proposed diffusion model considers the similarity of topic-of-interest between users and also between users and messages. It

also considers the popularity and location information of the users to perform the diffusion process. We also propose a novel topic-aware influence maximization algorithm based on the CIC diffusion model named the MINT algorithm for topic-aware seed set selection. Experimental evaluations show the effectiveness and efficiency of our proposed framework on six real-world network datasets. Results show that the proposed MINT algorithm performs better in comparison to the considered baseline algorithms in terms of influence spread and speedup.

The above outcomes of the objectives ensure that we achieved the defined goals of this thesis and the proposed models solve the problems which we aimed to solve. The experimental and theoretical results represented in this thesis show that a considerable amount of research work is contributed by this thesis in the field of Network Science.

7.2 Future Research Directions

In this section, we discuss several new avenues of research that have been opened up by this thesis.

7.2.1 Link Prediction

The possible future research agenda that can be formulated from this thesis in the field of Link Prediction in dynamic social networks are as follows.

- It would be interesting to explore advanced Deep learning models for link prediction in dynamic networks.
- It would be interesting to explore and use some other relevant features that may also be responsible for predicting the links in the networks.
- It would be interesting to explore and use the topic of interest-based weights in the traditional greedy algorithm.

- It would be interesting to use the proposed models for the prediction of links in different real-life applications such as friend recommendation in social networks, product recommendation in online marketing, team recommendation for projects, and many other potential applications.
- It would be interesting to implement the hospital, doctor, pathology, and treatment recommendation systems for patients and person in need using the proposed multi-feature analysis-based link prediction model.

7.2.2 Influence Maximization

The interesting future research agenda that can be enumerated from this thesis in the field of Influence Maximization in dynamic social networks are as follows.

- It would be interesting to explore the influence maximization model work as a fully online process instead of taking snapshots of dynamic networks.
- It would be interesting to explore the other available diffusion models and use in our proposed model and compare them.
- It would be interesting to use our proposed models in real-time applications such as fake news containment, controlling the spread of diseases like COVID 19, product-based viral marketing, and exploring many other possibilities of its uses.
- It would be interesting to explore other learning models for the behaviour prediction of users and communication pattern of the links between users.