



MEDITERRANEAN SCHOOL OF COMPLEX NETWORKS

V edition
1-8 September 2018

<http://mediterraneanschoolcomplex.net>



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Introduction to the school

GOALS OF THIS EDITION

The goal of this school is twofold:

1. **Provide a theoretical background** to students (Master, PhD) and young researchers in the field, with particular attention to current trends in Network Science.
2. **Promote philosophical and scientific exchange** between all participants, i.e., lecturers and attendants.

For this reason, the program will involve **lectures from experts** in different fields (social science, game theory, human mobility, neuroscience, etc) for 70% of the duration of the school. The remaining time will be dedicated to **participants talks** given by attendants, followed by debates.

PRIZES AND FELLOWSHIPS

The School will award two prizes: i) to one attendant, for the participant talk; ii) to one lecturer, for the best lecture.

PhD students and Junior Post Doctoral researchers (no more than two years from their PhD completion) who are members of the CSS (cssociety.org/home) are eligible to get a fellowship covering the School fee and the participation to social events. We granted two fellowships.

LOCATION

The school will take place in Salina, a small island in the north of Sicily (Italy). Salina, fully covered by green vegetation and surrounded by the sea, represents a suitable small and quiet environment to achieve the purposes of this school.

Organization

DIRECTORS

Alex Arenas	Universitat Rovira i Virgili, Spain
Manlio De Domenico	Fondazione Bruno Kessler, Italy

ORGANIZERS

Alex Arenas	Universitat Rovira i Virgili, Spain
Manlio De Domenico	Fondazione Bruno Kessler, Italy

LOCAL ORGANIZING COMMITTEE

Serafina Agnello	Fondazione Bruno Kessler, Italy
Annalisa Armani	Fondazione Bruno Kessler, Italy

LECTURERS

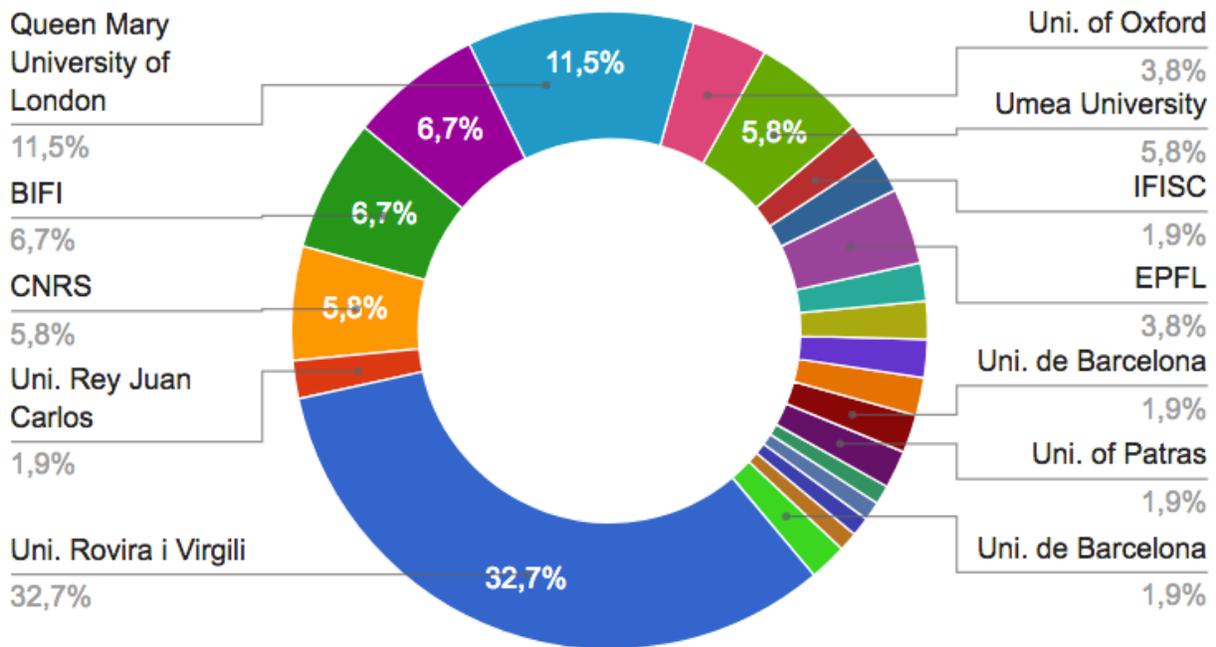
Vito Latora	Queen Mary University, UK
Martin Rosvall	Umea University, Sweden
Dirk Brockmann	Humboldt University of Berlin, Germany
Jesus Gòmez-Gardeñes	Universidad de Zaragoza, Spain

SPEAKER

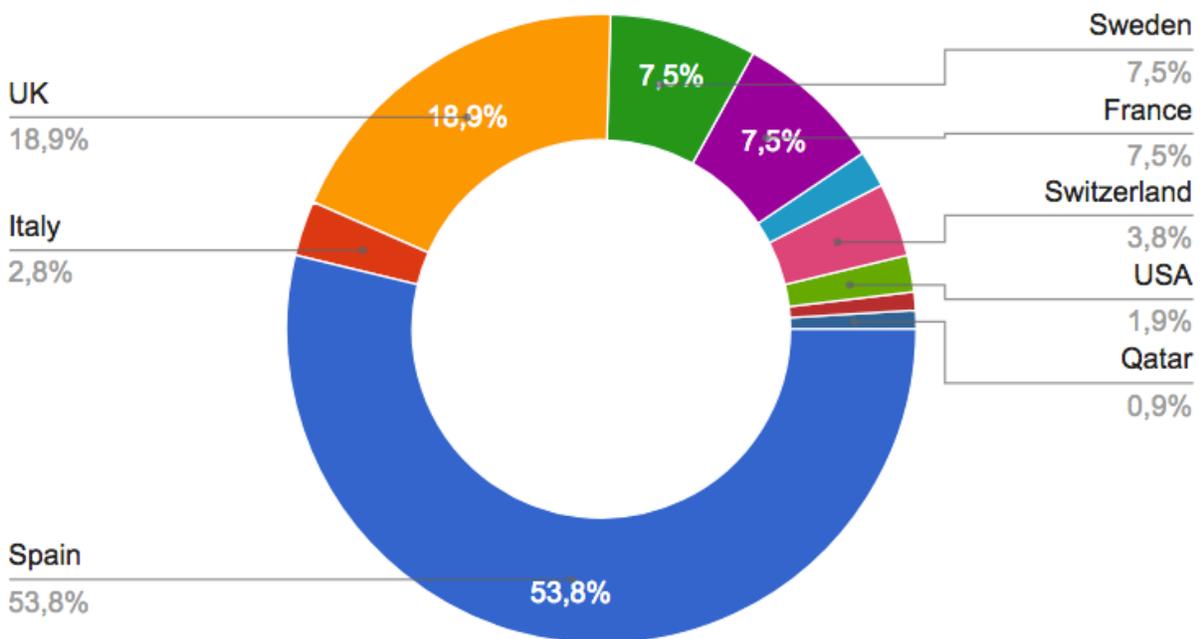
Andrea Baronchelli	City University of London, UK
Clara Granell	Universitat de Barcelona, Spain
Joaquin Goñi	Purdue University, Indiana
Leto Peel	Université de Namur, Belgium
Valerio Maggio	Fondazione Bruno Kessler, Italy

