Kobe Workshop on Computational and Network Science 2016

Date: September 30, Friday, 2016

Venue: Integrated Research Center, Kobe University

Organizers: Shigenori Tanaka & Mitsuo Yokokawa (Graduate School of System Informatics & Education Center on Computational Science and Engineering, Kobe University)

Program

13:20-13:25 Opening Remarks

13:25-14:25 "Predicting human behavior in techno-social systems: fighting abuse and illicit activities", Emilio Ferrara (University of Southern California)

14:25-15:10 "Immunizing networks by targeting collective influencers", Teruyoshi Kobayashi (Graduate School of Economics, Kobe University)

15:10-15:25 Break

15:25-16:10 "Simulations of financial distress propagation on production network on a nationwide scale", Yoshi Fujiwara (Graduate School of Simulation Studies, University of Hyogo)

16:10-16:55 "Statistical tests of the difference between two networks with incomplete observation", Takaharu Yaguchi[1], Sonomi Kawasaki[2], Kouhei Masumoto[3], Narihiko Kondo[3], Shuichi Okada[3] ([1]Graduate School of System Informatics, Kobe University; [2]Chukyo TV. Broadcasting Co., Ltd.; [3]Graduate School of Human Development and Environment, Kobe University)

16:55-17:00 Closing Remarks

Predicting human behavior in techno-social systems: fighting abuse and illicit activities

Emilio Ferrara (Univerisity of Southern California)

The increasing availability of data across different socio-technical systems, such as online social networks, social media, and mobile phone networks, presents novel challenges and intriguing research opportunities. As more online services permeate through our everyday life and as data from various domains are connected and integrated with each other, the boundary between the real and the online worlds becomes blurry. Such data convey both online and offline activities of people, as well as multiple time scales and resolutions. In this talk, I'll discuss my research efforts aimed at characterizing and predicting human behavior and activities in techno-social worlds: starting by discussing network structure and information spreading on large online social networks, I'll move toward characterizing entire online conversations, such as those around big real-world events, to capture the dynamics driving the emergence of collective attention. I'll describe a machine learning framework leveraging these insights to detect promoted campaigns that mimic grassroots conversation. Aiming at learning the signature of abuse at the level of the single individuals, I'll illustrate the challenges posed by characterizing human activity as opposed to that of synthetic entities (social bots) that attempt emulate us, to persuade, smear, tamper or deceive. I'll then explore applications to the study of online extremism and information weaponization, illustrating possible strategies for computational counterterrorism. I'll conclude envisioning the design of computational systems that will help us making effective, timely decisions (informed by social data), and create actionable policies to make a better future society.

*** Biography ***

Dr. Emilio Ferrara is Research Assistant Professor at the Univerisity of Southern California and Computer Scientist at the USC Information Sciences Institute. Ferrara's research interests include designing machine-learning systems to model and predict individual behavior in techno-social systems, characterize information diffusion and information campaigns, and predict crime and abuse in such environments. He has held various research positions in institutions in Italy, Austria, and UK (2009-2012). Before joining USC in 2015, he was a Research Assistant Professor in the School of Informatics and Computing of Indiana University (2012-2015). Ferrara holds a Ph.D. in

Mathematics and Computer Science from the University of Messina (Italy), and has published over 70 articles on machine learning, network science, and social media, appeared in top venues including Proceeding of the National Academy of Sciences, Communications of the ACM, Physical Review Letters, and several ACM and IEEE transactions and top conferences. His research on social network abuse and crime prediction has been featured on the major news outlets (TIME, BBC, The New York Times, etc.) and tech magazines (MIT Technology Review, Vice, Mashable, New Scientist, etc). He was named IBM Watson Big Data VIP Influencer in 2015, and ranked 28th as Big Data Experts to Follow in 2016 by Maptive. He received the DARPA Young Faculty Award 2016. His research is supported by DARPA, IARPA, and Office of Naval Research. Ferrara is General Chair of Social Informatics 2016. Finally, he is a top 0.5% Kaggle competitor and enjoys participating to data science competitions.

Immunizing networks by targeting collective influencers

Teruyoshi Kobayashi (Graduate School of Economics, Kobe University)

A practical approach to protecting networks against contagion processes such as spreading of infectious diseases and harmful viral information is to remove some influential nodes beforehand to fragment the network into small components. Because determining the optimal order to remove nodes is a computationally hard problem, various heuristics have been proposed to efficiently break the connectivity of networks. Morone and Makse proposed an algorithm called the collective influence (CI) algorithm, which outperforms various existing algorithms. However, many empirical networks have community structure, compromising the assumption of local tree-like structure on which the CI algorithm is based. We develop an alternative algorithm by synergistically combining the Morone-Makse algorithm and coarse graining of the network in which we regard a community as a supernode. The proposed algorithm allows us to efficiently identify nodes that connect different communities at a reasonable computational cost. Our algorithm works better than the original CI algorithm and other previously proposed algorithms on many real-world networks.

