

707.000
Web Science and Web Technology
„Overview and Motivation“

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Web Science and Web Technology

- Welcome
- Motivation
- Introduction of Instructor and Teaching Assistants
- How this course is organized
(and how you obtain a grade)
- Introduction to the course
- Some course highlights

In Spring 2008 ...

[Kaminsky] was looking at an error coded into the heart of the Internet's infrastructure.

This would allow him to reassign any Web address, reroute anyone's email, take over banking sites, or simply scramble the entire global system. The question was:

Should he try it?

"Oh shit," he mumbled.

"I just broke the Internet."

Secret Geek A-Team Hacks Back, Defends Worldwide Web

By Joshua Davis  11.24.08

*"The first thing I want to say to you," Vixie told Kaminsky, trying to contain the flood of feeling, "is **never, ever repeat what you just told me over a cell phone.**"*



From that moment on, they would talk only on landlines, in person, or via heavily encrypted email. Secrecy was critical. They had to find a solution before the problem became public.

Kaminsky was alone in his Seattle apartment when he discovered a security vulnerability that could leave banks, online retailers, and ISPs open to hackers.

Photo: John Keatley

Criminality

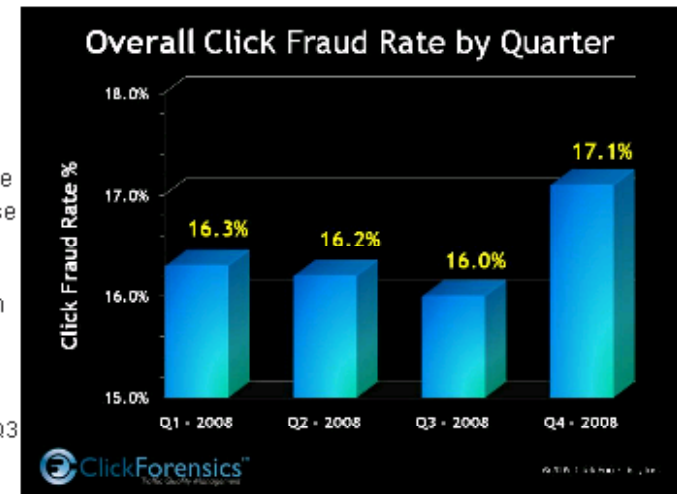
How can we identify spam, link farms and click fraud on the web?

Click Fraud Index



Now in its third year, the Click Fraud Index monitors and reports on data gathered from the Click Fraud Network. The Click Fraud Network provides statistically significant industry PPC data collected from online advertising campaigns for both large and small companies across all the leading search engines. Key findings from data reported for Q4 2008 include:

- The overall industry average click fraud rate grew to 17.1% for Q4 2008. That's up from 16.0% in Q3 2008 and from the 16.6% rate reported for Q4 2007.
- The average click fraud rate of PPC advertisements appearing on search engine content networks, including Google AdSense and the Yahoo Publisher Network, was 28.2%. That's up from the 27.1% rate reported for Q3 2008 and down slightly from the 28.3% rate reported for Q4 2007.
- Traffic from botnets was responsible for 31.4% of all click fraud traffic in Q4 2008. That's up from the 27.6% rate reported for Q3 2008 and the 22.0% rate reported for Q4 2007.
- In Q4 2008, the greatest percentage of click fraud originating from countries outside the U.S. came from Canada (7.4 percent), Germany (3.0 percent) and China (2.3 percent).



"Based on the data we tracked in Q4 2008, it seems that the online advertising industry is not immune to the growing tide of cybercrime during this recessionary period," said Tom Cuthbert, president of Click Forensics. "Both the overall click fraud rate and the rate of click fraud originating from botnets were the highest ever in Q4 2008. In addition, we've started to see old schemes like click farms reemerge. Advertisers should pay close attention to these types of threats in their online campaigns throughout the year."

Random Social Connections

How do random social graphs differ
from „real“ social networks?



<http://vimeo.com/9669721>

<http://bits.blogs.nytimes.com/2010/02/13/chatrouettes-founder-17-introduces-himself/>

Privacy

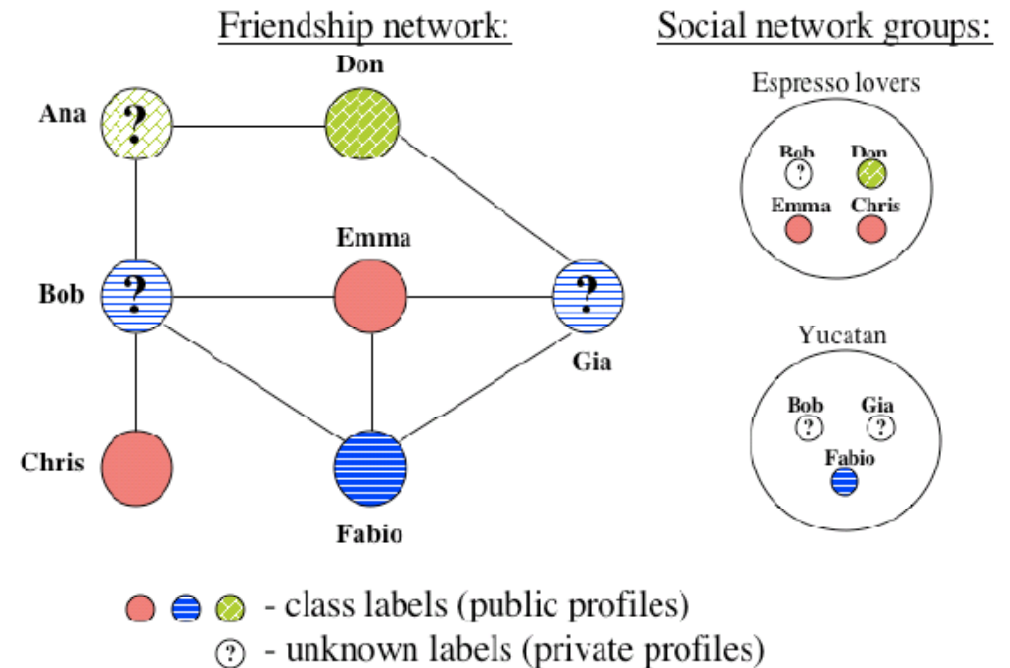
To join or not to join: the illusion of privacy in social networks with mixed public and private user profiles [WWW 2009]

Elena Zheleva

Department of Computer Science
University of Maryland, College Park

Lise Getoor

Department of Computer Science
University of Maryland, College Park



6 degrees of separation?

http://arxiv.org/PS_cache/arxiv/pdf/0803/0803.0939v1.pdf

- 30 billion conversations among 240 million people of Microsoft Messenger
- Communication graph with 180 million nodes and 1.3 billion undirected edges
- Largest social network constructed and analyzed to date (2008)

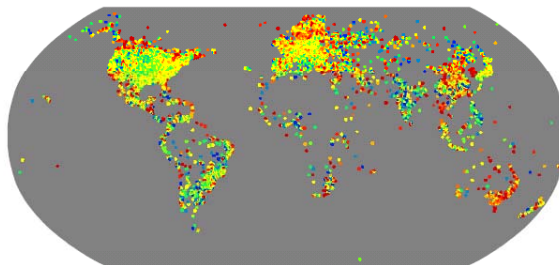


Figure 10: Number of users at a particular geographic location. Color represents the number of users. Notice the map of the world appears.