Lecturers

Lecturers by institutions



Lecturers by country



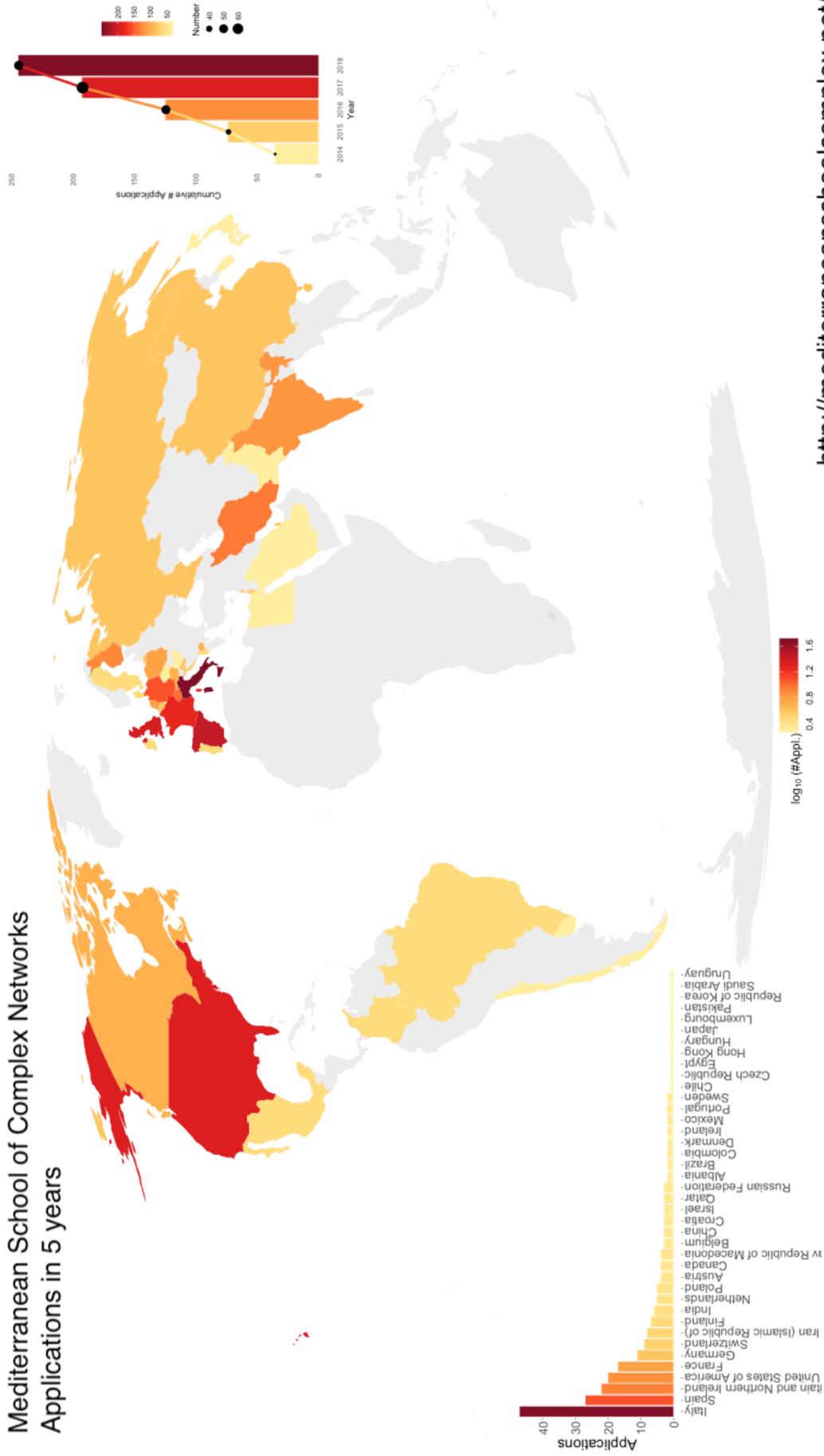
Students

Name	Surname	Affiliation
Alba	Bernini	Politecnico di Milano
Alice	Wittig	Humboldt University
Alejandro	Viloria Cano	ETH Zurich
Arash	Beiranvand	University College Dublin (UCD)
Arkadiusz	Jędrzejewski	Wrocław University of Science and Technology
Camill	Harter	University Rotterdam
Clara	Jongen	Humboldt-Universität zu Berlin
David	Blair	Universitat Pompeu Fabra
David	Soriano	University of Zaragoza
Davide	Bau	IGENOMIX
Duy	Duongtran	Purdue University
Elena	Tomas	
Francesca	Larosa	CMCC
Gáspár Sámuel	Balogh	Eötvös Loránd University
Hong-Lan	Botterman	Laboratoire d'Informatique de Paris 6
Indushree	Banerjee	Delft University of Technology
Ivan	Bonamassa	University of Bar-Ilan
Ivana	Bachmann	NIC Chile Research Labs
Jeyashree	Krishnan	RWTH Aachen University
Jordi	Nin	BBVA Data & Analytics, UB
Krishna	Kanhaiya	Åbo Akademi University
Loan	Vulliard	
Lorenzo	Lucchini	FBK
Maciej	Falkiewicz	Wroclaw University
María	Palazzi	Universitat Oberta de Catalunya
Marion	Hoffman	ETH Zurich
Maxime	Lucas	Lancaster University

