Timetable (all in CET, Vienna, Austria)

Monday, March 22, 2021

09:55-10:00	Welcome & Opening Remarks – Stefan Thurner
10:00-11:30	B1 (1) Renaud Lambiotte – Lecture 1
11:30-11:50	Break
11:50-13:20	B2 (1) Andrea Rapisarda – Lecture 1
13:20-14:00	Lunch break
14:00-15:30	B1 (2) Renaud Lambiotte – Lecture 2
15:30-15:50	Break
15:50-17:20	B2 (2) Andrea Rapisarda – Lecture 2

Tuesday, March 23 , 2021

10:00-11:30	B3 (1) Vittorio Loreto – Lecture 1
11:30-11:50	Break
11:50-12:20	B1 (3) Renaud Lambiotte – Discussion
12:20-13:30	Lunch break

13:30-14:00	B2 (3) Andrea Rapisarda – Discussion
16:00-17:30	B4 (1) Simon DeDeo – Lecture 1

Wednesday, March 24, 2021

10:00-11:30	B3 (2) Vittorio Loreto – Lecture 2
11:30-11:50	break
11:50-12:20	B3 (3) Vittorio Loreto – Discussion
16:00-17:30	B4 (2) Simon DeDeo – Lecture 2
17:30-18:00	B4 (3) Simon DeDeo – Discussion
18:00-19:00	Networking Opportunity I via *wonder.me*

Thursday, March 25, 2021

10:00-11:30	B5 (1) Fariba Karimi – Lecture
11:30-11:50	Break
11:50-12:20	B5 (2) Fariba Karimi – Discussion
12:20-12:30	break
12:30-13:30	Networking opportunity II via *wonder.me*
13:30-14:00	Feedback session & Closing remarks

Speakers & Lectures

Renaud Lambiotte | Network Science

Renaud Lambiotte is professor of networks and nonlinear systems at the University of Oxford and a member of the CSH External Faculty. His research interests include network science, data mining, stochastic processes, social dynamics and neuroimaging. He has published around 130 peer-reviewed articles and one book on temporal networks. He is also the co-founder of L'Arbre de Diane, a publishing company at the interface between science and literature.

Lecture 1 – Dynamics and Modularity

In this lecture, I will provide an overview of the inter-related aspects of community structure and linear dynamics on networks. I will first identify how assortative communities or more general block structures affect dynamical processes. As we will see, such structures translate into specific properties for the *eigenvalues* (time-scale separation) and *eigenvectors* (symmetries) of the system matrix governing the dynamics. I will then consider the opposite viewpoint, and considered how dynamics can enable the extraction of important information from a network and, more specifically, uncover block structures hidden in large networks. To this end, I will present quality functions to uncover communities at different resolutions, depending on the time scale of the associated dynamics, and show connections with a range of network-theoretical concepts, including the Newman-Girvan modularity and embeddings techniques.

Assigned reading: https://www.nature.com/articles/s41567-019-0459-y

Lecture 2 – Higher Order Networks

Over the last 20 years, networks have emerged as a powerful paradigm to model complex systems. Despite its many successes, the abstraction of a system in terms of nodes and edges also has some fundamental modelling limitations, that have become more apparent with the increasing availability of multi-way relational data recently. Within the emerging field of higher-order networks, researchers have tested the limits of the network paradigm, and proposed extensions with richer interactions, including multiplex networks, higher-order Markov models and multiway networks. Multiplex networks aim at modelling systems where nodes can be connected by different types of interactions. Higher-order Markov models do not take edges as fundamental units of connectivity, but walks of length generally greater than one. Multiway networks also question the role of edges as fundamental units, and focus instead on interactions involving more than two nodes, as in hypergraphs for instance. In each type of higher-order model, the notion of connectivity is altered, hence leading to different types of diffusion and community structure. In this lecture, I will discuss recent results on Higher-Order Networks, including their impact on dynamics and on algorithms.

Assigned reading: https://arxiv.org/abs/1804.06268

Andrea Rapisarda | The beneficial role of randomness

Andrea Rapisarda is professor of theoretical physics at the University of Catania, Italy. He is also the coordinator of a PhD program in Complex Systems for Physical, Socio-economic and Life Sciences, co-director of the International School on Complexity of the Ettore Majorana Foundation in Erice and member of the Council of the Complex Systems Society. His main interests are complex systems, statistical mechanics, deterministic chaos, nonlinear dynamics, complex networks and agent-based models.

Lecture 1
From physics to socio-economic systems: How to face the Peter principle and improve democracy by lot.

Lecture 2
From physics to socio-economic systems: How to tame financial markets and improve success in science.

