

Introduction to Social Network Analysis

Outline

- What are Social Networks
- Social Network Views: Science, Technology
- Social Network Concepts
- Social Networks and Knowledge Management
- Social Networks and Semantic Web
- Applications
- Directions

Social Networks

<http://www.flairandsquare.com/archives/167>

- ✘ A social network site allows people who share interests to build a 'trusted' network/ online community. A social network site will usually provide various ways for users to interact, such as IM (chat/ instant messaging), email, video sharing, file sharing, blogging, discussion groups, etc.
- ✘ The main types of social networking sites have a 'theme', they allow users to connect through image or video collections online (like Flickr or You Tube) or music (like My Space, lastfm). Most contain libraries/ directories of some categories, such as former classmates, old work colleagues, and so on (like Face book, friends reunited, Linked in, etc). They provide a means to connect with friends (by allowing users to create a detailed profile page), and recommender systems linked to trust.

Popular Social Networks

- ✘ Face book - A social networking website. Initially the membership was restricted to students of Harvard University. It was originally based on what first-year students were given called the “face book” which was a way to get to know other students on campus. As of July 2007, there over 34 million active members worldwide. From September 2006 to September 2007 it increased its ranking from 60 to 6th most visited web site, and was the number one site for photos in the United States.
- ✘ Twitter- A free social networking and micro-blogging service that allows users to send “updates” (text-based posts, up to 140 characters long) via SMS, instant messaging, email, to the Twitter website, or an application/ widget within a space of your choice, like MySpace, Facebook, a blog, an RSS Aggregator/reader.
- ✘ My Space - A popular social networking website offering an interactive, user-submitted network of friends, personal profiles, blogs, groups, photos, music and videos internationally. According to AlexaInternet, MySpace is currently the world’s sixth most popular English-language website and the sixth most popular website in any language, and the third most popular website in the United States, though it has topped the chart on various weeks. As of September 7, 2007, there are over 200 million accounts.

Social networks: Interdisciplinary Field

- social network analysis is an interdisciplinary social science;
- Sociologists, computer scientists, physicists and mathematicians have made large contributions to understanding networks in general (as graphs) and thus contributed to an understanding of social networks
- [Social network analysis] is grounded in the observation that social actors [i.e., people] are interdependent and that the links [i.e., relationships] among them have important consequences for every individual [and for all of the individuals together]. ... [Relationships] provide individuals with opportunities and, at the same time, potential constraints on their behavior. ... Social network analysis involves theorizing, model building and empirical research focused on uncovering the patterning of links among actors. It is concerned also with uncovering the antecedents and consequences of recurrent patterns. (from Linton C. Freeman)

Social Networks: History

- “Sociograms” were invented in 1933 by Moreno.
- In a sociogram, the actors are represented as points in a two-dimensional space. The **location** of each actor is significant. E.g. a “central actor” is plotted in the center, and others are placed in concentric rings according to “distance” from this actor.
- Actors are joined with lines representing ties, as in a social network. In other words a social network is a graph, and a sociogram is a particular 2D embedding of it.
- These days, sociograms are rarely used (most examples on the web are not sociograms at all, but networks). But methods like MDS (Multi-Dimensional Scaling) can be used to lay out Actors, given a vector of attributes about them.
- Social Networks were studied early by researchers in graph theory (Harary et al. 1950s). Some social network properties can be computed directly from the graph.
- Others depend on an adjacency matrix representation (Actors index rows and columns of a matrix, matrix elements represent the tie strength between them).

Social networks as technology

- email, newsgroups, and weblogs
- search engines: e.g., Google (<http://google.com>)
 - Google's Page Rank algorithm gives more weight to popular webpages.
 - A webpage is considered popular if many other webpages link to it.
- collaborative filtering and/or recommender systems; e.g., amazon.com's feature: "People who bought this book also bought..."

Technology : LinkedIn

- **What is Your Network?**

When your connections invite **their** connections, your Network starts to grow.

Your Network is your connections, their connections, and so on out from you at the center.

- **How do you classify users?**

Your Network contains professionals out to “three degrees” — that is, friends-of-friends-of-friends. If each person had 10 connections (and some have many more) then your network would contain 10,000 professionals.