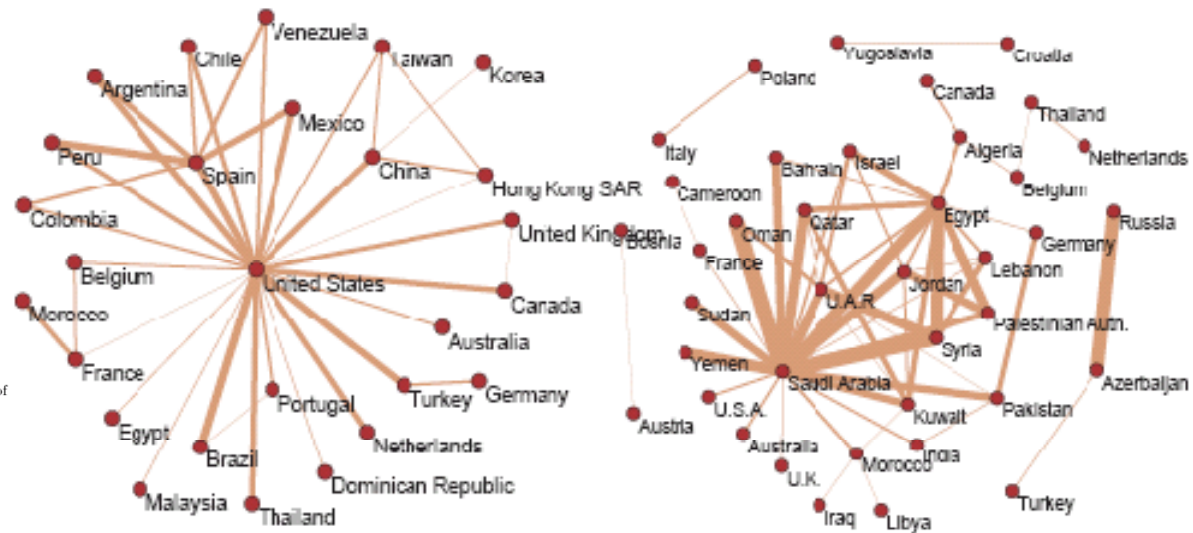
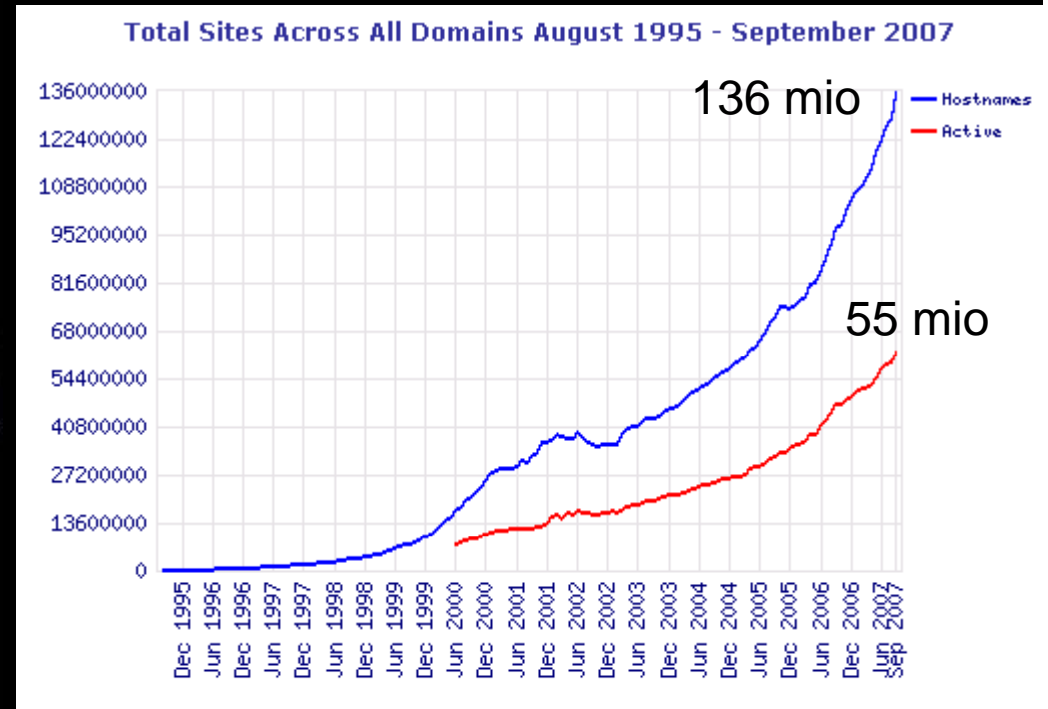
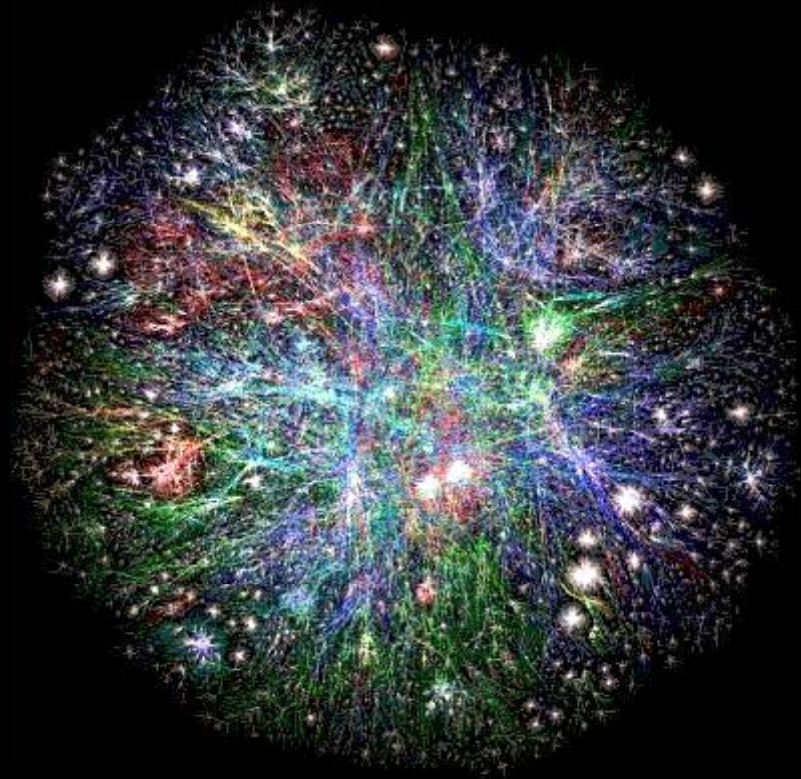


Figure 14: (a) Communication among countries with at least 10 million conversations in June 2006. (b) Countries by average length of the conversation. Edge widths correspond to logarithms of intensity of links.

The Web in 2007



(courtesy, www.opte.org)

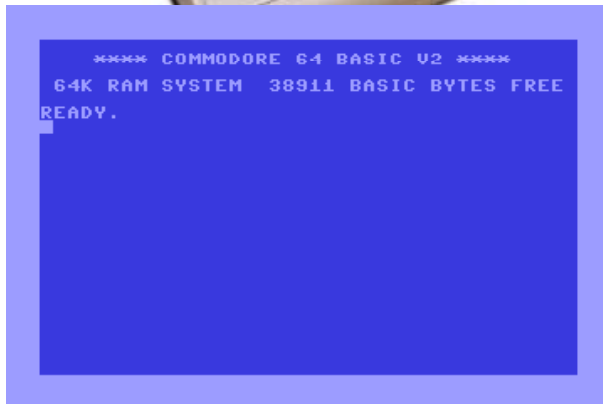
Sept 2007, Netcraft

Search (like it's 1997!)

