European Territorial Cooperation Programme
Greece - Italy
2007-2013
INVESTING IN OUR FUTURE

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European Territorial Cooperation Programme

Greece-Italy 2007-2013

INTERSOCIAL: Unleashing the Power of Social Networks for Regional SMEs

Deliverables D5.2.3: Course on Social Networking

Action 5.2: New Course on Social Networking

WP5: Training and Knowledge Transfer

Priority Axis 1: Strengthening competitiveness and innovation
Specific Objective 1.2: Promoting cross-border advanced new technologies

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Course on Social Networking

Deliverable D5.2.3 Action 5.2

WorkpackageWP5: Training and Knowledge Transfer

Responsible Partner:	UPATRAS (P3)		
Participating Partner(s)			
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*Purpose:*Preparing and offering a course on social networking.
*Results:*UNIBA has finished to prepare the material for the new course on social networking and given it as a tutorial at the 8th IEEE International Conference on Global Software Engineering (ICGSE 2013), which was held in Bari at the end of August.
Conclusion:The tutorial was given at the IEEE International Confrence on Global Software Engineering (about a hundred participants).

Approved by the project coordinator: Yes
Date of delivery to the JTS/MA: 20/1/2014

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When	Who	Comments
2013/10/15	Daskalaki Sofia, Nikos Tselios Nikos Avouris	Initial version
2013/10/31	Ioannis Fudos	Minor administrative corrections

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Course module 1: Social Network Analytics

Description: The course on Social Network Analytics addresses the subject of Social Networks from a performance analysis viewpoint. The objective is to cover the basic measures commonly used for characterizing a network, analyzing its structure and measuring its performance.

The course starts with an introduction on Social networks where the basic notions and terminologies are introduced. It continues with a presentation on the basic measures of network performance, where theory of graphs and its mathematical background play a leading role.Connectivity and centrality, two fundamental metrics for networks are extensively presented. Additional local and global measures are also covered as well as certain probability distributions that arise in social networks. The different types of networks are studied along with their characteristics in terms of the usual metrics. Twitter becomes one example for applying certain methodologies previously discussed, while a portion of the course is devoted to study vulnerability and robustness of the networks. A case study on a network of political blogs concludes the course.

Course Module Outline

- 1.1 Introduction to Social Networks
- 1.2 Measures of Network Performance
- 1.3 Twitter Data Analytics
- 1.4 Networks under Attack

Course module 2: Integrate Social Media into an SME workflow

Description: The course on Social Media integration into an SME workflow addresses the ways Social Media could be used to enhance customer loyalty and increase reputation and sales of Small/Medium Enterprise. Initially, basic definitions related to social media are offered and ways to use them in business are explored. Subsequently, the basic types of social media are presented. Then, the differences between traditional media (and Web 1.0) marketing are highlighted and discussed. Towards this end, consumer behavior is highlighted as well as the impact of digital media on her behavior. Then the scope of Social Media as a tool for business marketing is presented. Finally an integrated step by step social media strategy is presented.

Course Module Outline

- 2.1 What is social media and how is it used in businesses?

- 2.2 A quick tour of the social media universe – what tools are out there?
- 2.3 The differences and interaction between traditional and social media-Consumer behavior and digital media
- 2.4 Defining the scope of Social Media: Customer, Marketing, Industry Watch
- 2.5 What’s the plan? Developing a social media marketing strategy

APPENDIX

Tutorial on Social Networks Analytics

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Department of Electical & Computer Engineering

October 2013

Outline

1. Introduction to Social Networks
2. Measures of Network Performance
3. Twitter Data Analytics
4. Networks under Attack

Networks

What is a network?

- In a general context, a structure with interconnected entities
  `Example`: a yogurt manufacturer has a distribution network
- Mathematical abstraction: an object called "graph"
- Graph is formally a collection of nodes (or vertices or points) connected through edges (or arcs or lines or branches or ties)
- Edges may have direction ("directed graph")
- Additional characteristics may be added to suit practically any field of knowledge or application, for example the distance or the strength of the relationship

Social Networks

What is a Social Network (SN)?

A structure made of individuals (or organizations or other entities related to activities of individuals) called *nodes*, connected by a certain type of interdependency or interactivity, such as friendship, common interests, authorship, bibliographical citations, etc.

- Nodes are often termed "ACTORS" and edges "RELATIONS"
- Example: A network with names Maria, Kostas, etc.

Social Network Analysis

Social Network Analysis (SNA) studies the *structure* and *evolution* of social networks as well as the *interaction* between actors.

- ◇ Even though not new as a subject, SNA became very popular because of the explosive growth and popularity of the on-line social networks and media, for example Facebook, Twitter, LinkedIn, Flickr, YouTube, etc.
- ◇ The availability of massive amounts of data in online settings of social networks provide an excellent opportunity for scientifically and statistically robust studies in the field of social networks, forming the *Computational Social Network Analysis*.

Social Network Analysis

In general what does SNA do?

- extracts information by examining the structure and properties of ties linking social actors
- requires systematic empirical data
- uses graphic imagery and data visualization
- uses mathematical and/or computational models
- embodies concepts, ideas and results from social theories on individual or group behaviour

Categorization of Social Networks

Social networks are categorized in two ways:

- In terms of *evolution in time*
  - Static (when relations are not changing or change very slowly over time)
  - Dynamic (when one or more of their features are continously changing, e.g. # of nodes, connections, etc.)
- In terms of *content*
  - One-mode social network
  - Two-mode social network

Categorization of Social Networks Analysis

Static vs Dynamic Analysis

Static Analysis of the whole network in batch mode over particular snapshots

Dynamic Analysis of network data that stream in continously when interactions change at a very high rate

Measures of Network Performance

Link-based Analysis Offers tools for studying structural and linkage behaviour, such as determining the distribution of connections, important nodes, communities, strong or weak links, etc.

Content-based Analysis Offers tools for extracting meaningful conclusions out of massive amounts of textual data that is shared among actors of a social network

Outline

1. Introduction to Social Networks
2. Measures of Network Performance
3. Twitter Data Analytics
4. Networks under Attack

Graphs

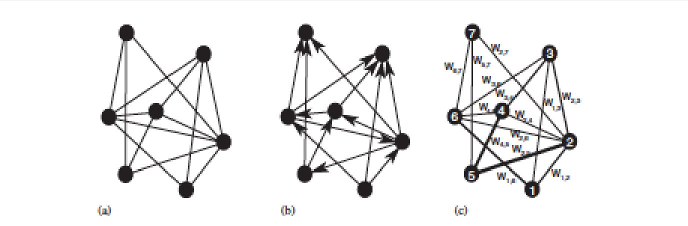
Graphs are modeling tools suitable for the link-based analysis of social networks. The goal is to use the well established theory of graphs to expose the structural properties and statistical characteristics of social networks.

Preliminaries on Graphs

A graph can be defined as $G = \{V, E, f\}$, where V is the set of vertices (nodes), E the set of edges (links) and f a mapping function that defines the structure of G.

Graphs may be

- undirected or directed
- weighted or unweighted



Mathematical Representation of Graphs

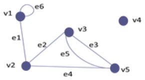
For an undirected graph we say:

- vertex v_i is *adjacent* to v_j if there is a link that connects them.
- link $e_{i,j}$ is *incident* to vertices v_i and v_j.

Mathematically a graph may be represented by a matrix:
Adjacency Matrix or *Incidence Matrix*

☐ Adjacency matrix

	v1	v2	v3	v4	v5
v1	2	1	0	0	0
v2	1	0	1	0	1
v3	0	1	0	0	2
v4	0	0	0	0	0
v5	0	1	2	0	0

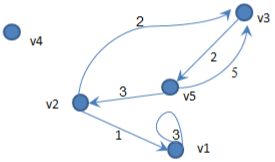


☐ Incidence matrix

	e1	e2	e3	e4	e5	e6
v1	1	0	0	0	0	2
v2	1	1	0	1	0	0
v3	0	1	1	0	1	0
v4	0	0	0	0	0	0
v5	0	0	1	1	1	0

Mathematical Representation of Graphs

For a weighted graph, $w_{i,j}$ denotes the weight of link i, j. Then the total weight of node i is $w_i = \sum_{k=1}^{d_i} w_{i,k}$.
A weighted graph can still be represented by a matrix.



	v1	v2	v3	v4	v5
v1	3	0	0	0	0
v2	1	0	2	0	0
v3	0	0	0	0	2
v4	0	0	0	0	0
v5	0	3	5	0	0

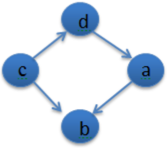
Graphs and Linear Algebra

Given the mathematical representation of graphs Linear Algebra can provide solutions to certain graph problems.