Michał B.	Paradowski	University of Warsaw
Mozhgan	Khanjaniapak	IASBS
Naomi	Arnold	Queen Mary University of London
Natalia	Meshcheryakova	National Research University
Oscar	Fajardo Fontiveros	SEESlab
Paco	Majic	ETH Zurich
Rita María	Del Río-Chanona	University of Oxford
Sara	Heydari	Aalto University
Sara	Nicoletti	Università degli Studi di Firenze
Sebastian	Morel Balbi	University of Bath
Sergey	Shvydun	HSE
Susana	Garcia	The Pennsylvania State University
Thais	Uzun	ITA
Vincent	Thibeault	Laval University
Wouter	Devos	Ghent University
Xavier	Roy-Pomerleau	Laval University
Xiaolong	Zhang	Heidelberg University
Yacoub	Kureh	University of California, Los Angeles



Mediterranean School of Complex Networks Applications in 5 years



<http://mediterraneanschoolcomplex.net/>

Complex Networks

In the last decade, network theory has been revealed to be a perfect instrument to model the structure of complex systems and the dynamical process they are involved into. The wide variety of applications to social sciences, technological networks, biology, transportation and economic, to cite just only some of them, showed that network theory is suitable to provide new insights into many problems.

Given the success of the Fourth Edition in 2017 of the Mediterranean School of Complex Networks, we call for applications to the Fifth Edition in 2018.



Transfer schedule

HOURS	SATURDAY 1 SEPTEMBER	SATURDAY 8 SEPTEMBER
7.00		Departure from Salina
12:00		Arrive in Catania airport (approx)
15:00	Meeting point at Catania airport with the School bus	
16.00		
17.00	Arrive in Milazzo	
18:00	Hydrofoil to Salina Island (approx)	
19.00	Arrive in Salina (approx)	

School schedule

	Lecturers
Session I	Vito Latora: <i>"Structure and dynamics of multiplayer networks"</i>
Session II	Martin Rosvall: <i>"Higher-order network models"</i>
Session III	Dirk Brockmann: <i>"Critical phenomena in complex network"</i>
Session VI	Jesus Gomez-Gardeñez: <i>"Spreading processor in complex networks"</i>
Seminare I	Joaquin Goñi; Andrea Baronchelli
Seminare II	Clara Granell; Leto Peel
Tutorial	Valerio Maggio: <i>"Network analysis with python"</i>

Hours	2/09	3/09	4/09	5/09	6/09	7/09
9:30	OPENING					
10:00	INDIVIDUAL PRESENTATIONS	SESSION I <i>Part I</i>	SESSION II <i>Part I</i>	SESSION III <i>Part I</i>	SESSION IV <i>Part I</i>	FOCUSED SEMINARS II
11:00	PROJECTS					
12:00		SESSION <i>Part II</i>	SESSION II <i>Part II</i>	SESSION III <i>Part II</i>	SESSION IV <i>Part II</i>	
16:30		STUDENTS TALKS	STUDENTS TALKS	SOCIAL BOAT	FOCUSED SEMINARS I	PROJECT PRESENTATIONS
17:30						
18:30		TUTORIAL	TUTORIAL			AWARD AND
19:30						CLOSING CERIMONIES
20:30					SOCIAL DINNER	

SESSION I

Structure and dynamics of multiplayer networks.

Vito Latora (Queen Mary University of London, UK)

The constituents of a wide variety of real-world complex systems interact with each other in complicated patterns that can encompass multiple types of relationships and change in time. Recently, the interest of the research community towards such systems has increased because accounting for their "multilayer" features is a challenge. In this lecture, we will review the most recent advances in this new field, with main attention to the emergent properties induced by the structure of multiplex networks.

Topics covered:

- From complex systems to multilayer networks.
- Structural properties of multilayer networks.
- Reducibility of multilayer networks.
- Dynamical properties of multilayer networks.

STUDENT TALKS

EXTENDED TALK

Marion Hoffman

A STATISTICAL MODEL FOR THE ANALYSIS OF FACE-TO-FACE INTERACTIONS

Understanding face-to-face interactions is at the core of the conceptualization and study of human social behavior. One limitation of the current network models, however, is that they cannot entirely deal with face-to-face interactions. I therefore propose a model that follows a similar logic to Relational Event Models and Dynamic Network Actor Models that can help us to draw inferences on the mechanisms underlying the formation and dissolution of face-to-face interactions.

David Soriano Paños

CHARACTERIZATION OF THE COMPETITION OR COOPERATION BETWEEN CO-EXISTING DISEASES

This talk is aimed at proposing a model which allows us to understand the consequences of the interaction between two coexisting diseases. Thus, we introduce a parameter which accounts for this interaction and we reveal that the interplay between either cooperative or competitive diseases yields a very rich phase space where interesting physical phenomena take place such as abrupt transitions or the existence of bi-stability regions.

Lorenzo Lucchini

FOLLOWING THE FOOTSTEPS OF GIANTS: A NETWORK APPROACH TO CULTURAL ANALYTICS

"Network science has revealed to be a valuable tool in studying a wide variety of social systems.

In our work, we borrow standard techniques from this theory to describe the migration network of culturally relevant historical figures and to define cultural attractiveness. This helps us to capture the natural tendency of people to form clusters sharing the same interests in different cultural areas.

In particular, we show that the choice of the place that was to migrate is concentrated in a reduced number of locations with respect to birth location. Our aim is to model the distribution of visited places, in terms of a preferential growth, by means of a weighted random walk process. The data set we work with is retrieved by using flexible natural language processing techniques that process historical migration data from the Wikipedia's biographies of a selected set of these culturally relevant figures.