[<http://web.archive.org/web/19981111183552/google.stanford.edu/>]

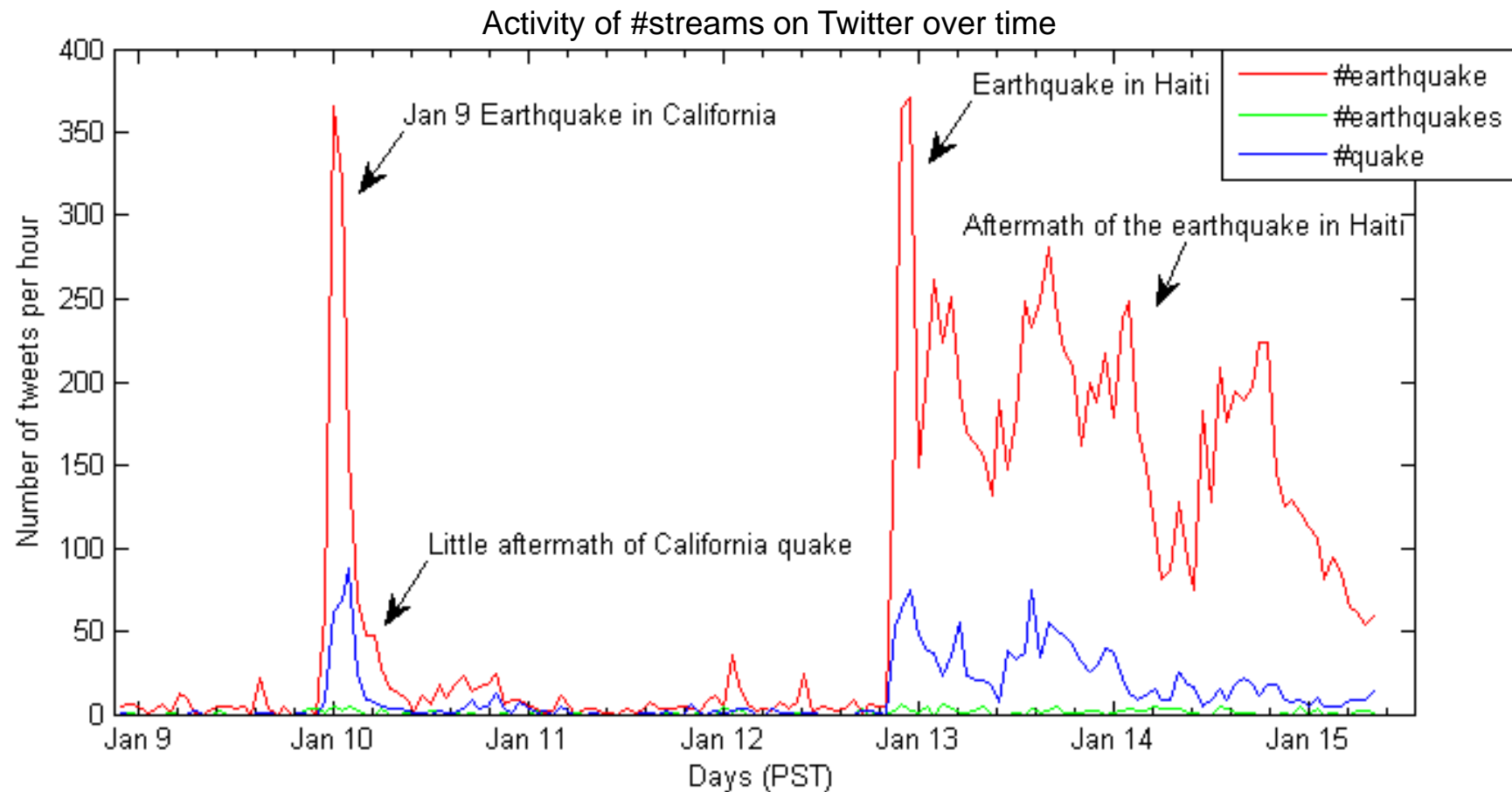


Computers - another 10 years back (1987)



„Web science? Can you say that again?“

2010



Motivation

*“[...] As the Web has grown in complexity and the number and types of interactions that take place have ballooned, it remains the case that **we know more about some complex natural phenomena** (the obvious example is the human genome) **than we do about this particular engineered one.**”*

A Framework for Web Science

T. Berners-Lee and W. Hall and J. A. Hendler and K. O'Hara and N. Shadbolt and D. J. Weitzner Foundations and Trends® in Web Science 1 (2006)

Course team

- Instructor: Markus Strohmaier
- Teaching Assistants:
 - Ingo Holzmann
 - Florian Klien
 - Christian Körner
 - Jan Pöschko
- e-mail addresses:
 - `klien at student.tugraz.at`
 - `christian.koerner at tugraz.at`
 - `poeschko at student.tugraz.at`
 - `ingo.holzmann at student.tugraz.at`
- For general, course- or assignment-related questions, **please use the newsgroup `tu-graz.lv.web-science`**

About me

Education:

- 2002 - 2004 PhD. in Knowledge Management, Faculty of Computer Science, TU Graz
- 1997 - 2002 M.Sc., Telematik, TU Graz

Background:

- July 2007 - present: Ass. Prof. (Univ.Ass.), TU Graz, Austria
- 2006 - 2007 15 months Post-Doc, University of Toronto, Canada
- 2002 - 2006 Researcher, Know-Center, Austria

About me

Research Background:

- Web Research / Knowledge Management

Research Interests:

- Web Science with a focus on networks and Social Computing
- Intentional Structures and Representations on the Web

Interesting topics for projects, Bachelor / Master thesis:

- If you are interested in the topics of this course, it is likely that you are interested in doing a project / a thesis with me as well.

Contact me to discuss opportunities.



Course Context

- 707.000 Web Science and Web Technology
 - 3rd year
 - Has been held before thrice
 - Home assignments are different from last year's course!
- Part of „Software Engineering & Business“
 - Bachelor studies, 6th semester
 - **programming skills** are required
- Your feedback is appreciated

Course Organization and Logistics

- **Lectures**
*Mondays 12:15 - 13:45,
Mar 2010 - June 2010,
Room HS i12 (Inffeldgasse 16b, Ground Floor)*
- **Website:** <http://kmi.tugraz.at/staff/markus/courses/>
- **Newsgroup:** *tu-graz.lv.web-science*
 - *Please use the newsgroup for all questions related to the course*



Enroll!

In order to obtain a grade, you need to enroll for this course until **March 15 2010** via TUG online!

- **Weekly Readings**
Password to access protected documents on the course website:

Grading

So how do you receive a grade in this course?