Abstract:

I will review some of my recent studies on the beneficial role of randomness which can be extremely useful in many real situations. Inspired by successful examples in physics, in my first lecture, I will show how random strategies and chance could be adopted to successfully face the problems of the Peter principle in hierarchical organizations and how it is possible to have a more efficient and democratic Parliament introducing some of its members by lot. In my second lecture, I will discuss how it is possible to reduce crisis and losses in financial markets by means of random strategies and how one can exploit the unpredictable role of luck and foster innovation in science.

Bibliography & Suggested Reading:

1. The Peter principle revisited: a computational study , A. Pluchino, A. Rapisarda, C. Garofalo, **Physica A** 389 (2010) 467
2. Efficient promotion strategies in hierarchical organizations, A. Pluchino, A. Rapisarda, C. Garofalo, **Physica A** 390 (2011) 3496
3. Accidental politicians: how randomly selected legislators can improve Parliament efficiency, A. Pluchino, C. Garofalo, A. Rapisarda, S. Spagano, M. Caserta, **Physica A** 390 (2011) 3944.
4. Reducing financial avalanches by random investments, A.E. Biondo, A. Pluchino, A. Rapisarda, D. Helbing, **Phys Rev. E** 88 (2013) 062814
5. Talent vs Luck: the role of randomness in success and failure, A. Pluchino, A.E. Biondo, A. Rapisarda, **Advances in Complex systems** 21 (2018) 1850014
6. The Origins of Extreme Wealth Inequality in the Talent Versus Luck Model, D. Challet, A. Pluchino, A.E. Biondo, A. Rapisarda, **Advances in Complex Systems**, 23 (2020) 2050004
7. Exploring the role of interdisciplinarity in physics: success, talent and luck, A. Pluchino, G. Burgio, A. Rapisarda, A.E. Biondo, A. Pulvirenti, A. Ferro, T. Giorgino, **PLoS ONE** 14(6): e0218793.
8. Inequalities, chance and success in sport competitions: Simulations vs empirical data, P. Sobkowicz, R.H. Frank, A.E. Biondo, A. Pluchino, A. Rapisarda, **Physica A** 557 (2020) 124899

Vittorio Loreto | Dynamics of Novelties and Innovation

Vittorio Loreto has been a member of the CSH Faculty since May 2017. He is also full professor of physics of complex systems at Sapienza University of Rome. Presently, he is the Director of the SONY Computer Science Laboratories in Paris where he heads the team on “Innovation, Creativity and Artificial Intelligence”. His scientific activity is focused on the statistical physics of complex systems and its interdisciplinary applications.

Lecture 1 – Dynamics of Novelty and Innovation 1
The statistics of the new: Zipf's, Heaps' and Taylor's laws.

Temporal patterns of innovations: triggering effects, trends and correlation phenomena. Empirical pieces of evidence: Human and socio-technological systems.

Lecture 2 – Dynamics of Novelty and Innovation 2
The notion of Adjacent Possible and its implementation in advanced modelling schemes.

Historical remarks and early modelling schemes: Yule-Simon, Polya's urns and Laplace's rule of succession Urn schemes with innovation: the Hoppe model, the Chinese restaurant process Urn schemes incorporating the notion of Adjacent Possible: its implementation in advanced modelling scheme. Predictions and comparisons with empirical findings.

Simon DeDeo | Cultural Data Science

Simon DeDeo is assistant professor of Social and Decision Sciences at Carnegie Mellon University, and external faculty at the Santa Fe Institute as well as the Complexity Science Hub Vienna. He leads the Laboratory for Social Minds, whose collaborative work appears in journals ranging from Physical Review and Journal of the Royal Society Interface to Cognition and PLoS Computational Biology.

Lecture 1
Cultural Data Science 1: Pattern Making, Pattern Breaking

The human mind is a pattern recognition machine. The most basic aspects of our experiences are filtered through an inferential system that distorts reality in unexpected ways—from the visual system all the way up to the values and insights we experience in "high-level" domains such as politics, literature, and science itself. I'll introduce you to some basic, but powerful, tools from information theory and statistics, and apply them to large-scale archives including data from the French Revolution, the British Parliament, 20th Century American Poetry, and theoretical high-energy physics. I'll show how they can be used to answer a pair of basic questions: where do new things come from, and what do we do when we get them?

Assigned reading:

1) „Crash course" in information theory - http://tuvalu.santafe.edu/~simon/it.pdf
2) https://www.pnas.org/content/115/18/4607.short

Lecture 2
Cultural Data Science 2: Sense-Making at Scale

We don't just know things—we try to explain them. This is a complex task because we value a variety of different things in an explanation, and those values can go both very right (e.g., modern science), and very wrong (e.g., conspiracy theories). I'll build on ideas from lecture one to show how we can identify large-scale structural patterns in what we choose to accept as a good explanation. I'll then apply these ideas two polar human experiences: papers from the early history of Western science, and comments and posts from online conspiracy forums.

