Influence Maximization

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In an online, connected world where any information about you can be written and exposed, Influence Maximization is a topic regularly practiced and rarely discussed. It can be found applied in some of the most common systems utilized in a connected world since the birth of the World Wide Web. Also, its applications are very attractive to eCommerce companies that are interested in discovering information about their customers to recommend the best products, or social media giants that want to connect their users for a more fluid experience. This networking technology can be used for an abundant of applications that involve research or analysis of desired data.

Before describing the variable applications that Influence Maximization, it is important to understand the characteristics of such technology. For this reason, Influence Maximization is derived from the Influence Maximization Problem that analyzes a graph model in network diffusion to find the shortest possible time [1]. To do this, the S subset should be selected as seed set from the nodes in such a way that under a diffusion model with probability p leading to activating most the number in the given graph [1]. The Influence Maximization Problem has been proven as NP-Hard and was provided an alternative solution consisting of a General Greedy (GG) slgorithm with an optimal approximation of $1 - 1/e = 0.63123$ [1]. What our Influence Mazimization Problem yields is an efficient way to calculate the best connections possible (based on the social media network graph), but with a difficulty of NP-Hard an alternative was necessary as shown.

Social networks can expand as the best example for the applications of this technology. As discussed by Zhang et. al, mobile social networks are a similar communications system that involves the social relationship of the users. In a similar manner, mobile users can spread information, opinions, ideas, and rumors [15]. This can be traversed using Influence Maximization, however, existing methods of influence maximization are heuristic algorithms based on network topology and greedy algorithms based on spreading [15]. The connection of such techniques still require weight analysis of network nodes, but the traversal still requires too many sequences to be used efficiently.

Social media tyrants are the primary occupants of Influence Maximization. Amongst a variety of companies (such as Facebook, Twitter, WhatsApp, Instagram, etc...) Influence Maximization is incorporated on a model based on network topology that is the result of people's interactions on that social network [7]. Methods of measurement examined by Guo et. al can be divided into three measures titled *node degree*, *shortest path*, and *random walk characteristics* [7]. We have seen network topology algorithms in class such as the Distance Vector (DV) or Link State (LS) algorithms that exhibit shortest path and random walk characteristics respectively.

References

[1] Zahra Aghaee and Afsaneh Fatemi. An influence maximization algorithm based on community detection using topological features. In *2021 11th International Conference on Computer Engineering and Knowledge (ICCKE)*, pages 128–133, 2021.

[2] Yigit E. Bayiz and Ufuk Topcu. Decentralized online influence maximization. In *2022 58th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, pages 1–8, 2022.

[3] Deboleena Bhattacharyya, Khavin Shankar G, P Aaranan, K Raja, Amira Alturki, and Mithileysh Sathiyanarayanan. Predicting nodes for effectively spreading vaccine awareness: An influence maximization approach. In *2021 4th International Symposium on Advanced Electrical and Communication Technologies (ISAECT)*, pages 1–6, 2021.

[4] Hao Chen, Weiqing Xiong, Peichen Xiong, and Jiaying Zhao. Study on inter-temporal pricing to suppress negative network externalities of merchants in two-sided markets. In *2020 39th Chinese Control Conference (CCC)*, pages 6668–6673, 2020.

[5] Xiaoheng Deng, Fang Long, Bo Li, Dejuan Cao, and Yan Pan. An influence model based on heterogeneous online social network for influence maximization. *IEEE Transactions on Network Science and Engineering*, 7(2):737–749, 2020.

[6] Thang Dinh, An Nguyen, Uyen Nguyen, and Giang Nguyen. Quantum social computing approaches for influence maximization. In *GLOBECOM 2022 - 2022 IEEE Global Communications Conference*, pages 5832–5837, 2022.

[7] Yuning Guo, Jianxiang Cao, and Weiguo Lin. Social network influence analysis. In *2019 6th International Conference on Dependable Systems and Their Applications (DSA)*, pages 517–518, 2020.

[8] Kundan Kandhway. Multi-objective information maximization in a social network. In *2023 17th International Conference on Ubiquitous Information Management and Communication (IMCOM)*, pages 1–4, 2023.

[9] Radosław Michalski, Jarosław Jankowski, and Piotr Bródka. Effective influence spreading in temporal networks with sequential seeding. *IEEE Access*, 8:151208–151218, 2020.

[10] Shambhavi Mishra and Rajendra Kumar Dwivedi. Leveraging deep learning to spot communities for influence maximization in social networks. In *2023 International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT)*, pages 377–382, 2023.

[11] Amit Mittal, Meenal Arora, and Ajay Rana. Imep: Influence maximization on social media with the impact of e-commerce products. In *2022 5th International Conference on Contemporary Computing and Informatics (IC3I)*, pages 1789–1793, 2022.

[12] Ashis Talukder, Md. Golam Rabiul Alam, Nguyen H. Tran, Dusit Niyato, and Choong Seon Hong. Knapsack-based reverse influence maximization for target marketing in social networks. *IEEE Access*, 7:44182–44198, 2019.

[13] Chengcheng Wang, Xingjian Ma, Wenwen Jiang, Liang Zhao, Na Lin, and Junling Shi. Imcr: Influence maximisation-based cluster routing algorithm for sdvn. In *2019 IEEE 21st International Conference on High Performance Computing and Communications; IEEE 17th International Conference on Smart City; IEEE 5th International Conference on Data Science and Systems (HPCC/SmartCity/DSS)*, pages 2580–2586, 2019.

[14] Yishu Wang, Guanghui Yan, Zhe Li, and Ye Lv. Research on influence maximization of citation network from the perspective of meme. In *2021 3rd International Academic Exchange Conference on Science and Technology Innovation (IAECST)*, pages 509–512, 2021.

[15] Xinxin Zhang, Li Xu, and Zhenyu Xu. Influence maximization based on network motifs in mobile social networks. *IEEE Transactions on Network Science and Engineering*, 9(4):2353–2363, 2022.

References

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