Michael Uftring
Indiana University
Independent Study, Fall 2018

Objective

The aim is to study and visualize the stability of nodes in temporal networks, specifically in terms of clusters and communities.

Background

Networks are everywhere around us. They model and represent many things concrete and conceptual -- living organisms, vast ecosystems, transportation, human relationships, collaboration -- and most networks change over time.

Within networks, groups of nodes and links form around commonalities. These groups are often called clusters or communities. Comparing clustering similarity measures across temporal snapshots of networks we can measure node stability, in terms of the clusters and communities.

Purpose

The purpose of this project is to identify and show the structural change in temporal networks such that we may gain insight into how, when, and why clustering and community formation, expansion, contraction, and dissolution in temporal networks is happening.

Activities

Further knowledge and understanding will be gained through research in relevant literature in the areas of: graph and network theory, dynamic networks, clustering and community detection, and associated metrics and measures.

Applying this analytical process on different networks, the aim is to gain specific insights into topical trends and changes.

Examples:

(1) With the American National Election Studies (ANES) data, we can study the trend of American political ideology, and shifts in general population beliefs between 1948 and 2016.

(2) Examining changes in the citation network for climate change research over a specific time span may show when breakthroughs were discovered, or when a concept or belief was disproved or superseded.

Outcome

The outcome will be a software package which will visualize the clustering evolution temporal network dataset. It will show the evolution of the network as a whole (addition and subtraction of nodes and links), and show the evolution of communities in the network (forming, expanding, contracting, dissolving).

References

1. Alexander J. Gates, Ian B. Wood, William P. Hetrick, Yong-Yeol Ahn; On comparing clusterings: an element-centric framework unifies overlaps and hierarchy, 2017
2. Alexander V. Mantzaris; *Uncovering nodes that spread information between communities in social networks* , 2014
3. Laetitia Gauvin; TENSOR -BASED METHODS FOR TEMPORAL NETWORKS
4. Alessandro Baroni, Alessio Conte, Maurizio Patrignani, and Salvatore Ruggieri; Efficiently Clustering Very Large Attributed Graphs, 2017
5. Marco A. Janssen, Örjan Bodin, John M. Anderies, Thomas Elmqvist, Henrik Ernstson, Ryan R. J. McAllister, Per Olsson and Paul Ryan; Toward a Network Perspective of the Study of Resilience in Social-Ecological Systems, 2006
6. Wei Liu, Xingpeng Jiang, Matteo Pellegrini & Xiaofan Wang; Discovering communities in complex networks by edge label propagation, 2016, Nature

7. Rosvall, Martin, Carl T. Bergstrom; Mapping Change in Large Networks, 2010, PLOS ONE
8. American National Election Studies (ANES); https://electionstudies.org
9. Werner Marx, Robin Haunschild, Andreas Thor, Lutz Bornmann; Which early works are cited most frequently in climate change research literature? A bibliometric approach based on Reference Publication Year Spectroscopy, 2016, Scientometrics, Springer