Naomi Arnold

UNCOVERING NETWORK EVOLUTION USING TEMPORAL DATA

Finely timestamped datasets of real network topologies are becoming increasingly available. We have also seen a wealth of models aimed at capturing different network evolution mechanisms, with examples including the Barabasi-Albert and rank-preferential attachment models. An important problem lies in assessing the fit of these models to real networks. We investigate our own likelihood based measure for model fitting which calculates the probability of generating the entire evolution of the network from a candidate model. As well as providing a rigorous measure for discriminating which of two or more candidate models is a better fit for a network, we demonstrate its use in fitting linear combinations of models, hence capturing multiple evolution mechanisms. Finally, we present a work in progress using this likelihood measure for detection of changepoints in a network's evolution.

ONESHOT TALK

Vincent Thibeault

THE IMPACT OF COMMUNITY STRUCTURE ON NETWORK DYNAMICS: THE CASE OF SYNCHRONIZATION

We study the synchronization of dynamics in networks with clear community structures, such as those generated by the stochastic block model (SBM). We find new regions in the structural parameter space where exist chimeras, which are dynamical states characterized by a simultaneous cohabitation of full synchronization in certain communities and partial synchronization in others. We also measure the effect of structure on the chaotic behavior of chimeras. Finally, we use structural information to successfully predict the critical coupling above which the synchronization of the whole network can occur.

Natalia Meshcheryakova

POWER OF COUNTRIES IN A FOOD TRADE NETWORK

Several new centrality measures that take into account individual attributes of nodes, the group influence as well as long-range connections are applied to the trade food network. The approach helps us to assess node-to-node influence in a network, which further may be aggregated into the index of the total influence or the import dependency index. Our analysis is focused on three main products for food security (wheat, rice, poultry meat) that are studied separately. Direct and indirect connections were analyzed in order to explain why some countries are import dependent. We also provide time series analysis of influence indices considering 1996 – 2016 period.

Ivana Bachmann

MODELLING THE INTERACTIONS BETWEEN THE INTERNET BACKBONE AND THE BGP NETWORK

"Given its importance in our society, it is relevant to understand the Internet network behaviour under adverse scenarios.

The Internet can be studied through different angles: by studying the Border Gateway Protocol (BGP) network, the Internet Backbone, the complete physical network, etc. However, these networks do not exist in isolation, but rather interact with one another. Furthermore, it has been shown that networks can be more fragile when coupled. Indeed, the single network approach to study the Internet's behaviour has been criticized in the past by Willinger et al~\cite{willinger2013internet}. Thus, the purpose of this work is to model the Internet as an interdependent network system composed by the Internet Backbone and the BGP network coupled together, and measure the Internet robustness under adverse scenarios, such as failures, or attacks.”

Francesca Larosa

MAPPING THE LANDSCAPE OF CLIMATE INNOVATION THROUGH SCIENTIFIC COLLABORATION NETWORKS

The provision of climate information has been shown useful in supporting individuals, communities and organisations in adapting to climate change. Climate services are using scientific knowledge as core inputs and trigger innovation in a number of fields: from economics to meteorology. The aim of this talk is to provide insights about the structural properties of individual, institution and country research networks and to understand how their core features impact on the spread of information across Europe and beyond. The analysis offers employs tools and methods belonging to bibliometrics, network analysis and statistical methods. Thirty-five centrality measures are studied: Principal Component Analysis (PCA) is performed and offers a scientifically robust and objective strategy to rank individual agents within the networks they operate. The talk contributes to opening new research horizons and offers a methodological approach to study collaboration networks.

FLASH TALK

Xiaolong Zhang

GENERATIVE MODEL OF HUMAN BRAIN NETWORK IN SCHIZIPHRENIA

The human connectome represents a network map of the brain. Generative models of human connectome designed according to different wiring rules can be used to investigate the generative rule which shape the topology of human topology. With diffusion MRI, we not only replicated results that matching model performed better than degree and clustering models, but also found that the penalty for distance was weaker in schizophrenia relatives and patients than healthy controls, which suggested that there are more long-distance connectivity in schizophrenia.

Elena Tomas

REDEX: BUILDING A CUSTOMER-SUPPLIER GRAPH: LESSONS LEARNT AND INFRASTRUCTURE

The talk summarizes the work we have carried out for the last two years , which consists on building a graph of customer-supplier relationships for companies with real data from BBVA. I will describe the main problems we have come across: record linkage, deduplication, graph infrastructure and graph filtering, our approaches to solve them and possible improvements.

R Maria del Rio Chanona

THE MULTIPLEX NATURE OF GLOBAL FINANCIAL CONTAGION

"Financial contagion and the relationship between network structure and the susceptibility of the financial systems to shocks are topics that gained prominence since the Global Financial Crisis. A key issue is the extent to which network properties contribute to systemic risk by amplifying shocks

to individual systems or assets. This paper studies contagion in a multilayer financial network in contrast to the aggregated network. We show that the extent of financial contagion is potentially larger and spreads faster in a multiplex network. Ignoring the multiplex nature of the system

can potentially lead to a biased assessment of the extent and identities of countries impacted by contagion.”

Oscar Fajardo Fontiveros

PREDICTIONS USING METADATA

Big data and data science recently become a big field of research with big interest in society. Our job is to improve a model that predicts links in complex networks using bayesian inference. This time we want to add the metadata of the nodes (genre, age in case of people) and see if it can help us to improve our predictions.

TUTORIAL

Network analysis with python.

Valerio Maggio (FBK, Italy)

Python is nowadays considered one of "the" programming languages for data science, thanks to its very shallow learning curve, and a solid stack of libraries and modules for efficient numerical processing and data visualisation. For what concerns `_Network Analysis_` in particular, the 'networkx' package provides a comprehensive set of pre-defined tools to process and manipulate network data in a very easy and intuitive way.

This lecture will introduce the basics and practical aspects of graph theory using Python and 'networkx'. Case study will be also discussed and analysed.