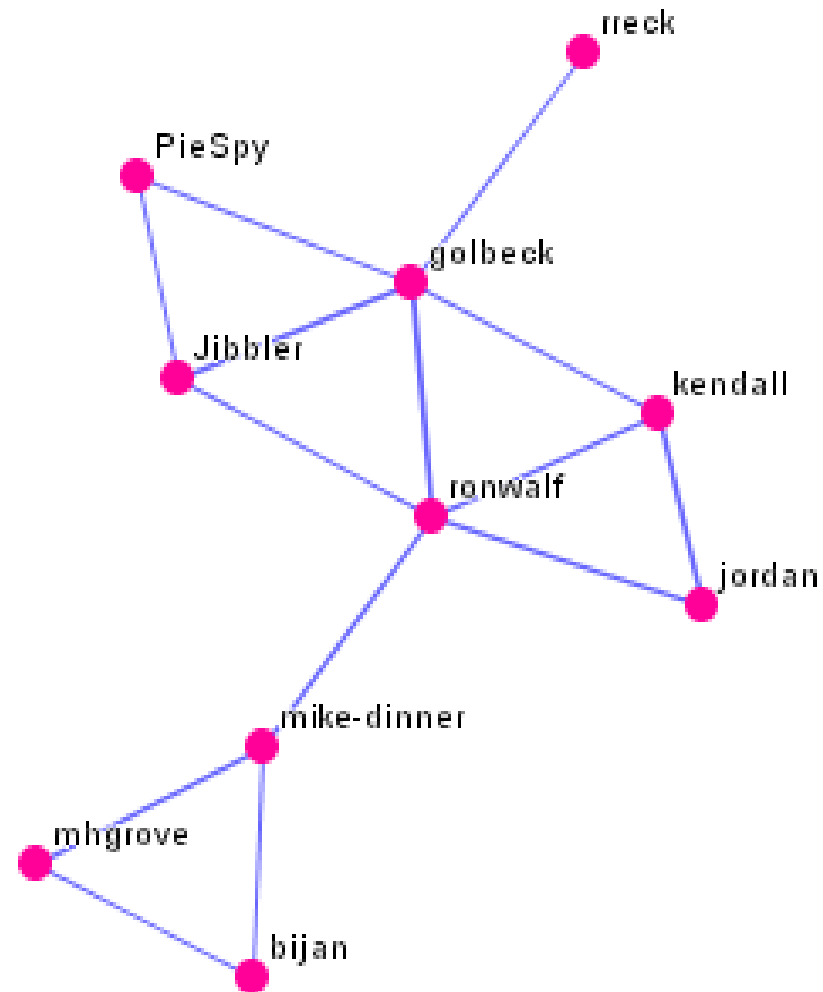
How do you see who is in your Network?

- LinkedIn lets you see your network as one large group of searchable professional profiles.

Social Networks:

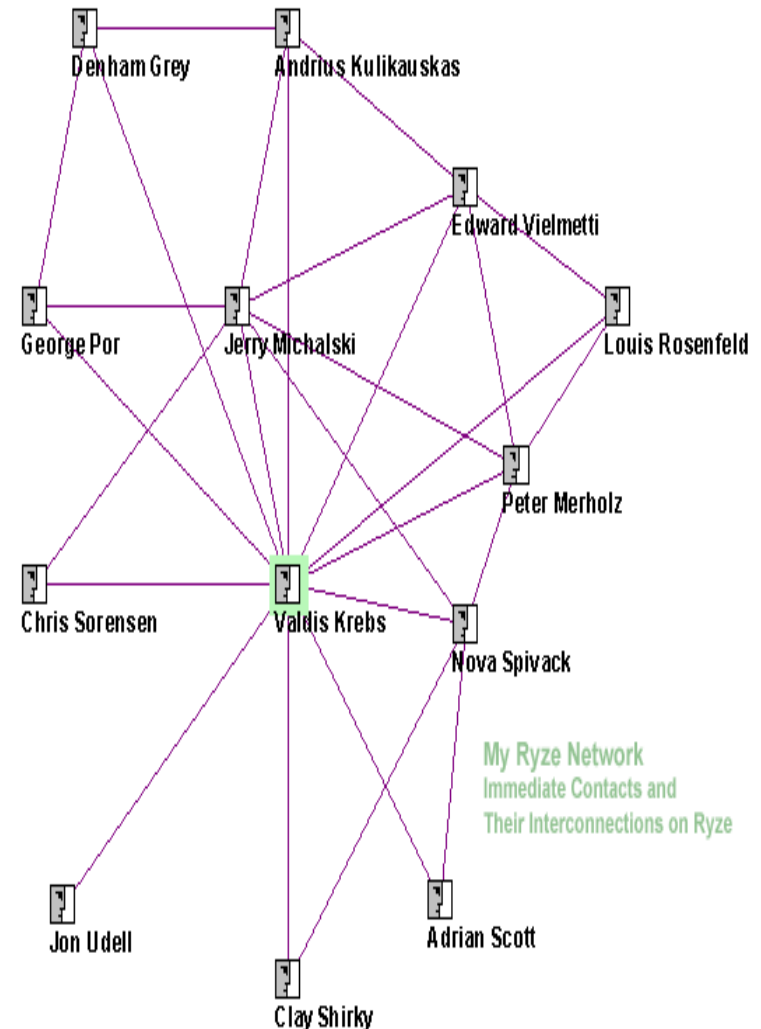
More formal definition

- ✗ A structural approach to understanding social interaction.
- ✗ Networks consist of **Actors** and the **Ties** between them.
- ✗ We represent social networks as **graphs** whose **vertices** are the **actors** and whose **edges** are the **ties**.
- ✗ Edges are usually weighted to show the strength of the tie.
- ✗ In the simplest networks, an Actor is an individual person.
- ✗ A tie might be “is acquainted with”. Or it might represent the amount of email exchanged between persons A and B.



Social Network Examples

- ✘ Effects of urbanization on individual well-being
- ✘ World political and economic system
- ✘ Community elite decision-making
- ✘ Social support, Group problem solving
- ✘ Diffusion and adoption of innovations
- ✘ Belief systems, Social influence
- ✘ Markets, Sociology of science
- ✘ Exchange and power
- ✘ Email, Instant messaging, Newsgroups
- ✘ Co-authorship, Citation, Co-citation
- ✘ SocNet software, Friendster
- ✘ Blogs and diaries, Blog quotes and links



Social Networks Basic Questions

- **Balance:** important in **exchange** networks
- In a two-person network (dyad), exchange of goods, services and cash should be balanced.
- More generally, exchanges of “favors” or “support” are likely to be quite balanced.
- **Role:** what role does the actor perform in the network?
- Role is defined in terms of Actors’ neighborhoods.
- The neighborhood is the set of ties and actors connected directly to the current actor.
- Actors with similar or identical neighborhoods are assigned the same role.
- What is the related idea from semiotics?
- **Paradigm:** interchangeability. Actors with the same role are interchangeable in the network.

Social Networks Basic Questions

- **Prestige:** How important is the actor in the network?
- Related notions are **status** and **centrality**.
- Centrality reifies the notion of “peripheral vs. central participation” from communities of practice.
- Key notions of centrality were developed in the 1970’s, e.g. “eigenvalue centrality” by Bonacich.
- Most of these measures were rediscovered as quality measures for web pages:
 - Indegree
 - Pagerank = eigenvalue centrality
 - HITS ?= two-mode eigenvalue centrality

Social Network Concepts

✘ Actor

- ✚ An “actor” is a basic component for SNs. Actors can be:
- ✚ Individual people, Corporations, Nation-States, Social groups

✘ Modes

- ✚ If all the actors are of the same type, the network is called a **one-mode** network. If there are two groups of actor then it is a **two-mode** network.
- ✚ E.g. an **affiliation network** is a two-mode network. One mode is individuals, the other is groups to which they belong. Ties represent the relation: person A is a member of group B.

✘ Ties

- ✚ A tie is the relation between two actors. Common types of ties include:
 - ✘ Friendship, Amount of communication, Goods exchanged, Familial relation (kinship), Institutional relations

Practical issues: Boundaries and Samples

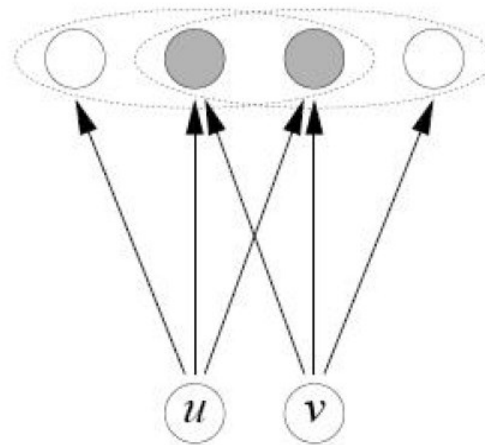
- Because human relations are rich and unbounded, drawing meaningful boundaries for network analysis is a challenge.
- There are two main approaches:
- Realist: boundaries perceived by actors themselves, e.g. gang members or ACM members.
- Nominalist: Boundaries created by researcher: e.g. people who publish in ACM CHI.
- To deal with large networks, sampling is necessary. Unfortunately, randomly sampled graphs will typically have completely different structure. Why?
- One approach to this is “snowballing”. You start with a random sample. Then extend with all actors connected by a tie. Then extend with all actors connected to the previous set by a tie...

