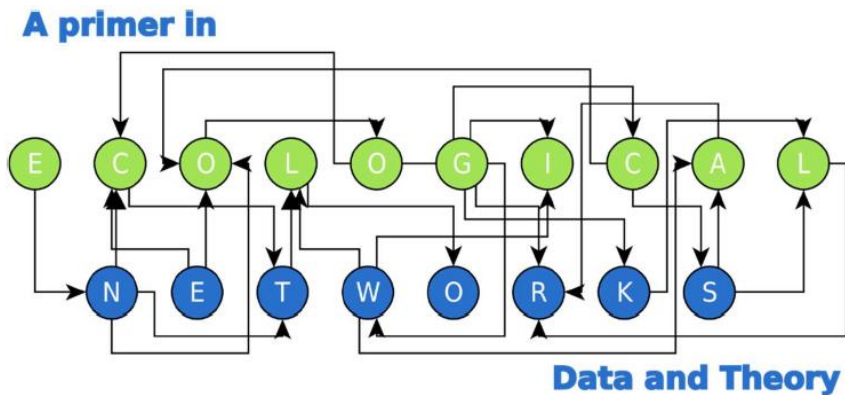


PHD PROGRAM:

EVOLUTIONARY BIOLOGY AND ECOLOGY  
UNIVERSITY OF PARMA, FERRARA AND FLORENCE (ITALY)



UNIVERSITY OF PARMA, CAMPUS, PARCO AREA DELLE  
SCIENZE

INTERNATIONAL SUMMER SCHOOL

TITLE 2018: “**NETWORKS AS TOOLS TO DISENTANGLE THE  
COMPLEXITY OF SOCIOECOLOGICAL SYSTEMS**”

**September 4, 5, 6 - 2018**

*"There are always connections; you have only to want to find them."*  
Umberto Eco - Foucault's Pendulum

*"Nothing is more practical than theory"*  
Richard Levins, Harvard University

School Description

Networks have become the paradigmatic representation of the complexity of natural and human dominated environments, whose dynamics is the result of the multiplicity of interactions between their many components. Networks have been used to represent and investigate species and their relationships (ecological networks), social interactions (social networks), protein interactions and gene regulatory mechanisms (biological networks). The last frontiers of ecological and social research identify networks as the ideal means to understand the nature of these systems and their

dynamics, which is full of counterintuitive behaviors and feedbacks. Moreover, the two domains interact: social relationships, paradigms and attitudes shape policies through which human enterprises manage and affect nature. It is thus important that social and ecological networks are seen as integrated in a social-ecological realm so that causes and effects of environmental changes can be really understood. The summer school aims to introduce network analysis to graduate students and early postdocs but participation is possible to anyone who has interest in studying networks: from data collection to theoretical analysis, using a wide array of network types (food webs, ecosystem models, social networks and protein interaction networks) as well as mathematical and statistical tools to investigate them. From this year on, the school intends to focus on network applications to investigate social-ecological systems.

### **Instructors**

**Ferenc Jordán:** Centre for Ecological Research, Hungarian Academy of Science, Budapest, Hungary.

**Marco Scotti:** GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany.

**Balázs Vedres:** Department of Network Science and Data Science; and Department of Sociology and Social Anthropology, at Central European University, Budapest.

### **School coordination**

**Antonio Bodini:** Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Parma, Italy

## **Syllabus**

*Tuesday, September 4, 2018*

### **09:00-09:45**

*Antonio Bodini* (director of the school)

- Opening lecture: presentation of the school, aims, topics and their relevance in the current pathways of scientific investigation.

Lectures by *Ferenc Jordán*

**Title ó *The versatility of networks for the construction of a systemic view of science***

### **Morning (9:45-13.00)**

- Food webs.
- Animal social networks.
- Protein interaction networks.
- Habitat landscape networks.
- Similarities and differences between the systems.
- Old and new methods for studying networks.

### **Afternoon (15.00-18.00)**

- Network analyses on some example networks (software program: UCINET).
- Comparing the results of different approaches and discussing their use.

Wednesday, September 5, 2018

Lectures by *Balázs Vedres*

**Title** *ó Social networks and applications*

**Morning (9:00-13.00)**

- Conceptual foundations, and schools of thought in social networks.
- Basics of R (R-studio) for social network data, libraries.
- Statistical testing for network hypotheses: the configuration model.

**Afternoon (15.00-18.00)**

- Centralities and centralizations; brokerage roles: measures of node importance.
- Strength of weak ties and closure; comparison of human and animal networks.
- Cohesive communities: methods of identifying and representing network groups.
- Useful and useable visualization with ggplot.

Thursday, September 6, 2018

Lectures by *Marco Scotti*

**Title** – *Qualitative modelling of complex systems*

**Morning (9:45-13.00)**

- Networks as qualitative signed digraphs. Qualitative analysis of complex systems.
- Loop analysis: basic principles and its use for modelling signed digraphs.
- Application of the qualitative algorithm of loop analysis to predict how food web interactions can mediate responses to perturbations: the case study of the Black Sea ecosystem in the years 1960-1990.
- LevinsAnalysis: a package for loop analysis in R.

**Afternoon (15.00-18.00)**

- How to create and import digraphs in the format required by the package LevinsAnalysis.
- Use of loop analysis to generate predictions for all systems variables following the perturbation of target variables.
- Properties of the digraphs (e.g. number of paths and their strength).
- Null models to test the significance of the results generated.
- Interpretation of the main outcomes from loop analysis.
- Visualization and graph layout.

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Software tools needed (participants are requested to download these programs):

- Microsoft Excel
- UCINET: [www.analytictech.com](http://www.analytictech.com)
- R: <http://www.r-project.org/>
- R-studio: <https://www.rstudio.com/products/rstudio/download/R-studio>

R libraries that need to be installed: *igraph, msm, MASS, DiagrammeR, DiagrammeRsvg, rsvg*  
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## Registration

Enrollment is restricted to the first 40 registrants. Enrollment is free of charge but candidates are requested to provide on their own for travel, accommodation and living expenses. Registration will be open until September 1, 2018. Registration can be done by electronic mail to [antonio.bodini@unipr.it](mailto:antonio.bodini@unipr.it) (Antonio Bodini, director of the school). Attendants will be given an account for Internet access.

A certificate of attendance will be given to the participants.

Attendants are required to bring their own laptop computer with already installed the software indicated above. We advise the participants to download the free software in advance to secure the proper use during the school. It is mandatory that participants install on their lap top the software R-studio (<https://www.rstudio.com/products/rstudio/download/>) before the school begins. Programs are needed to accomplish the exercises that will be assigned in the afternoon sessions.

## Date and Location

The course will be held September 4,5,6 - 2018 at the University Campus, Centro Didattico Polifunzionale (see map below) Parco Area delle Scienze, Parma (Italy). From train station or city center the University Campus is served by bus n. 7, and 21. The last stop of the bus is right in front of the Centro Didattico Polifunzionale.

## CAMPUS MAP