The lecture is designed as a live tutorial presentation, in which all the materials and lecture notes will be available in the form of interactive Jupyter notebooks, for further study and use.

The data used, and the code presented throughout the tutorial will be also made available for reference afterwards.

Lecture notes and instructions to setup a working Python environment, are available on GitHub at:

<http://github.com/leriomaggio/network-analysis-mscx18>

Pre-requisites:

Basic programming skills are assumed, and required to attend the lecture.

Notes:

It is highly recommended to bring your laptop with you to get the best out of the tutorial, and to have fun with exercises and challenges. If you don't have any (or simply did prefer not to bring it), no worries! You can join other colleagues and work as a team.

SESSION II

Spreading processes: From Networks to Metapopulations.

Jesus Gomez-Gardeñez (Universidad de Zaragoza, Spain)

In this lecture we will combine two fields: theoretical epidemiology and mobility datasets. This will allow us to construct theoretical models capturing the back-and-forth movements (such as daily commutes) and the elementary contagion processes at work. We will introduce these framework from the basic compartmental models to the more elaborated metapopulation ones, showing the importance of characterizing urban and regional mobility patterns to understand the spread of an epidemic. Finally, we will particularize on the study of vector-borne diseases (such as Dengue, Chingunya and Zika) in urban systems, showing the reliability of these kind of approaches.

Syllabus:

- 1) Compartmental models
- 2) Networks and epidemics
- 3) Metapopulation approaches & recurrent mobility patterns
- 5) Mobility detriments spreading
- 6) Applications to Vector-borne diseases

STUDENT TALKS

EXTENDED TALK

Arsham Ghavasieh

REDUCING TOPOLOGICAL REDUNDANCY IN MULTILAYER NETWORKS

Multilayer networks are shown to provide insights about complex systems composed by units characterized by distinct types of interactions. However, some layers in such systems can be topologically similar, leading to redundant structural information. To decrease this redundancy, we propose a novel approach to reduce the network dimensionality by exploiting how information diffuses through the system. Capitalizing on the spectral entropy framework, recently developed, we show analytically and numerically that topological redundancy decreases as system's entropy deviates from the limit of free non-interacting layers. We will discuss potential applications to biological, social and technological systems.

Clara Jongen

DEFINING THE SCOPE: A CONTEXT SPECIFIC APPROACH TO IDENTIFYING KEY AIRPORTS DURING A PANDEMIC

Human transportation networks play an important role in the global spread of infectious diseases. To understand these phenomena and develop containment strategies, a family of centrality measures has been devised to identify network elements that facilitate the spread and thus require particular attention. However, most centrality measures are context insensitive. Using the example of the global air-transportation network, we introduce node scope and confluence - context dependent centrality measures designed to account for the initial outbreak location. Scope and confluence can strongly depend on regional aspects of an outbreak and therefore be adapted to specific scenarios. Each airport is characterized by a node specific profile as outbreak locations are varied. Scope and confluence also permit to address outbreak locations particularly threatening to specific nodes. Our method can be used as an assessment tool for

understanding global disease dynamics and permits a fast yet specific assessment of an airport's role.

Jordi Nin

DEFAULT PROPAGATION IN FINANCIAL NETWORKS

Systemic risk of financial institutions and sectorial companies relies on their inter-dependencies. The inter-connectivity of the financial networks has proven to be crucial to understand the propagation of default, and a way to assess the impact of single default event in the full system. Here, we take advantage complex network theory to shed light on the mechanisms behind default propagation. Using real data from the financial company BBVA, we extract the network of client-supplier transactions between more than 140000 companies, and their economic flows. We propose a computational model, based on the probabilities of default contagion, that allow us to assess the main statistics of default diffusion at individual and system levels. Our results show the exposure of different sectors to the default cascades, therefore allowing for a quantification and ranking of sectors accordingly. This information is relevant to propose countermeasures to default propagation in specific scenarios.

Arkadiusz Jedrzejewski

PHASE TRANSITIONS WITH QUENCHED AND ANNEALED DISORDERS

The q-voter model is one of the flagship agent-based models of sociophysics used to illustrate opinion dynamics. We study its behavior driven by stochastic noise arising from one out of two types of nonconformity: anticonformity and independence. We compare two approaches that were inspired by the famous psychological controversy known as the person–situation debate. We relate the person approach with the quenched disorder and the situation approach with the annealed disorder, and investigate how these two approaches influence order–disorder phase transitions observed within the model. We show that under the quenched disorder, differences between models with independence and anticonformity are weaker and only quantitative. In contrast, annealing has a much more profound impact on the system and leads to qualitative differences between models on a macroscopic level.

ONESHOT TALK

Alba Bernini

TOWARDS A MULTI-OBJECTIVE APPROACH TO DESIGN EFFECTIVE BIOSECURITY PLANS FOR LIVESTOCK EPIDEMICS

"The spread of infectious diseases in livestock farm systems can cause the culling of a large number of animals and serious economic and social impacts. Thus, the design of effective biosecurity plans is crucial and should account for a multiplicity of objectives.

Here, we evaluated the potential role played by farms in shaping the pattern of epidemic spread, with respect to different objectives. We considered a dairy system in the Emilia Romagna region (Northern Italy) and we developed a temporal multiplex network, with nodes representing farms and links describing the potential routes of pathogen transmission. We simulated the diffusion of epidemics through a Susceptible-Infected model.

Finally, in a multi-objective space, we identified the set of the most critical nodes where the implementation of biosecurity measures may reveal to be more effective. Trade-offs between the objectives did emerge, showing that the identification of key farms is not trivial."

Maria Palazzi

STRUCTURAL CHARACTERIZATION OF SYNTHETIC AND EMPIRICAL NETWORKS AT THE MESOSCALE

Identifying and explaining the structure of complex networks at the mesoscale has been a central aspect in many disciplines of research, from sociology and ecology to economy. Evidences increasingly suggests that some empirical networks exhibit multiple and hybrid architectures at the same time. In our work, we explore how and to what extent single and hybrid patterns can coexist. We consider three well known structural patterns: nestedness, modularity, and in-block nestedness. In the first place, we carry out our analysis on synthetic networks with planted partitions defining, analytically the area and range where the different structural patterns can coexist. We then analyze the coexistence of such patterns in collaborative development

environments. Results on the 100 most popular projects of GitHub show that this type of auto-organized collaborative teams have well defined organization principles that combine, possibly, the benefits of several structural patterns at once.

