RESILIENT GROUPS:
THE CHALLENGES OF COMPARING CLUSTERINGS AND COMMUNITIES

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MONDAY, MARCH 12
6:30 PM – 7:30 PM
Farzaneh Hall, Room 148

Clustering is one of the most universal approaches for understanding complex data; for example, in network science, communities capture central organizing principles of the link structure and are critical for understanding the dynamical processes that operate on networks. A pivotal aspect of understanding, evaluating, and leveraging identified clusterings is their quantitative comparisons. Clustering comparison is the basis for clustering method evaluation, consensus clustering, and tracking the temporal evolution of clusters. In particular, the quantification of clustering resilience, robustness and recovery requires evaluating the similarity of clusterings following perturbations to the data and throughout the restoration process. Yet, as we demonstrate, existing clustering comparison measures have critical biases which undermine their usefulness, and no measure accommodates both overlapping and hierarchical clusterings. Here, in collaboration with Ian Wood & Y.Y. Ahn, I unify the comparison of disjoint, overlapping, and hierarchically structured clusterings by proposing a new element-centric framework: elements are compared based on the relationships induced by the cluster structure, as opposed to the traditional cluster-centric philosophy. I will demonstrate that, in contrast to standard clustering similarity measures, our framework does not suffer from critical biases and naturally provides unique insights into how the clusterings differ. Furthermore, I will illustrate the strengths of our framework by revealing new insights into the organization of clusters from gene expression data, overlapping community structures in fMRI brain networks, the topological variation of communities in Facebook social networks, and by tracing the recovery of communities in electrical power networks following link failure.

Alexander Gates is a post-doctoral research associate at the Center for Complex Networks Research at Northeastern University. His academic research fuses mathematical and computational methods to study complex systems in biology, neuroscience, and sociology. Some of his recent contributions include a systematic quantification of control in gene regulatory networks, a dynamical protocell model for autopoiesis, and a novel framework for comparing overlapping and hierarchical clusters and communities. Before arriving at Northeastern, Alex received a joint Ph.D. degree in Informatics (complex systems track) and Cognitive Science from Indiana University, Bloomington, an M.Sc. from Kings College London in complex systems modeling, and a B.A. in mathematics from Cornell University. He currently works with Prof. Albert-László Barabási on the science of success and the dynamics of academic careers.

Analytics of Resilient Cyber-Physical-Social Networks

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