



MEDITERRANEAN SCHOOL OF COMPLEX NETWORKS

SECOND EDITION
3-8 September 2015

<http://mediterraneanschoolcomplex.net/>



The goal

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:

- **Flash talks** given by attendants, followed by debates;
- **Thematic round tables** involving lecturers and attendants.

Prizes & Fellowships

The School will award two prizes: i) to one attendant, for the best flash 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 three 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.

VADEMECUM

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Directors

Alex Arenas

Manlio De Domenico

Universitat Rovira i Virgili

Universitat Rovira i Virgili

Local Organizing Committee

Serafina Agnello

Manlio De Domenico

Universitat Rovira i Virgili

Universitat Rovira i Virgili

Lecturers

Alex Arenas

Anastasios Bezerianos

Javier Borge

Alessio Cardillo

Mario Chávez

Manlio De Domenico

Jordi Duch

Sergio Gómez

Jesús Gómez-Gardeñes

Marta González

Clara Granell

Vito Latora

Sandro Meloni

Elisa Omodei

Mason Porter

Universitat Rovira i Virgili Patras University / National

University of Singapore

Qatar Computing Research Institute

École polytechnique fédérale de Lausanne

CNRS

Universitat Rovira i Virgili

Universitat Rovira i Virgili

Universitat Rovira i Virgili

Universidad de Zaragoza

Massachusetts Institute of Technology

Universitat Rovira i Virgili

Queen Mary University of London

BIFI Zaragoza

Universitat Rovira i Virgili

University of Oxford

Lecturers by institutions

Universitat Rovira i Virgili

31.3%

Universitat de Barcelona

6.3%

Universidad de Zaragoza

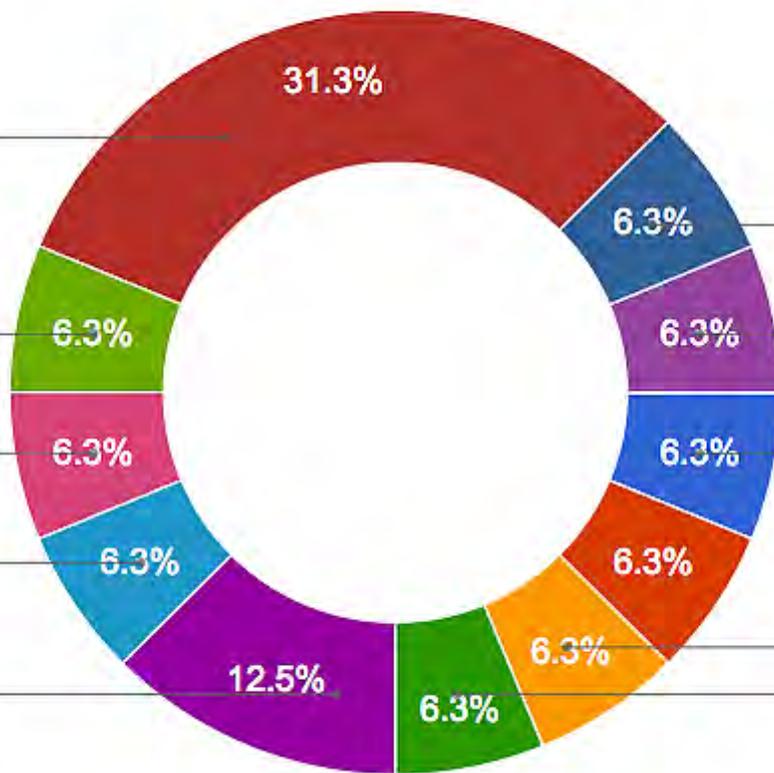
6.3%

Umea University

6.3%

Queen Mary University of London

12.5%



University of Oxford

6.3%

University of Patras

6.3%

BIFI

6.3%

Ecole

Polytechnique

Federale de

Lausanne

6.3%

MIT

6.3%

LECTURERS

VADEMECUM

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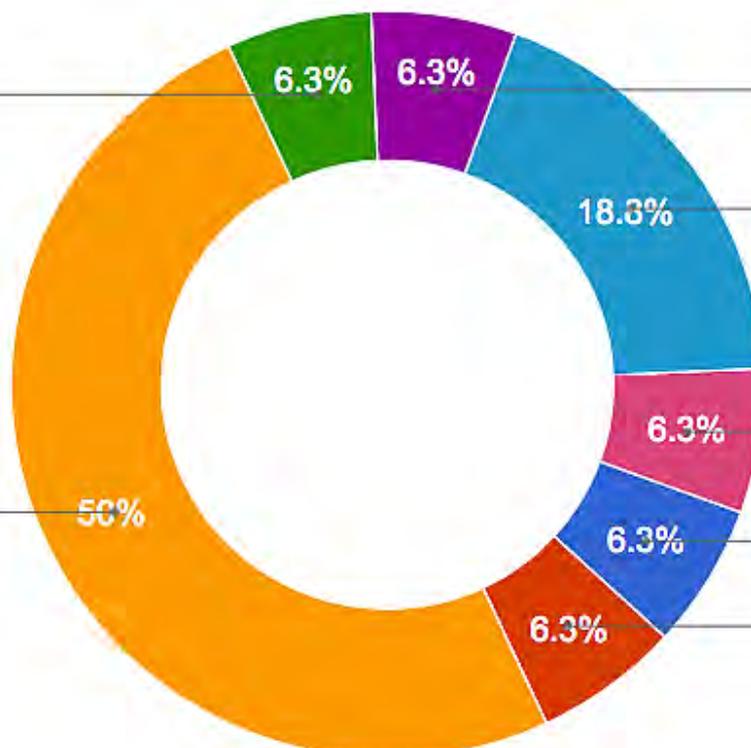
Lecturers by country

