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JOURNAL OF INTERDISCIPLINARY METHODOLOGIES AND ISSUES IN SCIENCE

Introduction to the special issue on *Graph and Network Analysis*

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I INTRODUCTION

This fifth issue of the *Journal of Interdisciplinary Methodologies and Issues in Science* (JIMIS) is dedicated to methods designed for the analysis of graphs and networks, as well as to applied works relying on the analysis of graphs and networks in specific domains. Its guest editor is Vincent Labatut (cf. Section III for affiliations and other details). This issue can be considered as a follow-up of the second issue of JIMIS, which focused on the modeling of social systems through graphs (Labatut and Figueiredo, 2017). Like before, it includes strongly interdisciplinary works. In addition, this issue widens the scope of the considered problems and systems, as the focus is not only on social systems anymore.

Graphs constitute a very generic modeling tool, which can be used to represent any system constituted of interacting or inter-related objects. This covers most of the scientific domains, which explains the popularity of graphs as a modeling framework. Thanks to this generic nature, it is possible to take a method designed to handle a specific system, and use it in a completely different context (with various levels of adjustment). For instance, Dugué *et al.* (2015) worked with a method initially designed by Guimerà and Amaral (2005) to detect functionally important proteins in biological networks, and adapted it to identify key-players in Twitter. However, due to lexical, methodological and cultural differences, being aware of the methods developed in other fields can be truly challenging for a researcher.

As with the previously mentioned issue, the goal of this special issue is to try to bridge this gap, by exposing researchers from Computer Sciences and from Humanities and Social Sciences to different tools and usages of the concept of graph, coming from out of their field. The selected articles describe graph analysis methods and models, as well as their application to specific historical, social and geographical systems.

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II IN THIS ISSUE

This issue is the continuation of MARAMI 2018[1] (*Modèles & Analyse des Réseaux : Approches Mathématiques & Informatiques*), the French conference on graph and network analysis, that took place in Avignon, France from the 17th to the 19th of October, 2018. However, in order to widen the audience, the call for paper was open to people that did not participate in the event. Therefore, some of the papers presented in this issue are extended versions of oral communications that took place during the conference, whereas others are new submissions.

We initially received a total of 10 submissions, 5 of which went all the way through the editorial process. This includes two rounds of reviews by two to three reviewers representing at least two disciplines, in order to give the authors both methodological and application-related feedback. The 5 articles constituting this special issue cover a large scientific range, from theoretical to applied aspects, and a variety of topics, including historical, geographic, and social networks.

In his article *Sur la chronologie des Éponymes rhodiens* (in French), Alain Guénoche (2019) tackles a historical problem, consisting in chronologically ordering so-called *Rhodian Eponyms*. Those are priests of the god Helios, located on the island of Rhodes during the Hellenistic period. A. Guénoche formulates this task as a *seriation* problem, by leveraging a recently elaborated epigraphic corpus (Cankardeş-Şenol, 2017). These data rely on stamps found on amphorae, and describing a correspondence between Eponyms and winemakers. A. Guénoche proposes a new heuristic to solve this very interesting and original problem, which is related to more classic scheduling problems.

Armel Jacques Nzekon Nzeko'o, Maurice Tchuente & Matthieu Latapy (2019) focus on a completely different problem in their article entitled *A General Graph-based Framework for Top-N Recommendation Using Content, Temporal and Trust Information*. They consider the recommendation of appropriate items to users of e-commerce platforms, based on their browsing, purchasing and streaming history. They propose a graph-based method called *GraFC2T2*, which allows combining heterogeneous types of information in a single model, including content-based features, the evolution of the users' preferences, and their trust relationships. They show how to take advantage of this model to perform recommendation, through a variant of the PageRank measure Xiang *et al.* (2010).

The work presented by Thibaud Arnoux, Lionel Tabourier & Matthieu Latapy (2019) in *Predicting Interactions Between Individuals with Structural and Dynamical Information* is more methodological than the other articles of this issue. They deal with the problem of predicting the amount of activity between two elements of a dynamic system. They adopt a *link stream* model to represent the system, which can be viewed as a very extreme case of dynamic network, as it corresponds to a sequence of time-stamped edges, each one representing a time-limited relationship or interaction between two vertices. T. Arnoux *et al.* leverage a variety of measures to perform their prediction based on the history of the link stream, and show the accuracy of their method by applying it to a collection of real-world datasets.