1. Number of Paths

The number of paths of length r from node i to node j is given as:

$$N_{ij}(r) = [A^r]_{ij}, \text{ where } A \text{ is the adjacency matrix of the graph}$$



$$A^2 = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

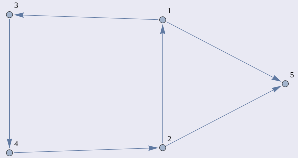
Graphs and Linear Algebra

2. Number of Loops of Length r

The number of loops of length r anywhere in the network is given as:

$$L(r) = \sum_i {A^r}_{ii} = Tr[A^r] = \sum_i {\lambda_i}^r$$

where λ_i's are the eigenvalues of the adjacency matrix.



$$A = \begin{pmatrix} 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad A^4 = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

Network Metrics

Two features of a network's topology are known to be important: *connectivity* and *centrality*. Through them many questions may be answered:

- Is it possible for actor i to reach actor j?
- Given they can be reached, how many steps are there from each other?
- How many different paths connect each pair of actors?

Connectivity

Connectivity refers to how actors in one part of the network are connected to actors in another part. In reality one actor can reach another if there is a *path* connecting them.

Path
: in a graph is a sequence of nodes and edges starting at one node and ending at another, tracing the indirect connection between the two. Strictly speaking, on a path you never go backwards or revisit the same node twice. For example: $a \to b \to c \to d$

Reachability between actors is measured by *distance*

Distance
: is the length of the shortest path between two nodes, and

Diameter
: of the network is the maximum distance between any two nodes — Indicates how much of a `small world` the network is.

Connectivity

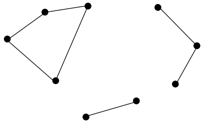
A graph is *connected* if there is at least one path connecting every pair of nodes in the graph.

Component is a connected graph or subgraph.

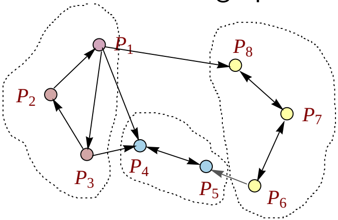
$\surd$ A component can be directed or undirected.
$\surd$ For an undirected component none of its nodes shares an edge with a node belonging to another part of the graph.
$\surd$ A directed component can be *strong*, if all nodes are mutually reachable or *weak*, if at least one node can reach the other.

Examples of components

An undirected graph with 3 components

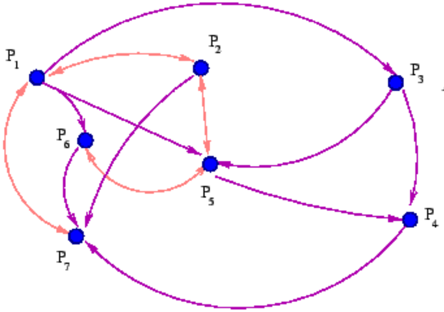


A directed graph with 3 components



Examples of components

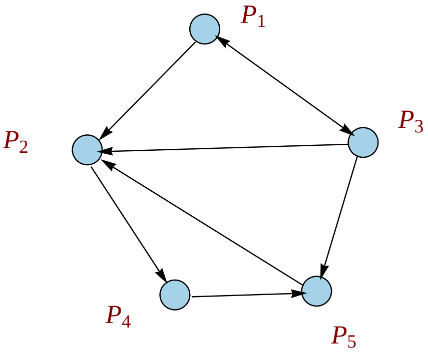
A strong component



$$M = \begin{bmatrix} 0 & 1 & 1 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Examples of components

A weak component



Centrality

Centrality refers to the location of an actor in a network.

Popular centrality measures:

Degree centrality – indicates how **connected** is an actor with the others. It is measured by the number of ties.

Closeness centrality – indicates the **distance** of a node to all others. It is measured using shortest paths (or geodesic distances)

Betweenness centrality – indicates the number of shortest paths between pairs of nodes that pass through a given node.

Degree Centrality

Degree centrality of a node is defined as the number of edges connected to the node.

$$C_d(n_i) = \sum_j x_{ij}, \text{ where } x_{ij} = 1 \text{ if node } n_i \text{ is adjacent to } n_j \text{ and 0 otherwise}$$

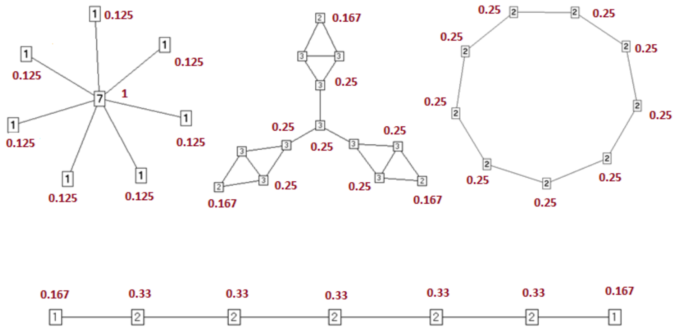
In a directed graph it is the sum of in-degree (number of edges pointing to node) and out-degree (number of edges departing from node).

The degree centrality can be normalized for comparison reasons. If g is the number of nodes, $g - 1$ is the maximum possible number of links that a node may have in a network, and

$$C_d'(n_i) = \frac{C_d(n_i)}{g - 1}$$

gives the proportion of nodes that are adjacent to n_i, while $C_d'(n_i) \in [0, 1]$

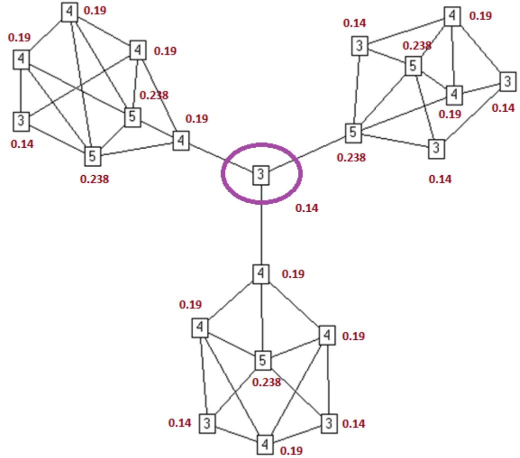
Degree Centrality–Examples



numbers in circles: degree centralities
numbers in red: normalized degree centralities

Degree Centrality–Examples

Degree centrality, however, can be deceiving, because it is a purely local measure.



Degree Centrality

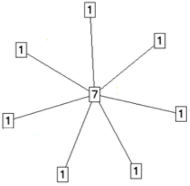
The degree centrality can be defined for a group of nodes also in order to be used as a global metric instead of just a local one.
If $C_d(n^*)$ denotes the maximum degree centrality in the network,

then

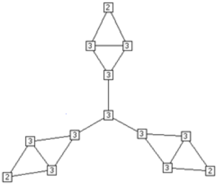
$$C_d = \frac{\sum_{i=1}^{g} [C_d(n^*) - C_d(n_i)]}{max \sum_{i=1}^{g} [C_d(n^*) - C_d(n_i)]} = \frac{\sum_{i=1}^{g} [C_d(n^*) - C_d(n_i)]}{(g-1)(g-2)}$$

is the *degree centrality for the network* and $C_d \in [0, 1]$.
This metric can be used as a measure of dispersion, alternatively to the usual variance of the individual degree centralities.

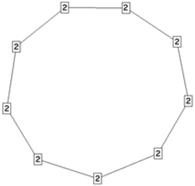
Degree Centrality–Examples



Degree centralization = 1.0



Degree centralization = 0.02



Degree Centralization = 0

Degree Centralization = 0.067

Closeness Centrality

Closeness centrality of node n_i is defined as the reciprocal of the total distance it has from all other nodes:

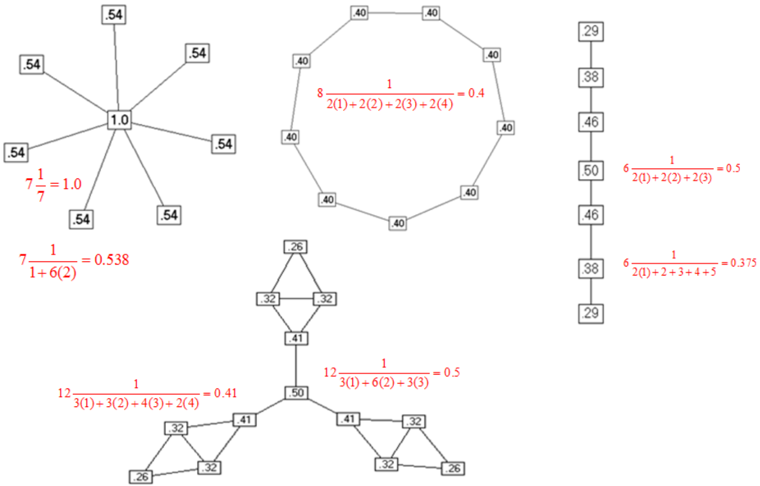
$$C_c(n_i) = \left[\sum_{j=1}^{g} d(n_i, n_j) \right]^{-1}$$

where $d(n_i, n_j)$ is the length of the shortest path (geodesic) connecting nodes n_i and n_j.