- 50% **home assignments**
- Due dates for submissions are announced on the course website

- 50% **final exam**
On 28.6. 2010, no aids are allowed

- **Prerequisites:** Course „Einführung in die Strukturierte Programmierung“, **General Programming Knowledge**

-
In order to successfully complete the course, you need to have a score of $\geq 51\%$

You can **cancel** your participation in this course anytime before the final exam:

just don't show up at the final exam, this will **not** result in a negative grade

Grading

The following weights will be assigned to home assignments and the final exam (totalling 100%):

- **MatLab/Octave Exercises** (30%), *Individual Work*
- **Projects** (20%), *Team Work (3-4 students)*
 - Details to be announced during this course
- **Final Exam: 50%**

Policies

- **Course documents:** Assignment descriptions and lecture notes will be made available on the course website
- **Deadlines:** Late submissions (same day) will result in a loss of 1/3 of all your points for this assignment. After the day of the deadline, no points will be awarded.
- **Plagiarism:** By submitting home assignments, you agree that your work will be processed by plagiarism tools.
- **Nachklausur:** Participating in the Final Exam is a prerequisite for every student who wants to obtain a positive grade for this course.
Because you can already obtain 50% of the points during Home Assignments ($\geq 51\%$ are necessary overall), no general "Nachklausur" will be offered. (Exception: illness, see details on course website)

For all course policy details, please see the course website:

http://kmi.tugraz.at/staff/markus/courses/SS2010/707.000_web-science/

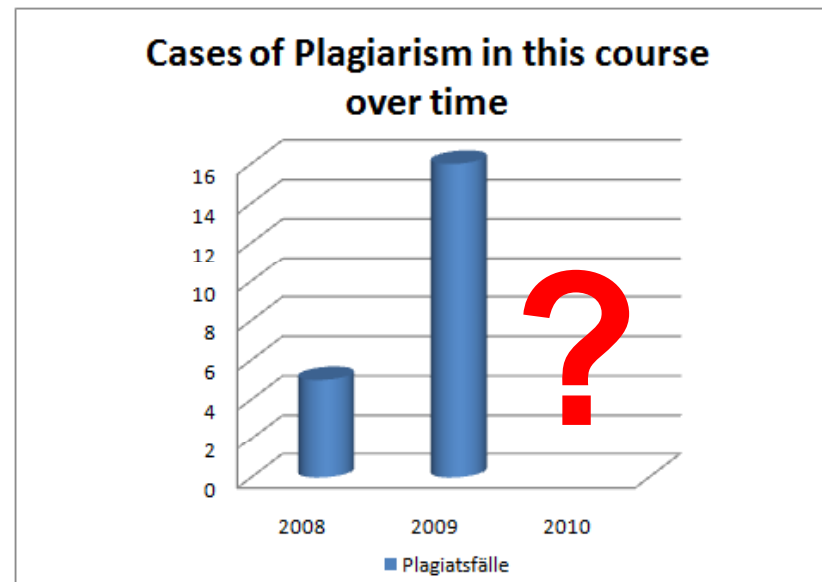
Plagiarism

You are **allowed** to discuss home assignments with colleagues, but
You are **not allowed** to jointly work on the assignments, copy solutions or share code.

We will apply sophisticated plagiarism detection software to your submissions.

707.000 Web-Science und
Web-Technologien

Students who submitted
plagiarized code for at least
one home assignment



Consequence: students could not complete the course in this year (repeat next year).

Course Organization

To successfully complete the course, I recommend attending the weekly lectures, in which we

- **discuss papers** (read before class!)
- **go through the theory necessary for home assignments**
- **answer questions related to home assignments**

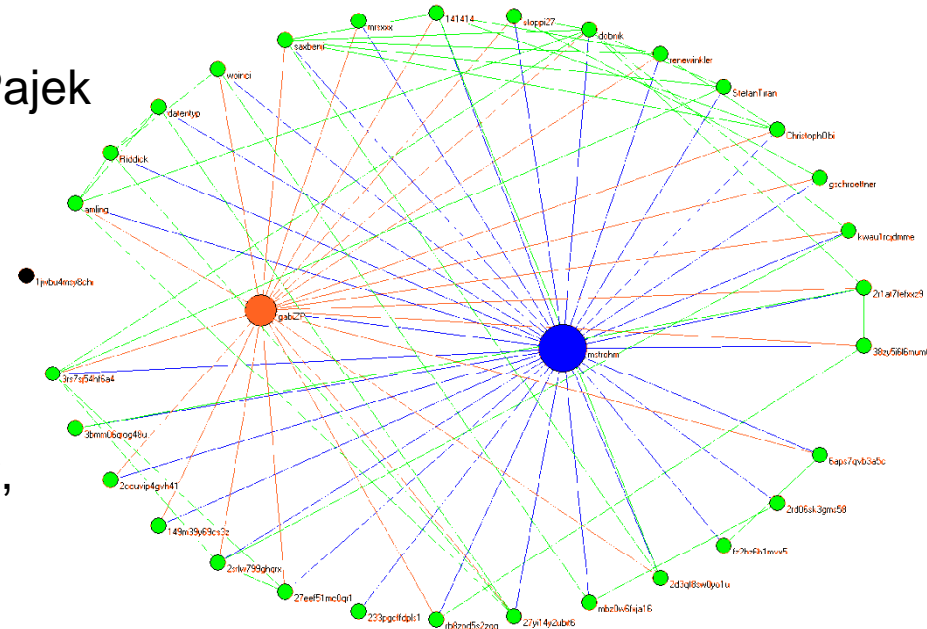
Course Goals

- To equip you with the basic knowledge and tools for performing independent (network) analysis on the web
 - Knowledge:
Network theory, search, mining, tagging, web technologies, applications, ...
 - Tools:
MatLab, Pajek, REST, simulators, network metrics

Excerpt!

Home Assignments HA1.1-1.5

- Tools
 - Matlab/Octave, ConExp, Pajek
- Networks
 - One-Mode Networks
 - Two-Mode Networks
- Analysis
 - Lattices
 - Metrics, such as Centrality, Redundancy
 - Ranking
 - Network simulators
 - Network infection



*How many of you know
MatLab/Octave?*

Home Assignment 1.1 will be handed out in week 3!

Home Assignments HA2

- To be announced and released Mid of May
- Team work (3-4 students)

Approximate Course Schedule

	MatLab/Octave Exercises	Project Assignments
March	<i>Ongoing submission of home assign.!</i>	
April	Easter holidays	
May		
June		

Home Assignments

- Have been somewhat revised from last year's course
-> **some are completely new**
- They might need clarification or refinement once they are handed out.
- **Changes and/or updates** to the assignments **will occur**
- **Once they occur, they will be announced in the newsgroup**, it is your responsibility to **obtain them!**

Course Topics

- World Wide Web
- What is network theory? Why is it relevant for the web?
- How do networks evolve?
- How do you search in networks?
- What are social parameters of networks?
- What are current web technologies?

But also e.g. a brief History of Smileys ;-)

Simulations: e.g. <http://cmol.nbi.dk/javaapp.php>

How many of you know...

- 6 degrees of separation (small world problem)
- Power law networks
- Network generators
- The Meaning of PageRank?
- Degree Distributions
- Galois Lattices
- ...

Preliminary Course Schedule

http://kmi.tugraz.at/staff/markus/courses/SS2010/707.000_web-science/

Non-Goals

In the research community, there is **no consensus** regarding the theoretical foundations of a „Science of the Web“ yet

So therefore, the topics of this course are necessarily **subjectively selective**.

Instead of giving an authoritative account of web science, this course aims to give an overview of **prominent, interesting** and/or **powerful research results** generated by related fields so far.

Recommended Literature

There is no required text book for this course, however you might find it helpful to have a look at the following resource:

- [Networks, Crowds, and Markets](#): Reasoning About a Highly Connected World, by David Easley and Jon Kleinberg, 2010 ([free online book](#))
- Also see the resources listed on http://kmi.tugraz.at/staff/markus/courses/SS2010/707.000_web-science/

Questions?

Raise them **NOW!**

Or ask them later:

- At the end of each class
- Via newsgroup

(now would be a good time though!)

Let's start!

