

Data-driven Future ICT for cybersecurity and social goods

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RESEARCH PROJECT

My PhD research project focuses on the analysis of complex structures, processes and dynamics allowing to design innovative context-aware ICT services based on collective **cooperation** and competition.

OBJECTIVES

- discovering the real complexity of systems and anticipating the evolution of **collective dynamics** and their consequences on the focused infrastructure
- evaluating the effect and the evolution of services
- analysing and leading strategies of the “Future ICT” in application domain such as security, public health, sustainability of energetic consumption, ...
- highlighting how some strategies lead the system dynamically towards the “common good”, that mean what brings benefits to the whole system in the most effective way possible, such us a correct use of shared resources

RESEARCH ACTIVITIES AND CONTRIBUTIONS

1. Literature, Related Work and Background
2. Study and Assessment
3. Research Areas of Interest Selection
4. Analysis
5. Research Question
6. Simulations
7. Proposal Contributions and Scientific Results
8. Future Work based on Potential Benefits and Drawbacks of the Research Areas

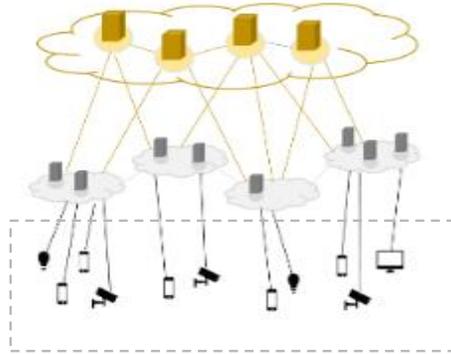
RESEARCH ACTIVITIES AND CONTRIBUTIONS

- **International School on Data Science and IoT**, University of Catania, 9 -13 September 2019
- **International Conference on Social Inclusion, Education and Digital Society**, Malta, 18-19 October 2019
- B. Attanasio, A. Di Stefano, A. La Corte, M. Scatà: "**A modeling approach based on Multiplexity and EGT for resource sharing in Fog/Cloud Computing**", International School on Data Science and IoT, 09/2019, Catania.
- A. Di Stefano, M. Scatà, B. Attanasio, A. La Corte, S. K. Das, P. Liò: "**A Homophily-based Multi-layer Game-theoretic Methodology in Mobile Crowdsensing**", IEEE Transactions on Network Science and Engineering. (Submitted)
- B. Attanasio, S. Grimaldi: "**A novel approach for the development of innovative services for social inclusion and education**" International Conference on Social Inclusion, Education and Digital Society, 10/2019, Malta.

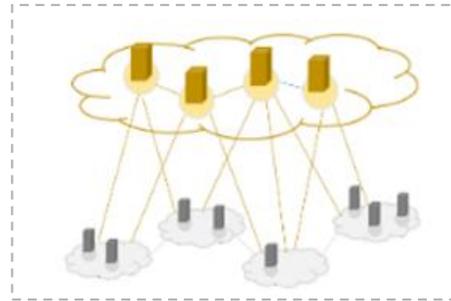
RESEARCH AREA OF INTEREST

- Addressing the **offloading problem** exploiting a model of **interplay and cooperation among Cloud and Fog entities** in IoT environment. The aim is to find out which is the role of exploring the evolution of cooperation in a service-based multiplex network in Cloud/Fog scenario to shed light on the way to manage resource sharing, which encompasses incorporating collective dynamics.
- Evaluating a game theoretical-approach in the formation of **cooperative mining pools** among constrained resource devices for the resolution mining process in mobile **Blockchain**.
- Quantifying the impact of homophily, network heterogeneity and social dilemmas on the **mobile crowdsensing**. Quantifying a novel measures of **QoI** and **user reputation score** based on the evolution of **human cooperation** in a **MEC** scenario.

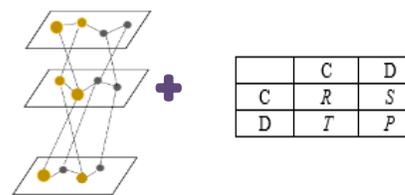
STAGES OF THE RESEARCH



Research problem: Offloading, constrained resources end devices need to delegate their task to cloud and fog nodes.



It is useful evaluating the role of **cooperation** in Fog and Cloud resource sharing



	C	D
C	R	S
D	T	P

Methodology: the modelling approach is based on Multiplex networks and EGT



- Node's profile
- Metrics
- Complex networks
- ...

Expected Outcomes: What are factors that influence cooperative dynamics? How to characterize Cloud / Fog nodes? What's the role of interactions among them on different layers?

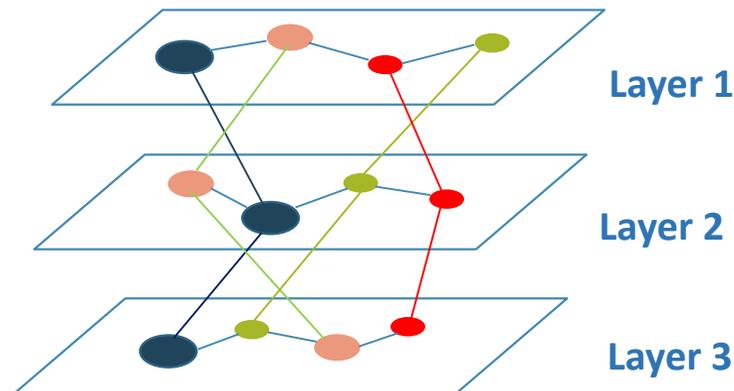
METHODOLOGY

- **Social networks**
- **Multilayer** and **Multiplex networks**
- **Epidemic models**
- **Game Theory** and **Evolutionary Game Theory**

