SOE 6: Dynamics of Social and Adaptive Networks I

Time: Thursday 11:45–12:45 Location: H3

SOE 6.1 Thu 11:45 H3

Understanding force directed layouts through latent space models — •Felix Gaisbauer, Armin Pournaki, Sven Banisch, and Eckehard Olbrich — Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany

This contribution brings together two strands of research: Latent space approaches to network analysis and force-directed layout algorithms. The former can be considered as extensions of spatial random graph models for social networks, which have the goal of embedding a graph/network in an underlying social space [1] and have been employed successfully in the estimation of ideological positions from follower networks on Twitter [2]. The latter are used ubiquitously for data exploration, illustration, and analysis. Nevertheless, an interpretation of the outcomes of graph drawings with force-directed algorithms is not straightforward. We show that interpretability can be provided by random graph models in which the nodes are positioned in a latent space. The closer the positions of the nodes, the more probable it is that they are connected. We show that force-directed layout algorithms can be considered as maximum likelihood estimators of such models. We also present ready-to-use implementation of the layout algorithm and show its application to Twitter retweet networks.

[1] P. D. Hoff, A. E. Raftery, and M. S. Handcock (2002). Latent space approaches to social network analysis. Journal of the American Statistical association, 97(460), 1090-1098. [2] P. Barberá (2015). Birds of the same feather tweet together: Bayesian ideal point estimation using Twitter data. Political analysis, 23(1), 76-91.

SOE 6.2 Thu 12:15 H3

Balanced Triad Formation explained by Dyadic Interactions — •Tuan Pham[1,2], Jan Korbel[1,2], Rudolf Hanel[1,2], and Stefan Thurner[1,2,3] — [1]Medical University of Vienna — [2]Complexity Science Hub Vienna — [3]Santa Fe Institute

The evolution of social (signed) triads towards so-called balanced states with either one or three positive links often results in the formation of clusters of positively-linked agents. We argue that –surprisingly– such cluster formation can emerge from *dyadic* interactions if homophily between agents is present. We show this in a Hamiltonian model, where every agent is linked to K others and holds binary opinions on G issues, in an opinion vector $\mathbf{s}_i$. If two agents i and j are connected by a link J_{ij} then $J_{ij} = \mathrm{sign}(\mathbf{s}_i \cdot \mathbf{s}_j)$. Without knowledge of the triads in their neighbourhoods, agents modify their opinions so as to minimize a social tension, $H^{(i)}$, defined via the weighted sum of opinion overlaps with friends and opinion discordance with enemies: $H^{(i)} = -\frac{\alpha}{G} \cdot \sum_{j:J_{ij}>0} \mathbf{s}_i \mathbf{s}_j + \frac{1-\alpha}{G} \cdot \sum_{j:J_{ij}<0} \mathbf{s}_i \mathbf{s}_j$, where α is the relative strength of positive interactions to that of negative ones. The model exhibits a transition from unbalanced- to balanced society at a critical temperature which depends on (G, K, α). As α exceeds $1/2$, another transition between steady states with different fractions of balanced triads occurs. We show that the model explains actual data of triad statistics in social networks. The model produces z-scores for triads that is compatible with empirical values in real social networks, such as the *Pardus* computer game and the United Nations General Assembly.