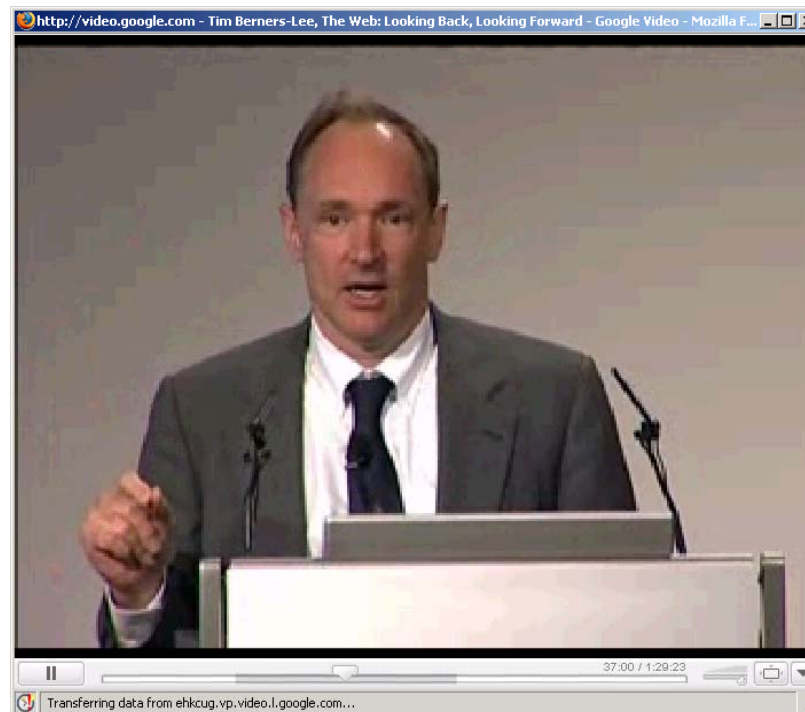
- Science and the Web -

The Web: Looking Back, Looking Forward

Tim Berners-Lee

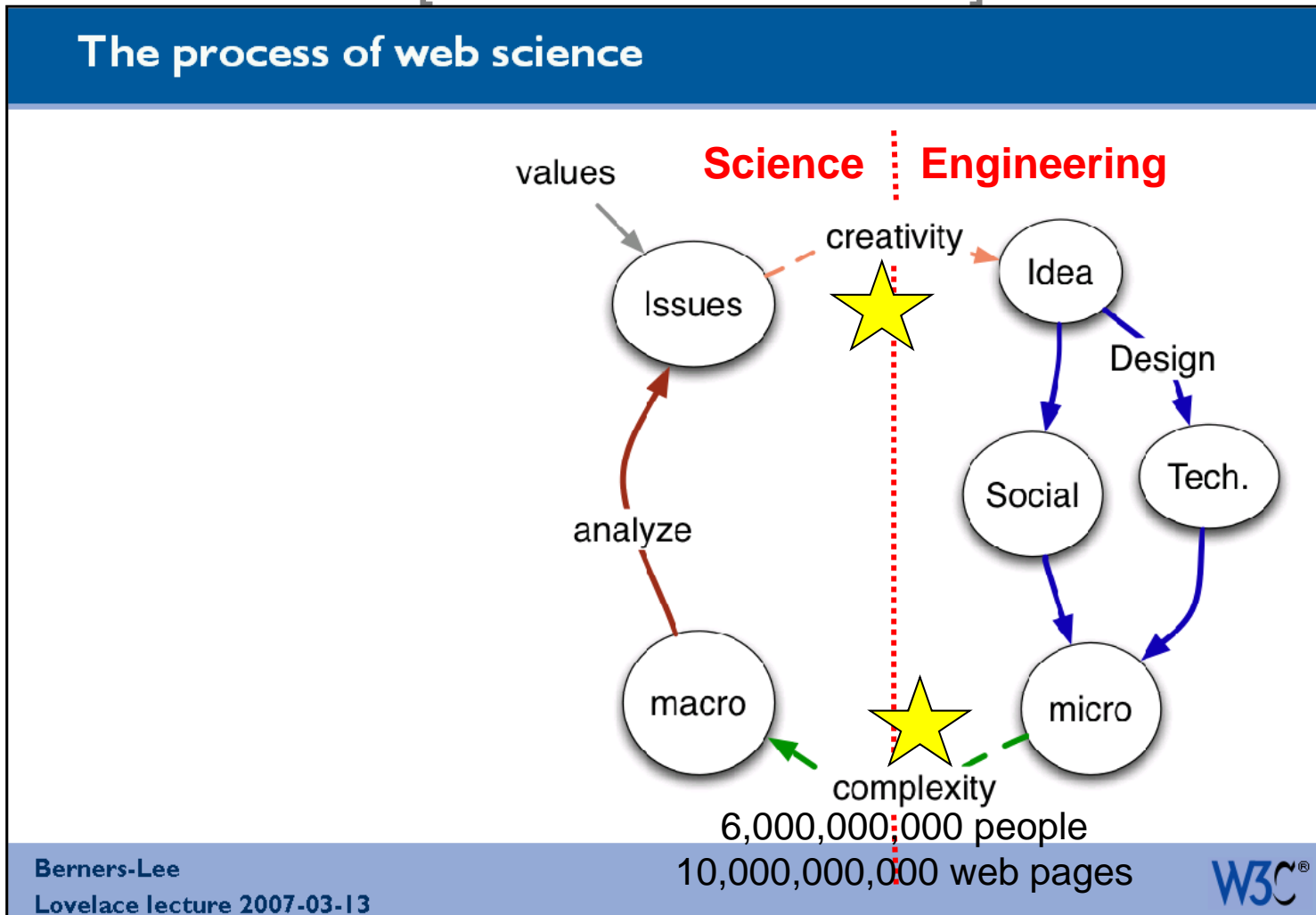
Talking about
Web Science

(~ 70mins)

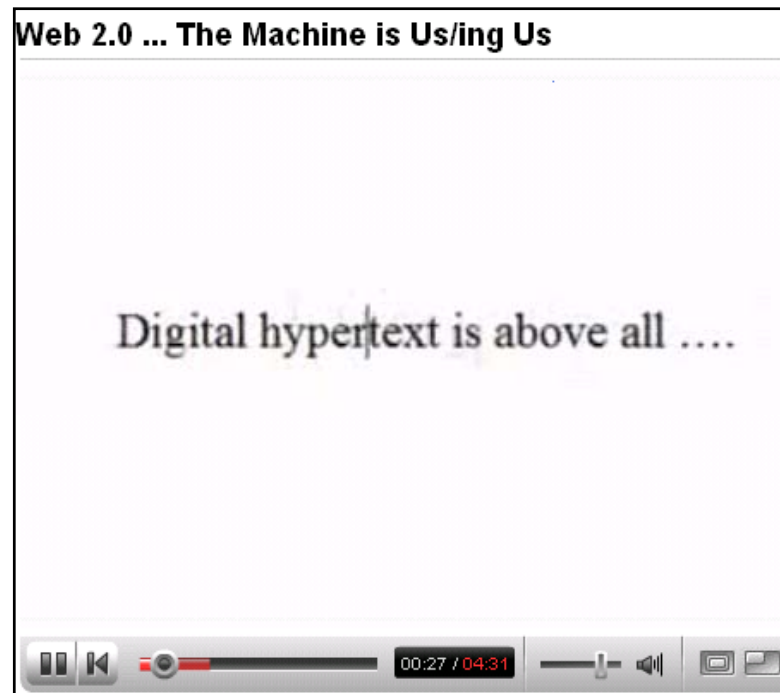


- <http://www.w3.org/2007/Talks/0313-bcs-tbl/> (slides)
- <http://www.bcs.org/server.php?show=nav.9996> (lecture)
- <http://video.google.com/videoplay?docid=5333648384150664992&hl=en-GB> (lecture)

The Web: Looking Back, Looking Forward [Berners-Lee 2007]



The Web Today



<http://www.youtube.com/watch?v=6gmP4nk0E0E>

How do the topics addressed in this movie relate to a Science of the Web?

