TCSN Newsletter –Issue Three– December 2018

Social Networks Technical Committee

Editors: Prof. De-Nian Yang, Prof. Damla Turgut, and Prof. Eirini Eleni

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CHAIR'S MESSAGE

When social media dominates the traffic over the Internet and mobile communication networks, there are further insights and engineering that could be developed based on understanding social networks in depth. Such interplay between technological networks and social networks have so many different aspects to inspire IEEE Communications Society members toward further frontier of communication technology and benefits of human society. Under such background, Technical Committee on Social Networks (TCSN) has been established since 2016, after incubation as a sub-committee in Emerging Technology. When we get to two years old, we are launching the TCSN Newsletters to allow more fluent exchange of vision, ideas, and technological opportunities, in addition to website and social media platforms. We have to appreciate remarkable volunteers at TCSN to make this inauguration issue come true. Last but not the least, we wish TCSN Newsletters serving an effective means for this exciting multi-disciplinary knowledge on social networks to blend humanity and technology in an even better way. Most important, please continue your interest in social networks and actively participate or initiate more volunteer services to TCSN and IEEE Communications Society.

Best wishes,

Neeli Prasad, Chair, TCSN, 2018-2020

UPCOMING CONFERENCES & CFP FOR SOCIAL NETWORKS TRACK

IEEE Globecom 2019: December 9 – December 13, Waikoloa Village, HI, United States
IEEE ICC 2020: June 7 – June 11, Dublin, Ireland

Social networks have become prevalent forms of communication and interaction on the Internet and make up an increasingly part of the network traffic. As a result, social networks have attracted significant research interests in a large number of related areas. Social networks have traditional been studied outside of the technological domains, but focus is now changing towards networking challenges such as cloud, privacy, data analytics, etc. while still keeping the social perspective such as focusing on improving quality-of-life. The interplay between social networks and technological networks such as mobile networks and mobile computing is becoming still strong and many areas are still to be exploited.

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RETHINKING RESOURCE ORCHESTRATION BASED ON USERS SOCIAL CHARACTERISTICS

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Resource Management Nowadays

Resource management in wireless networks is a very well-investigated research topic over the last decades. However, what makes this research topic still of great interest to the research community? Why all the challenging research and practical problems in this field have not already been addressed, but they keep reappearing in several forms and flavors? To answer these questions, we should think and observe that the key point that is missing nowadays from the prior studies is awareness of users' *social characteristics*. Users are social entities that act in an unpredictable manner within a network, e.g., wireless communication network, or a system, e.g., smart cities environment. Based on the available network resources for exploitation by the users, the latter may make different decisions and may exhibit a different behavior, while their actions may become interdependent. Users' *social behavior* within an environment of shared resources can become either aggressive or conservative towards occupying the necessary resources to fulfill their needs, where the latter can be translated in different levels of Quality of Service (QoS).

Existing approaches in the field of resource management in wireless networks have assumed that the end-users act as expected utility maximizers, who aim to maximize their perceived satisfaction and can act either in a *selfish and competitive manner* or try to *build coalitions* and collaborate with their peers to achieve the maximum benefit. The fundamental assumption of the current approaches is that the humans are *risk-neutral*. However, in a real communication environment the end-users are humans with social and personal characteristics and preferences, while they tend to exhibit *risk-averse* or *gain-seeking behavior*.

Tragedy of the Commons

The risk is introduced in the communication environment due to the shared nature of the network resources, which can be over-exploited, thus, fail to serve the users' QoS prerequisites. The latter phenomenon is identified as the *Tragedy of the Commons*, which concludes to the collapse of the shared resources and no user is satisfied within the network. With the advent of Internet of Things and 5G

communication networks, where billions of end-users' devices are connected to the wireless networks, this phenomenon and trend is intensified. To avoid the failure (i.e., fragility) of the shared resources, the users' social characteristics should be captured within the design of the resource orchestration in the future wireless networks.

Prospect Theory

The research path that is envisioned to capture users' social characteristics and risk-aware behavior is based on the *Prospect Theory*. Prospect Theory was introduced by Kahneman and Tversky in 1979, and it is a Nobel-prize-winning behavioral economics theory, where the individuals make autonomous decisions under risk and uncertainty of the associated payoff of their choices, which is estimated with some probability. In contrast to the expected utility theory, where all the individuals are assumed as risk-neutral with respect to their choices, the Prospect Theory embodies *individuals' behavioral patterns*, which demonstrate systematic deviations from the expected utility theory. In a dynamic environment of available choices with uncertain payoff, individuals tend to overweight low probability events and underweight high probability events. Prospect Theory also claims that individuals perceive greater dissatisfaction from a potential outcome of losses compared to their satisfaction from gains of the same amount.