Sweden

6.3%

Spain

50%



Switzerland

6.3%

UK

18.8%

USA

6.3%

France

6.3%

Greece

6.3%

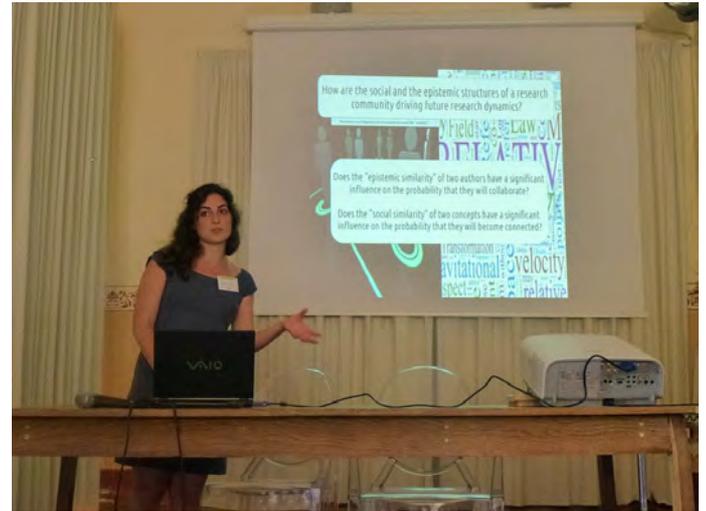


Complex Networks

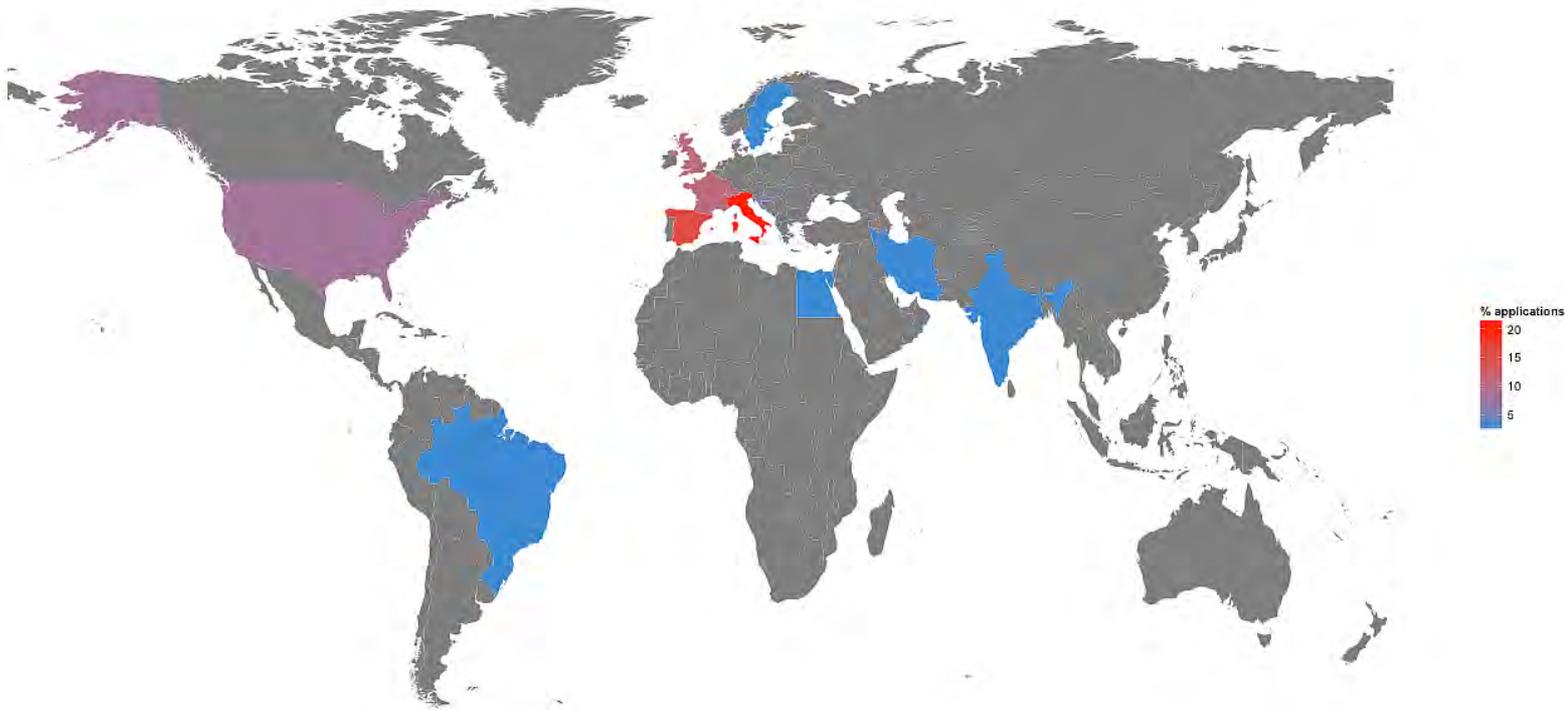
In the last decade, network theory has been revealed to be a perfect instrument to model the structure of complex systems and the dynamical process they are involved into. The wide variety of applications to social sciences, technological networks, biology, transportation and economic, to cite just only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

Given the success of the First Edition in 2014 of the Mediterranean School of Complex Networks, we call for applications to the Second Edition in 2015.

STUDENTS



Registrations to MSCX 2015



FOUR CONTINENTS

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The Program

	09:30	10:30	11:30	12:30
2 September				
3 September	Vito Latora	Sergio Gómez	Clara Granell	
4 September	Mason Porter	Alex Arenas	Elisa Omodei	
5 September	Sandro Meloni	Jesus Gomez-Gardenes	Marta Gonzalez	
6 September	Manlio De Domenico	Alessio Cardillo	Jordi Duch	
7 September	Tassos Bezerianos	Mario Chavez	Javier Borge	Award ceremony
8 September				

Session I	Structural properties of complex networks.
Session II	Dynamics on complex networks.
Session III	Applications to Social Science and Human Systems.
Session IV	Hot trends in complex networks.
Session V	Applications to Biological Systems.

	16:00	17:00	18:00	19:00	20:00	21:00
2 September	Meeting point at Catania airport					
3 September			Flash talks			
4 September			Cocktail Night Talk			
5 September	Guided tour by boat.					
6 September			Jesus Gomez-Gardenes			Social dinner
7 September						
8 September						

Round tables with attendants

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3 SEPTEMBER



Session I: Structural properties of complex networks

CHAIR
Alex Arenas

INTRODUCTION TO COMPLEX NETWORK AND STRUCTURAL DESCRIPTORS

Vito Latora

A basic introduction to complex networks: Why networks are ubiquitous and exciting? Networks from the real world, basic measures and models.

CLASSICAL COMPLEX NETWORK MODELS

Sergio Gomez

Models of complex networks are useful to understand the mechanisms behind their universal structural properties, to simplify the analysis of dynamics on top them, and to uncover the relationship between structure and dynamics. We will review the main models of complex networks (random graph models, evolving network models and small-world models), and give an overview of other interesting approaches.

