Introduction to Social Network Analysis

31 Mei 2021

Networks

- **Networks** are not the same as "**Networking**", or actively using a network to make connections to further one's personal goals.
- A network is simply a set of relationship between objects which could be people, organizations, nations, item found in a Google search, brain cells, or electrical transformers.

Social Networks

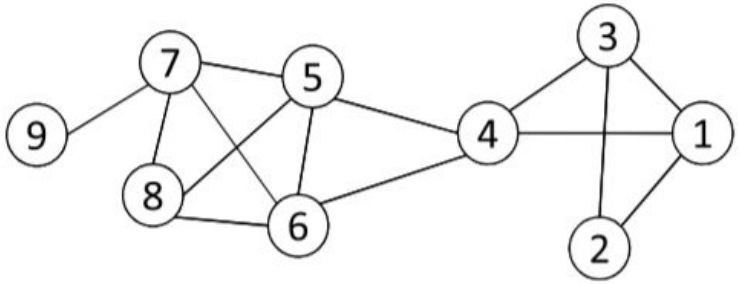
In this course, we are concerned with social networks, and what passes through these networks:

- **Friendship**
- **Love**
- **Money**
- **Power**
- **Ideas**
- **And even “Disease”!**

Network and Representation

Social Network: A social structure made of nodes (individuals or organizations) and edges that connect nodes in various relationships like friendship, kinship etc.

- Graph Representation



- Matrix Representation

Node	1	2	3	4	5	6	7	8	9
1	-	1	1	1	0	0	0	0	0
2	1	-	1	0	0	0	0	0	0
3	1	1	-	1	0	0	0	0	0
4	1	0	1	-	1	1	0	0	0
5	0	0	0	1	-	1	1	1	0
6	0	0	0	1	1	-	1	1	0
7	0	0	0	0	1	1	-	1	1
8	0	0	0	0	1	1	1	-	0
9	0	0	0	0	0	0	1	0	-

Network Analysis

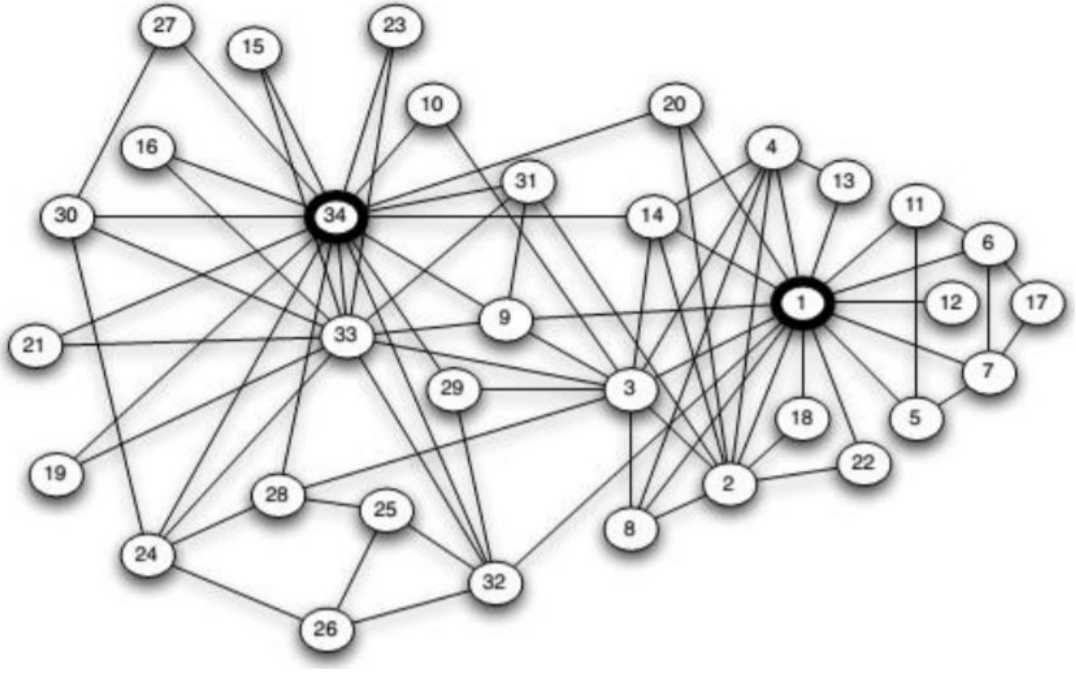
- Social Networks are now becoming popular
- Nonetheless, there is something mysterious about social networks
- We live surrounded by them, but usually cannot see more than one step beyond the people we are directly connected to
- It is just like being stuck in a traffic jam surrounded by cars and trucks. The traffic helicopter can see beyond our immediate surroundings
- **Network analysis is just like that helicopter**

