Titles and abstracts for:

Application of network theory in computational social science

Dec 1st, 2015, GESIS

Fakhteh Ghanbarnejad
Title: Interacting epidemic dynamics

Abstract:
Theoretical studying of epidemic dynamics on complex networks can help us to understand and predict better a wide range of phenomena such as spreading of memes, Tweets, computer viruses, innovations, language changes, gossips, pathogens, etc. These dynamics can exhibit a percolation transition, which separates non-epidemic regime from outbreaks. The transitions are commonly believed to be continuous; while some empirical studies have shown more violent spreading modes. Here we study the interaction of two spreading dynamics in mean field approximations and also within an agent based framework in order to figure out what can cause abrupt transitions. Therefore we investigate dynamics on different topologies like Erdos-Renyi networks and regular lattices. We show that cooperativity of two pathogens/states can lead to abrupt outbreaks, while the dynamics still might present some scaling laws. We argue how topological network features might affect the outbreaks [1,2].

[1] W. Cai, L. Chen, F Ghanbarnejad, P. Grassberger "Avalanche-Outbreaks Emerging in Cooperative Contagions"; Nature Physics.
[2] L. Chen, F Ghanbarnejad, W. Cai, P. Grassbergar “Outbreaks of coinfections: the critical role of cooperativity”, EPL.

Ingo Scholtes
Title: Analysis of Non-Markovian Temporal Networks: Spectral Methods and Centrality Measures

Abstract:
Recent research has highlighted limitations of studying complex systems with time-varying topologies from the perspective of static, time-aggregated networks. Non-Markovian characteristics resulting from the specific ordering of interactions in temporal networks were identified as one important mechanism that alters causality and affects dynamical processes. So far, an analytical explanation for this phenomenon and for the significant variations observed across different systems is missing.
Summarizing our recent research in this area, in this talk I will introduce a framework that allows to analyze temporal networks with non-Markovian characteristics. The framework is based on higher-order aggregate networks, a simple generalization of the commonly used static representation of temporal network data. I will show that spectral properties of such higher-order aggregate networks can explain the slow-down of diffusion processes compared to aggregate networks, which has been observed in a number of empirical data sets. I further show that we can derive an exact analytical prediction for the magnitude of this change compared to the weighted, time-aggregate network. I finally present recent results on the analysis of node centralities in non-Markovian temporal

networks, concluding that this approach provides interesting perspectives for (i) temporal community detection by spectral clustering, (ii) refined measures of centrality for time-evolving networks, and (iii) analytical studies of dynamical processes in complex systems with time-evolving interaction topologies.

Jérôme Kunegis
Title: Measuring Conflict in Signed Social Networks

Abstract:
In this talk, I present recent results on the measurement of conflict in signed social network. A signed social network is a network in which both positive and negative ties are present, for instance representing friendship and enmity, or trust and distrust. Such networks have long been studied under the aspect of balance theory, i.e., considering whether the individuals can be grouped into two groups, such that the sign of all ties reflects the partition, or equivalently in terms of the individual configuration of triads. The failure of such a structure to be present in a signed social network is usually designated as conflict, and measuring the amount of conflict in a given signed social network is an open problem. In this work, I present a novel measure of conflict, based on algebraic graph theory, and considering a previously known variant of the Laplacian matrix for signed graphs. The talk will show both theoretical motivations for the measure, as well as an evaluation of its utility at signed social network analysis using multiple real-world signed social networks.

Stefan Bornhold
Title: Consensus formation and the scientific process: When does consensus equal truth?

Abstract:

Science partly is a social endeavor: Not only has a scientific truth to be found, but also be accepted by the scientific community. History of science is full of scientific discoveries that took considerable time to break a prevalent (untrue) consensus, often surpassing the lifetime of the discoverer, as for example the concept of continental drift by Alfred Wegener.

A first mathematical model studying the interplay of convergent opinion formation and exploratory truth seeking was proposed by Hegselmann and Krause [1]. We here study an alternative implementation, replacing the one-dimensional opinion space of that model by an infinitely large space of possible hypotheses, as proposed in a recent cellular automaton model for the emergence of paradigms [2]. Striving for new ideas is represented by a never-return rule that breaks detailed balance of exchange of ideas, while pressure towards consensus is implemented through social interaction rules. One observes that consensus-seeking counteracts truth discovery in the model. These models may provide insights for science funding and policy.

[1] R. Hegselmann and U. Krause, Truth and Cognitive Division of Labor: First Steps towards a Computer Aided Social Epistemology, Journal of Artificial Societies and Social Simulation 9 (2006).

[2] S. Bornholdt, M.H. Jensen, and K. Sneppen, Emergence and Decline of Scientific Paradigms, Phys. Rev. Lett. 106 (2011) 058701.

Luis E C Rocha
Title: Diffusion of information and epidemics on dynamic contact networks

Abstract:
Human contact networks are characterized by the structure of connections and by temporal patterns of node and link activity. Extensive research has been done to understand how structure constrains dynamic processes, such as opinion dynamics, random walks or epidemics, taking place on networks. On the other hand, the role of the timings of node and link activation remains little understood. In this talk, I will discuss some of our contributions to the field, in particular, recent results on the competition between time and structure to regulate diffusion processes and methods to model epidemics on human contact networks. I may also present an adaptive network model where the feedback between diffusion of information and adaptive node behavior spontaneously generates heterogeneous structural and temporal patterns.

Katharina Anna Zweig
Title: Algorithm Literacy - how to assess the suitability of algorithms

Abstract:
Most of us do not implement their algorithms themselves but use various software packages. How much can you rely on them? Can you use this very interesting software package you found on the web and that says it does exactly the thing you want it to do? Did the computer scientist in your team choose the best method to analyze your data? Or are you a computer scientist that needs to understand your colleague speaking "sociolese" to finally understand what he or she actually wants to know about the data? Algorithm literacy gives you an insight in how we today talk about the results of algorithms and why this is dangerous in interdisciplinary academic teams. Additionally, our communication culture regarding algorithms also has huge implications on our life as citizens. The talk will thus animate you to become more literate in choosing the algorithms that influence your life.