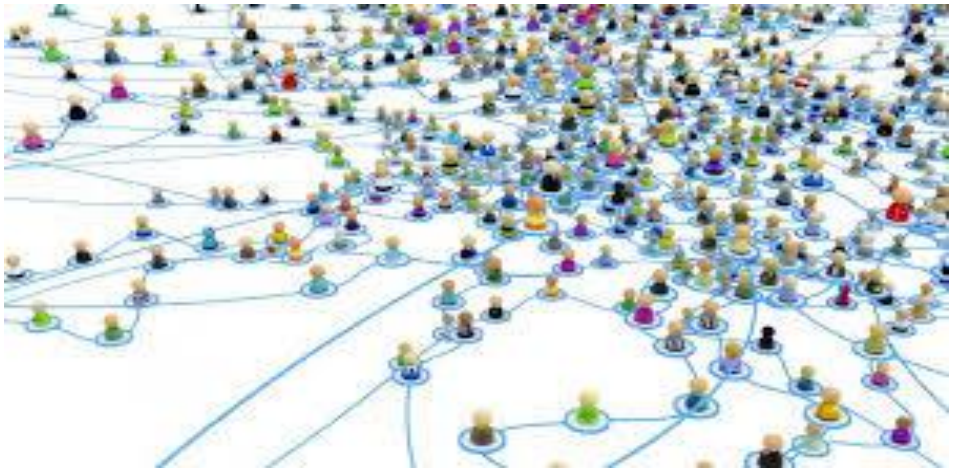
Social Network Analysis

MACRO STRUCTURE OF SOCIAL NETWORK



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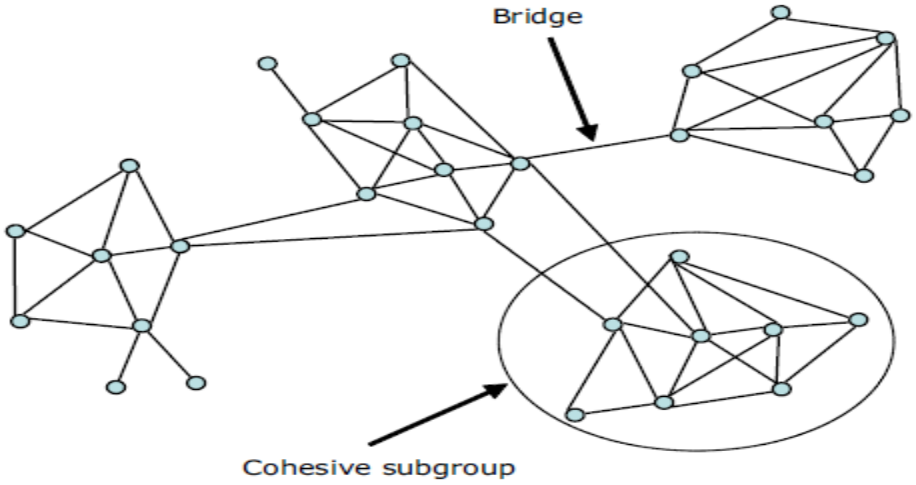
Social Network Analysis

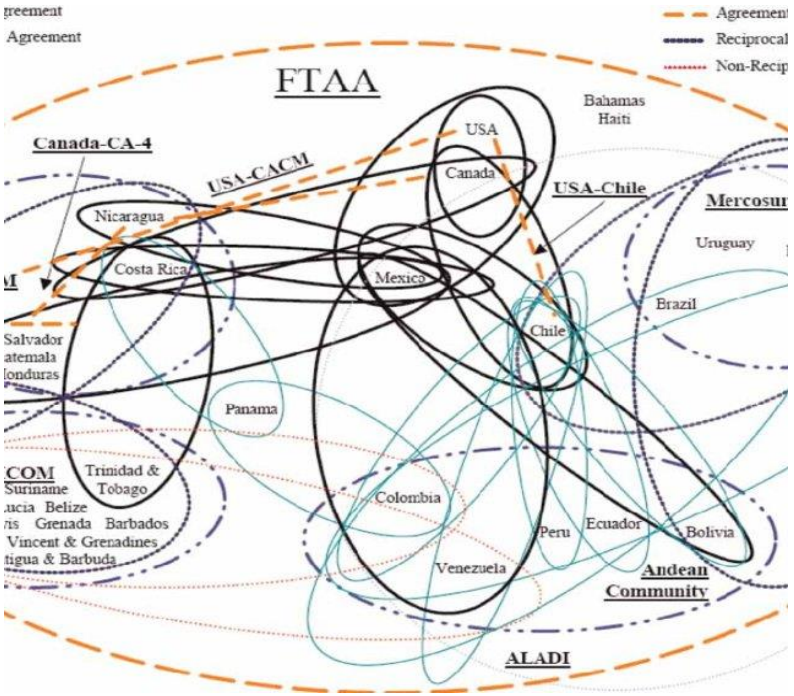
Global structure reveals dense clusters sparsely connected to each other by few ties