COMMUNITY DETECTION

Clara Granell

One of the most interesting features of complex networks is their community structure, because it might be the key to unveil the interplay between their topology and dynamics. Community detection is an active and prolific research field in complex networks because of the lack of a universal definition of what a community is and because of the challenging algorithmic complexity it requires for its calculation. In this lecture, we are going to review the different methods for finding communities in networks and, in particular, we focus on modularity optimization and multi-resolution analysis.

9:30 - 12:30

VADEMECUM



3 SEPTEMBER



Flash Talks Session

CHAIR

Clara Granell

**SPATIAL GRAPH
STRUCTURES AND
DYNAMICS. APPLICATION TO
ROAD NETWORK**

Claire Lagesse

My work focuses on space networks, especially road network. By characterizing their structures I try to understand their organizations and dynamics. Developed indicators are used on various kind of patterns to distinguish shared properties from more specific ones. A "grammar" of characterization is set, gathering non-redundant indicators, and a research of universality between different kinds of space networks is started.

**LEARNING FROM ANTS:
GREEDINESS BUILDS
BALANCED TRANSPORT
NETWORKS**

Arianna Bottinelli

The colonies of the polydomous Australian meat ant can be represented as a network of trails that allows for the exchange of resources among spatially separated nests. Meat ant optimal transport networks feature a remarkable trade-off between efficiency, cost and robustness rather than prioritising one design goal over the other two. I will show that a simple and biologically plausible model of network growth based on local cost minimisation leads to the same trade-off between design criteria as observed in ant colonies.

**NETWORK DATA
TECHNIQUES TO ANALYSE
SURVEY DATA**

**Juan-Francisco Martínez-
Cerdá**

On the one hand, we know that there are many techniques for analysing networks that are being applied to problems related to social networks, biology, etc. On the other hand, the analysis of survey data is being done through numerous statistical techniques, such as PCA, clusters, SEM, etc. Thus, the interest of my research is aimed towards the implementation of network data techniques to analyse survey data, which are not related to social networking contexts.

18:30 - 19:30

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3 SEPTEMBER



Flash Talks Session

CHAIR

Clara Granell

**EVALUATING RISKY
INDIVIDUAL BEHAVIOR
DURING EPIDEMICS USING
MOBILE NETWORK DATA**

Antonio Lima

Epidemic models are used to forecast the evolution of the epidemic both globally and regionally, while contact tracing is used to reconstruct the chain of people who have been potentially infected, so that they can be tested, isolated and treated immediately. We propose a novel approach that goes beyond epidemic modeling and contact tracing, and leverages behavioral data generated by mobile carrier networks to evaluate contagion risk on a per-user basis. We simulate a realistic epidemic scenarios, based on an Ebola virus outbreak; we find that gradually restricting the mobility of a subset of individuals reduces the number of infected people after 30 days by 24%.

**IMPACT OF NON-MARKOVIAN
MOBILITY MODELS ON
SPREADING DYNAMICS**

Joan Matamalas

The way how humans travel among different regions might have a huge impact on their lives. Understanding how we move can be crucial to explain migration flows, traffic congestions or, as we show in this work, to describe how contagious diseases spread across a country. We use mobile phone data records to build a new non-Markovian model that better captures some distinctive properties of human mobility. Our model reproduces more realistic mobility patterns than the state of the art when coupled to spreading dynamics, making it more suitable to predict the incidence of a disease or determine the geographical origin of an epidemic outbreak.

18:30 - 19:30

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3 SEPTEMBER



Flash Talks Session

CHAIR

Clara Granell

MULTIPLEX SOCIAL NETWORKS FOR SOCIAL SIMULATIONS

Carlos Sureda Gutiérrez

I propose a modelisation of structure(topology) and behavior of social networks using multiplex networks. Some of the questions that will be discussed: How to integrate a social network generated through a dynamic process? What is the relationship between layers and behaviors? How to perform a Multi Agent Simulation with multiplex networks?. The case study presented will be Terrorist Networks.

INFORMATION SPREADING ON MULTIPLEX NETWORKS

Hongrun Wu

In multiplex networks, the common neighbors of a node across layers, called chums, are usually close friends in the real world. People usually tends to agree with chums' opinion much easier than compared with other neighbors, especially on online social platforms as Twitter and Facebook. We focus our attention on Twitter and try to simulate the spreading of a meme in multiplex networks. Our findings show interesting relationships between spreading dynamics and the presence of chums.