Users' behavioral patterns are already extracted through the *social networks* via *machine learning* and/or *deep learning techniques*. The users' profiles are constructed dynamically over the time, the conditions of the environment, the interactions with the peers and even during emergency events, e.g., public safety scenarios. Users' behavioral patterns can act as an input to and interact with the prospect-theoretic resource orchestration to conclude to more efficient allocation of the system's resources in terms of number of satisfied end-users, energy-efficiency and improved achievable data rate levels.

"A human is a social creature" Aristotle

The key takeaways are captured within Aristotle's inspirational quote. Humans are social creatures, who exhibit unpredictable, strange and enigmatic behavior. Thus, the resource orchestration approaches of the future wireless networks should embody the humans' social characteristics to overcome their existing drawbacks.

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BEING INTELLIGENT VIRAL MARKETING TRADERS OVER SOCIAL NETWORKS

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As social networks grow explosively, social media for spreading information and ideas play an increasingly important role in everyday life, and people are influenced by each other more rapidly. Based on this "word-of-mouth" phenomenon, viral marketing is expected to be much more cost-effective than traditional advertisements. Now marketing agencies provide services for helping clients to analyze customer behaviors, produce engaging content, work with Internet celebrities, and promote brands or products of clients. Viral Seeding[1] is an influencer marketing agency and helped woolroom, a luxury British brand, change their image and increase brand awareness of a new audience. They recruited influencers aligned with the new image of woolroom to post reviews. To promote the brand film on YouTube, Viral Seeding figured out the highly targeted audience and adjusted the target regularly by monitoring statistics on YouTube. The reviews and the film finally reached over 500K people and 185K views, respectively. UpViral[2] develops applications to provide structured incentives for visitors to refer others so that the site traffic of clients can be boosted. All visitors need to invite five friends to sign up for getting free downloads. In addition to business models, Ice Bucket Challenge[3] is also a renowned social campaign, which is an activity to raise awareness of the disease ALS. People who are nominated have to pour a bucket of ice water on their heads or make a donation to the ALS Association. Then they can nominate others on social networks to continue the challenge. Within one month, the ALS Association received more than $100 million and more than 70K tweets were generated per day with hashtags about the challenge.

[1] http://www.viralseeding.com/

[2] https://upviral.com/

[3] http://www.alsa.org/fight-als/ice-bucket-challenge.html

The above successful cases amazed people with the remarkable achievement of viral marketing over social networks. However, intelligent strategies are cornerstones for effective viral marketing. Suppose we have the social information on a social network, such as the influence relationships and the extent of influence strength. In order to make a new product (or idea) go viral, a critical question is to ask who should be the initial influencer to spread the influence so that the number of people on the social network being influenced is the largest. The issue of selecting the most influential individuals at the beginning for the widest influence spread within a limited budget is thus formulated as an optimization problem, named influence maximization (IM).

Modeling Influence Propagation, Solutions to IM, and Variants of IM

An essential step for the IM studies over social networks is the influence spread estimation. For this purpose, various models have been proposed to quantify the influence diffusion. Motivated by the thoughts in human minds that drive behaviors, one category of the diffusion models is the Threshold model, which assumes that each individual on a social network has a threshold in mind and takes actions to further pass out influences if and only if an individual gets sufficient motivations (or said, influences) larger than the threshold in mind. To reflect personal preferences, the threshold is usually different from person to person and could be impacted by many factors such as gender, age, education, social economic status, personality, etc. Of this category, there are two well-known models, the Majority Threshold (MT) model and the Linear-Threshold (LT) model. The MT concerns the decisions of a proportion of one's friends, while the LT emphasizes more the influence strengths and treats the strengths from different friends as the cumulative force. The other category is the Cascade diffusion model, which simulates the uncertainty of human behaviors and thus uses probabilities to determine whether or not an individual on a social network will be successfully influenced by the friends. Once an individual is successfully influenced and thus becomes active, he/she passes out influences to his/her friends and activates them also by some probabilities. The most famous model of this category is the Independent Cascade (IC). The "independent" represents that the effect of each influence is independent of each other, and thus that the active probabilities keep steady regardless of the order of influence diffusion over the social network. The Decreasing Cascade (DC) is also well-known. The DC decreases the active probabilities as the number of active individuals increases, to reflect the phenomenon of information saturation. Such models in both of the Threshold and Cascade categories are often used in real applications for modeling the diffusion of innovations, the spread of news, rumors, and voting, etc. Based on the diffusion models, intelligent initial marketing strategies for the IM problem over social networks is then extensively explored.