Closeness centrality can also be normalized by multiplying $C_c(n_i)$ by $g - 1$, the minimum possible number of links that a node requires to connect with all other nodes:

$$C_c^{'}(n_i) = \frac{g-1}{\sum_{j=1}^{g} d(n_i, n_j)} = (g-1)C_c(n_i)$$

Closeness Centrality–Examples



Betweeness Centrality

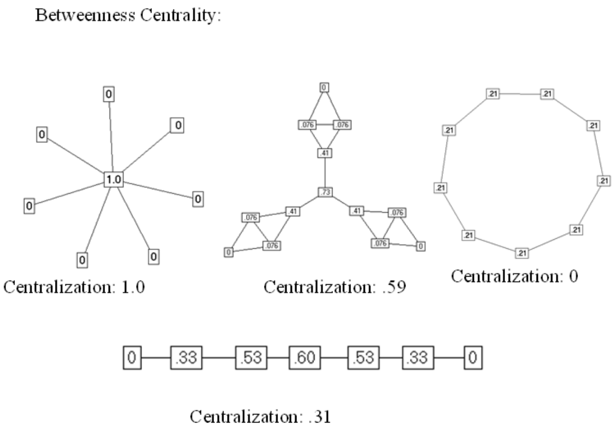
Betweeness centrality of node n_i is defined as the proportion of paths between all nodes in a network that pass through node n_i.

$$C_b(n_i) = \left(\frac{\sum_{j<k} l_{k,i,j}}{l_{k,j}} \right)$$

where the sum runs over all pairs k, j with $k \neq j$. It describes the node's position in a network in terms of the flow it is able to control. A node that belongs to many paths has high betweeness centrality.

Betweeness centrality is normalized by dividing $C_b(n_i)$ by $(g-1)(g-2)/2$, the maximum possible number of pairs of nodes that could exist with all other nodes besides n_i.

Betweeness Centrality–Examples



Betweeness Centrality

Betweeness Centrality of an edge gives the number of shortest paths between all node pairs that pass through the given edge.
Edges with high betweeness centrality scores:

$\hookrightarrow$ ensure that the graph stays interconnected (weak ties)

$\hookrightarrow$ reduce average path length

$\hookrightarrow$ help in information spreading, and

$\hookrightarrow$ increase the size of one's network for a given path length.

On the other hand, a network with large number of 'weak ties' is less clustered and more fragile.

Clustering Coefficient

Clustering Coefficient is a local network measure and gives the degree to which neighbors of a node connect to each other.

For an undirected graph there are two definitions:

1. If k_i is the degree of node i and Δ the number of *triangles* formed between i and its neighbors, then

$$C_i = \frac{3 \times \Delta}{\sum_i k_i(k_i - 1)/2} \quad \text{and} \quad \langle C \rangle = \frac{6 \times \Delta}{\langle \sum_i k_i(k_i - 1) \rangle}$$

   are the clustering coefficients of node i and the corresponding average for the whole network, respectively.

2. If e_i is the number of edges between its k_i neighbors of i, then

$$C_i = \frac{2e_i}{k_i(k_i - 1)} \quad \text{and} \quad \langle C \rangle = \frac{\sum_i C_i}{N}$$

   while for $k_i \leq 1$, $C_i = 0$.

Clustering Coefficient – Remarks

- Comparison of clustering coefficient among different graphs requires the same measure.
- Both measures are normalized (values between 0 and 1), and if the value is closer to 1 the graph is more interconnected.
- Clustering coefficient is more informative than the degree of a node.
- It is commonly used to classify networks into different types (e.g. lattice, random, small-world, scale-free, etc.)
- To understand cohesiveness of the network, one could have used cycles of n connected nodes instead of triangles.

Global Network Measures

- The *entropy* of a network measures the amount of information that is carried out through a message (number of bits of randomness in a graph).

  It is estimated by the expected number of bits of the degree sequence distribution f:

$$I(G) = -\sum_{i=1}^{max_d} p_i log_2(p_i), \text{ where } f = [p_1, p_2, ..., p_{max_d}]$$

- *Link efficiency*, $E(G)$, measures the efficiency of network G in terms of the average path length and the number of links.

$$E(G) = \frac{m - (Avg.path.length(G))}{m} = 1 - \frac{(Avg.path.length(G))}{m}$$

  where m is the number of edges in the graph. Higher values of this metric means more efficient graphs.

Statistical Distributions in a Network

- **Node-Degree Distribution** $P_K(k)$: the probability that any randomly chosen node has degree k.
- **Node Betweeness Distribution** $P_B(b)$: the probability that any randomly chosen node has betweeness b.
- **Distribution of Node Distance** $P_L(\ell)$: the probability that any randomly chosen pair of nodes is separated by distance ℓ.

  Alternatively, the node distance can be studied using the so called *Hop Plot* $M(\ell)$, expressing the average number of nodes within a distance less than or equal to l from a given node:

$$M(\ell) = N \sum_{i=0}^{\ell} P_L(i)$$

The moments of all previous distributions and especially the second moment is used to measure heterogeneity in a network. Different levels of heterogeneity define different network types.

Other Statistical Properties

- **Degree Correlation Function**. In some networks highly connected nodes are interconnected (assortative mixing). In others we observe the opposite (disassortative mixing). The degree correlation can be measured via the *average nearest neighbor's degree* $k_{nn,i}$ of a node i

$$\overline{k}_{nn}(k) = \frac{1}{N_k} \sum_i k_{nn,i} \delta_{k_i,k}$$

  where the sum runs over all possible nodes, N_k is the total number of nodes with degree k_i, and $\delta_{k_i,k}$ is the Kronecker's delta.

- **Average Clustering Coefficient**: Many real networks display a power-law decay of $\langle C_k \rangle$ as a function of k and points out a hierarchy where low degree nodes belong to well interconnected communities (high clustering coefficient) and hubs connect many nodes that are not directly connected (low clustering coefficient).

Social Network Analysis Tools

Here are a few popular SNA tools:

NodeXL: free and open-source network analysis and visualization software package from Microsoft

- Intended for users with little or no programming experience
- Integrates with Microsoft Excel 2007/2010
- Provides import tools for collecting data from social media
- Provides a library for network analysis and clustering

PAJEK: Free network analysis and visualization software package

- Suitable for very large networks
- Intuitive windows interface
- Started as a graphics program, but expanded to a wide range of analytic capabilities
- Can link to the R statistical package

Social Network Analysis Tools

UCINET from *Analytic Technologies*

- The Standard network analysis program, runs in Windows
- Good for computing measures of network topography for single nets
- Input-Output of data is a special 2-file format, but is now able to read PAJEK files directly
- Not optimal for large networks

We should also mention Gephi, NetDraw, NEGOPY, Cyram Netminer, SPAN and possibly others.

Types of Networks – Regular Networks

A *k-regular graph* is a graph where each node is connected to k exactly other nodes. For directed graphs an additional requirement is that $indegree = outdegree$ for each node.

- low or zero entropy (no randomness)
- every node can be reached in a small number of hops from every other node (link economy)
- sparse and connected network
- relatively small diameter and small average path length

Types of Networks – Random Networks

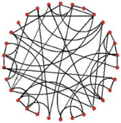
A *Random Network* is formed by taking n dots and drawing lines between randomly chosen pairs. Then each pair of nodes (i, j) has a connecting link with probability p. Under this assumption the node-degree distribution is *binomial*:

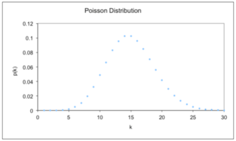
$$P[deg(v) = k] = \binom{n-1}{k} p^k (1-p)^{n-1-k}$$

If n is large the binomial distribution is approximated by *Poisson*:

$$P[deg(v) = k] = \frac{\lambda^k e^{-\lambda}}{k!}$$

where λ is the *mean node-degree* of the network.





Random Networks – Example

A random network with 16 nodes:

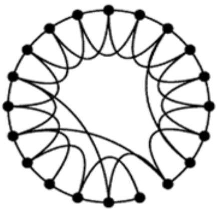
- 120 possible connections, 19 actual
- Average node degree: $\langle k \rangle = \frac{1}{n} \sum k_i = 2.375$
- Average path legth: $L \approx \frac{ln(n)}{ln(\langle k \rangle)} = 3.2$
- Clustering coefficient: $C = \hat{p} = \frac{\langle k \rangle}{n} = 0.148$

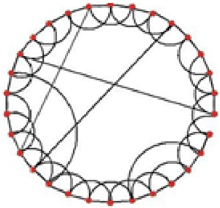
Random Networks – Properties

1. Poisson distribution for the node degrees when n is large,
2. high entropy for medium values of density,
3. sparse random networks exhibit small world effect,
4. a random network become less random as its density approaches that of a regular network,
5. small increase in numbers of links results to high decrease of the average path length

Types of Networks – Small-World Networks

As defined by Watts and Strogatz (1998) a *Small-World network* can be formed by taking a 2-regular (ring) network of n nodes and then adding shortcut links between random pairs of nodes with probability ϕ. Alternatively, we may start with any regular network.