Assigned reading: https://www.sciencedirect.com/science/article/abs/pii/S136466132030228X

Fariba Karimi | Computational Social Science

Fariba Karimi is the Hub's newest group leader in Computational Social Science. She is also an assistant professor at the Department of Network and Data Science at Central European University. Her current research focuses on computational and network approaches for addressing societal challenges such as gender disparities in collaboration and citation networks, visibility of minorities in social and technical systems, algorithmic biases, and sampling hard-to-reach groups.

Lecture

Current advances in Computational Social Science: Where Network Science meets Computational Social Science

Human society is a complex interactive system, and it requires complexity thinking to understand it and to tackle critical societal issues. This lecture will discuss important advances in Computational Social Science (CSS) from both a methodological point of view and an empirical perspective. I will cover the multidisciplinary aspect of CSS by showcasing the important contributions of social scientists, computer scientists, physicists, and mathematicians. I pay particular attention to the role of network science to address the emergence of inequality and biases in society and algorithms. Finally, I will address challenges and opportunities in this field.

Assigned Reading

Social Physics: How Social Networks Can Make Us Smarter by Alex Pentland

Experimental evidence for tipping points in social convention. Science (2018)
https://www.researchgate.net/publication/325639714_Experimental_evidence_for_tipping_points_in_social_convention

Homophily influences ranking of minorities in social networks. Scientific reports 8.1 (2018): 1-12.
https://publications.rwth-aachen.de/record/731410/files/731410.pdf

Computational social science: Obstacles and opportunities. Science, (2020)
https://science.sciencemag.org/content/369/6507/1060

IMPORTANT INFORMATION

Registration

The webinar is open to all scholars interested in the topics of the lecture series. Proficiency in English and a background in science or mathematics will be required.

By registering for this event, you will be granted access to join all live online lectures and discussion blocks as a **listener**. The active participation is reserved to our successful winter school applicants. Tuition fee is € 100 and will be charged via PayPal.

For registration to the conference, please click here.

Zoom

The entire lecture series will be available through videoconferencing software Zoom. The login details will be sent to registered participants prior to the event.

Lectures

As specified in the time schedule above, most lecturers present two 1,5 hour lectures. Please be aware that longer breaks in the program may be necessary to accommodate the different time zones of the speakers.

Discussion Sessions

The discussion session for each Speaker will be held separately to the lectures. Questions may however be asked during the lectures unless the Speaker states otherwise. Please note that questions can only be asked by **panelists** (all former Winter School participants who have been invited to join this event directly by CSH). To ask a question, please use the "raise hand" button in Zoom. The session host will then call out your name and you can ask your question.

Listeners can join the discussion sessions but cannot actively take part in the discussion. Listeners can however send a question to the session host via the Q&A function on the bottom of the Zoom screen. The question may be picked up by the session host.

Roles & rights

Panelists: can mute/unmute their microphone and switch their camera on/off. We kindly ask all panelists to mute their microphone during the lectures to avoid any background noise. If this occurs, the host may unmute your microphone.

Attendees ("Listeners"): will be muted per default by zoom and cannot unmute their microphone themselves. Attendees can use the chat and Q&A function.

Networking-Sessions

On March 24th and 25th 1-hour **Networking-opportunities** through the Browser-based Tool '**Wonder'** Will be offered. The link will be supplied to all participants (also listeners) prior to the first networking session.

Wonder is a practical tool that is designed for networking sessions in professional contexts. It does not require any download. The tool lets you move around from table to table in a virtual space mimicking a real life networking situation. We highly encourage participation in the networking sessions!

Website

The lecture series website is:
https://www.csh.ac.at/event/csh-online-winter-lecture-series/

Contact information

Should you have any questions or experience any technical issues, please do not hesitate to contact Stephanie or Emine via office@csh.ac.at

About the CSH

The Complexity Science Hub Vienna is a young research institute dedicated to a deeper quantitative and predictive understanding of complex systems for the betterment of society. We provide an exciting, creative, bureaucracy-free environment for open-minded visionaries who want to make a change and are brave enough to step out of mainstream science. Focus areas include smart cities, innovation dynamics, medical, social, ecological, and economic systems.

CSH is a joint initiative of AIT Austrian Institute of Technology, Central European University, Donau University Krems, Graz University of Technology, Institute of Molecular Biotechnology, IIASA International Institute for Applied Systems Analysis, Medical University of Vienna, Vienna University of Technology, Vienna University of Economics and Business, the University for Veterinary Medicine Vienna and the Austrian Chamber of Commerce.