DIPARTIMENTO DI INGEGNERIA
CORSO DI DOTTORATO IN INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE -
PHD COURSE IN INDUSTRIAL AND INFORMATION ENGINEERING - 37TH CYCLE

Title of the research activity:	Visual Analytics for Big Data and Complex Networks
State of the Art:	The use of visualization to analyze large amount of data is a well-established methodology and it is considered a valuable approach in a variety of application domains [4][9][10]. Visual analytics systems are especially relevant to analyze and mine data that can be modeled as graphs and networks, which are often large, complex, dynamic, and uncertain. This type of data is ubiquitous in many real-life applications such as social sciences, finance and economy, biology, and telecommunications [1][2][3]. In particular, the design of visualization algorithms to gain a deep understanding of a complex and large network, of its structural properties, and of its recurrent patterns is of utmost importance in several decision-making processes (e.g., [5][6][7][8]).
Short description and objectives of the research activity:	The aim of this research project is to design and develop efficient algorithms and visual analytics systems for big data, with special focus on networks that are complex, uncertain, and dynamically evolving over time. From a theoretical perspective, the research will concentrate on the design of graph drawing techniques capable of handling geometric and topological constraints. It will investigate the combinatorial properties of graphs and explore both graph visualization paradigms, also in dynamic scenarios. From a practical perspective, the research aims to conduct experimental validations of the designed algorithms, and to integrate these algorithms into visual analytics systems, which can be effectively used in different application domains. Overall, this research involves topics and skills from several broader areas, such as Algorithm Engineering, Software Engineering, Information Visualization, Human-Computer Interaction, Big Data Analytics and Data Science. The students will join the Computer Science and Engineering research group at the Department of Engineering of the University of Perugia. They will be provided with an adequate travel budget to attend international conferences and to visit foreign collaborators. Part of the research may require collaborations with external companies and institutions.
Bibliography:	[1] G. Di Battista, P. Eades, R. Tamassia, and I. G. Tollis, "Graph Drawing: Algorithms for the Visualization of Graphs", Prentice Hall, 1999. [2] R. Tamassia Ed., "Handbook of Graph Drawing and Visualization", CRC Press, 2013. [3] W. Didimo and G. Liotta, "Graph Visualization and Data Mining", Chapter in book: Mining Graph Data - Ed. D. Cook and L. Holder, pp. 35-63, Wiley, 2007. [4] C. Ware, "Information Visualization: Perception for Design", Third Edition, Elsevier, 2013.

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