In small-world networks, a group of people are closely related to each other, while a few people have far-reaching connections with people outside of the group

Small-World Networks – Properties

1. sparse adjacency matrix,
2. small average path length,
3. large clustering coefficient,
4. node-degree distribution similar to that of random networks but thiner and taller,
5. scalable entropy

More specifically: The typical distance L between two randomly chosen nodes grows proportionally to the logarithm of the number of nodes N in the network, that is:

$$L \propto logN \text{ and } L_{sw} \leq L_{rand}$$

For the clustering coefficient:

$$C_{sw} >> C_{rand}$$

Types of Networks – Scale-Free Networks

To form a *scale-free network* we start with a small number (n_0) of nodes. At every step, we add a new node with m ($\leq n_0$) links to connect it with m other nodes already present in the system. This step is characterized by *preferential attachment*, i.e. choosing the nodes to which the new node will be connected depends on their degree k_i. So *rich-get-richer*, because new nodes prefer to attach to ‘‘popular’’ nodes

Examples of scale-free networks:

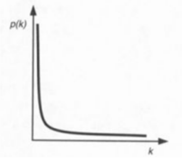
- WWW : new documents link to well-known sites (CNN, YAHOO, NewYork Times, etc)
- Citations : well cited papers are more likely to be cited again

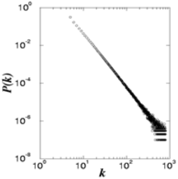
Scale-free Networks – Properties

1. the node degrees of a scale-free networks follow a power-law distribution with a flat tail for large k,

$$p(k) = Ck^{-\alpha} \text{ for } k > k_{\text{min}}$$

where the exponent α is greater than 1 and usually $2 < \alpha < 3$





2. hubs (nodes with quite high degrees) are formed,
3. clustering coefficient follows a power-law,
4. lowest average closeness compared to other network types.

Outline

1. Introduction to Social Networks
2. Measures of Network Performance
3. Twitter Data Analytics
4. Networks under Attack

Preliminaries

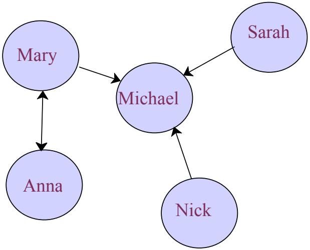
Twitter is an online social networking and microblogging service for fast communication. It enables registered users to send and read short messages, not exceeding 140 characters, known as "'tweets".

Created in 2006, very quickly became popular and by 2012 had 500 million registered users who post approximately 340 million tweets per day. (http://en.wikipedia.org/wiki/Twitter)

Twitter's impact on society has been proven since its use as *means for organizing protests*, like the 2011 Egyptian revolution and the Occupy Wall Street movement, and as *an emergency communication system* for breaking news on natural disasters, such as the Hurricane Sandy.

Social networking using Twitter

Users of Twitter, the *Twitterers*, form a social network through the relationship "`following`". Any user may follow another user without requesting permission and may be followed by others without granting permission. An example of a Twitter network would look like:



Mary is followed by Anna
Mary follows Anna and Michael
Michael is followed also by Nick and Sarah

The network is a directed graph with the users as nodes and the "`following`" relationships as edges.

Social networking using Twitter

The "`following`" relationship between twitterers indicates the most "important" ones, users with the largest number of followers (largest in-degree centrality).

Twitaholic, is a tool that tracks down statistics on any Twitterer and reports the numbers of followers, followees, and tweets broadcasted. One may immediately find the 100-most, 200-most, or 1000-most popular twitterers in a given location worldwide.

For example, the 100-most popular twitterers in Greece in terms of number of followers:
http://twitaholic.com/top100/followers/bylocation/Greece/

Similar tools are: *Twitter Grader*, *Twitter Counter*, and *Klout*.

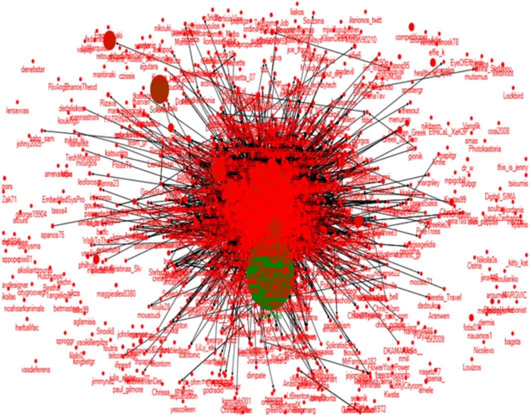
Collecting Data from Twitter

Besides all publicly available processed data, raw data from Twitter may be extracted using its public APIs. Examples of available methods:

- *GetProfile*, to extract information about a user
- *GetFollowers*, to extract all followers of a user
- *GetFriends*, to extract all twitterers a user follows
- *GetStatuses*, to access the tweets and retweets of a user
- *GetSearchResults*, to access tweets that contain a certain keyword or hashtag.

A Network of Greek Twitterers

In June 2011 we studied the network of 1003 Greek Twitterers. The data were collected with the help of twitaholic.com and Twitter APIs and the image was created with NodeXL.



A Network of Greek Twitterers

- Nodes are screen names of twitterers with location in Greece.
- Edges are "`following`" relationships between greek twitterers.
- Size of the node indicates number of followers for the twitterer.
- Colour gives the in-degree centrality of the node:
  Red $\mapsto$ smaller in-degree, Green $\mapsto$ larger in-degree.
  [**Note:** the followers may be from all over the world, where the in-degree is calculated only for this subnetwork]

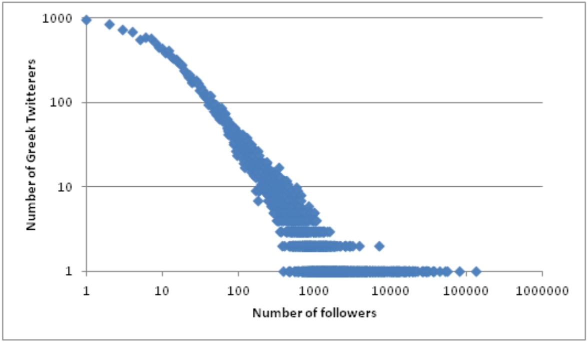
A Network of Greek Twitterers

Summary of metrics on the Network of Greek Twitterers

GRAPH METRIC	VALUE
Graph Type	Directed
Vertices	1003
Total Edges	12877
Connected Components	209
Maximum Vertices in a Connected Component	792
Maximum Edges in a Connected Component	12872
Maximum Geodesic Distance (Diameter)	7
Average Geodesic Distance	2,693586

A Network of Greek Twitterers

The distribution of followers appears to follow the power law (discrete pareto distribution), with $a = 2.2$ and $xmin = 614$.



Outline

1. Introduction to Social Networks
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4. Networks under Attack

Vulnerability and Robustness of Networks

Vulnerability of a network is classified along three dimensions:

1. failure of a node,
2. failure of a link,
3. instability of the network due to removal of a stabilizing link

Measuring Damage of a Network

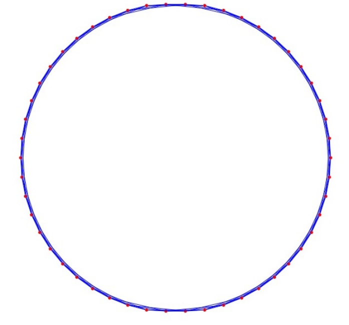
Certain topological quantities can be used to measure the damage after an attack:

- $\frac{S_g}{N}$, where $S_g =$ the size of the largest component in the network after damage with respect to the undamaged network. If $S_g/N > 0$ then a significant fraction of nodes is still able to communicate, while if $S_g/N \cong N^{-1}$ then the network has been fragmented into small disconnected components.
- The *diameter of the network* as a function of the fraction of removed nodes. It is important to identify a threshold where the network still provides some functionality.
- Considering node removal, random graphs are more sensitive than scale-free when nodes are removed randomly, while scale-free networks are more sensitive to targeted attacks (e.g. attack to nodes with large degrees)

An Empirical Application on Network Attacks

1. Simulation of different network types with 50 nodes (R package igraph).
2. Calculation of basics measures (NodeXL).
3. Random and targeted attacks to each network and observing the consequences to each network type.
4. Representation of the network of Political Blogs before 2004 elections in USA (using Gephi).
5. Calculation of Metrics (NodeXL) and discussion which of network types is closer to Political blogs network.
6. Discussion about a Random and a Targeted attack consequences to the network.