Simulations of Financial Distress Propagation on Production Network on a Nationwide Scale

Yoshi Fujiwara[*]

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Extended Abstract

Supplier-customer relationship among firms in a production network is the arena where financial distress propagates from distressed debtors of customers to their creditors of suppliers. While the events of bankruptcies can be observed easily, the underlying contagion effect of financial distress can have considerable consequences such as a chain of bankruptcies.

DebtRank is a model to quantify the propagation of financial distress, which has been applied recently for analyzing and evaluating systemic risk for interbank contagion. Because the production network in Japan, which comprises more than 10^6 of firms as nodes and millions of supplier-customer relationship as links, is much larger than the interbank credit network, it has been a formidable task to study the model of DebtRank on such a large-scale production network.

This work studies the financial distress propagation on the real data of production network by employing an implementation of DebtRank on one of world-fastest supercomputer, K computer. We found that the DebtRank of individual firms has a significant correlation with firm-size with non-linearity, indicating that the DebtRank for big firms becomes much larger than what is expected naively. The analysis for individual sector shows that depending on the sector's position in the upstream and downstream, its DebtRank deviates from a linear relationship between DebtRank and the sector-size. In addition, one can measure vulnerability by using the DebtRank analysis, which is potentially useful to identify likelihood of the failures of firms in more vulnerable sectors.
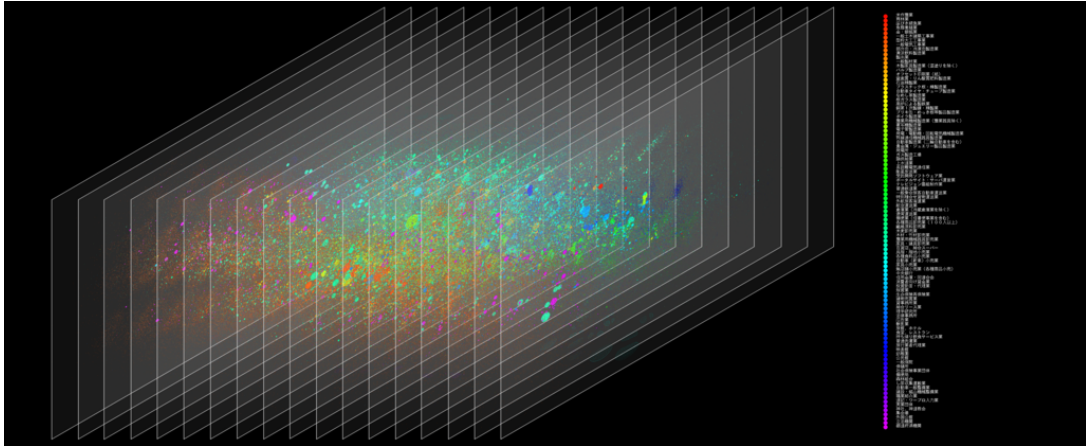
This work is based on the paper [1].

Figure 1: A million firms network sliced by industrial sectors; nodes are firms and links (not shown) are supplier-customer relations (graph layout by N-body simulation in astrophysics).

Reference

[1] Fujiwara, Y., Terai, M., Souma, W. and Fujita, Y., "DebtRank Analysis of Financial Distress Propagation on a Production Network in Japan", Research Institute of Economy, Trade and Industry (RIETI) Discussion Paper Series, (2016) 16-E-046 http://www.rieti.go.jp/jp/publications/dp/16e046.pdf

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Statistical Tests of the Difference
Between Two Networks With Incomplete Observation

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In this talk, we develop a method of statistically testing the difference between two networks, which is designed for situations where only partial data of the structure of the networks are available.

This research is motivated by a socioscientific problem. The number of elderly persons dying alone and filed requests to search for missing persons who disappeared due to dementia-related wandering have increased. In order to solve these problems, the mutual support and cooperation of community residents are essential. In this regard, several case studies on improving the structure of the community have been reported.

In the studies, it is desirable to test statistically whether any significant change in the community was brought about; however, the following two obstacles exist. Firstly, no established procedure for statistically testing the difference of given two networks exists. Secondly, observation of the complete information of the structure of the networks is often expensive and hence impossible.

To address these difficulties, we develop a method of statistical testing of the difference between the two networks, in which only the partial knowledge, e.g. degree distributions or the number of isolated vertices, of the structure of the networks is required. For illustration purpose, an application to the above socioscientific problem is also shown.