Fast Algorithms for Influence Measure in Social Networks

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Location: LIP6 - Sorbonne Université - 4 place Jussieu, Paris, France
Topic: Algorithms in complex networks

Context

In online social platforms, it is crucial to measure the importance of users. For instance, identifying the users that are most likely to affect the opinion of a population is key for companies for better marketing of their products [1], or for security agencies to develop defense mechanisms against the spread of misinformation [2]. Another use case are recommendation systems and prediction algorithms, which can leverage the importance of users to just focus on the ones that determine new trends [3]. Consequently, it is essential to develop algorithms that allow us to rank users by their influence in the large and dynamic social networks that are ubiquitous nowadays.

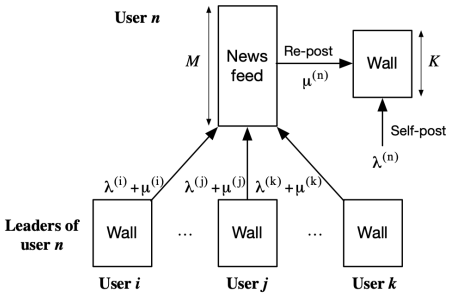

Figure 1: Social platform from the point of view of a user

Goal

Recently, a social influence measure, called Ψ-score, was proposed in [4] as a means to provide a very precise ranking of user influence in social networks: it combines the user position on the social graph with user rate of (re-)posting activity. However, despite the large expressiveness of the Ψ-score, it scales poorly to large networks and do not adapts well to networks that evolve over time. Therefore, our ambition is twofold: firstly, we aim to develop fast algorithms that can compute the Ψ-score in social networks of realistic sizes; secondly, we aim to adapt the Ψ-score to networks that evolve over time.

A key property of the Ψ-score is that it can be seen as a generalization of the standard PageRank algorithm. We are thus interested in building upon recent acceleration techniques based on Chebyshev polynomials [5] that provide state-of-the-art convergence speed for PageRank and some of its generalizations. Yet, this adaptation calls for a deep study of the spectral properties of the Ψ-score and to extend Chebyshev polynomials for graphs with directed edges. We also plan to explore generalizations of the Ψ-score to time-evolving networks [6]. Our goal is to go beyond the sequence of graphs point of view: we look for a metric that considers the dynamics of vertices and edges, yet when the network does not change over time we should get the classical Ψ-score as a particular case.

Requested profile

This internship is directed at students with various background (complex networks, algorithmic, graph theory) but with a strong interest in graph algorithmics and/or theory and its applications.

The intern will be part of the Complex Networks and Network and Performance Analysis teams of the LIP6 (SU-CNRS), located in Paris on Jussieu Campus.

References

[1] D. Kempe, J. Kleinberg, and É. Tardos, "Maximizing the spread of influence through a social network," in *Proceedings of the ninth ACM SIGKDD international conference on Knowledge discovery and data mining*, pp. 137–146, 2003.

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[3] C. Musto, P. Lops, M. de Gemmis, and G. Semeraro, "Context-aware graph-based recommendations exploiting personalized pagerank," *Knowledge-Based Systems*, vol. 216, p. 106806, 2021.

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[6] M. Ghanem, F. Coriat, and L. Tabourier, "Ego-betweenness centrality in link streams," in *2017 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM)*, pp. 667–674, IEEE, 2017.