

Social Networking Analysis

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A large group of people/entities interacting among one other can be modelled as a graph in which a vertex represents an entity and an edge between a pair of entities represents interaction. These graphs are potentially large networks and give rise to many interesting questions: What are the properties of these graphs; how are they dynamically produced; Can they be partitioned into 'similar' groups' called communities; Which are the most important nodes; Do some nodes influence other nodes etc. Mathematical properties of networks as well as Algorithms addressing these questions are taught in this course.

Course Outline

1. Mathematics of Networks
 - (a) Networks and their representation
 - (b) Types of Networks: Weighted; Directed; Hypergraphs
 - (c) The graph Laplacian
2. The Large-scale Structure of Networks
 - (a) Components
 - (b) Shortest paths and small-world effect
 - (c) Degree distributions
 - (d) Power laws and scale-free networks
3. Centrality Measures
 - (a) Degree centrality, Closeness centrality
 - (b) Homophily, Transitivity and Preferential attachment
 - (c) Clustering coefficient and Assortative mixing
 - (d) Eigenvector centrality
 - (e) Katz centrality, Betweenness centrality
 - (f) Page rank, Hubs and Authorities
4. Community Detection Algorithms for Social Networks

- (a) The Kernighan-Lin Algorithm
 - (b) Agglomerative/Divisive Algorithms
 - (c) Markov Clustering
 - (d) Multi-level Graph Partitioning
 - (e) Spectral Algorithms
 - (f) Modularity Maximization
 - (g) Other Approaches
5. Network Models
- (a) Random Graphs and properties
 - (b) Models of Network Formation : BA model, The small world model, Exponential random graph model
 - (c) Vertex copying models, Forest fire model
6. Current Research and Applications
- Study of research papers on the problems of Community detection, Link prediction and Node classification in social networks; Social Media Analytics; Event detection and tracking; Privacy in Social Networks; Epidemic studies; Influence maximization in Social Networks etc.

References:

- Network Data Analytics, ed. Charu C. Agarwal, Springer, 2011
- Networks: An introduction, M.E.J. Newman, Oxford University Press, 2012.