CoCo Seminar Series Fall 2017

[CoCo/Data Science TWG Joint Seminar]

Centrality Analysis and Community Detection for Temporal and Multilayer Networks

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Wednesday September 27, 2017 11:00am-12:00pm (note the irregular time)
Engineering Building H-9 (Knoll-MacDonald Commons / Watson Commons)

The social and biological sciences often give rise to datasets represented by multilayer networks in which different layers encode different types of interactions. In particular, many networks are time-varying and can be modeled as a temporal sequence of layers. Despite their commonality, the mathematical foundations for such data structures are not well established. I will present my recent work in this area for two network-analysis methodology classes. First, I will present a temporal generalization of eigenvector-based centrality measures (e.g., PageRank), giving a tunable framework to analyze the importances of network nodes over time. As case studies, we examine the fame of actors during the Golden Age of Hollywood and department prestige for academic institutions. Next, I will describe the detection of small-scale communities in temporal networks, which is a paradigmatic problem in cybersecurity for detecting anomalies such as fraud and intrusions. To provide theoretical guidance, we develop random-matrix theory to analyze phase transitions in which the dominant eigenvectors of modularity matrices localize onto the communities, thereby allowing their detection. We propose and address a foundational question by asking when is it beneficial to preprocess a temporal network by first aggregating the layers into time windows. We find that layer aggregation via summation and thresholding can be effectively used as a preprocessing filter to allow super-resolution detection of communities that are otherwise too small to detect. This work paves the way for further theoretical research that is holistic in that it simultaneously considers the network-preprocessing and network-analysis steps.

Dr. Dane Taylor is an Assistant Professor of Mathematics at the University at Buffalo, SUNY. He obtained his PhD in Applied Mathematics at the University of Colorado in Boulder. He was a postdoctoral fellow at the UNC Chapel Hill before joining SUNY. His research interests include network-data analytics and dynamics of and on networks.

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