Network Simulation – 6-Regular Lattice

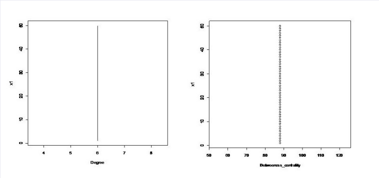


Static Measures

Nodes : 50, *Edges* : 150
Diameter : 9
Average Path Length : 4.5
Avg Clustering Coefficient : 0.6
Average Degree : 6
Avg Closeness Centrality : 0.004
Avg Bet/ness Centrality : 88.0
Density : 0.12245

Network Simulation – 3-Regular Lattice

Statistical Distributions of Measures: Estimates of node degree distribution and betweeness centrality distribution using kernels.



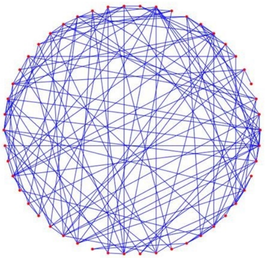
Global Network Measures

Entropy : 0

Link Efficiency : 0.91

Network Simulation – Random Network

Consider a random graph using Erdos-Renyi generative process with 144 edges in order to have the same number of links with the 3-regular.



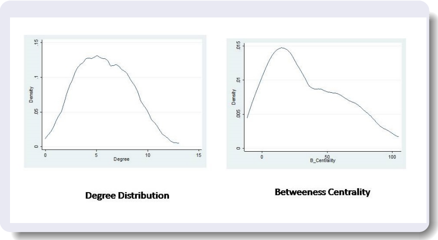
Random Graph

Static Measures

Nodes : 50, *Edges* : 144
Diameter : 5
Average Path Length : 2.434
Avg Clustering Coeff : 0.161
Average Degree : 5.76
Avg Closeness Centrality : 0.009
Avg Bet/ness Centrality : 34.64
Density : 0.11755

Network Simulation – Random Network

Statistical Distributions of Measures: Estimates of node degree distribution and betweeness centrality distribution using kernels.



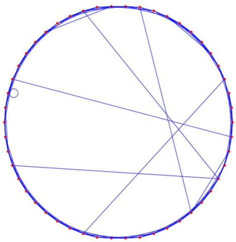
Global Network Measures

Entropy : 3.26

Link Efficiency : 0.98

Network Simulation – Small-World Network

We consider a small-world network using Watts-Strogatz generative procedure (with rewiring probability 0.05).

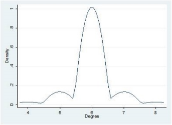


Static Measures

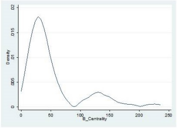
Nodes : 50, *Edges* : 150
Diameter : 6
Average Path Length : 3.17
Avg Clustering Coefficient : 0.54
Average Degree : 6
Avg Closeness Centrality : 0.006
Avg Bet/ness Centrality : 53.08
Density : 0.12163

Network Simulation – Small-World Network

Statistical Distributions of Measures: Estimates of node degree distribution and betweeness centrality distribution using kernels.



Degree Distribution



Betweeness Centrality

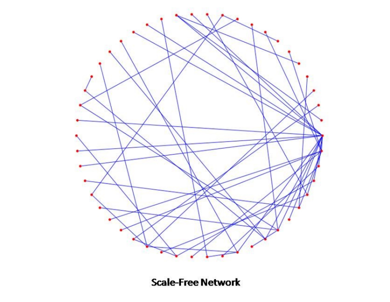
Global Network Measures

Entropy : 1.19

Link Efficiency : 0.979

Network Simulation – Scale-Free Network

We consider a scale-free network using a procedure that constructs a Barabasi- Albert model based on (linear) preferential attachment.

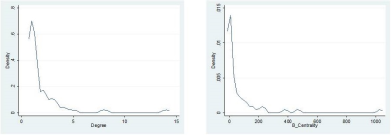


Static Measures

Nodes : 50, *Edges* : 49
Diameter : 9
Average Path Length : 1.71
Average Clustering Coefficient : 0
Average Degree : 1.96
Average Closeness Centrality : 0.006
Avg Betweeness Centrality : 69.2
Density : 0.04

Empirical Application
Network Simulation

Statistical Distributions of Measures: Estimates of node degree distribution and betweeness centrality distribution using kernels.



Degree Distribution　　Betweeness Centrality

Global Network Measures

Entropy : 1.675

Link Efficiency : 0.965

Empirical Application – Comparison of Networks

1. Scale-free networks require small number of edges compared to others (more sparse). Conversely, regular networks are denser.
2. Scale-free networks ensure the smallest average path length and regular graphs the longest. Studies on real world networks suggest short average path lengths (small-world phenomenon), so scale-free, random and small-world networks are preferable models.
3. The average clustering coefficient is larger for the regular and the small-world networks compared to the others.
4. The degree distribution of the scale-free network approximates a power law, while the random graph approximates Poisson. In addition, while the average degree is lower for the scale-free networks, the maximum degree is 12 (formation of hubs).
5. The average closeness centrality is smaller for the regular networks (smaller distance between nodes), while betweeness centrality is highest, i.e. nodes influence large amount of information. In random networks, each node has larger average distance from others and influence the least amount of information. Betweeness centrality, in scale-free network obeys a power law, unlike the other types.

Node Attacks and Network Stability

We consider two types of attacks

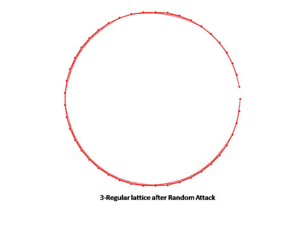
1. *Random Attack*: remove nodes randomly (removal of 5 nodes, e.g. 10% of network)
2. *Targeted Attack*: remove nodes with highest degree (removal of 3 nodes, e.g. 6% of network)

Metrics used for evaluating the consequences of the attack

- $\frac{S_g}{N}$: allows for checking the communication level after damage.
- $\frac{Diameter}{Nodes}$: Larger values indicate difficulties in communication for the remaining network.
- *Entropy and link efficiency* after the attack are used to evaluate its impact on network efficiency.

Node Attacks: 3 Regular Lattice

Random Attack



Nodes:45, Edges:114

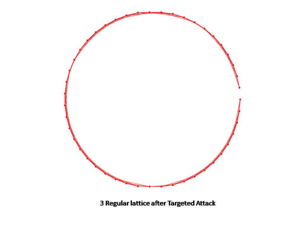
$\frac{S_g}{N} = 45/50 = 0.9$

$\frac{Diameter}{Nodes} = \frac{17}{45} = 0.37778$

Entropy: 1.80903

Link Efficiency:0.86825

Targeted Attack



Nodes:47, Edges: 126

$\frac{S_g}{N} = 47/50 = 0.94$

$\frac{Diameter}{Nodes} = \frac{17}{47} = 0.3617$

Entropy:1.41671

Link Efficiency:0.87109

Node Attacks: Random Network

Random Attack

Nodes:45, Edges: 113

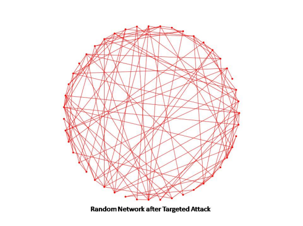
$\frac{S_g}{N} = 45/50 = 0.9$

$\frac{Diameter}{Nodes} = \frac{5}{45} = 0.111$

Entropy:3.01891

Link Efficiency: 0.97787

Targeted Attack



Nodes:47, Edges:114

$\frac{S_g}{N} = 47/50 = 0.94$

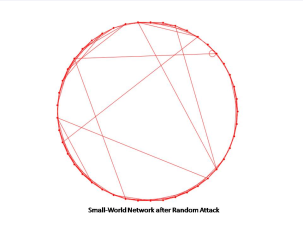
$\frac{Diameter}{Nodes} = \frac{5}{47} = 0.10638$

Entropy: 2.94096

Link Efficiency: 0.97786

Node Attacks: Small-World Network

Random Attack



Nodes:45, Edges: 121

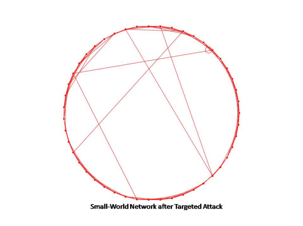
$\frac{S_g}{N} = 45/50 = 0.9$

$\frac{Diameter}{Nodes} = \frac{6}{45} = 0.13333$

Entropy:1.91577

Link Efficiency: 0.97522

Targeted Attack



Nodes:47, Edges: 127

$\frac{S_g}{N} = 47/50 = 0.94$

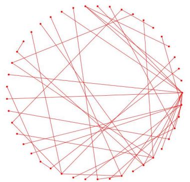
$\frac{Diameter}{Nodes} = \frac{6}{47} = 0.12766$

