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# (Social) Network Analysis as a paradigm for knowledge extraction in various contexts

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# Introduction

- Social Network Analysis (SNA) is a highly versatile methodology that precedes Twitter and Facebook for at least 30 years
- In few words, SNA can be described as a «study of human relationships by means of graph theory»
- SNA was largely applied to social media because, in this context, data are easily available and research opportunities are numerous and promising
- Before the advent of social media, SNA was investigated by few researchers and it was little considered
- With the advent of Online Social Networks this scenario has radically changed
- SNA is based on a central concept: our relationships, taken as a whole, define who we are and how we act

# Introduction

- A social network can be seen as a collection of sentences describing relationships; for instance, «Alice – Loves – Bob»
- A sentence of this type represents the basic unit of SNA and is called dyad
- Each dyad represents a relationship, i.e. an arc in the traditional graph theory
- In SNA nodes have a type: they can represent people, hashtags, etc.
- If a graph contains nodes of only one type then it is called 1-mode graph. If it contains nodes of two types then it is called 2-mode graph. There also exist multi-modal graphs
- There could also exist several types of arcs
- From the previous description it appears that there is a strict correlation between SNA and graph theory (and, then, complex networks) and that many of the results of SNA can be applied to graph theory (and, then, to complex networks), and vice versa

General idea of our research:

## Applying methods, approaches, technologies and results of (Social) Network Analysis in several (highly heterogeneous) research fields

- We mainly considered four research fields:
  - Neurological Disease Investigation
  - Data Lakes
  - Internet of Things
  - Innovation Management

# Neurological Disease Investigation

Cerebral analysis represents one of the most important biomedical investigations

The classification present in the literature considers three kinds of connection, namely *anatomic*, *functional* and *real*

One of the most common tools in this kind of analysis is EEG, because it is cheap and not invasive

Our research activity in this field, conducted in cooperation with the Neurolab Laboratory of University Mediterranea of Reggio Calabria and with the Bonino-Pulejo center of Messina, focused on the analysis of the network connectivity and on the detection of connection patterns therein

# Neurological Disease Investigation

Starting from these ideas we were able to analyze three different patologies, namely:

Mild Cognitive impairment (MCI) and Alzheimer‘s Disease (AD)

Creutzfeldt-Jacob Disease (CJD)

Childhood Absence Epilepsy (CAE)

# Data Lakes


Currently, more than 80% of information available on the Internet is unstructured

The too rigid Data Warehouses are often flanked, or even substituted, by data lakes, characterized by a flat architecture and a rich set of metadata


The extraction of semantic relationships between the concepts of a data lake requires approaches completely different from the past ones (e.g., how unstructured data can ben somehow «structured»?)

Once a right approach has been found, the classical issues addressed in data analysis can be extended to this new context; think, for instance, of the extraction of knowledge patterns

# Internet of Things


Social Network Paradigm is considered one of the most effective ways to analyze and implement the Internet of Things

In this context, in the last years, researchers are recognizing that modeling activity based on a unique global Internet of Things is not effective and efficient

To address this issue, we proposed a new Multi-IoT paradigm, capable of modeling the new real scenario and of favoring the cooperation among things belonging to different IoTs

Furthermore, to give a first idea of the impact of the new paradigm, we redefined the betweenness centrality measure in such a way as to make it suitable for the Multi-IoT paradigm. Then, we proposed a new crawler

# Innovation Management

In the last years, thanks to the growing availability of data, the interest for scientometry and innovation management is enormously increasing

Network Analysis was, and currently is, very used for these investigations. However, often, only classic metrics are adopted for this purpose

Think, for instance, of Patent Network. In this application context, classical metrics are not very effective

In this field, we conducted some research efforts in cooperation with the ICRIOS center of the «Bocconi» University, aimed to: *(i)* perform «*hub*» detection, *(ii)* measure the centrality in «*Patent Networks*»

- Specifically, we addressed the following issues:

  - Extraction of knowledge patterns on the research activities and hubs of a group of countries
  - Extraction of knowledge patterns on innovation geography starting from a world patent database
  - Definition of a new centrality measure to evaluate patents and their citations

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