Under the above diffusion models, the simple greedy strategy for IM is proved to approximate the optimal solution. However, computing exact influence spread in the greedy strategy is a difficult task, as is simulating influence spread by Monte-Carlo approach. Novel heuristics and techniques, like degree discount, local influence regions, reverse influence sampling, to name a few, are proposed to tackle the problem and make it possible to solve IM in large-scale social networks.

Furthermore, in order to address practical issues in the real-world applications, active research also studies on extended IM problems from various aspects, such as topic, time, location, dynamic, competitive, and so on. The following presents an overview of each aspect.

1. Topic-aware IM: It is natural that people are usually affected more by friends with similar interests. A piece of information may be spread more widely among people who prefer its characteristics. Hence, the topic-aware IM problem is two-fold: developing a new topic-dependent influence diffusion model and maximizing the influence on a set of targets who are interested in the specified topic.
2. Time-aware IM: In the real-world applications, the influence spread usually matters before a deadline. Besides, as observed in the real world, the influence usually propagates from one to another with a time delay. These motivate the time-aware IM, which adopts probability distributions to capture the activation time delay and finds the optimal seed group for maximum influence spread at the specified step for influence diffusion.
3. Location-aware IM: Note that the geographical information plays an important role in positioning the market. As the location-based social networks and mobile devices are pervasive, people's locations become accessible. The location-aware IM is thus to maximize the influence spread on the targets who are relevant to a specific region.
4. Dynamic IM: Since the real-world social networks evolve continuously, such as new relationships formed, new users added, old users left, and so on, the dynamic IM is to continuously find the seed group for each timing. Moreover, note that the changes of social networks are not always observable. The dynamic IM also addresses to find the approximate solution for maximum influence spread by probing the changes of networks.
5. Competitive IM: The competition between rivals is ubiquitous in real-world marketing. The competitive IM thus aims at maximizing one's influence and minimizing the influence of the other rivals, as their influences propagate over the same social network at the same time and their diffusions affect each other. Generally, there are two types of assumptions for the competitive IM. One assumes the opponent strategies are known and focuses on blocking the influence spread of the rivals, while the other has a more general assumption that the opponent strategies are unknown.

Machine Learning on Social Influences

With diverse aspects coupled with various diffusion models, simulations of wide influence spread better comply with that in the real world and effectively facilities the exploration of intelligent marketing strategies for the IM problem. However, there is still an open problem on how to derive the social influences among people (w/ or w/o diverse aspects). A possible solution is to infer the social influence from observed diffusion cascades, or said action logs. The action logs carry the information about what action is performed by whom at which timestamp. Then, the social influence can be learned by maximizing the likelihood of observing the actions performed in the logs. On the other hand, several probabilistic models for capturing the influence propagation from direct friends on the social network are also proposed. Specifically, the influence propagation is observed when a user takes some action after his/her friend did. The models thus not only learn the social influence but also predict the timing of being influenced. Nevertheless, there exists a challenging of data sparsity since the social influences usually are topic-aware, which means the action logs should be topic-aware or even time-aware as well. To ensure the accuracy of the learned social influence, it is necessary to infer the social influences from multiple related diffusion cascades by exploring the commonality of them. Moreover, as the action logs are continuously generated, the learning process in a streaming environment concerning the space and memory limitation is also a practical issue.

Obviously, the word-of-mouth effect is a force to be reckoned with. By carefully modeling and learning the influence diffusion over social networks, solving the corresponding IM problems are able to provide intelligent strategies for viral marketing and bring exponential growth of awareness. Being an intelligent viral marketing trader over social networks isn't a dream in many future applications. Let's go viral and work miracles!

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TO USE OR NOT TO USE? THIS SHOULD NOT BE A DILEMMA: NEWSFEED ROUTING FOR BEHAVIORAL THERAPY ON SOCIAL NETWORK ADDICTIONS

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When social media has become popular and inspires a large amount of research, few of them notice the addiction issues of online social networks (OSNs). In fact, Social Network Mental Disorders (SNMDs) have already been recognized as a mental disorder with pathological behaviors that are similar to substance dependence as it fits the criteria of tolerance, withdrawal, and craving. Some others hold the views of SNMDs as a behavioral addiction since it is similar to gambling behavior with the components of salience, mood modification, tolerance, withdrawal, conflict, and relapse. This is perhaps the most dominant theory nowadays for SNMD explanation. Problems with impulse control are also used to explain SNMDs. Losing control, being impulsive and ego-syntonic patterns are often observed among users of SNMDs. Having difficulties to control their impulses usually lead to pathologically and obsessively using the social media even though patients sometimes claim that “we DO WANT to stop, but we CAN’T!”