METHODOLOGY

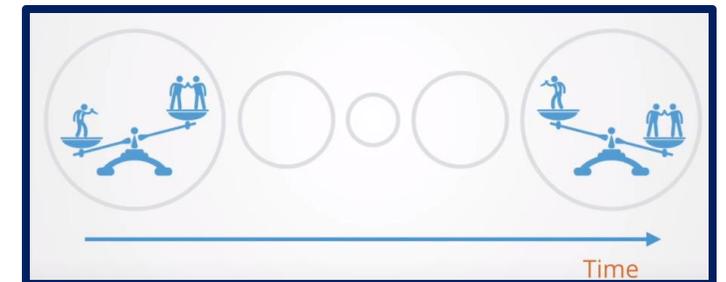
- To understand the behavioural dynamics and, in particular, the **evolution of cooperation**, it is crucial taking advantage of powerful tools able to represent underlying structure and mechanisms which influence strategies such as:

MULTIPLEX NETWORKS are particular kind of multilayer networks where the only type of interlayer connection is between a node and its counterparts in other layers. they provide a description for systems in which entities have a different set of neighbours in each layer.



EGT constitutes the mathematical framework to study the evolution of strategic interactions within a complex system highlighting how and why some behaviours emerge and are able to persist in a system.

	C	D
C	$b-c$	$-c$
D	b	0

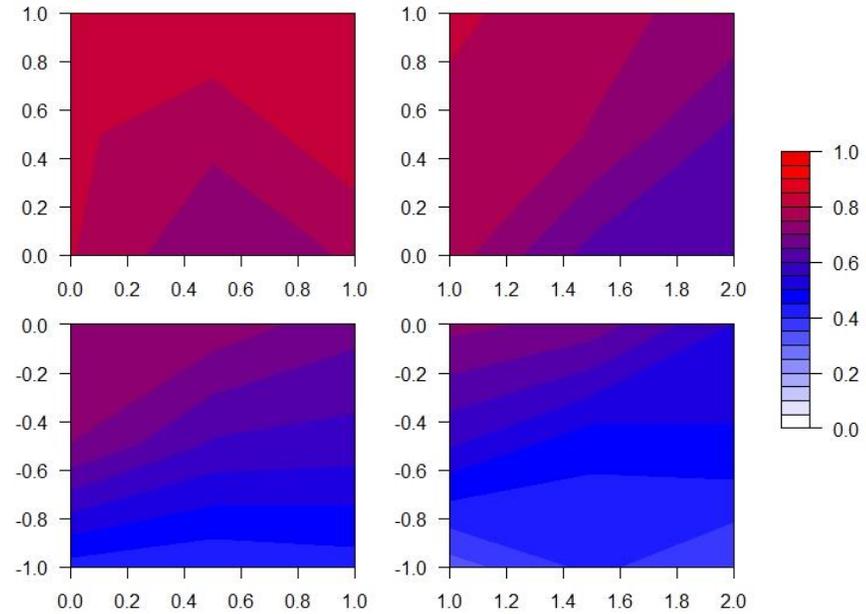
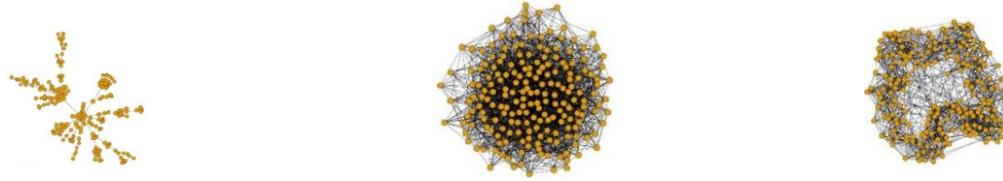
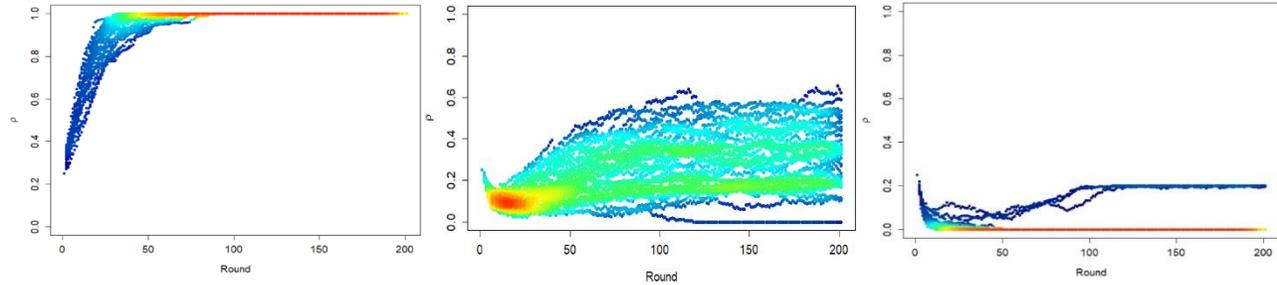


METHODOLOGY

Factors which play a fundamental role for the spread of cooperative behaviours:

- **Homophily** is the principle that similarity encourages connection, that is similar nodes are more likely to connect.
- **Critical Mass** is the minimum number of initial contributors, which has the power to involve the rest of population, for example, persuading the remaining members of the population towards the adoption of a specific behaviour.
- **Communicability** is the number of possible paths with which two nodes can communicate

SIMULATIONS



FUTURE WORKS

- To investigate various systems and methods of **data integration, machine learning** and **deep learning**.
- To analyze those application scenarios that could benefit from the cooperation between Cloud and Fog nodes, for instance **healthcare, smartcare, etc...** in which real-time processing and event response are critical.
- To develop new models, to perform tests and to collect data.