Example: Co-authorship network publishes colleagues within institute, rarely do projects with researchers abroad



Social Network Analysis

- Dense the graph with fewer the dimensions of the visualization results in meaningless “spaghetti bowl” tangle of nodes
- Clustering algorithms helps to uncover subgroup structure
- Identifies subgroups of disjoint or overlapping subset of nodes



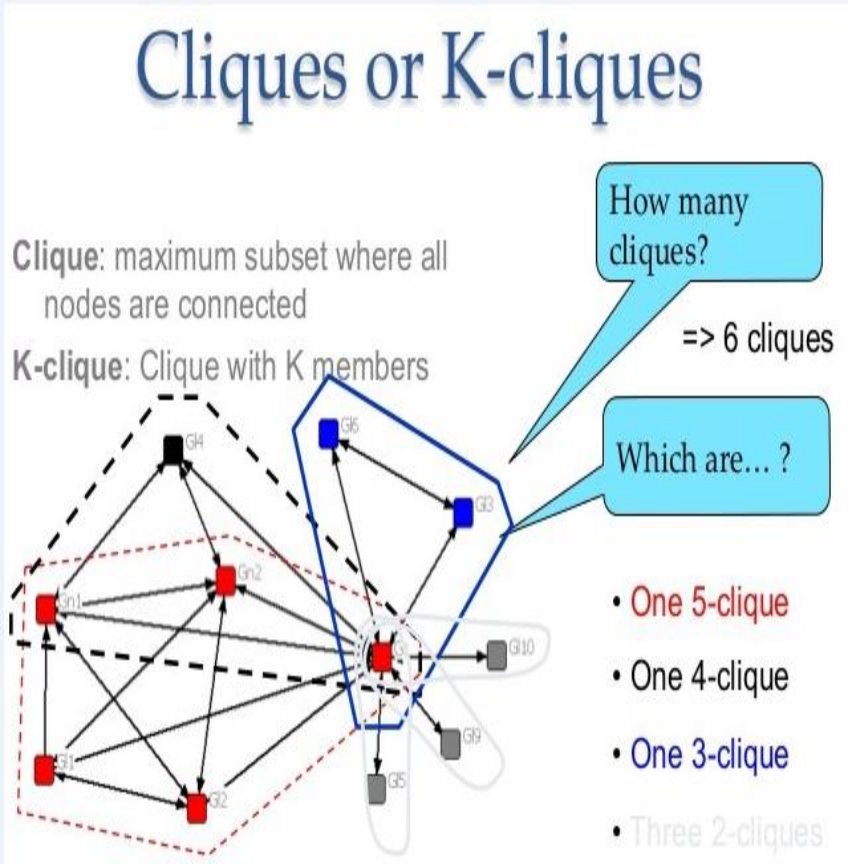
Spaghetti Bowl

Social Network Analysis

- A *clique* in a graph is maximal complete subgraph of three or more nodes

- *k-plex* is a maximal subgraph in which each node is adjacent to no fewer than gs − k nodes in the subgraph