Entropy:1.93047

Link Efficiency: 0.97516

Node Attacks: Scale-Free Network

Random Attack



Scale-Free Network after random Attack

Nodes:45, Edges: 43

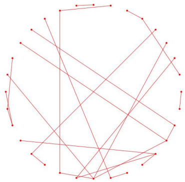
$\frac{S_g}{N} = 41/50 = 0.82$

$\frac{Diameter}{Nodes} = \frac{8}{45} = 0.17778$

Entropy:1.71652

Link Efficiency:0.91646

Targeted Attack



Scale-Free Network after Targeted Attack

Nodes:32, Edges:24

$\frac{S_g}{N} = 10/50 = 0.2$

$\frac{Diameter}{Nodes} = \frac{6}{32} = 0.1875$

Entropy:1.34475

Link Efficiency:0.92235

Node Attacks – Conclusions

- **6-regular network**: Random attack isolated larger portion, drove to greater randomness and reduced link efficiency. For regular networks random and targeted attacks are equivalent, consequences from random attacks seem larger because of removal of more nodes.
- **Random Network**: In random network consequences from the 2 types of attacks are comparable. Random attack led to larger longest path between two nodes, thus information flowing is more time consuming while targeted attack led to a higher amount of loss of randomness, thus to a larger perturbation of network structure. But, values of entropy and $\frac{Diameter}{Nodes}$ are close after the two attacks.
- **Small-World Network**: In small-world network, random attack led to a higher value of the longest of shortest paths between two nodes but to a lower change of entropy (randomness). Link efficiency remains almost the same after the attacks. Two attack types had similar consequences.
- **Scale-Free Network**: In scale-free networks, as we expected targeted attack led to much greater damage.Targeted attack, led to only 20% maximum connection of nodes (network broke to pieces), increased longer distance between two nodes and reduction of randomness.

Case Study – A Network of Political Blogs

For this application the data are from a directed network of hyperlinks between weblogs on US politics, recorded by Adamic and Glance (2005). However, we considered the network as undirected since we were only interested in connections between blogs and not direction.

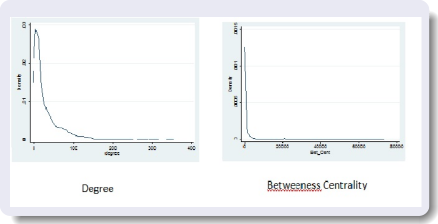
Political Blogs Network

Static Measures
Nodes: 1490 (1224 w/ links, 266 w/out links (0.1785%))
Edges: 19025 (14411 unique edges)
Diameter: 8
Average Path Length: 2.73528
Average Clustering Coefficient: 0.320
Average Degree: 27.317
Average Closeness Centrality: 0.002
Avg Bet/ness Centrality: 1059.029
Density: 0.02233

Empirical Application

Network of Political Blogs

Statistical Distributions of Measures: Estimates of node degree distribution and betweeness centrality distribution using kernels.



Global Network Measures

Entropy: 5.83892

Link Efficiency: 0.99981

Network of Political Blogs – Classification

Regular: The *diameter*, *average path length*, *average clustering coefficient* and *density* indicate that the network cannot be regular. Also, *entropy* for the political blogs' network indicate randomness – not true for regular networks.

Random: The *average path length* and *density* indicate that the network cannot be random. Also, the *distribution of node degrees* is different, since in political blogs' network we observe a power law decay of tails.

Small-World: Small-world network have larger *average path lengths* and *densities* than the political blogs' network. Also, the *distribution of node degrees* does not display a power law decay of tails as in political blogs network. Moreover, the *average path length* is smaller than $Log(N)$ (2.735 instead of a 3.088 expected).

Scale-Free: The political blogs network can be considered closer to scale-free networks. This can be concluded based on *density* (comparable sparsity), *degree distribution* (power law decay of tails) and betweeness centrality (kernel graph). The average path length is even smaller than a small world.

Network of Political Blogs – Random and Targeted Attacks

We consider a random attack to 100 randomly selected nodes and a targeted attack to 10 highest-degree nodes.

Random Attack

Nodes:1390 (256 with no links)
Edges: 17151(12969 unique)
Diameter: 7
Average Path Length: 2.7162
Avg Clustering Coefficient: 0.330
Avg Bet/ness Centrality: 965.048
$\frac{S_g}{N} = 1129/1224 = 0.92239$
$\frac{Diameter}{Nodes} = \frac{7}{1134} = 0.00617$
Entropy: 5.79125
Link Efficiency: 0.9998

Targeted Attack

Nodes:1480 (300 with no links)
Edges: 16364 (12448 unique)
Diameter: 8
Average Path Length: 2.8815
Avg Clustering Coefficient: 0.258
Avg Bet/ness Centrality: 1101.195
$\frac{S_g}{N} = 1178/1224 = 0.96242$
$\frac{Diameter}{Nodes} = \frac{8}{1180} = 0.00678$
Entropy: 5.73227
Link Efficiency: 0.99981

Network of Political Blogs – Conclusions

- Random attack deleted 100 blogs (6.7%) and targeted attack only 10 blogs (0.67%). The targeted attack's scope is to hit much less targets (blogs) and achieve more pernicious results.
- Original network had 17.85% isolated nodes, Random attack led to 18.42% isolated nodes and targeted attack led to 20.27% isolated nodes and fewer links (more damage).
- *Diameter* and *average path length* are larger after the targeted attack. This indicates that for the giant component there is larger distance between 2 nodes after the attack. Also, the *average clustering coefficient* decreased after targeted attack.
- *Entropy* reduced but not so much after the attacks and *link efficiency* remained almost the same.
- $\left(\frac{Diameter}{Nodes}\right)$ indicate greater difficulties in communication for the giant component after the targeted attack.

Network of Political Blogs – Overall Conclusion

The targeted attack to the network of political blogs led to a more segregated network, although only 10 blogs were deleted. This is in fact an additional suggestion that the network should be classified as scale free.

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Social media for Business

Presentation outline

- 2.1 What is social media and how is it used in businesses?
- 2.2 A quick tour of the social media universe – what tools are out there?
- 2.3 The differences and interaction between traditional and social media-Consumer behavior and digital media
- 2.4 Defining the scope of Social Media: Customer, Marketing, Industry Watch
- 2.5 What's the plan? Developing a social media marketing strategy

What is social media and how is it used in businesses?

What is social media

- Social media is a category of sites based on user participation & user generated content
- Social media has afforded everyone the tools to publish, broadcast and compete
- No longer dependent on big budgets

The power of social media

- The internet is everywhere, and it has changed the way we interact, learn and socialize
- Television viewing, radio listening is eroding
  - Newspaper reading is declining
  - People are avoiding advertising - too much noise
- Enterprises can no longer ignore the power of social media given
  - the increasingly large number of consumers using them to express their needs and complaints
  - as well as opinions about proprietary products and services

How it is used in business

- “If you are not out there telling your story, they will make one up for you. And that will inevitably become reality.”
- Puts the human factor back into marketing.
- Talking with your customers, not at your customers. It’s a two-way conversation.

How it is used in business

- Reputation management
- Event detection, issue and crisis management
- Competitor analysis
- Trend and market research plus campaign monitoring
- Influencer detection and customer relationship management
- Product and innovation management

A quick tour of the social media universe – what tools are out there?

Social media tools

- Various types of Social Media
- Blogging and Microblogging (Twitter)
- Video and Photo Sharing (YouTube, Flickr)
- Location-Based Networks (FourSquare, GoWalla)
- Social Networking (Facebook, LinkedIn, MySpace)
- Podcasting and LiveCasting (Ustream, Justin.tv)

Blogging and microblogging

- Blog: a shared online journal
- Easy to start with and maintain
- Blogger, Wordpress, Tumblr
- More than 300 million readers (pingdom.com)

Blogging and microblogging

- Establishes you as authority within your industry
- Make your content easy to share
- Build relationships with other bloggers
- Keywords, tags, links
- Make your content easily available - RSS Feeds

Microblogging: Twitter

- Other people can “follow” you and you can “follow” them
- Fast-paced, real-time
- **#HashTags** - allow you to organize and search

Video and Photo Sharing

- Youtube
- Flickr
- Keep it short
- How can you make a video go viral?
  - Good Content
  - Make your video easy to share
- Integrate on other platforms
- Create and brand your YouTube channel