Aspect of Networks

In the most basic sense, A **network** is any **collection of objects** in which some pairs of these objects are connected by **links**

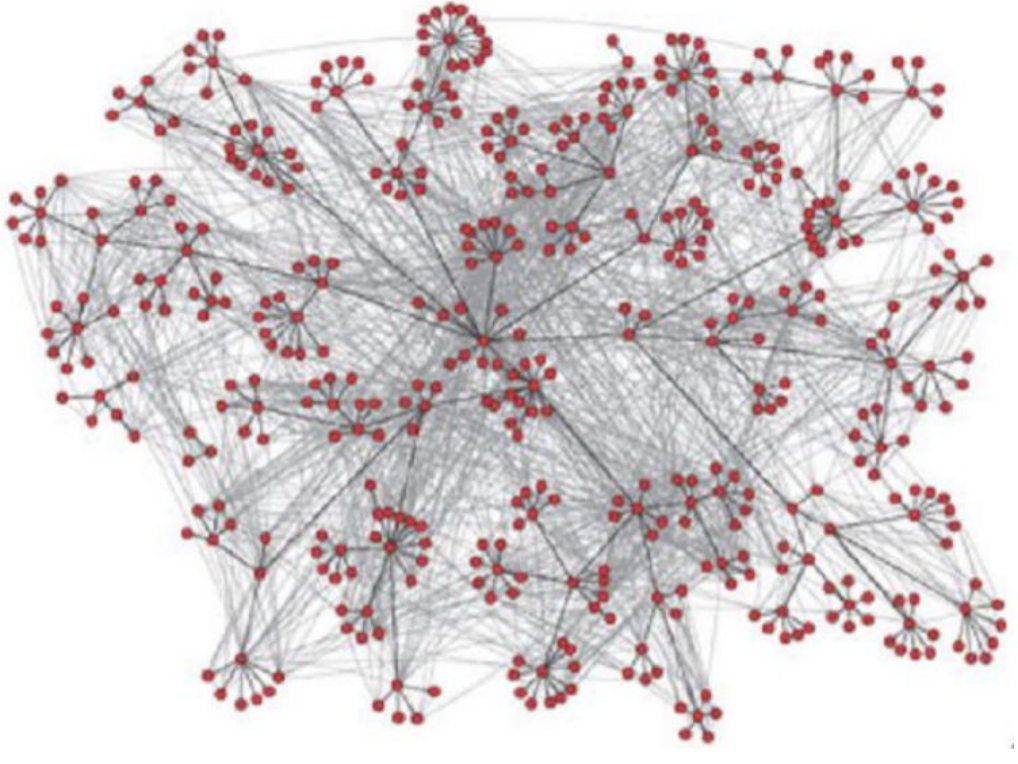
Aspects of Networks

The social network among **34 people** in a university karate club studied by the anthropologist **Wayne Zachary** in the 1970s.