The Web as a Social Network

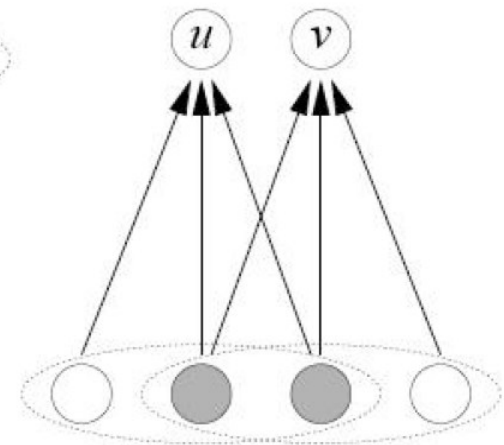
- Social networks are formed between Web pages by hyperlinking to other Web pages.
- A hyperlink is usually an explicit indicator that one Web page author believes that another page is related or relevant.
- The possibility to publish and gather personal information, a major factor in the success of the Web
- **Two Major Tasks**
 - **Social Network Extraction from the Web**
 - **Social Network Analysis**
- Social Networking Services (SNS).
 - Friendster; Orkut

Inferring Communities in Web

- Bibliographic Metrics
 - bibliographic coupling
 - co-citation coupling



(a)



(b)

Blogsphere as a Social Network

- Weblogs have become prominent social media on the Internet that enable users to quickly and easily publish content including highly personal thoughts.
- Bloggers might list one another's blogs in a *Blogroll* and might read, *link to a post*, or *comment* on other blogs' posts (A post is the smallest part of a blog which has some contents and readers can comment on it. A post also has a date of publish).

Semantic Web and Social Network

- Semantic Web: having data on the Web defined and linked in a way that it can be used by people and processed by machines in a "wide variety of new and exciting applications"
- SW and SN models support each other:
 - Semantic Web enables online and explicitly represented social information
 - social networks, especially trust networks, provide a new paradigm for knowledge management in which users "outsource" knowledge and beliefs via their social networks

Semantic Web and Social Network

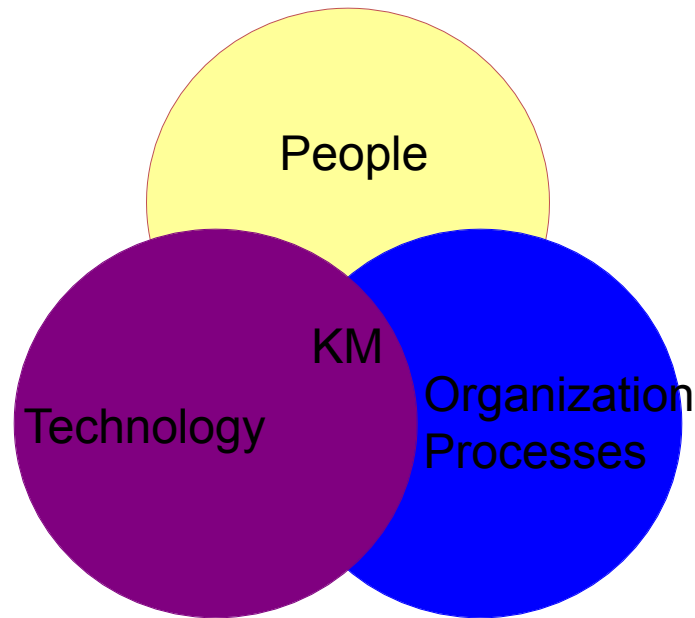
- ✗ Drawbacks to Centralized Social Networks
 - ✚ the information is under the control of the database owner
 - ✚ centralized systems do not allow users to control the information they provide on their own terms
- ✗ The friend-of-a-friend(FOAF) project is a first attempt at a formal, machine processable representation of user profiles and friendship networks.
- ✗ The Swoogle Ontology Dictionary shows that the class *foaf:Person* currently has nearly one million instances spread over about 45,000 Web documents.
- ✗ The FOAF ontology is not the only one used to publish social information on the Web.
- ✗ For example, Swoogle identifies more than 360 RDFS or OWL classes defined with the local name "person".

SW and SNA (issues)

- **Knowledge representation.**
 - Small number of common ontologies
- **Knowledge management.**
 - efficient and effective mechanisms for accessing knowledge, especially social networks, on the Semantic Web
- **Social network extraction, integration and analysis**
 - extracting social networks correctly from the noisy and incomplete knowledge on the (Semantic) Web
- **Provenance and trust aware distributed inference.**
 - manage and reduce the complexity of distributed inference by utilizing provenance of knowledge

Social networks and KMS

- Why Social Networks in KMS?