Newly research, however, found the interesting correlations between SNMD and brain functions. SNMD is associated with structural or functional impairments in the orbitofrontal cortex, dorsal-lateral prefrontal cortex, left anterior cingulate cortex, left posterior cingulate cortex, left insula, and left lingual gyrus. Those regions mentioned above are involved in the processing of reward, motivation, memory, and cognitive control. No matter which explanation you buy, the most important thing is to realize that social media plays a role as “platform” for mental disorders to express its pathological symptoms. It is also a haven for people who have mood disturbances and frustrations to escape from the real challenges in their real daily life.

SNMD Types and Clinical Intervention

Since problematic SNMD, or perhaps a much fancier word "i-Disorder", gradually becomes research field favorite, how to treat those disorders apparently attracts clinicians' attention. To better formulate the treatment plans, SNMD are categorized into three types: 1) Information Overload, including compulsive receiving of user status and newsfeeds, leading to lower productivity and less social interactions with family or friends offline; 2) Net Compulsion, including compulsive online social gaming or gambling, often resulting in financial problems; and 3) Cyber-Relationship Addiction, including the addictions to social networking functions, checking and sending to the point where social relationships to virtual and online friends become more important than real-life ones.

Noted that no matter from substance abuse or behavior addiction approach, clinicians in medical field tend to choose either cognitive, or behavioral, or combine the two of it approaches to be the treatment options helping our patients. Some professionals argue if the pharmacotherapy should be included into treatment plans, but current mainstream treatment remains psychotherapy that is believed to be able to somehow alter patients' thoughts and behaviors thoroughly. One naïve intervention treatment is total abstinence, i.e., restricting the access of OSNs by parents. However, such a significant behavioral change usually results in relapse, i.e., revert to excessive usage after the prohibition. Meanwhile, compulsory enforcement may lead to tragedies. For example, a teenager in India who killed herself after her parents forbade her to use Facebook left a note saying she 'couldn't live without the site'.4

Newsfeed Addictiveness Quantification and Routing

Different from conventional intervention approaches, the addictiveness of OSN contents can be analyzed for individual patients in order to carry out "personalized" behavioral therapy since different contents jointly affect the SNMD scores of users. The main idea of behavioral therapy, similar to e-cigarettes, is to substitute highly addictive newsfeeds with informative and supportive contents based on behavioral therapy. The previous study shows that the addictiveness of a newsfeed is related to social interaction and the content information. For social interaction, parasociality represents an imbalanced relationship, i.e., only one user takes actions (e.g., sending or relaying messages) to the other but never/merely gets response. This process resembles the process of watching online streaming videos of Internet celebrities. That is, when users receive recent status of other people or are the audience of others, users create an illusionary intimacy with Internet celebrities, which leads to addictions. On the other hand, for content information, the effect of Echo Chamber describes the phenomenon that people prefer sharing similar opinions with friends and messages propagates only within small subgroups, which strongly related to information overload on OSNs. Moreover, information overload can also incur by the compulsive tracing of newsfeeds from competitors due to malicious envy.

With the quantification of the addictiveness of each newsfeed, proper OSN contents can be selected and routed for SNMD patients to gradually reduce their addictions. However, treating SNMDs still requires caution since controlling social interactions is complicated. When we jointly treat some patients, it may

[4] https://www.dailymail.co.uk/news/article-2477401/Teenager-killed-parents-banned-Facebook.html

generate some ripple effects and propagate to the whole social networks. For example, when users received some newsfeeds, they may automatically relay the newsfeeds to others, which may unexpectedly route to other users. In accordance with social support theory, likes, relays, and comments on a newsfeed are crucial to remedy loneliness of users. Therefore, if we always filter out the addictive newsfeeds, the chances that some lonely users get social support through receiving responses on OSNs are significantly reduced.

Key Takeaways

Before social networking sites such as Facebook, Twitter, and Snapchat, attempt to solve the issues of problematic usage, several suggestions about what a user should do on social networking sites are listed below.

1) Set a goal to gradually reduce the usage instead of abstinence.
2) Do not follow your active colleagues with similar backgrounds (malicious envy), but follow active colleagues with different backgrounds (benign envy).
3) When there is no response for some of your friends' posts, try to relay the posts, click "Likes", or post a "Sticker", for showing social support to reduce the additions of friends.
4) Break the Echo Chamber by being magnanimous. Do not block/unfollow someone because s/he does not share the same opinion. Stand in others' shoes.

SNMDs should be taken more seriously by social networking sites. Awareness of the impacts of excessive using in social network needs to be emphasized in societal level hence struggling in using it or not will not problematic anymore.

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