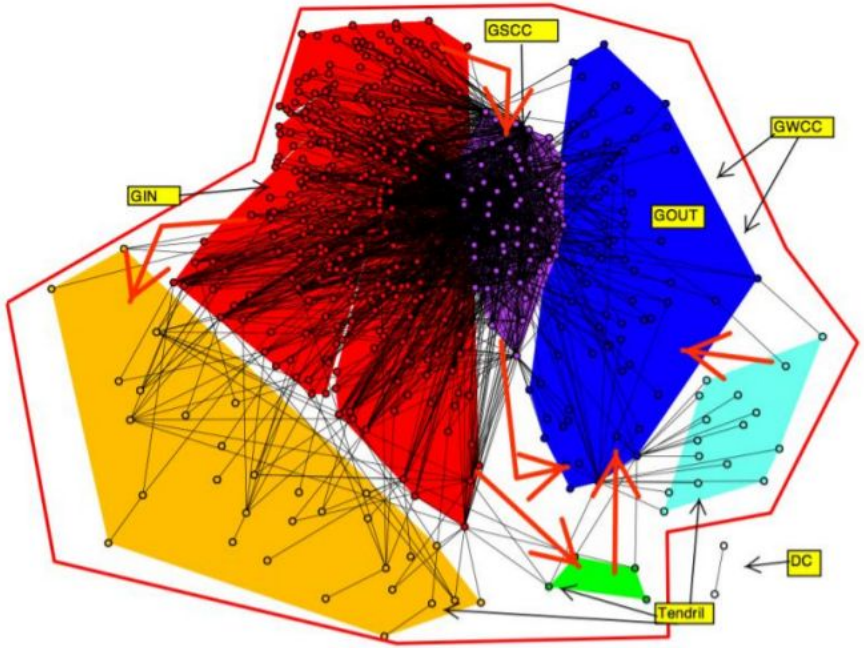
Aspects of Networks

The pattern of **email communication** among **436 employees** of Hewlett Packard Research Lab.



Aspects of Networks

- **Really complex!**
- It is generally difficult to summarize the whole network succinctly



- **SCC**: Strongly Connected Components
- **IN**: nodes that can reach the giant SCC but cannot be reached from it
- **OUT**: nodes that can be reached from the giant SCC but cannot reach it
- **Tendrils**
- **Disconnected**

Behavior and Dynamics

- Not only the **structure of the networks**
- When people talk about the "**connectedness**" of a complex system, there are two issues:
  - One is connectedness at the **level of structure**
  - The other is connectedness at the **level of behavior**
- We also need a framework for reasoning about **behavior and interaction in network contexts** !

Social Computing Tasks

- Social Computing: a young and vibrant field
- Many new challenges
- Tasks
  - Network Modeling
  - Centrality Analysis and Influence Modeling
  - Community Detection
  - Classification and Recommendation

Network Modeling

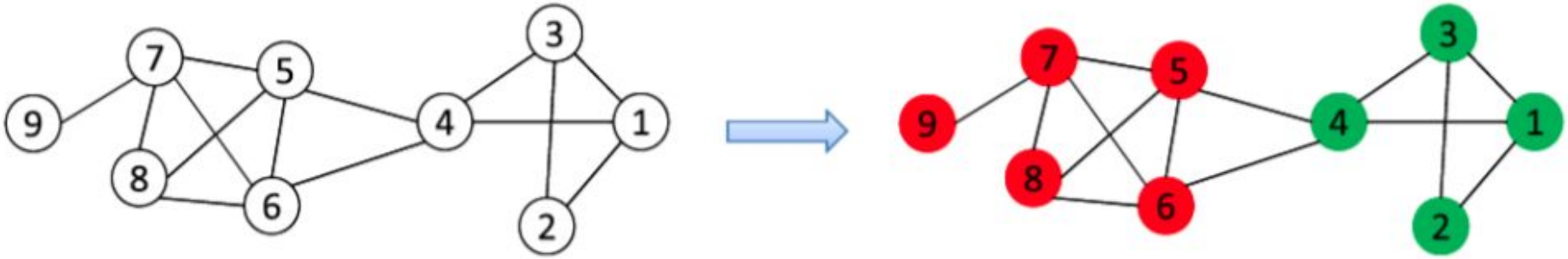
- Large Networks demonstrate statistical patterns:
  - Small-world effect (e.g., 6 degrees of separation)
  - Community structure (high clustering coefficient)
- Model the network dynamics
  - Find a mechanism such that the statistical patterns observed in large-scale networks can be reproduced.

Centrality Analysis and Influence Modeling

- Centrality Analysis:
  - Identify the most important actors or edges
  - Various criteria
- Influence modeling:
  - How is information diffused?
  - How does one influence each other?
- Related Problems
  - Viral marketing: word-of-mouth effect
  - Influence maximization

Community Detection

A **community** is a set of nodes between which the interactions are (relatively) **frequent**. A.k.a., group, cluster, cohesive subgroups, modules.



Classification and Recommendation

Common in social media application (Tag suggestion, Friend/Group Recommendation, Targeting)