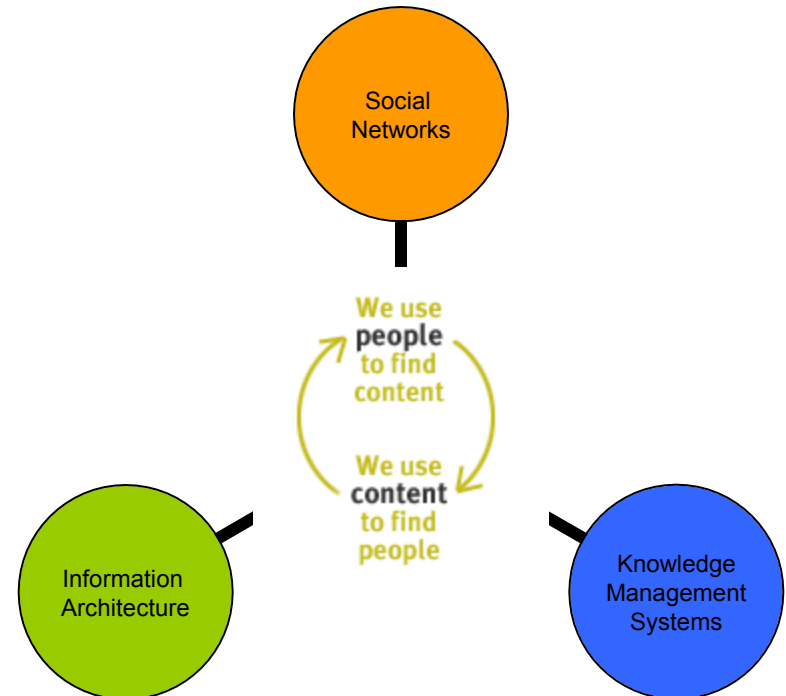


Knowledge Management involves people, technology, and processes in Overlapping parts.

Social Networks and KMS

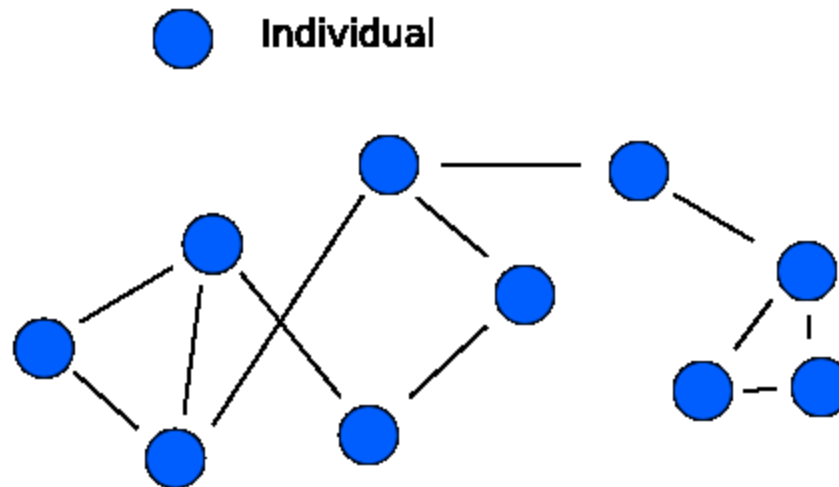
- Why are we studying Social Networks ?

What ties Information Architecture, Knowledge Management and Social Network Analysis more closely together is the reciprocal relationship between people and content.



Social Network Analysis

- Social network analysis [SNA] is the mapping and measuring of relationships and flows between people, groups, organizations, computers or other information/knowledge processing entities.
- The nodes in the network are the people and groups while the links show relationships or flows between the nodes.



Social Network Analysis (SNA)

We measure Social Network in terms of:

1. Degree Centrality:

The number of direct connections a node has. What really matters is where those connections lead to and how they connect the otherwise unconnected.

2. Betweenness Centrality:

A node with high betweenness has great influence over what flows in the network indicating important links and single point of failure.

3. Closeness Centrality:

The measure of closeness of a node which are close to everyone else.

The pattern of the direct and indirect ties allows the nodes any other node in the network more quickly than anyone else. They have the shortest paths to all others.

Application of SNA: Building the 9/11 [Al- Qaeda Network](#).

Directions

- Reduce Complexity
- Geo-social networks
- Integrating concepts from semantic web, social network, and knowledge management
- Geo-social semantic web
- Visualizing social networks
- Security and Privacy
- Mining and analysis of social networks
- Predicting what the memebtrs would do next