Applied Math Seminar scheduled on Friday, November 16, 2018, 11-12pm, LO1326

Speaker: Prof. Laura Smith Chowdhury (California State University, Fullerton)

Title: Community Detection through Epidemic Diffusion and Information Flow

Abstract:

Real-world networks are often organized as modules or communities of similar nodes that serve as functional units. Spectral clustering is widely used to partition graphs into distinct modules or communities. Existing methods for spectral clustering use the eigenvalues and eigenvectors of the graph Laplacian, an operator that is closely associated with random walks on graphs. This talk will examine two different underlying processes on networks, namely epidemic diffusion and information flow on a content-rich network, and will propose methods for detecting communities with the corresponding process. An epidemic is a dynamic process that, unlike the random walk, simultaneously transitions to all the neighbors of a given node. We show that the replicator, an operator describing epidemic diffusion, is equivalent to the symmetric normalized Laplacian of a reweighted graph with edges reweighted by the eigenvector centralities of their incident nodes. Thus, more weight is given to edges connecting more central nodes. We demonstrate that the replicator gives preference to dense, clique-like structures, enabling it to more effectively discover communities that may be obscured by dense intercommunity linking. The second process of information flow will focus on networks that are rich in content, with nodes having distinguishing features or attributes. In order to discover a network's modular structure, it is necessary to take into account not only its links but also node attributes. We describe an information-theoretic method that identifies modules by compressing descriptions of information flow on a network. Our formulation introduces node content into the description of information flow, which we then minimize to discover groups of nodes with similar attributes that also tend to trap the flow of information. The method is conceptually simple and does not require ad-hoc parameters to specify the number of modules or to control the relative contribution of links and node attributes to network structure. We demonstrate that adding node attributes helps recover the underlying community structure in content-rich networks more effectively than using links alone. In addition, we show that our method is faster and more accurate than alternative state-of-the-art algorithms.

About the speaker:

Laura Smith Chowdhury got her Ph.D. at the University of California, Los Angeles. She then completed a Postdoc at the University of Southern California Information Sciences Institute. She is now an associate professor at California State University, Fullerton and serves as the Associate Director of the Center for Computational and Applied Mathematics.

For more information, you can visit her webpage at http://mathfaculty.fullerton.edu/lausmith/lausmith.html