A Brief Overview of the Web

[Berners Lee et al 1994]

- Vision: the W3 operates without regard to
 - Where information is stored
 - How information is stored or
 - What system is used to manage it
- **Documents** referring to each other by **links**
- Analogy to spiders' construction: the web
- **Hypertext paradigm**
 - Sensitive parts of text representing links
 - A link is followed by mere pointing and clicking (or typing a ref. Nr.)
 - No primary focus on search
- Hypertext links may be made to any data in non-W3 servers (FTP, Gopher, WAIS or internet news) as W3 clients have the ability to present all such data as hypertext.

- The World Wide Web combines Hypertext and Search

the web != internet

The web: Presentation and Extraction [Berners Lee et al 1994]

The architecture of W3 (fig. 2) is one of browsers (clients) which know how to *present* data but not what its origin is, and servers which know how to extract data but are ignorant of how they will be presented. Servers and clients are unaware of the details of each other's operating system quirks and exotic data formats.

All the data in the Web is presented with a uniform human interface (Fig. 3). The documents are stored (or generated by algorithms) throughout the internet by computers with different operating systems and data formats. Following a link from the SLAC home page (the entry into the Web of a SLAC user) to the NIKHEF telephone book is as easy and quick as following the link to a SLAC Working Note.

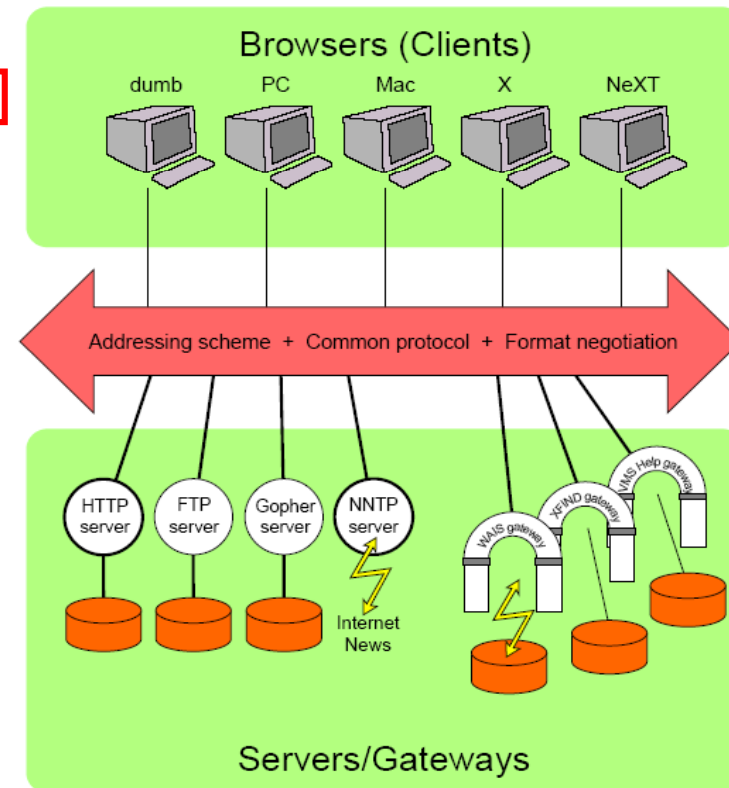


Fig. 2: Architecture of W3

The web [Berners Lee et al 1994]

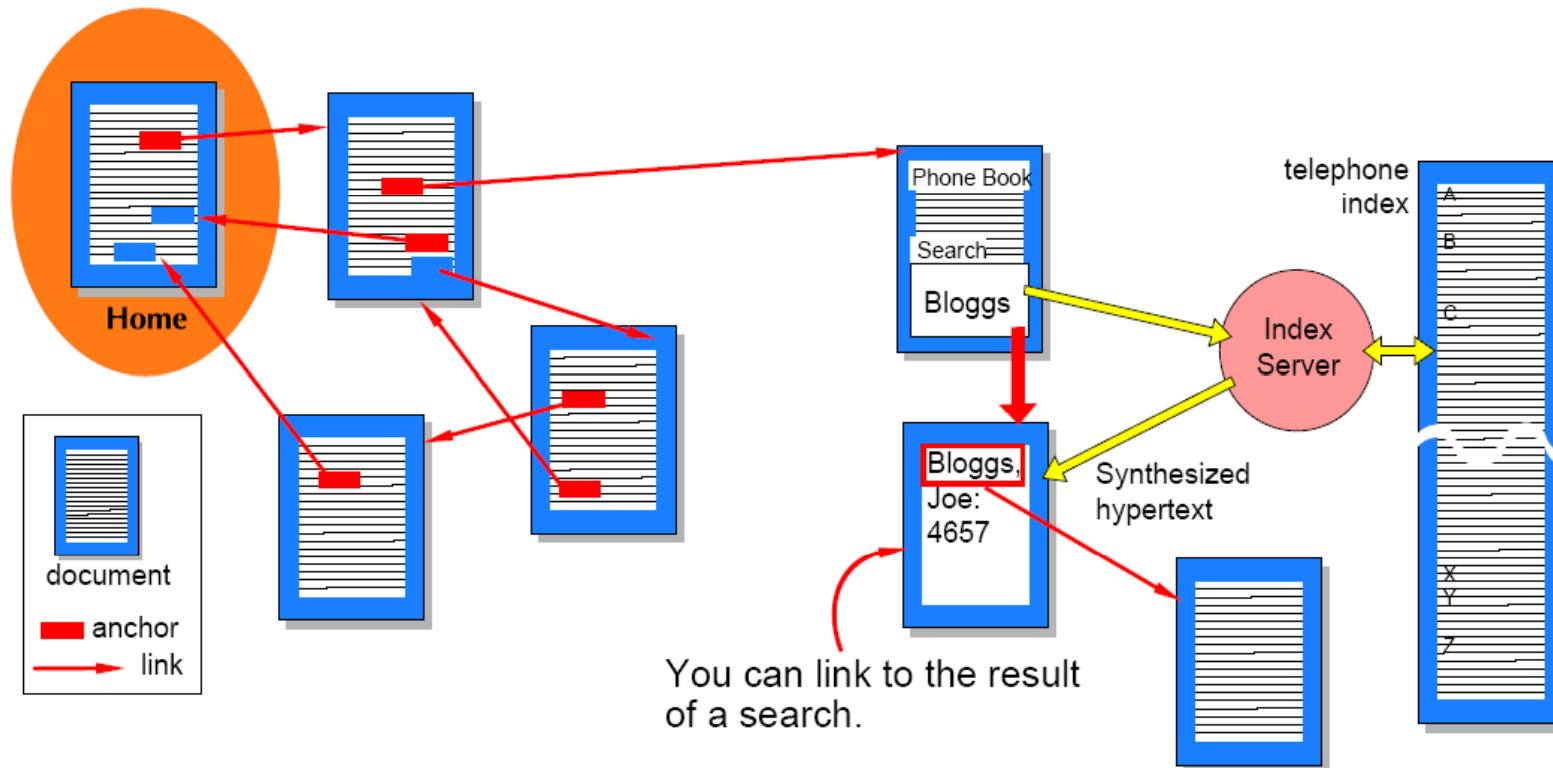


Fig 1. The basic hypertext model is enhanced by searches.