Yacoub Kureh

ADAPTIVE VOTER MODEL: SIMULATION AND APPROXIMATION

Voter models have been studied extensively since the 1970s. In its most simple form, the model takes place on a static network where nodes are assigned an opinion and an update rule regulates how a node's opinion changes to match of one of its neighbors. In 2006, Holme and Newman introduced an adaptive voter model in which the network coevolved with the opinions. This model has been challenging to analyze and approximation schemes often produce quantitatively inaccurate results. In this talk, we'll discuss the connection between the initial conditions of the network's topology and the quasi-stationary phase of the system.

DUY DUONG-TRAN

A MORPHOSPACE FRAMEWORK TO ASSESS FUNCTIONAL NETWORKS' FLEXIBILITY

"Human uniquely possess cognitive capability to harmonically balance individual difference within race-induced neuro-signatures. In recent years, neuroscience has progressed itself to an exciting, new era of publicly available datasets which contain valuable cognitive information that trademark both commonality and individuality patterns of human brains. Despite plethora depository of literature to both extremes (individuality and commonality neuroscience), the flawless cognitive shifts between continuously integrated and segregated states of the brain remains largely challenging to understand. In this paper, through the construction of modularity morphospace, the intertwined commonality/individuality cognitive traits are unravelled through the lense of functional flexibility theory. Specifically, we are able to go from conceptualising to quantifying two key components in functional flexibility: task-general reconfiguration and task-to-task preconfiguration.

The continuously shifting nature within complex neuromodulatory systems, as seen through traversedly integrated/segregated states of functional connectomes, are hypothesized and proven

to be projected from individuality/commonality cognitive traits through a fine-grain approach using functional networks.”

Camill Harter

EUROPEAN HINTERLAND CONTAINER TRANSPORT AS A COMPLEX NETWORK – HOW IS ROBUSTNESS AFFECTED BY THE MULTI-MODE STRUCTURE?

“Robustness of transport networks has widely been studied for unimodal networks. Hinterland container transport, however, comprises multiple interlinked networks formed by different transport modes, which impacts robustness. On the one hand, alternative transport modes provide backup capacities, on the other hand, disruption can cascade easier across interlinked networks.

We show that robustness against random and targeted failure differs substantially between multimodal networks and their unimodal counterparts and assess how this generalizes to other multimodal networks. We use a unique dataset containing all intermodal services scheduled in the European hinterland from 2016-2018.”

FLASH TALK

David Blair

THE COGNITIVE CHOIR: ACTIVATION PATTERNS AND TRANSMISSION IN THE BRAIN

"The detection and quantification of co-activation patterns is a longstanding problem in neuroscience. Lopes-dos-Santos (2013) describes a method to identify these patterns in neural networks and extract the time courses of their activity. By combining this method with a mean-field model capable of whole-brain neural simulations, one can detect co-activation patterns of brain regions at arbitrary temporal resolution, allowing both the spatial and temporal characterization of interregional interactions. This framework has provided evidence for an optimal timescale that allows a rich spatiotemporal dynamical repertoire in the brain. In the future, it may be more generally employed in order to recover high-frequency signals at the whole-brain level, a substantial improvement on the temporal resolution of current imaging methods.

We propose to use this adaptation to estimate the optimal timescale for information transmission in the human brain, and to determine whether this timescale changes as a function of consciousness."

Loan Vulliard

NETWORK-BASED APPROACH TO DRUG-GENE INTERACTIONS

"Being able to stratify individuals according to whether a given drug will provide an adapted treatment to their condition or not is highly challenging and requires a deep understanding of the rules underlying drug effectiveness.

To address these challenges at the molecular level, we compare the effect of well-chosen chemical compounds and genetic perturbations on human cell lines, separately and in combination. High-resolution images will allow us to extract the corresponding comprehensive morphological profiles. Our group has recently established a novel methodology to construct detailed interaction maps from such high-dimensional morphological data, giving a precise

assessment of how exactly genes and drugs interact with each other. The results can then be interpreted as a multi-edged bipartite network with genes on one side and drugs on the other. This talk will underline how networks science can help the design of these experiments as well as the analysis of the results.”

Susana Garcia

A MULTIPLEX APPROACH TO VIRTUAL WATER TRADE NETWORKS' SPATIAL AND ECONOMIC INTERCONNECTIONS

Water is required to produce nearly every product we use or consume. It is embedded or virtually present in every step of economic production processes, linking water to all sectors of the product economy. An appealing and powerful way to study the indirect dependence of the product economy on water is through the analysis of virtual water trade networks (VWTNs). VWTNs result from and are influenced by multiple natural (e.g., landscape, climate, and vegetation) and socioeconomic & technological factors (e.g., spread of ideas, communication networks, economic agglomeration, and industrial specialization) that are reflected in the topology and community structure of the network. Our analysis of the U.S. VWTN aims to link the entire product economy through a multiplex configuration of the network to understand and enhance water security and sustainability by fostering shareholder accountability.

Sara Heydari

MULTICHANNEL SOCIAL SIGNATURES AND PERSISTENT FEATURES OF EGO NETWORKS

"The structure of egocentric networks reflects the way people balance their need for strong, emotionally intense relationships and a diversity of weaker ties. This structure can be quantified with 'social signatures', which describe how people distribute their communication effort across the members (alters) of their personal networks.

Social signatures based on call data have indicated that people mostly communicate with a few close alters; they also have persistent, distinct signatures. To examine if these results hold for other channels of communication, we compare social signatures built from call and text message data, and develop a way of constructing mixed social signatures using both channels. We observe

that all types of signatures display persistent individual differences that remain stable despite the turnover in individual alters. We also show that call, text, and mixed signatures resemble one another both at the population level and at the level of individuals. This similarity is surprising because the choice of channel appears to be alter-specific with no clear overall pattern, and ego networks constructed from calls and texts overlap only partially in terms of alters. These results demonstrate individuals vary in how they allocate their communication effort across their personal networks and this variation is persistent over time and across different channels of communication.”