TOWARDS AUTOMATIC API MIGRATION

Klérison Paixão

Software systems are complex, and as they grow larger, they become more difficult to modify. The use of frameworks and libraries is one way to deal with such complexity. However frameworks and libraries change their APIs. Migrating an software to the new API is tedious and disrupts the development process. To better understand the requirements for migrating APIs we believe that analysis of complex networks could reveals software patterns which could also aid the migration process.

18:30 - 19:30

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3 SEPTEMBER



Flash Talks Session

CHAIR

Clara Granell

SYLLABUS NETWORKS

Suzana Antunovic

We propose a new approach to syllabus design that is based on complex networks theory. We devise a series of measures and discover graphs that correspond to syllabi with maximal and minimal complexity thus allowing minimizing time necessary to reach a certain educational goal.

AUTOMATIC IDENTIFICATION OF RELEVANT CONCEPTS IN SCIENTIFIC PUBLICATIONS

Andrea Martini

We propose a method that automatically select meaningful concepts in a given corpus of scientific articles based on the number of articles where a concept appears and its frequency inside the articles (TF). After pinpointing meaningful concepts, they are used to construct a network of content similarity between papers, showing how its community structure reveals groups of papers that correspond to different topics of science.

SHORT-RANGE MOBILITY AND THE EVOLUTION OF COOPERATION: AN EXPERIMENTAL STUDY

Alberto Antonioni

In this work, we have carried out laboratory experiments with human subjects playing a Prisoner, Dilemma in diluted grids. In contrast to previous results on purposeful rewiring in relational networks, we have found no noticeable effect of mobility in space on the level of cooperation. Our results highlight the difficulties that mobile agents have to establish a cooperative environment in a spatial setting.

18:30 - 19:30

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Session II: Dynamics on complex networks

CHAIR

Manlio De Domenico

A SIMPLE GENERATIVE MODEL OF COLLECTIVE ONLINE BEHAVIOR

Mason Porter

One of the most common strategies in studying complex systems is to investigate and interpret whether any "hidden order" is present by fitting observed statistical regularities via data analysis and then reproducing such regularities with long-time or equilibrium dynamics from some generative model. Unfortunately, many different models can possess indistinguishable long-time dynamics, so the above recipe is often insufficient to discern the relative quality of competing models. We use the example of collective online behavior to illustrate that, by contrast, time-dependent modeling can be very effective at disentangling competing generative models of a complex system.

DYNAMICS ON MULTILAYER NETWORKS

Alex Arenas

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 include other types of complications. The interest of the research community increased towards such systems because accounting for their "multilayer" features is a challenge. We will discuss real-world examples and review the most recent advance in this new field, with applications to disease spreading, game theory and traffic congestion.

DYNAMICS ON SOCIAL NETWORKS

Elisa Omodei

One of the most prolific applications of network theory is without doubt the analysis of social systems. This has given birth in recent years to a new discipline called Computational Social Science. In this lecture we will give an overview of the main characteristics of the structure of empirical social networks. We will then review some models of dynamics on social networks, focusing in particular on the evolution of opinions and cultural traits. Lastly, we will discuss some of the latest advances, challenges and open problems of the field.

9:30 - 12:30

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Session III: Applications to Social Science and Human Systems

CHAIR
Mason Porter

INFORMATION AND EPIDEMICS SPREADING IN SOCIAL NETWORKS

Sandro Meloni

The rapid development of the 2009 Influenza A pandemic and the fact that the video of a drunken kitten is on top of your Facebook timeline share more similarities than you can imagine. We will start introducing some basic epidemiological concepts fundamental in both epidemic and information spreading. Then we'll move to some classical spreading models applied to complex networks and, when possible, their analytical treatment. In the second part we'll focus on the recent developments of the field with special attention on interacting/competing epidemics and how those models can be naturally extended to multiplex networks. Finally, if time allows, we'll show some "real world" applications aimed at epidemic forecasting.

COOPERATION AND DEFECTION IN SOCIAL AND ECONOMICAL SYSTEMS

Jesus Gomez-Gardeñes

We will review the basics of Game Theory and Social Dilemmas and their generalization to Evolutionary Game Dynamics. After this brief introduction we will describe how evolutionary games are implemented on top of Complex Networks. We will show how cooperation is promoted by the heterogeneous architecture of real networks in different game scenarios.

A REVIEW OF HUMAN MOBILITY: BASIC MECHANISMS AND URBAN EFFECTS

Marta Gonzalez

We will review up to date findings in human mobility. In the first part we cover the mechanisms to model of individual spatial-temporal trajectories that compare with travel diaries. Next we review its implications for modeling trips in the streets and the potential of smart commute apps given realistic congestion scenarios in various cities. We close with future directions and open questions in the area.