where gs is the number of nodes in the subgraph



Social Network Analysis

Cohesive subgroup defined by lambda-set analysis method

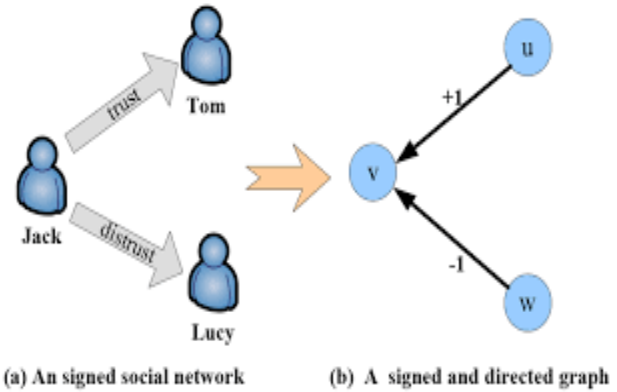
The lambda-set analysis method is based on the definition of edge connectivity

Edge connectivity of two vertices *vi* and *vj* is the minimum number of lines should be removed in a graph to leave no path between the two vertices

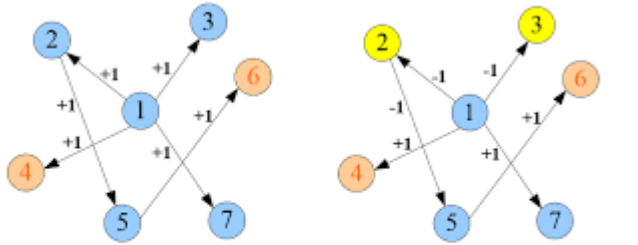
Social Network Analysis

A lambda-set defined for a pair of nodes has a larger edge connectivity than any pair of nodes, when one node is from within the set and the other node is from outside the set

Example. Signed network Relations with positive affections one subgroup and negative affections in other subgroup



(a) An signed social network (b) A signed and directed graph

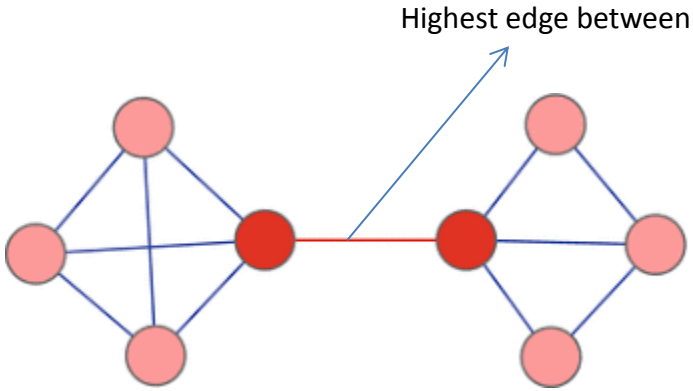


(a) A graph of an unsigned social network (b) A graph of a signed social network

Social Network Analysis

- Clustering method focusing on ties connect them than focusing on subgroups
- Ties between groups are spotted by betweenness

$$Edge\ Betweenness = \frac{fraction\ of\ edge\ that\ contains\ them}{set\ of\ all\ shortest\ paths\ in\ the\ graph}$$

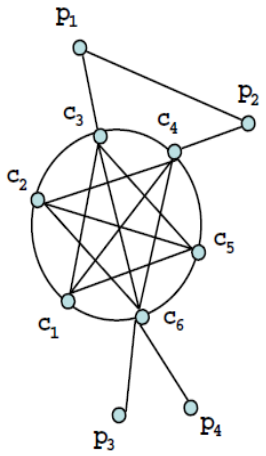


Social Network Analysis

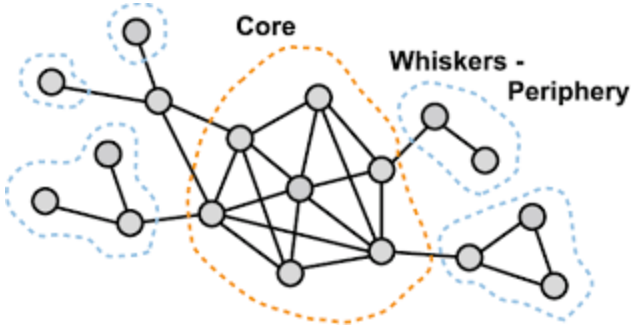
Another typical pattern in social network is *Core-Periphery (C/P) structure*

