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present

Hypergraph Analytics: High Dimensional Data Analysis from a Graph Theoretical Perspective

by

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Date: Friday, December 1, 2017
Time: 11:00 a.m. to 12:30 p.m. -- 11:00 Pizza/Networking, 11:30 Presentation
Location: RIT Campus, Golisano Hall - Bldg 70, Room 1610
Computer Society announcements and venue information:
http://ewh.ieee.org/r1/rochester/computer
Cost: Free. Open to IEEE members and non-members.
Registration requested for food/pizza count: https://events.vtools.ieee.org/m/48562

Abstract

Graph-structured data and its attendant "network science" are a leading paradigm in data analytics. As a kind of relational mathematical model, graph data are typified by sparse connections amongst a large collection of entities, as is common, for example in social, biological, or infrastructure networks.

Graphs code pairwise associations between entities, and we thus recognize them as a special case, compared to the general case of coding associations amongst an arbitrary number of entities. Hypergraphs are this more general structure, providing a natural representation of a range of such sources as set-valued data, tabular data, and bipartite data.

As hypergraph-structured data are more general than graph-structured data, so hypergraphs formally generalize graphs as mathematical objects; indeed, we can conceive of hypergraphs literally as "multi-dimensional graph". But while hypergraph methods are not novel in data science, they are hardly prominent. This is in large part due to their higher formal and data complexity, despite the ubiquity of multi-dimensional data sources. But researchers willing to pay the price for hypergraph methods can gain both a more natural structure for multi-dimensional data, and a much richer mathematical paradigm to operate in, including access to a collection of combinatorial and topological methods not available on graphs.

Our research group is dedicated to this range of topics in complex data analysis. In this talk I will review this landscape, including the mathematical foundations of hypergraph models, generalizations of network science methods to multi-dimensional graphs, the use of hypergraphs as the foundations of canonical information fusion methods based on topological sheaves, and our applications to both test and real-world data sets.

Speaker's Biography

Dr. Cliff Joslyn is the Chief Scientist for Knowledge Sciences at the Pacific Northwest National Laboratory in Seattle, and an Adjunct Professor of Systems Science at Portland State University. With prior positions at the Los Alamos National Laboratory and NASA Goddard Space Flight Center, he has a 25-year career leading U.S. Government research programs. His technical work has been dedicated to exploring and understanding classes of formal models for representing and analyzing complex information systems, and how they can be interrelated, translated, and integrated. His research activities include discrete mathematics and applications of order theory and finite topological models, knowledge discovery in multi-dimensional databases, semantic technologies and graph databases, computational semiotics, and generalized information theory; applied in areas like scientific workflows, digital currency analysis, cyber systems analysis, homeland defense, threat anticipation, bioinformatics, law enforcement, spacecraft diagnosis, nuclear non-proliferation, and risk analysis. He holds a BA in Cognitive Science and Mathematics with High Honors from Oberlin College, and an M.S. and a Ph.D. in Systems Science from SUNY Binghamton.

His website is at https://signatures.pnnl.gov/bios/cliff-joslyn .