Description of the funded research project
1st Call for H.F.R.I. Research Projects to Support Faculty Members & Researchers and Procure High-Value Research Equipment

Title of the research project: eFficient Algorithms for NeTwork Analysis (FANTA)

Principal Investigator: Loukas Georgiadis

Reader-friendly title: FANTA

Scientific Area: Mathematics & Information Sciences

Institution and Country: Department of Computer Science & Engineering, University of Ioannina, Greece

Host Institution: University of Ioannina
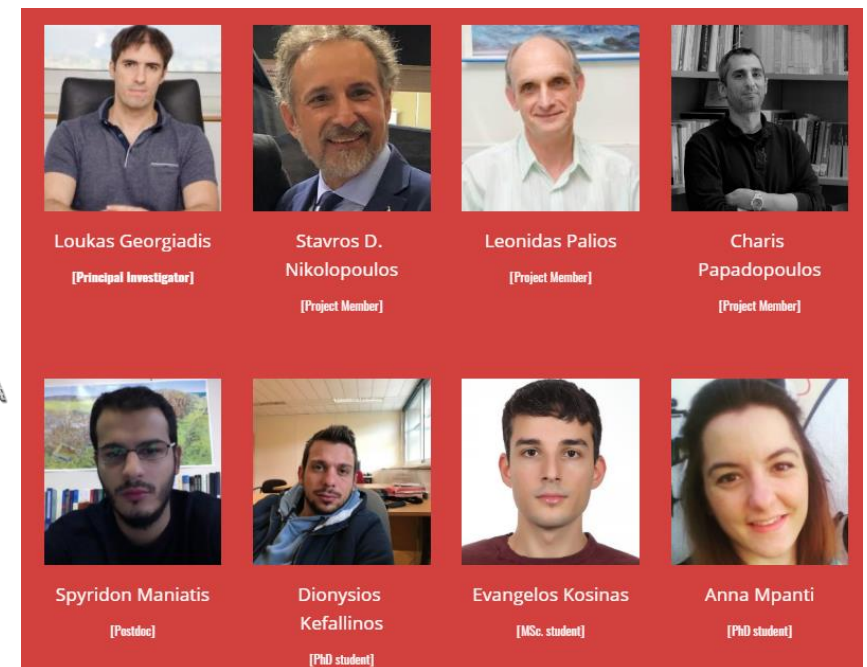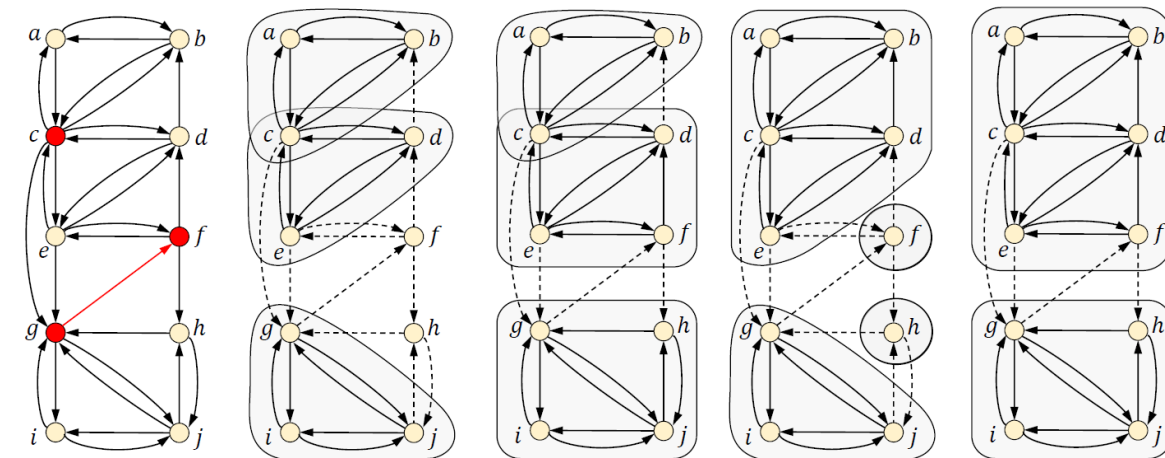
Collaborating Institution(s):
- LUISS University, Rome, Italy
- University of Bergen, Norway

Project webpage (if applicable): https://sites.google.com/view/effantaproject

Budget: 170.000 €

Duration: 36 months

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Charis Papadopoulos [Project Member]

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Research Project Synopsis

Networks model many diverse natural or artificial systems, capturing both the structure and the dynamics of the underlying system. Examples include but are not limited to the world-wide web, transportation, communication and social networks, databases, biological systems, circuits, and the control-flow of computer programs. Despite the broad range of applications of network models, there are problems of fundamental importance that cut across different types of networks and different research areas.

There are deep theoretical questions about network analysis and optimization problems underlying these practical problems, such as connectivity, reachability, dominators, and cuts. Algorithms and data structures for such fundamental graph problems have been the subject of extensive research for decades. Nevertheless, the area of graph algorithms continues to attract a lot of attention and to produce many significant results related to the above problems. Furthermore, recent applications, as well as theoretical advances, motivate the study of novel variants of well-known problems.

Our objective is to study novel problems and advance the state of the art in previously-studied problems, from the perspective of both theory and practice, along the following directions:
- Algorithms for connectivity and reachability problems on static and dynamic graphs.
- Network connectivity under failures.
- Survivable network design.
- Algorithmic network analysis in practice: engineering and applications.

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Project originality

The proposed project aims to advance the state of the art in algorithm design, complexity, and engineering in the area of network analysis and optimization. We investigate problems of established importance, as well as novel problems motivated by practical applications. We expect that our research will lead to the design of new algorithms with good theoretical and practical performance, and to the development of new algorithmic techniques. One important and innovative aspect of the proposal is that it will help to reveal new interconnections between the main research themes which may open new directions in the domain.

Today, networked data are ubiquitous in many different aspects of life, and their study goes far beyond computer science. For example, the explosion of online social networks has raised the expectation that we are finally in the position to understand better human behavior by studying the underlying networked data. Therefore, efficient algorithms for analyzing networks can contribute to better understand processes that govern their operation, e.g., understanding or controlling diffusion and propagation processes in domains such as social networks and epidemiology.

Expected results & Research Project Impact

Expected results
- Develop new algorithmic techniques and provide practical solutions for key problems in important application areas.
- Transfer advanced algorithmic technologies through experiments and algorithm engineering

Project impact
- Help advance basic and applied research in Greece in challenging areas that are relevant not only to computer science but also to other fields due to the interdisciplinary nature of their applications.
- Train young researchers in important research areas in algorithm design and algorithm engineering.
- Benefit from the collaboration with leading scientists in foreign institutions. This will be a valuable experience for student's professional careers.

The importance of this funding

The funding of this project from HFRI contributes decisively to the achievement of our goals for the following reasons:

- Enables our talented students to conduct high-quality research while staying in Greece.
- Allows us to develop and strengthen collaborations with highly-esteemed universities and research centers abroad.
- Provides us with the opportunity to present our research results to top-tier international conferences.
- Helps us upgrade the infrastructure of the Algorithms Engineering Laboratory at the Department of Computer Science & Engineering of the University of Ioannina.

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