

WEST UNIVERSITY OF TIMIȘOARA
FACULTY OF MATHEMATICS AND INFORMATICS
DEPARTMENT OF COMPUTER SCIENCE

PhD THESIS

Summary

Algorithmic strategies for changing
collaboration patterns in online social media



Thesis adviser:
Prof. Dr. Gabriel Istrate

Candidate:
Brîndușescu Alin

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Summary

It is widely recognized that online social media wields a substantial influence on society, affecting everything from individuals' political views and consumer behavior to their overall sense of happiness. This profound impact underscores the need for a deeper understanding of how social media dynamics operate and shape these aspects of life. As social media platforms continue to evolve and integrate into daily routines, it becomes crucial for researchers and developers to investigate how these platforms affect user behavior and perceptions. Their goal is to design and implement mechanisms that not only protect users from potential harm but also correct misleading or harmful content. By enhancing these protective and corrective measures, researchers and developers aim to create a more balanced and equitable online environment, ultimately fostering a healthier digital society.

This thesis provides a set of strategies aimed at guiding specialized social media platforms in making informed decisions about where to direct their growth investments and how to build robust protection mechanisms. For these platforms, the initial phase—before achieving critical mass—is particularly crucial, as the decisions made during this period can significantly influence the platform's overall success. The thesis primarily focuses on exploring advanced algorithms for detecting leaders and communities within both static and evolving network structures. It also examines strategies for effectively managing collaboration while staying within budget constraints. Many specialized social media platforms depend on incentive programs to drive user engagement and growth. To ensure these incentive models are not undermined by fraudulent activities, it is vital to implement protective mechanisms that safeguard against such behavior. Consequently, this thesis delves into various strategies and algorithms for trust propagation and fraud detection, assessing their effectiveness and impact on a real-world social media platform. Through this detailed exploration, the thesis aims to contribute valuable insights and practical solutions for enhancing the reliability and success of specialized social media platforms.

Contributions

The contributions of this thesis, with respect to the state-of-the-art algorithms and methods, are both theoretical and practical, as summarized below.

- We simulated an evolving social network and in that context we have:
 - discovered a mechanism to build evolving networks to be used in experiments and simulations;
 - analyzed standard standard centrality measures in the context of an evolving network;
 - proposed a new algorithm for collaborator group detection.
- We considered a natural mechanism for changing the propensity of users to participate in the game and we analyzed the mechanism using two types of games: *network centrality games* and *credit attribution games*. Our results showed that:
 - uncovered a number of optimal manipulation strategies of player power indices;
 - highlighted the cases when no manipulation is possible;
 - analyzed fractional attacks
- In the context of online social media with an incentive program for user acquisition and retention we have:
 - introduced a mathematical framework for describing the trust propagation and fraud problems;
 - created models for typical trust propagation scenarios;
 - proposed new algorithms for trust propagation
 - simulates the trust propagation results based on different methods for selecting the starting user base
- We conducted an empirical analysis of the impact of algorithms applied to a real social media platform:
 - implemented trust propagation algorithms in a real social network platform;

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- used centrality measures and community detection ideas into the social platform;
 - extracted the relevant data from the platform and made publicly available to the research community;
 - analyzed the impact of the algorithms on the network structure;
 - discovered that, despite using an unconventional connectivity model, the resulting network still displays key characteristics of both scale-free and small-world networks.

Keywords

coalitional games, reliability extension, Shapley value, manipulation, social networks, centrality measures, network analysis, gamification, fraud-detection, simulation, centrality measures, social networks, co-authorship, network analysis, author ranking, collaborator group ranking, conference analysis, bibliometrics, trust-propagation

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