C/P has two subgroups:

- *nodes in the core densely connected with each other*
- peripheral nodes are not connected with each other , but with the core nodes
- Algorithms divides the set of nodes in a way that the error the between the actual image and the “perfect” image is minimal



c_1	c_2	c_3	c_4	c_5	c_6	p_1	p_2	p_3	p_4
1	1	1	1	1	1	0	0	0	0
1	1	1	1	1	1	0	0	0	0
1	1	1	1	1	1	1	0	0	0
1	1	1	1	1	1	0	1	0	0
1	1	1	1	1	1	0	0	0	0
1	1	1	1	1	1	0	0	1	1
0	0	1	0	0	0	0	1	0	0
0	0	0	1	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0

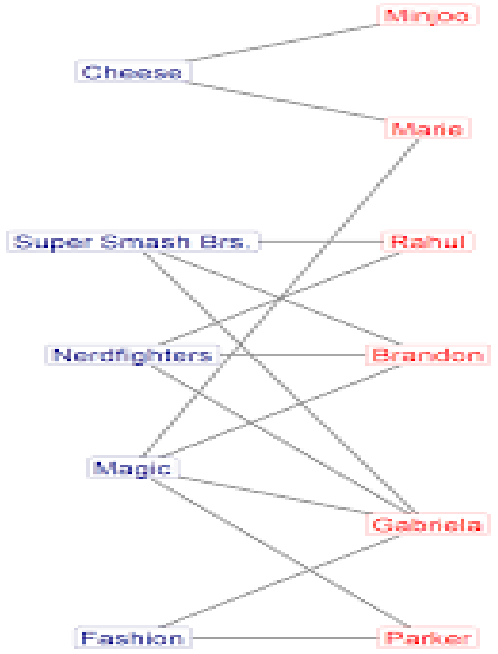


Social Network Analysis

- Attributes allows us to group the nodes into subgroups
  E.g. Affiliation Networks - network into clusters based on shared interests or affiliations

- Affiliation networks contain information about the relationships between two sets of nodes: a set of subjects and a set of affiliations

- Represented by *bipartite graph*, also known as a *two-mode network*



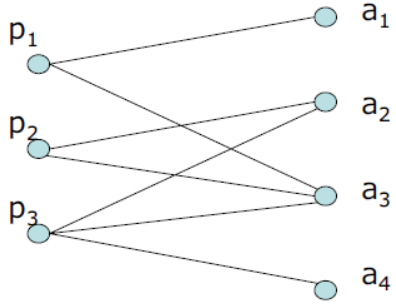
An n-partite graph or n-mode network is a graph $G = < V, E >$ where there exists a partitioning $V = \bigcup_{i=1}^{n} V_i$ such that $\bigcap_{i=1}^{n} V_i = 0$ and $(V_i \times V_i) \cap E = 0$

Social Network Analysis

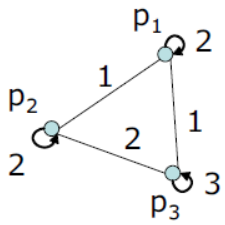
Affiliation networks are transformed directly to a regular, one-mode network

Transformation considers the overlaps between the affiliations as a measure of tie strength between the actors

E.g. Interlocking Directorates – overlaps in board membership of companies



	p_1	p_2	p_3	a_1	a_2	a_3	a_4
p_1	0	0	0	1	0	1	0
p_2	0	0	0	0	1	1	0
p_3	0	0	0	0	1	1	1
a_1	1	0	0	0	0	0	0
a_2	0	1	1	0	0	0	0
a_3	1	1	1	0	0	0	0
a_4	0	0	1	0	0	0	0



	p_1	p_2	p_3
p_1	2	1	1
p_2	1	2	2
p_3	1	2	3

Social Network Analysis

Summary

Some social structures revealed in Social Networks from global view

- Densely connected subgroups with sparse inter subgroup connection
- Core – Periphery structure with core node densely connected and periphery node may / may not connected with themselves, but with core nodes
- Affiliation network – Two / n-mode network, actors on one side, interest / affiliation shared on other sides, attributes may overlap