Graph And Social Network Analysis

Rationale

A graph has nodes and edges which connect some pairs of nodes. The edges can be directed or undirected. Graph theory has broad application to areas of physics, chemistry, communication science, biology, electrical engineering, operations research, psychology, linguistics, and social networks.

1 Course Description

The course first studies fundamental concepts in graph theory including data structures that can represent graphs. Concepts include flows and connectivity (e.g., Mengers theorem), planarity (coloring), Eulerian and Hamiltonian graphs. Then the course studies fundamental concepts, metrics, and algorithms associated with Social Networks.

Topic Lists

- Fundamentals
  - Graphs and subgraphs
  - Connected graphs
  - Trees
- Flows and Connectivity
  - Non-separable graphs
  - Flows in networks
  - Edge and Vertex Connectivity
- Graph Representation and Algorithms.
  - Adjacency matrix and adjacency-linked lists
  - Dijkstra's Shortest Path Algorithm

- Planarity and the Four-Colour
- Independent Sets
- Cliques and Quasi Cliques
- Matching
- Eulerian and Hamiltonian Cycles
- Vertex and Edge Covers
- Dominating Sets
- Random Network Models
- Social Network Analysis
  - Types of Social Networks
  - Homophily
  - Multiplexity
  - Mutuality/Reciprocity
  - Propinquity
  - Bridges
  - Degree Centrality
  - Betweenness Centrality
  - Closeness Centrality
  - Network Reach
  - Network Integration
  - Boundary Spanners
  - Peripheral Players
  - Density
  - Structural Holes
  - Tie Strength
  - Communities

Learning Objectives

Students will be able to

- Formally apply graph-theoretic terminology and notation
- Apply theoretical knowledge acquired to solve practical graph problems
- Understand and apply social network analysis techniques

Assessment

There will be two exams to assess understanding of the theoretical concepts of Graph Theory: a Midterm (30%) and a Final (30%). There will be Homework and Programming Projects (30%) to assess knowledge of algorithms.