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Report on Dr. Hartman's abilitation Dissertation on
"Properties of Networks Characterizing Dynamical Systems"

Monday, March 6, 2023

Dear Prof. Doležal,

As laid out in his habilitation thesis, Dr. David Hartman's work focuses on understanding complex networks and their processing. These networks are models of dynamic complex systems, and their utilization requires working with data, minimizing uncertainty, and studying the theoretical properties of graphs and other structures. The main goal of this thesis is to present selected papers coauthored by Hartman, which cover the different aspects of complex network analysis.

The thesis is organized into four groups based on the different stages in the pipeline for complex network analysis.

The first group studies the reliability of analyses for the systems defined by behavioral connectivity. When using various connectivity measures, Dr. Hartman and his coauthors pay special attention to constructing networks from data accounting for dataset properties. The focus is identifying the best methods for constructing reliable and accurate networks.

The second group contains results about the global structures of these networks, such as graph decompositions or small-world character. Dr. Hartman and his coauthors investigate the properties of complex networks at a global level, such as the existence of small-world characteristics or graph decompositions. They analyze the behavior of these networks as a whole, identifying patterns and structures that emerge from the interactions between nodes.

The third group deals with the potential symmetry of complex networks studying various symmetries applicable to large networks, such as homomorphism-homogeneity or regularity of centralities. Symmetry plays a crucial role in complex network analysis, as it can reveal important structural properties of the network. Dr. Hartman and his coauthors explore different types of symmetry and their applicability to large networks, such as homomorphism-homogeneity or regularity of centralities. They identify the most relevant symmetries for different types of networks and propose methods for detecting and analyzing symmetry in complex networks.

The last group deals with uncertainty in the data, discussing the adoption of the interval algebra on matrices as a potential representative of complex networks. Uncertainty is a common challenge in complex network analysis, as data can be incomplete, noisy, or subject to measurement errors. Dr. Hartman and his coauthors propose using interval algebra on matrices to represent and analyze uncertain data in complex networks. They demonstrate the effectiveness of this approach in different applications, such as identifying missing links in network data or detecting changes in network behavior over time.

Overall, Dr. Hartman’s work provides a comprehensive overview of complex network analysis, covering different aspects of the pipeline, from data preprocessing to network analysis. The work is highly original as it offers new insights and techniques for constructing reliable and accurate networks, analyzing the global structures of these networks, identifying and analyzing symmetry in complex networks, and dealing with uncertainty in the data. These contributions have important implications for a wide range of applications, from social networks to biological systems, provide a solid foundation for further research in the field, and enjoy many citations.

Finally, the Turnitin system did not report any inappropriate overlap with work from others; hence it is clear to me that Dr. Hartman's thesis represents original work.

Sincerely yours

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Stefan Szeider