TUTORIAL

Network analysis with python.

Valerio Maggio (FBK, Italy)

Python is nowadays considered one of "the" programming languages for data science, thanks to its very shallow learning curve, and a solid stack of libraries and modules for efficient numerical processing and data visualisation. For what concerns `_Network Analysis_` in particular, the 'networkx' package provides a comprehensive set of pre-defined tools to process and manipulate network data in a very easy and intuitive way.

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SESSION III

Critical phenomena in complex networks.

Dirk Brockmann (Humboldt University of Berlin, Germany)

TBD

SESSION IV

Higher-order network models.

Martin Rosvall (Umea University, Sweden)

Random walks on networks is the standard tool for modelling spreading processes in social and biological systems. This first-order Markov approach is used in conventional community detection, ranking and spreading analysis, although it ignores a potentially important feature of the dynamics: where flows move to may depend on where they come from. In this lecture I will analyze pathways from different systems and show that ignoring the effects of higher-order Markov dynamics has important consequences for community detection, ranking, and information spreading. For example, capturing dynamics with a second-order Markov model allows us to reveal actual travel patterns in air traffic and to uncover multidisciplinary journals in scientific communication. Consequently, accounting for higher-order memory in network flows can help us better understand how real systems are organized and function.

FOCUSED SEMINARS SESSION I

Joaquin Goñi (Purdue University, Indiana)

ADVANCES IN NETWORK NEUROSCIENCE

On the quest of fingerprints in brain networks: identifiability and beyond.

In the 17th century, physician Marcello Malpighi observed the existence of patterns of ridges and sweat glands on fingertips. This was a major breakthrough and originated a long and continuing quest for ways to uniquely identify individuals based on fingerprints. In the modern era, the concept of fingerprinting has expanded to other sources of data, such as voice recognition and retinal scans. It is only in the last few years that technologies and methodologies have achieved high-quality data for individual human brain imaging, and the subsequent estimation of structural and functional connectivity. In this context, the next challenge for human identifiability is posed on brain data, particularly on brain networks, both structural and functional.

I will present how the individual fingerprint of a connectome (as represented by a network) can be maximized from a reconstruction procedure based on group-wise decomposition in a finite number of brain connectivity modes. By using data from the Human Connectome Project, I will introduce different extensions of this work, including subject identifiability, heritability analysis of brain networks, as well as identifiability when assessing inter-task brain functional networks. Finally, results on this framework for inter-scan identifiability based on a second dataset acquired at Purdue University will be also discussed.

Andrea Baronchelli (City University of London, UK)

COGNITIVE NETWORK ANALYSIS

The Dynamics of Social Conventions: From Names to Cryptocurrencies.

How do conventions emerge and evolve in complex decentralized social systems? This question engages fields as diverse as sociology, linguistics, cognitive science and network science. Various attempts to solve this puzzle pre-suppose that formal or informal institutions are needed to facilitate a solution. The complex systems approach, by contrast, hypothesises that such institutions are not necessary in order for social consensus to form. In this talk, I will present experimental results that demonstrate the spontaneous creation of universally adopted social

conventions. In doing so, I will show how a population's network structure controls the dynamics of norm formation, as captured by the simple Naming Game model. Then, within the same framework, I will discuss how social norms can evolve in the absence of a centralized authority. Finally, I will present some recent results on the modeling of the cryptocurrency market. Adopting an ecological perspective, I will show that the so-called neutral model of evolution reproduces key statistical properties of the market, despite the fact that it assumes no selective advantage of one cryptocurrency over another. These results shed light on the properties of the cryptocurrency market and establish a first formal link between ecological modeling and the study of this growing system.

FOCUSED SEMINARS SESSION II

Clara Granell (Universitat de Barcelona, Spain)

COMMUNITY DETECTION: A PRIMER

Community detection is an important problem that consists on grasping the intrinsic topological structures of networked data, without any previous knowledge about the size or number of groups to be found. This is of utmost importance in exploratory data analysis, specially in experimental fields like biology, chemistry, and many others. The main difficulty that scientists face when trying to do community analysis relies on finding the appropriate definitions and algorithms for each problem at hand. Nowadays, a myriad of methods are available, and some are even embedded in network analysis tools, making it easy for scientists to apply the most popular community algorithm right away, but also hiding the whole community detection process in a black box. In this lecture we will review community detection from its very definition, considering the advantages and drawbacks of the most popular approaches, in hopes to build a grounded knowledge about this problem so that every scientist is able to critically choose the appropriate solution for his problem.

Leto Peel (Université catholique de Louvain/ Université de Namur, Belgium)

NETWORK INFERENCE IN PRACTICE

An Introduction to Statistical Inference for Network Scientists

Statistical inference is an important tool for data analysis and network data is no exception! In this seminar, we will first introduce the popular probabilistic generative model, the stochastic block model (SBM) and its variants. Using the SBM we will explore a number of statistical inference methods for tasks such as inferring parameters, models selection, making predictions and hypothesis testing. Finally, we will briefly discuss some applications of these methods.

Location

SCHOOL LOCATION

The School will take place in "Palazzo Marchetti" (Via Conti 28, Malfa, Salina Island). If you do not intend to join the transfers organised by the School, please refer to information below to travel from Catania to Salina. Once in Salina, you might want to get the public bus from SM Salina to Malfa (available only for arrivals before 7pm) or book a taxi (about 20€) in advance. In any case, please contact "Salina Servizi Turistici" for local support and to know the exact location of your accommodation.

The fastest way to reach Salina is to:

- fly to the international airport in Catania or Palermo
- move by bus from Catania (or Palermo) to Milazzo (public transport available, see below)
- move by hydrofoil/ship from Milazzo to Salina (public transport available, see below)

ACCOMODATION

The fee includes accommodation in shared house with 2-3 rooms (from 3 to 5 beds) with shared bathroom, available from September 1 2018 to September 7 (night) included. Attendants who wish to arrive before, or leave after, these dates should arrange for other accomodation on their own (ask the local organising committee for help). Each house comes with a fully equipped kitchen.