9:30 - 12:30

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Session IV: Hot trends in complex networks

CHAIR

Marta Gonzalez

MULTILAYER MODELING AND ANALYSIS OF REAL-WORLD COMPLEX NETWORKS

Manlio De Domenico

We will introduce the tensorial formulation of complex networks and their generalization to multilayer graphs. We will show how this representation will help to naturally extend network descriptors widely adopted for the analysis of single-layer networks. Finally, we will discuss an application concerning the dynamical robustness (i.e., navigability) of the multilayer transportation network of London and its resilience to realistic failures.

SCIENCE OF SCIENCE

Alessio Cardillo

The explosion of the number of scientific contributions demands for the development of objective methodologies to evaluate their impact in the light of a wiser distribution of the (limited) available economical resources. The birth of "science of science" was aimed to provide an objective machinery to evaluate the quality/impact of scientific contributions. However, science of science has undergone a steady growth up to becoming an independent discipline aimed at studying the plethora of different phenomena occurring inside science. I will make an overview of the contributions that "network science" has provided in the domain of science of science.

INTRODUCTION TO DATA ANALYSIS

Jordi Duch

In this course we will discuss the basic techniques to perform data analytics, from the original data to the results. We will cover the data preprocessing part (filtering, cleaning, aggregating), the data analysis part, and finally we will discuss data visualization and other knowledge representation techniques.

9:30 - 12:30

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Round Table Session

CHAIR

Alex Arenas

Jesus Gomez-Gardeñes

Two hours where students and lecturers freely discuss about different topics related to complex networks, Science and philosophy of Science.

(Social dinner will follow at 21:00)

18:00 - 20:00

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Session V: Applications to Biological Systems

CHAIR

Sergio Gómez

**FROM CELL TO BRAIN
NETWORK DYNAMICS**

Tassos Bezerianos

Connectivity in organisms comes in many forms - for example, molecular interactions, metabolic pathways, synaptic connections from micro to meso and macroscopic level of cells, organs and systems. In our lecture we will present graph theory models we developed to study: (a) the intracellular pathways based on intergenomics data and (b) time varying brain networks dynamics from EEG and fMRI data.

**ANALYSIS OF
MULTIMODAL/MULTIPLEX
BRAIN NETWORKS**

Mario Chavez

Understanding brain connectivity has become one of the most important issues in neuroscience. But connectivity data can reflect either the functional relationships of the brain activities or the anatomical properties between brain areas. Although one should expect a clear relationship between both representations, this is not straightforward. In this talk I'll discuss this relationship between anatomical and functional connectivity. I will illustrate one of these procedures to aggregate a set of functional networks from different subjects in an aggregated network that is compared with the structural connectivity.

**UNCONVENTIONAL METHODS
FOR THE ANALYSIS OF
ONLINE NETWORKS**

Javier Borge

The analysis of online networks has created methodological challenges. For instance, the appearance of a rich Web 2.0 ecosystem enforced, among other reasons, the development of a new network science: multilayered systems. Closely related, down-to-the-second temporal precision in digital traces underlies the emergence of research on temporal networks. With this in mind, I will introduce unconventional approaches to online timestamped data where 'unconventional' refers to their lack of prevalence in social network science research. These include time series analysis, the modelling of evolving networks, and methodologies borrowed from the analysis of biological systems.

9:30 - 12:30

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School location and Accommodation

The School will take place in "Palazzo Marchetti" (Via Conti 28, Malfa, Salina Island). If you do not intend to join the transfers organized 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:

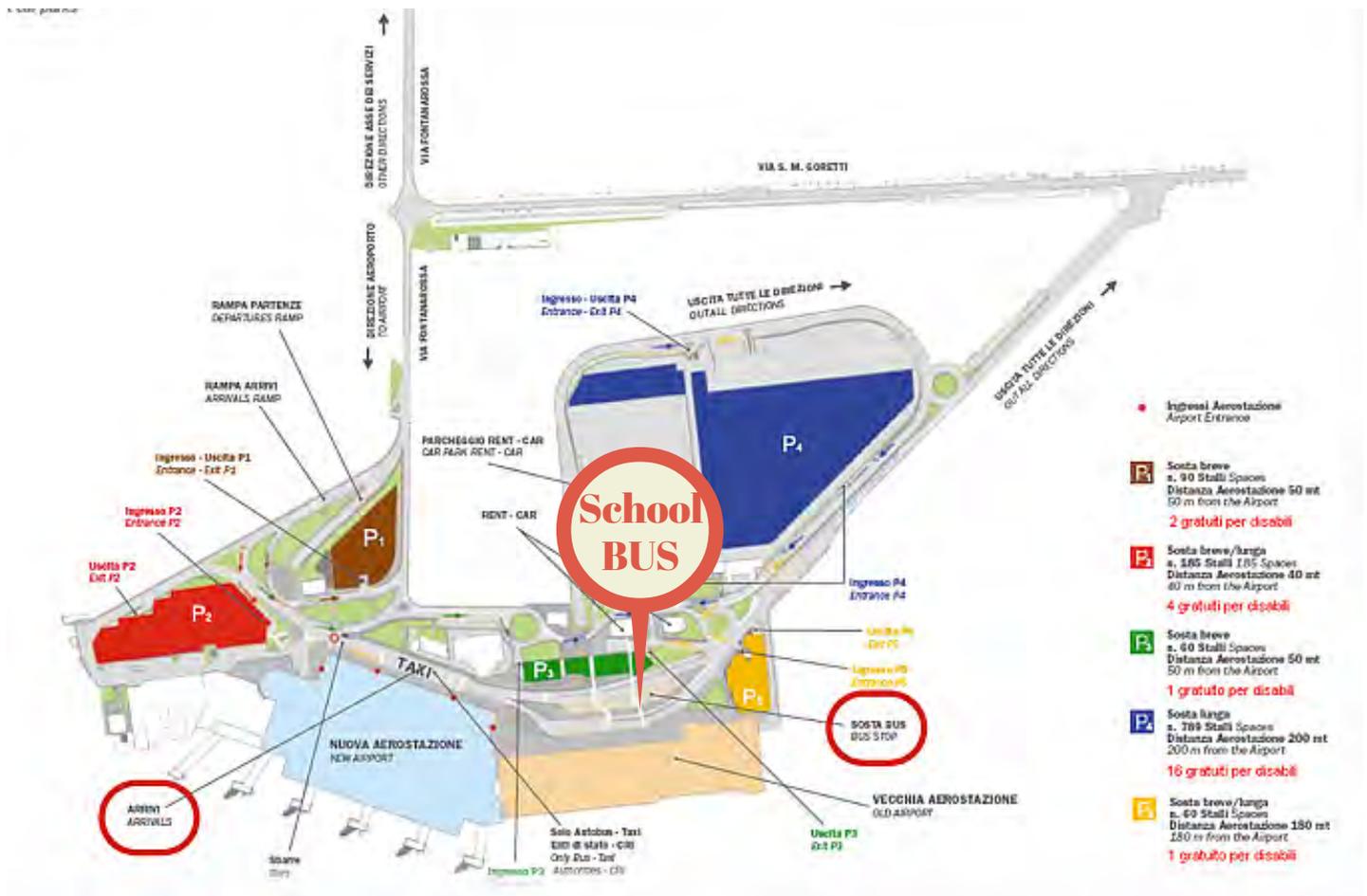
- fly to the international airport in Catania or Palermo
- move by bus from Catania (or Palermo) to Milazzo (public transport available, see below)
- move by hydrofoil/ship from Milazzo to Salina (public transport available, see below)



Transport organized by the School

The best and cheapest strategy is to exploit the free transfers from Catania airport to Salina and from Salina to Catania airport organized 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.

Map of the meeting point (Catania Airport)



Public transport and hotels



If you can not take advantage of the organized 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 2nd September 2015 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. If you will not join the transfers organized 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>

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).

Car renting:

<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 (15 min journey), the village where the School will take place and you will find your house.

Useful links



SalinaLive – Hydrofoil - Ferries:

<http://www.salinalive.it/numeri-utili-orari-aliscafi/come-arrivare.html>

Usticalines - Hydrofoil - Ferries:

<http://www.usticalines.it/default.asp>

Siremar - Hydrofoil - Ferries:

<http://www.siremar.it/linee-e-orari/mappa-dei-collegamenti/orari-navi-ed-aliscafi.html>

N.G.I. - Hydrofoil - Ferries:

<http://www.ngi-spa.it>

Sponsors



Algorithms embedded in physical systems



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