DY 4: Statistical physics of complex networks I

Time: Monday 12:00–13:00 Location: H3

DY 4.1 Mon 12:00 H3

Ranking and Community detection in unweighted networks — •Andrea Baldassarri[1], Ciro Cattuto[1,2], Vito Servedio[1,2], Vittorio Loreto[1], Miranda Grahl[3], Andreas Hotho[3], Christoph Schmitz[3], and Gerd Stumme[3] — [1]Dipartimento di Fisica, Università La Sapienza, P.le A. Moro 2, 00185 Roma, Italy — [2]Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, Compendio Viminale, 00184 Rome, Italy — [3]Knowledge & Data Engineering Group, University of Kassel, Wilhelmshöher Allee 73, 34121 Kassel, Germany

Networks are a way to encode relational informations between many interacting entities (nodes). This information can be used in different ways in order to capture relevant features of the system. Site ranking algorithms, as for instance the PageRank algorithm, use topological informations embedded in a directed network to infer the relative importance of nodes. Recently, we introduced a ranking procedure, the FolkRank algirthm, for a new class of social annotation networks, so-called folksonomies. Differently to PageRank, it allows for undirected networks.

On the other hand, community detection algorithms try to detect relation similarities at a higher level. An example is the Markov Clustering algorithm (MCL), in which a renormalization-like scheme is used in order to detect communities of nodes in weighted networks.

In this paper, we will analyse the commonalities ot the two approaches. In particular we identify the relationship between ranking and community building in folksonomies.

DY 4.2 Mon 12:15 H3

Applying direct weighted networks to recommendation systems — •Stefano Battiston, Frank Walter, and Frank Schweitzer — Chair of Systems Design, ETH Zurich, Kreuzplatz 5, 8032 Zurich, Switzerland

Models of large evolving social networks find today numerous applications in on-line web services, in particular for recommendation systems. We model an evolving weighted directed network in which agents ask for recommendations to their peers about a set of items. A node represents an agent with expertise in a specific domain and with heterogenous preferences (summarized in a profile), while the weight of a link represents the trust of an agent towards another one. Differently from other network models, here the weights of the outgoing links of a node evolve according to a utility function of the node. By means of mean field approximations, we derive an expression for the performance of the system as a function of the frequency and heterogeneity of profiles across agents. We find that the critical parameters for the performance of the system are network density, preference heterogeneity among agents, and expertise sparseness. The mean-field approximation leads to accurate predictions in a broad range of these parameters and provides useful constraints for the design of real applications.

DY 4.3 Mon 12:30 H3

Generating random networks with arbitrary two-point correlations — •Sebastian Weber and Markus Porto — Institut für Festkörperphysik, Technische Universität Darmstadt, Hochschulstr. 8, 64289 Darmstadt, Germany

Random networks are heavily used as null models to investigate properties of complex networks. We describe a generator of two-point correlated undirected random networks without self- or multiple-connections among vertices [1]. With the goal to systematically investigate the influence of two-point correlations, we develop a formalism to construct a joint degree distribution $P(k,k')$ which allows to fix an arbitrary degree distribution $P(k)$ and an average nearest neighbor function $k_{\mathrm{nn}}(k)$ simultaneously. The formalism is demonstrated with scale-free networks ($P(k) \propto k^{-\gamma}$) and empirical complex networks ($P(k)$ taken from graph) as an example. Finally, we introduce the notion of an annealed graph which allows a graph to be represented in a mean-field like manner.

[1] S. Weber and M. Porto, in preparation

DY 4.4 Mon 12:45 H3

Graphpartitioning and modularity of graphs with arbitrary degree distribution — •Jörg Reichardt[1] and Stefan Bornholdt[2] — [1]Universität Würzburg, Institut für Theoretische Physik III, Am Hubland, 97074 Würzburg — [2]Universität Bremen, Institut für Theoretische Physik, Otto-Hahn-Allee, 28359 Bremen

We solve the graph bi-partitioning problem in dense random graphs with arbitrary degree distribution using the replica method. We find the cut-size to scale universally with $\langle\sqrt{k}\rangle$, regardless of the degree distribution. In contrast, earlier results studying the problem only in graphs with a Poissonian degree distribution had found a scaling with $\sqrt{\langle k\rangle}$ [Fu and Anderson, J. Phys. A: Math. Gen. **19**, 1986], which, however, does not generalize to other degree distributions. The new scaling also applies to the problem of q-partitioning. Further, the result can be used to find expectation values of an important quality measure for graph clusterings, namely the modularity Q [Newman and Grivan, Phys. Rev. E, **69**, 2004] , which allows for assessing the statistical significance of the output of community detection or graph clustering algorithms.