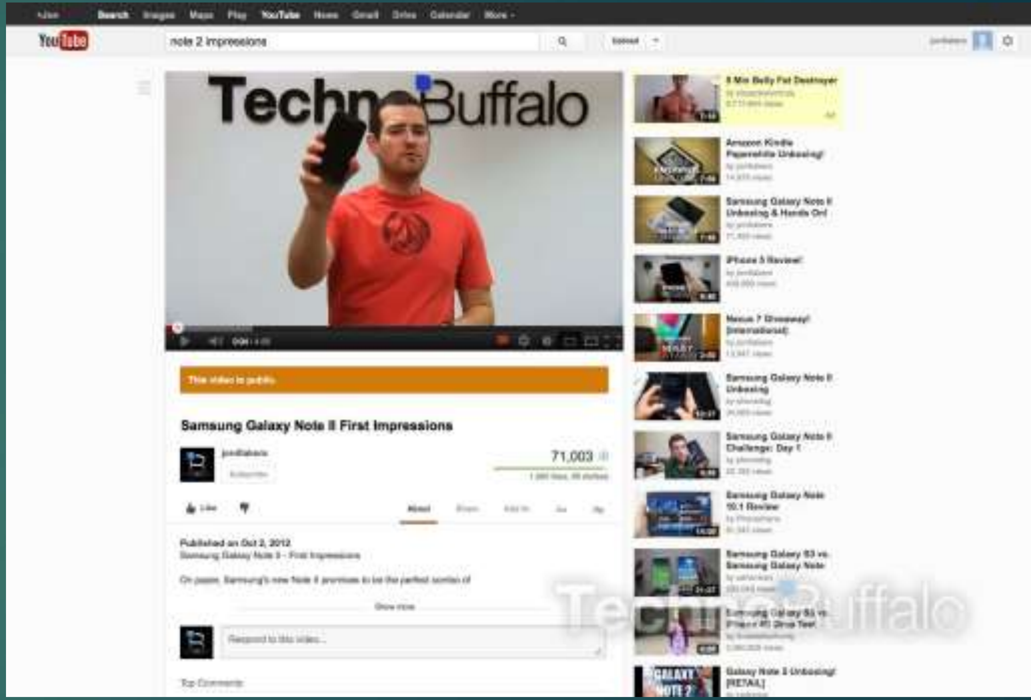


Photo sharing (Flickr)

- Effective use of tagging, captions,
- Great way to showcase products
- Post high quality pictures
- Question of ethics big in this area

Location-Based Networks

- Foursquare
- Allows users to check-in to places they visit
- Users add venues
- Users earn badges and “mayorship” based on loyalty and recency
- Gowalla

Social Networking

- Facebook: more than 1 billion users
  - Allow you to connect with like-minded people,

friends and family

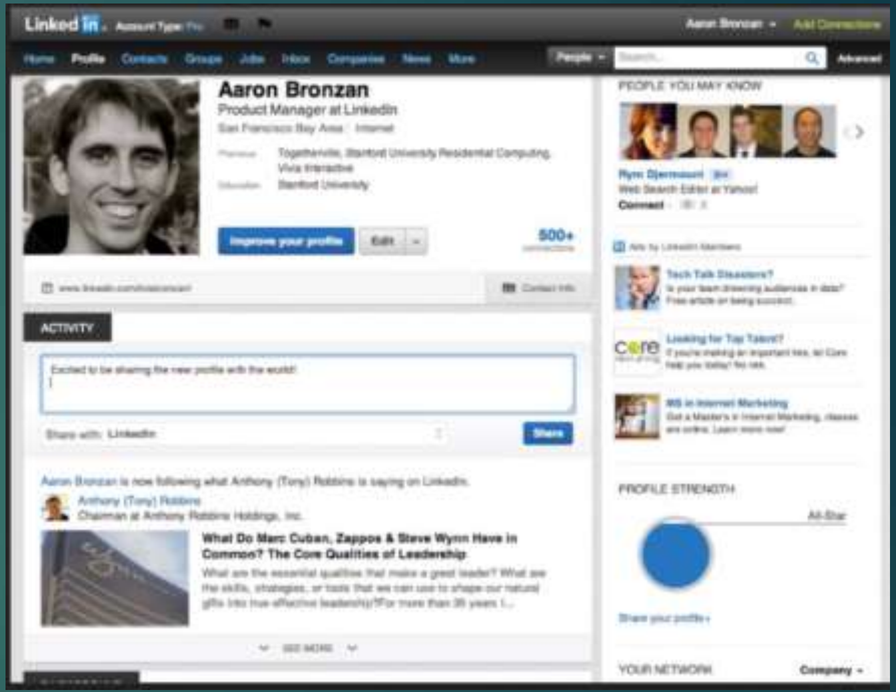
  - Social networks geared toward different groups
  - Professional: LinkedIn, Facebook Pages
- Google+
- Linkedin

Facebook

- Profile
  - For personal use
  - If connected to friends and colleagues can get tricky
- Pages
  - What you should use for your business
  - Users choose to "like" your business
  - "Boxes" good way to brand your page
  - Welcome and encourage fan content and interaction
  - Allow you to post events, notes, videos, photos

Social Networking (Linkedin)

- Over 50 million members worldwide (Jan 2010)
- People, Groups, Discussions, Events
- Find jobs, find employees
- Keep your profile up to date
- Get recommendations
- Make use of LinkedIn Groups
- Answer questions relevant to your industry



Podcasting and LiveCasting

- Digital or audio files made available online
- Listeners can subscribe to your podcasts, giving regular access to them
- Industry news, trends, interviews
- Establishes credibility

The differences and interaction between traditional and social media

Interaction between traditional and social media

- 2,5 billion Internet users
- 84% of them are comfortable with search engines
- Access to a variety of sources
- Ability to cross-check attitudes towards products
- Comparison of features with minimal hassle

Online consumer profile

- Online consumer is diverse and sophisticated
- She requires highly targeted marketing in this data rich world
- Over 85% of shoppers find vendor sites by typing product or store/brand name into search engine or going directly to the site
- Most online shoppers plan to purchase product within a week, either online or at a store
- Most online shoppers have a specific item in mind

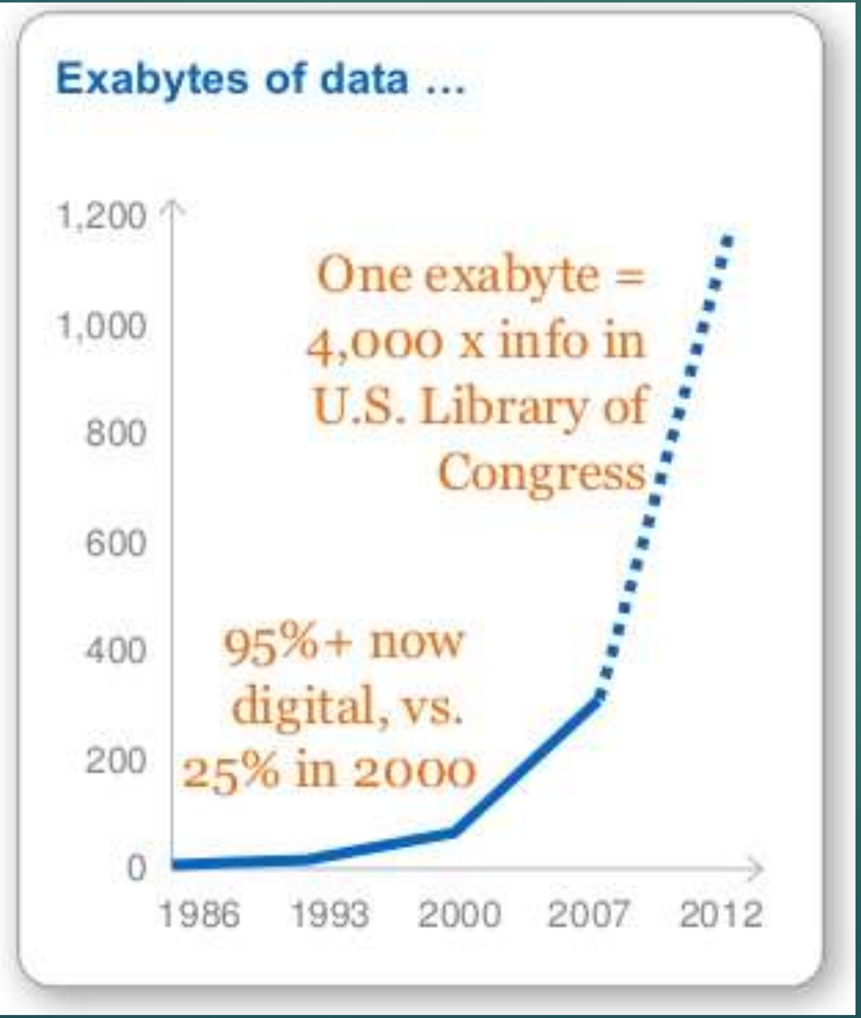
Is traditional media dead?

