SOE 16: Networks: From Topology to Dynamics III (with BP, DY)

Time: Wednesday 15:30–17:00 Location: GÖR 226

SOE 16.1 Wed 15:30 GÖR 226

Traveling Salesman Problem with Clustering — •Johannes Josef Schneider[1], Thomas Bukur[2], and Antje Krause[2] — [1]Department of Physics, Mathematics, and Computer Science, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany — [2]Fachhochschule Bingen – University of Applied Sciences, 55411 Bingen, Germany

In the original traveling salesman problem, the traveling salesman has the task to find the shortest closed tour through a proposed set of nodes, touching each node exactly once and returning to the initial node at the end. For the sake of the tour length to be minimized, nodes close to each other might not be visited one after the other but separated in the tour. However, for some practical applications, it is useful to group nodes to clusters, such that all nodes of a cluster are visited contiguously. Here we present an approach which leads to an automatic clustering with a clustering parameter governing the sizes of the clusters.

[1] Johannes J. Schneider, Thomas Bukur, and Antje Krause, Traveling Salesman Problem with Clustering, J. Stat. Phys. 141, 767-784, 2010.

SOE 16.2 Wed 15:45 GÖR 226

Importance of Industrial Sectors within the Overall Economy — •Christian Hirtreiter[1] and Johannes Josef Schneider[2] — [1]Faculty of Physics, University of Regensburg, 93040 Regensburg, Germany — [2]Department of Physics, Mathematics, and Computer Science, Staudinger Weg 7, 55099 Mainz, Germany

We have a look at the overall economy of a state focussing on the exchange of goods and services between the various sectors of that economy. Depending on the market theory, either the best seller (the sector selling the largest value of goods and services to other sectors) or the best buyer (the sector buying the largest value of goods and services from other sectors) is the most important sector within the overall economy. We generate a sequence of sectors depending on their importance using the exchange matrix between these sectors. Furthermore, we show that this problem is an extreme case of the Traveling Salesman Problem with Clustering, which was recently introduced by us [1].

[1] Johannes J. Schneider, Thomas Bukur, and Antje Krause, Traveling Salesman Problem with Clustering, J. Stat. Phys. 141, 767-784, 2010.

SOE 16.3 Wed 16:00 GÖR 226

Emergent bipartiteness in an adaptive social network — •Charo Del Genio and Thilo Gross — Max-Planck-Institut für Physik komplexer Systeme – Nöthnitzer Straße 38 – D-01187 Dresden – Deutschland

Representing complex systems as adaptive networks has become a very important method for analysing the properties of many real-world networks, with fields of application ranging from epidemiology to the Internet to social sciences.

We present a model of a social network in which the nodes belong to two different species, which we call "truthfuls" (T) and "liars" (L) and the existence or permanence of a link between next-neighbouring nodes is determined by the "advice" of the common neighbour. In particular, an agent node connects to one of its next-neighbours, or maintains a link with it, if the common neighbour reports the target node as truthful. Vice versa, the link is removed if the common neighbour reports the target node as a liar. Also, truthfuls always state the real species of a target node, while liars always report the false.

We show that if the fractions of truthfuls and liars are close enough, the network self organizes in a perfectly bipartite graph. On the other hand, if the excess of one of the two species is greater than a size-dependent critical value, the network splits into two components, of which one is bipartite and the other contains only the excess species and is densely connected.

SOE 16.4 Wed 16:15 GÖR 226

The emergence of critical behavior in evolving economies — João da Cruz[1,2] and •Pedro Lind[1,3] — [1]Departamento de Física, Faculdade de Ciências da Universidade de Lisboa, 1649-003 Lisboa, Portugal — [2]Closer Consultoria Lda, Avenida Engenheiro Duarte Pacheco, Torre 2, 14º-C, 1070-102 Lisboa, Portugal — [3]Center for Theoretical and Computational Physics, University of Lisbon, Av. Prof. Gama Pinto 2, 1649-003 Lisbon, Portugal

We address the controversy in the study of financial systems, sometimes taken as brownian-like processes and other as critical systems with fluctuations of arbitrary magnitude, by introducing a model of financial networks which reproduces critical behavior. The model considers a collection of economical agents which establish trade connections among them according to basic economical principles properly translated into physical properties and interaction. Agents accumulate asset or liability by means of internal energy storage, as a product of energy balance that takes into account the labor performed by the agent and the payment it gets in return. With such model we are able to reproduce the evolution of macroscopic quantities, namely the logarithmic return of the total internal energy taken as a financial index. Furthermore, we correctly retrieve the common exponent value characterizing several indices in financial markets.

SOE 16.5 Wed 16:30 GÖR 226

Evolutionary dynamics and conditional cooperation in the iterated prisoner's dilemma — •Jelena Grujić, José A. Cuesta, and Angel Sánchez — Grupo Interdisciplinar de Sistemas Complejos (GISC), Departamento de Matemáticas, Universidad Carlos III de Madrid, Leganés, Madrid, Spain,

We have recently performed an experiment to test the emergence of cooperation in the presence of an underlying structure [Grujic et al., PLoS ONE 5(11): e13749 (2010)]. Human subjects played a PD with each of their neighbors in a 13x13 square lattice. The results show that the population consisted of cooperators and defectors, who respectively cooperate or defect with high probability regardless of their and their neighbors' previous actions, and conditional cooperators, whose behavior does depend on those previous actions.

Here we take a first step towards an evolutionary explanation of the experimental results. Specifically, we use replicator dynamics to describe the evolution of a set of strategies that mimics the observations, in a simplified context consisting of a well-mixed population of players confronted in iterated Prisoner's Dilemma games. The dynamics exhibits two attractors: one for a population consisting only of defectors, and an interior point with population frequencies comparable to those observed in the experiment. The former has a much smaller basin of attraction than the latter, which therefore becomes the most probable evolutionary outcome. This is the first hint that the experiment may be amenable to an evolutionarily explanation.

SOE 16.6 Wed 16:45 GÖR 226

The role of short-cuts for the emergence of cooperation in random topologies. — •Daniele Vilone[1], Angel Sánchez[1], and Jesús Gómez-Gardeñes[2] — [1]GISC - Mathematics Department, Universidad Carlos III de Madrid, Spain — [2]Biocomputation and Complex Systems Institute, Universidad de Zaragoza, Spain

We present a detailed study about the role of the short-cuts of a network in promoting the emergence of cooperation in a population of agents playing the Prisoner's Dilemma Game (PDG). We introduce a model which allows to tune the topology of the system from the one-dimensional euclidean lattice (a ring) to the complete graph just changing the value of one parameter (the probability p to add a link between two nodes not already connected in the euclidean configuration). We show that there is a region of values of p in which cooperation is largely enhanced, whilst for smaller values of p only a few cooperators are present in the final state, and for p->1 cooperation is totally suppressed. We present analytical arguments that provide a very plausible interpretation of the simulation results. Our work makes it clear how short-cuts can be decisive in promoting (or suppressing) cooperation in the absence of other mechanisms such as clustering. Implications for other dynamics are also drawn.