Node Query-Aided Influence Maximization in Unobservable Networks

Cong Tran\textsuperscript{1,2} and Won-Yong Shin\textsuperscript{2}
\textsuperscript{1}Dankook University, \textsuperscript{2}Yonsei University
trancong208@gmail.com, wy.shin@yonsei.ac.kr

Abstract

The influence maximization (IM) problem aims at identifying a set of seed nodes in the sense of maximizing the influence spread in a network. More recently, researchers have paid attention to a more challenging IM problem where the structure of the underlying network is initially unknown. In this paper, we present IM-META, an end-to-end framework for effectively solving the IM problem in unknown networks using node queries aided by nodal metadata.

I. Introduction

In real-world applications of influence maximization (IM) \cite{KempeKleinbergTardos2003}, we often encounter the case where the network structure is initially unknown \cite{ValentePumpuang2007}. In such a case, an influence maximizer may identify a set of the most influential seed nodes by exploring only a part of the underlying network given a small budget for node queries. Motivated by the fact that collecting metadata of nodes such as node features is much more cost-effective than investigating the relationship between nodes via queried nodes in many practical situations, we introduce an end-to-end framework for effectively solving the IM problem in unknown networks.

II. Methodology

In our study, we aim at retrieving information from jointly discovering a sequence of node queries and a set of nodes maximizing the influence spread. Unlike the conventional setting of IM \cite{KempeKleinbergTardos2003}, our problem is ill-defined due to the uncertainty of the unexplored part that is not obtained from node queries. To resolve this issue, we design a framework making full use of the available nodal metadata by iteratively performing three steps: 1) learning the relationship between collected metadata and edges via a Siamese neural network model, 2) constructing a reinforced weighted graph by selecting only a limited number of confident edges, and 3) discovering the next node to query using the proposed topology-aware ranking strategy balancing between degree centrality of a target node and its geodesic distance to potential seeds. The finally reinforced weighted graph is used as input of a modified greedy IM algorithm, which aims to find a set of seed nodes.

III. Experimental Results

Fig. 1 shows the performance comparison between our proposed IM-META and competitive methods, namely Rand, NF-only, and CHANGE with respect to the expected influence spread $\sigma$, using four real-world networks (i.e., CS, Physics, Douban, and Ego-Facebook) given the number of node queries, $T$. The result illustrates the superiority of our method.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Experimental results}
\end{figure}

ACKNOWLEDGMENT

This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2021R1A2C3004345), by the Republic of Korea’s MSIT (Ministry of Science and ICT), under the High-Potential Individuals Global Training Program (No. 2020-01463) supervised by the IIITP (Institute of Information and Communications Technology Planning Evaluation), and by the Yonsei University, Republic of Korea Research Fund of 2021 (2021-22-0083).

REFERENCES

\begin{itemize}
\end{itemize}