Andrey Grunin (2019) uses graphs to assess the validity of several historical research assumptions in his article *Réseau politique des agents du pouvoir central : lexemple des missi dominici* (in French). His goal is to study the organization of the *missi dominici*, some agents of the central authority established by the Caroligian dynasty during the Early Middle Ages. For this purpose, he develops several models of their political network, and proposes a multimodal method to analyze them. It allows to consider simultaneously different types of information

[1] https://marami2018.sciencesconf.org/

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(spatial distances, family ties, connections to places and sovereigns, time) while taking into account a common characteristic of historical data: its incomplete nature.

The article *Multi-Dimensional Urban Network Percolation* by Juste Raimbault (2019) focuses on network percolation as a means to characterize the hierarchical structure of urban systems. In order to take into account the various aspect of this structure, J. Raimbault adopts a multi-dimensional approach allowing to consider both the spatial distribution of the population and the topology of the transportation networks. He applies his method to the European urban system to identify endogenous mega-urban regions, and shows that varying the parameters of the percolation allows considering different definitions of the notion of urban region, and could be leveraged to study sustainability issues.

III SCIENTIFIC COMMITTEE

Each issue of JIMIS deals with a special topic, and as such it has its own scientific committee. Here are the members of the scientific committee selected for this *Graph and Network Analysis* issue (in alphabetical order):

Rémy Cazabet
Complex networks, Digital-currencies transaction networks
Université de Lyon / UMR 5205 Laboratoire d'InfoRmatique en Image et Systèmes d'information (LIRIS) / Institut rhônalpin des systèmes complexes (IXXI), Lyon (France)

Alexis Conesa
Urban planning, Regional planning, Public transportation
Université de Strasbourg / UMR 7362 Laboratoire Image Ville Environnement (LIVE), Strasbourg (France)

Jean-Valère Cossu
Recommender systems, E-reputation management, Information retrieval
My Local Influence, Aubagne (France)

Laurent Jegou
Medieval and Ancient History and Archaeology
Université Paris 1 Panthéon-Sorbonne / UMR 8589 Laboratoire de médiévistique occidentale de Paris (LAMOP), Paris (France)

Márton Karsai
Human dynamics, Computational social science, Data science
Central European University, Budapest (Hungary) / Institut rhônalpin des systèmes complexes (IXXI), Lyon (France)

Vincent Labatut
Complex networks analysis, Information retrieval
Université d'Avignon et des Pays de Vaucluse / EA 4128 Laboratoire Informatique d'Avignon (LIA) / FR 3621 Agorantic, Avignon (France)

Claire Lagesse
Extraction and Analysis of Spatial Complex Networks
Université Bourgogne Franche-Conté / UMR 6049 Théoriser pour modéliser & aménager (ThéMA), Besançon (France)

Thomas Louail
Spatial dimensions of social dynamics, Human mobility
UMR 8504 Géographie-Cités, Paris (France)

Günce Keziban Orman
Complex network analysis, Community detection, Data mining
Galatasaray Üniversistesi, Istanbul (Turkey)

Michael Poss
Integer programming, Robust optimization, Network design
UMR 5506 Laboratoire d'Informatique, de Robotique et de Microélectronique de Montpellier (LIRMM), Montpellier (France)

Alexandre Reiffers
Game theory, Optimization, Stochastic processes, Machine learning
IISC Bangalore, Robert Bosch Centre for Cyber-Physical Systems, Bangalore (India)

François Ribac
Popular music, Performing arts, Compared history of science and technology
Université de Bourgogne / EA 4177 Communications, Médiations, Organisations, Savoirs (CIMEOS), Dijon (France)

Giulio Rossetti
Complex network, Community detection, Dynamic networks
Knowledge Discovery and Data Mining Laboratory (KDD-lab) / Consiglio Nazionale delle Ricerche (CNR), Pisa (Italy)

Lena Sanders
Urban dynamics, Spatial statistics, Complex systems
UMR 8504 Géographie-Cités, Paris (France)

Sébastien de Valeriola
Actuarial Science, History of economic thought, Data mining, Graph theory
ICHEC Brussels Management School, Brussels (Belgium)

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