Features of the web

[Berners Lee et al 1992]

Features to note are:-

- Information need only be represented once, as a reference may be made instead of making a copy;
- Links allow the topology of the information to evolve, so modeling the state of human knowledge at any time without constraint;
- The web stretches seamlessly from small personal notes on the local workstation to large databases on other continents;
- Indexes are documents, and so may themselves be found by searches, and/or following links. An index is represented to the user by a “cover page” which describes the data indexed and the properties of the search engine.
- The documents in the web do not have to exist as files: they can be “virtual” documents generated by a server in response to a query or document name. They can therefore represent views of databases, or snapshots of changing data (such as the weather forecast, financial information, etc).

Uniqueness

Networkability

Scalability

Indexability

Adaptability /
Customizability

Historical Vision of the Web

Is a space in which

- *Resources* are identified by Uniform Resource Identifiers (URIs)
- *Protocols* support interaction between agents (HTTP)
- *Formats* represent information resources (HTML)

URI

Uniform Resource Identifier

- Resources may be anything that can be linked to or spoken of
 - Resources can contain a reference to another resource
- *Identifiable*, but not necessarily *retrievable*
 - (e.g. protected access)
- A single global system of identifiers
 - Each URI ideally identifies a single resource in a context-independent manner
- URIs act as names and addresses
- URIs require institutions
 - E.g. the registry that handles domain names

HTTP & HTML: High Level Overview

<http://www.w3.org/Protocols/HTTP/HTTP2.html>

HTTP: A protocol that is basically stateless, a transaction consisting of

- Connection
 - The establishment of a connection by the client to the server - when using TCP/IP port 80 is the well-known port, but other non-reserved ports may be specified in the URL;
- Request
 - The sending, by the client, of a request message to the server;
- Response
 - The sending, by the server, of a response to the client;
- Close
 - The closing of the connection by either both parties.

HTML: A representation format


- Idea: Decoupling of content and representation
- Cues for graphical presentation of content

```
<div>  
<map name="introLinks" id="introLinks">  
<div class="banner">  
<span class="invisible"><a class="bannerLink" href="#">  
Visitors</a> | <a class="bannerLink" href="#">  
<a class="bannerLink" title="Contact Us" href="#">Contact Us</a>  
</div>  
</map>  
</div>
```

Why Web Science?

- Dynamics and evolution
- The “deep web” (resources not available by robots)
- Sampling, lack of complete enumeration
- Scale (e.g. “What’s the percentage of web pages updated daily?”)
- Search (e.g. “What’s the percentage of web pages indexed by search engines?”)
- Web topology
- Artifacts of social interaction (weblogs, etc), web sociology
- ...

Science (in a nutshell)




University of Toronto

Department of Computer Science

What type of question are you asking?

<p>→ Existence:</p> <ul style="list-style-type: none"> ↳ Does X exist? 	<p>→ Relationship</p> <ul style="list-style-type: none"> ↳ Are X and Y related? ↳ Do occurrences of X correlated with occurrences of Y?
<p>→ Description & Classification</p> <ul style="list-style-type: none"> ↳ What is X like? ↳ What are its properties? ↳ How can it be categorized? ↳ How can we measure it? ↳ What are its components? 	<p>→ Causality</p> <ul style="list-style-type: none"> ↳ Does X cause Y? ↳ Does X prevent Y? ↳ What causes X? ↳ What effect does X have on Y?
<p>→ Descriptive-Process</p> <ul style="list-style-type: none"> ↳ How does X work? ↳ What is the process by which X happens? ↳ In what are the steps as X evolves? ↳ How does X achieve its purpose? 	<p>→ Causality-Comparative</p> <ul style="list-style-type: none"> ↳ Does X cause more Y than does Z? ↳ Is X better at preventing Y than is Z? ↳ Does X cause more Y than does Z under one condition but not others?
<p>→ Descriptive-Comparative</p> <ul style="list-style-type: none"> ↳ How does X differ from Y? 	<p>→ Design</p> <ul style="list-style-type: none"> ↳ What is an effective way to achieve X? ↳ How can we improve X?

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What could theories for the web look like?

A few examples of assertions:

- Every page on the web can be reached by following less than 10 links. (True/False/Depends?)
- A wikipedia page contains, on average, 0.03 false facts (True/False/Depends?)
- 1%-4% of users express their search queries in the form of goals such as “increase adsense revenue” (True/False/Depends?)
- The average number of words per search query is more than 3 (True/False/Depends?)

Can these statements be easily validated? Can they lead to good/interesting theories? What constitutes good theories?

Some Quality Characteristics of Theories

- Clarity
- Simplicity
- Predictive Power
- Explanative Power
- Utility
- Testability
- Falsifiability (vs. Falsification)

Networks

A significant part of this course will focus on network theory.

- Graph theory vs. Network theory
 - While graph theory focuses on mathematics, network theory focuses on networks that can be observed in the „real world“
 - Evolution of networks
- There are many different forms of networks available on the net

– Can you name a few of them?



The Web as a Network of Related Sites

<http://www.touchgraph.com/TGGoogleBrowser.html>

(based on Google's „related sites“ functionality)

The screenshot displays the TouchGraph application interface. On the left, a sidebar shows a list of related sites with columns for Name, URL, and Sim# (similarity score). The main area features a network graph where nodes represent websites and edges represent relationships. The 'O'Reilly' node is highlighted in red and is the central focus of the graph. Other prominent nodes include 'Web 2.0', 'WordPress.com', 'YouTube', and 'eHubs'. The interface includes a search bar at the top with the keyword 'web 2.0', a zoom control, and a filter section in the sidebar.

Name	URL	Sim#
Add Video to QuickList R...	video.yahoo...	1
MySpace and YouTube ...	radar.oreilly...	1
Is Corporate America Fin...	blogherald.c...	1
YouTube - Web 2.0 ... The...	connect.edu...	1
All Things Web 2.0 ... YouT...	allthingsweb...	1
YouTube - Web 2.0 ... The...	nota-bene.or...	1
[spam-stopper] mistaken...	comox.textdr...	1
Microsoft pushes spam-fi...	news.com.c...	1
Alexa Web Search - Top 5...	alexa.com/s/...	1
Hitwise Intelligence - Bill...	weblogs.hit...	1
An Inventive Video Journe...	somewhatfr...	1
Web 2.0 Workgroup - A n...	web20workg...	10
Webbreakstuff, a design, d...	webbreakstuff...	1
Emily Chang - eHub	emilychang...	1
Ajaxian	ajaxian.com	1
ProgrammableWeb - Ma...	programma...	1
ReadWriteWeb	readwritew...	1
FeedBlitz - The Leading...	feedblitz.com	1
Web 2.0 Explorer ZDNE...	blogs.zdnet...	1
MobileCrunch	mobilecrunc...	1
TC Techncrunch	techcrunch.c...	1
Particletree	particletree.c...	1
Web 2.0 Expo	web2expo.c...	11
Blog: Shawn Rogers: April...	b-eye-netwo...	1
WEB2 EXPO 07	encounters.t...	1
Web 2.0 Expo 2007, April...	conferences...	1
Web 2.0 Expo 2007, April...	web2expo.c...	1
Web 2.0 Expo 2007, April...	conferences...	1
Web 2.0 Expo 2007, April...	conferences...	1
Flickr: Photos tagged with...	flickr.com/ph...	1
web2expo: Blogs, Photos...	technorati.co...	1
Microformats at Web 2.0 ...	slideshare.n...	1
Web 2.0 Expo San Franc...	newsletter.w...	1
O'Reilly -- What Is Web 2.0	oreillynet.co...	13