- No, at least for now
- Social Media is an addition to your marketing plan - not a replacement

A Generic Purchasing-Decision Model

1. Need identification
2. Information search
3. Evaluation of alternatives,
4. Purchase and delivery
5. Post-purchase behavior

Consumer behavior and digital media



Consumer behavior and digital media

- A wealth of data related to consumer activity is available
- Some of them are related to your organization
- They could inform decisions (data-based decision making)
- And in turn impact managing processes and business

Internet Marketing

- Marketing: The strategies and actions firms take to establish a relationship with a consumer and encourage purchases of products and services
- Internet marketing: Using the Web, as well as traditional channels, to develop a positive, long-term relationship with customers, thereby creating competitive advantage for the firm by allowing it to charge a higher price for products or services than its competitors can charge

‘Traditional’ internet marketing terms 1/2

- **conversion rate**

  The percentage of clickers who actually make a purchase

- **click-through rate (or ratio)**

  The percentage of visitors who are exposed to a banner ad and click on it

- **click-through ratio**

  The ratio between the number of clicks on a banner ad and the number of times it is seen by viewers; measures the success of a banner in attracting visitors to click on the ad

‘Traditional’ internet marketing terms 2/2

- **hit**
  A request for data from a Web page or file
- **visit**
  A series of requests during one navigation of a Web site; a pause of a certain length of time ends a visit
- **unique visits**
  A count of the number of visitors entering a site, regardless of how many pages are viewed per visit
- **stickiness**
  Characteristic that influences the average length of time a visitor stays in a site

Online Advertising Methods

- **banner**

  On a Web page, a graphic advertising display linked to the advertiser's Web page
- **keyword banners**

  Banner ads that appear when a predetermined word is queried from a search engine
- **random banners**

  Banner ads that appear at random, not as the result of the user's action

Online Advertising Methods

- **banner swapping**

  An agreement between two companies to each display the other's banner ad on its Web site

- **banner exchanges**

  Markets in which companies can trade or exchange placement of banner ads on each other's Web sites

Online Advertising Methods

- **pop-up ad**

  An ad that appears in a separate window before, after, or during Internet surfing or when reading e-mail
- **pop-under ad**

  An ad that appears underneath the current browser window, so when the user closes the active window the ad is still on the screen
- **interstitial**

  An initial Web page or a portion of it that is used to capture the user's attention for a short time while other content is loading

Online Advertising Methods

- **E-Mail Advertising**
  - E-mail advertising management
  - E-mail advertising methods and successes
- **Newspaper-Like and Classified Ads**
- **Search Engine Advertisement**
  - Improving a company's search-engine ranking (optimization)
  - Paid search-engine inclusion

Online Advertising Methods

- **associated ad display (text links)**

  An advertising strategy that displays a banner ad related to a key term entered in a search engine
- **Google—The online advertising king**

- **Advertising in Chat Rooms, Blogs, and Social Networks**

Online Advertising Methods

- **Other Forms of Advertising**
  - **advertorial**

    An advertisement “disguised” to look like editorial content or general information
  - Advertising in newsletters
  - Posting press releases online
  - **advergaming**

    The practice of using computer games to advertise a product, an organization, or a viewpoint

collaborative filtering

- A market research and personalization method that uses customer data to predict, based on formulas derived from behavioral sciences, what other products or services a customer may prefer
- Predictions can be extended to other customers with similar profiles
- Variations of collaborative filtering include:
  - Rule-based filtering
  - Content-based filter
  - Content-based filter
- Legal and ethical issues in collaborative filtering

Defining the scope of Social Media: Customer, Marketing, Industry Watch

Defining the scope of Social Media

1. **Marketing**. Monitoring, analysis and response of customer conversations through social listening tools. Integration of social marketing into other campaign tactics like email marketing.

2. **Sales**. Understanding where prospects are discussing selection of products and services offered by you and competitors and determining the best way to get involved in the conversation to influence sales and generate leads. Within B2B, Linked-In is an obvious location that should be monitored.

3. **Service and support**. Customer self-help through forums provided by you and neutral sites.

Defining the scope of Social Media

4. **Innovation**. Using conversations to foster new product development or enhance online offerings is one of the most exciting forms of social CRM for me. I have written about the many software tools to encourage customer feedback.

5. **Collaboration**. This is ebusiness collaboration within an organisation through an intranet and other software tools to encourage all forms of collaboration which support business process.

6. **Customer experience.** This references the use of social CRM to enhance the customer experience and add value to a brand which is implied by many of the other aspects above.

What’s the plan? Developing a social media marketing strategy

A social media marketing strategy

1. Spend time every day executing your social media strategy
2. Develop a 3-Month Editorial Plan
3. Use the 10-4-1 Rule
4. Involve your sales team in your social media marketing
5. Make it easy to share your content and follow your company on social media
6. Follow your customers and key prospects on social media and monitor regularly
7. Review your analytics monthly and adjust tactics accordingly

1.Spend time every day executing your social media strategy

- Invest at least the equivalent of 25% of a full-time employee daily to execute your social media marketing strategy
- Otherwise you will not get the results you need and expect
- Assign social media manager responsibilities to an employee
- The social media manager should be measuring, communicating, posting, responding and analyzing your social media marketing every day

2.Develop a 3-Month Editorial Plan

- Identify who you want to reach and
- where you plan to find them,
- you need to develop an editorial calendar that identifies the content and message you want to communicate over a 3-month period
- Your social media editorial plan should be developed together with your content calendar, promoting the blog posts and content offers that you will be publishing
- It's important to execute it daily so that your communications are timely and reflect the current news

3.Use the 10-4-1 Rule

- The talk should not be always about you.
- it's appropriate to share your blog posts and landing pages on social media
- However, you need to be helpful above all else
- Post interesting content from other sources (trade journals, business press, etc.) that your ideal customers would find valuable
- 10:4:1 rule (B2B Social Media Book by Kipp Bodnar and Jeffrey Cohen)
  - For every 15 social media posts, there should be
  - 1 link to one of your landing pages,
  - 4 links to your blog posts and
  - 10 helpful content items (such as articles, news, etc.) from other sources

Recommended practices

- Listen
- Add value (useful posts, be helpful)
- No hard-selling
- Engage and interact
- Be real, be nice, be honest, be grateful
- Focus on quality, not quantity

4.Involve your sales team in your social media marketing

- Optimize your company's social media marketing channels
- But at the same time, have your sales and management team amplify your efforts with their personal accounts
- For instance, if you're publishing a new article on your company blog, encourage your sales team to share it on their personal LinkedIn accounts

5.Make it easy to share your content and follow your company on social media

- Social media is all about sharing.
- Provide "follow" buttons on your website, email signatures and marketing collateral.
- Include “share” buttons on your email marketing, landing pages and blog articles.
- Most email marketing and internet marketing software products have share and follow modules that make it easy for you to include them.

6.Follow your customers and key prospects on social media and monitor regularly

- What better way to learn what is important to your prospects and customers than to see what they say on social media?
- Follow your customers on their networks and see what they have to say.
- This will give you insight into what’s important for.

7.Review your analytics monthly and adjust tactics accordingly

- Look at Key Performance Indicators (KPIs) every month to ascertain what is working well. Some of the KPIs to monitor include:

- leads generated by social media network
- customers produced by social media network
- new followers/likes by social media network
- social media mentions
- shares/retweets by social media network
- blog posts published and views/comments/shares by blog article
- These metrics will help you determine which social media networks work best for your business
- Use Social Media Monitoring tools! (discussed in the following)

Social media monitoring tools

- Extracting useful information from the vast amount of unstructured data that users generate daily on social media platforms is by no means an easy and cost-free task
- social media monitoring tools and platforms have emerged to address
  - the need for customer listening methods, as well as
  - to harness the wealth of information available online in the form of user generated content

Social media monitoring tools

- There are more than 200 tools specializing on SMM in the market today
- Differences in:
  - the main concepts related to Social Media monitoring (analysis, insights, engagement, workflow management and influence)
  - the technology used by the tools and
  - the most important aspects related to the user interface

Social media monitoring tools: Intersocial Monitoring

- The INTERSOCIAL Monitoring Tool is a Facebook and Twitter specific search engine, built upon Facebook's and Twitter's publicly available APIs
- Capabilities: Keyword monitoring, Reputation management, Competitor analysis, monitoring multiple networks

Social media monitoring tools: Soneta

- SONETA is a tool that can be used to monitor and enhance the social media presence of an SME. The tool enables tracking of social media traffic in Twitter for a user-defined set of keywords within a user-specified time period and within user-defined geographical region(s).
- Capabilities: Keyword monitoring, Trend analysis, Geolocation monitoring, Reputation management, Competitor analysis, Data filtering and analytics, campaign monitoring

Social media monitoring tools: ESA

- The ESA (Enterprise Social Aggregator for SMEs) tool allows the management and monitoring of three of the most widely used social network platforms (i.e. Facebook, Twitter, and Google+).
- Currently the tool is available both as a Wordpress widget and as an Android mobile application.
- Capabilities: Keyword monitoring, Reputation management monitoring and management of multiple networks, Data filtering and analytics

Social media monitoring tools: Hootsuite

- HootSuite is a social Network Management Tool that enables monitoring, searching and custom analysis of social traffic.
- Furthermore it acts as a global aggregator of the most popular social networks (i.e. Facebook, Twitter, LinkedIn, Google+, Foursquare, Wordpress and Mixi) and
- allows users to participate in their social networks through one single point.
- Capabilities: Keyword monitoring, Reputation management, Competitor analysis, Trend analysis, Monitoring and management of multiple networks, Data filtering and analytics, Campaign monitoring, Influencer detection.

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