BREAKFAST, COFFEE BREAK AND MEALS

Participants should arrange for breakfast, lunch and dinners by their own. However, they can have a (cheap) typical Sicilian breakfast in the places close to their house and to the School.

Some refreshments will be available during the morning sessions and are included in the fee.

Participants can have lunch and dinner in different places. A full list of places where it will be possible to have lunch/dinner (at reduced price) and social networking will be made available prior to the beginning of the School.

SOCIAL EVENTS

Social events will include:

- A guided tour by boat
- A social dinner
- Cocktail night talks given by invited speakers between 7 pm and 8 pm. The talks will be sponsored by local producers of wine and sweets.

Travel information

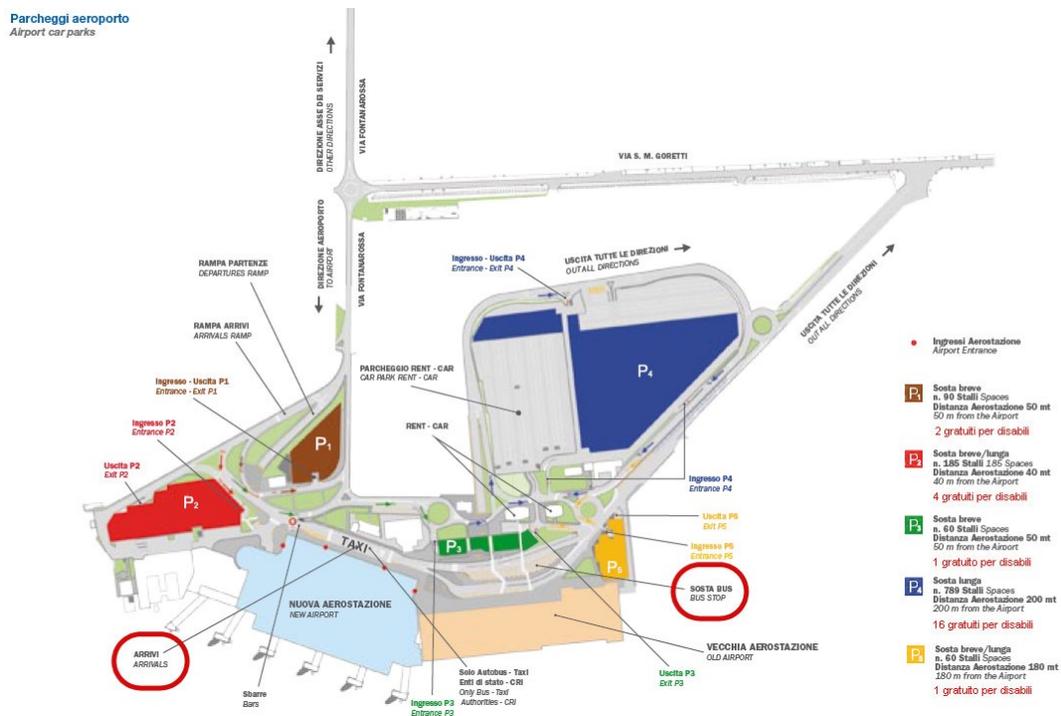
TRANSPORT ORGANISED BY THE SCHOOL

The best and cheapest strategy is to exploit the free transfers from Catania airport to Salina and back organised by the School, and included in the fee. If you prefer, you can also join us in Milazzo, where we will take the hydrofoil/ship.

To schedule your flights, please consider that our departure from Salina will be at 7.00am: this is to allow you to reach the Catania airport at 12.30am at most (accounting for possible traffic congestion). Please, DO NOT schedule flights before 13:30h on the departure day. If for some reason you can not book a flight after 13:30h, than you might want to consider the possibility to depart from Salina on your own (see the travel information in the Website) the day before, book an Hotel close to the airport and the day after get a bus to reach the airport.

IMPORTANT: We do not manage personal trips, hotel booking out of Salina and we can not refund them.

MAP OF THE MEETING POINT (CATANIA AIRPORT)



BUS COMPANY



The School bus should look like in the above picture, and expect to read “MSCX” somewhere inside.

While at the Catania airport, look around for these faces:



Alex Arenas: +34 661 349710



Manlio De Domenico: +39 338 5863802

PUBLIC TRANSPORT AND HOTELS

If you can not take advantage of the organised transport, below you can find information about hotels in Catania and Milazzo. Please, consider that we are not managing alternative journeys. We warmly recommend that before 03 Sept 2017 you stay in Milazzo, close to the port where you should easily take the hydrofoil, while after the end of the School we recommend to stay in Catania, close to the airport.

[Hotels Milazzo](#)

[Hotels Catania](#)

If you will not join the transfers organised by the School, here you will find some useful information for your journey from Catania to Milazzo (bus) and Milazzo to Salina (hydrofoil).

http://www.eoliando.it/arrivo/arrivo_eng.asp

<http://www.eoliebooking.com/navetta/indexeng.asp>

<http://www.estateolie.net/en/tourist-information/transfer-catania-milazzo.html>

Liberty lines: <http://www.libertylines.it/>

Note that this is not a public service and it costs a bit more than public one. However, this is also the fastest and simplest way: they will pick you up in Catania and can manage also to buy your hydrofoil ticket.

Another alternative might be to take one almost-hourly bus from Catania to Messina and there, take the daily hydrofoil departing at 2pm, every day. The distance between Messina station and the hydrofoil point is within walking distance.

For those of you who like to drive, an alternative could be to rent a car, reach Milazzo Harbour and there take the hydrofoil (you can buy the ticket there, but we recommend to buy it in advance: look the website for further detail).

<http://www.avis.com/car-rental/location/EUR/IT/Catania,+Sicily>

<http://www.rentalcars.com>

In any case, remember that your destination is S.M. Salina. Once there, you will need to pick the local minibus (ticket is just 1€ or 2€) to move to Malfa (5 min journey), the village where the School will take place and you will find your house.

Sponsors



COMPLEX SYSTEMS SOCIETY