Markus S

The Web as a Network of Search Results

<http://www.kartoo.com> (search for „web2.0“)

The screenshot displays the Kartoo search engine interface. At the top, the search bar contains the query "web2.0" and shows "5 690 000 Found results 1 - 14". The main area features a network diagram with nodes representing search results, connected by lines. Nodes include:

- web2.blogbeta.com
- del.icio.us professional
- www.CrystalGraphics.com
- www.web2expo.com
- technorati
- tagged
- www.web2con.com conference
- companies
- web2.0awards.org
- www.flickr.com
- www.go2web20.net
- applications
- user focus
- interface
- www.oreillynet.com
- momentumdesignlab.com
- en.wikipedia.org
- www.criteo.com

On the left side, there is a "Topics" sidebar with a list of categories:

- open source applications
- emerging web technologies
- summit ? october
- 2007 ? san francisco
- december 2006
- tags web2
- professional
- user
- focus
- interface
- applications
- conference
- technorati
- companies
- tagged

Below the topics, there are sponsored advertisements:

- Professional Web Templates**: Hundreds of stylish, affordable and easy-to-use Web Templates. <http://www.CrystalGraphics.com>
- User Interface Design**: We provide focused and streamlined user experiences for your customers. <http://momentumdesignlab.com>
- Criteo Recommendation Engine**: Get Web 2.0, try Criteo's new predictive recommendation engine. <http://www.criteo.com>

The interface also includes navigation buttons like "Web", "Images", "Videos", "Wikipedia", "Search", "help", and "next map".

Delicious as a Network of tags

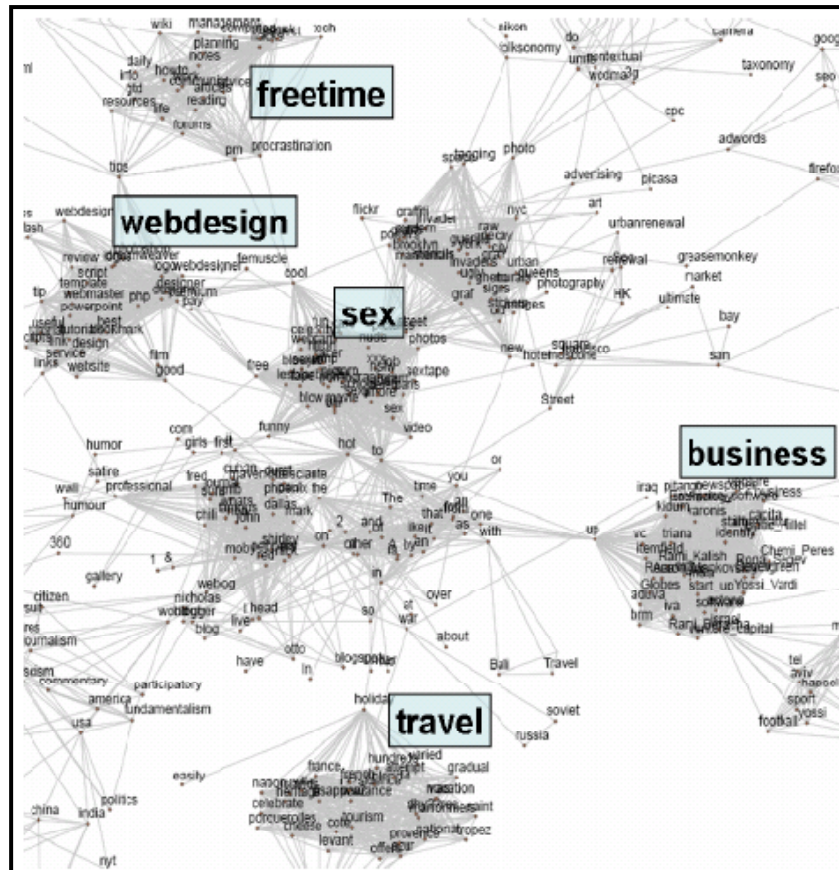


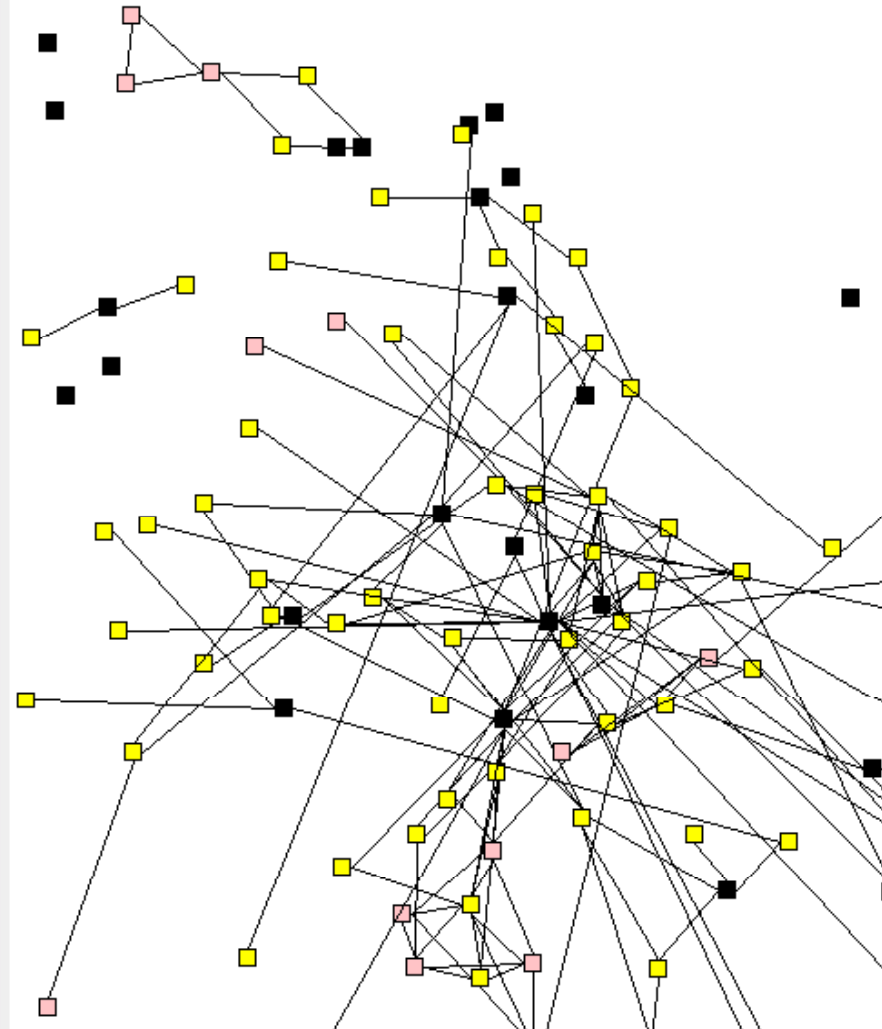
Fig. 1. The delicious tags associated through co-occurrence on items and the clusters emerging

Table 1. The five main clusters of interest based on the Concept-Object network

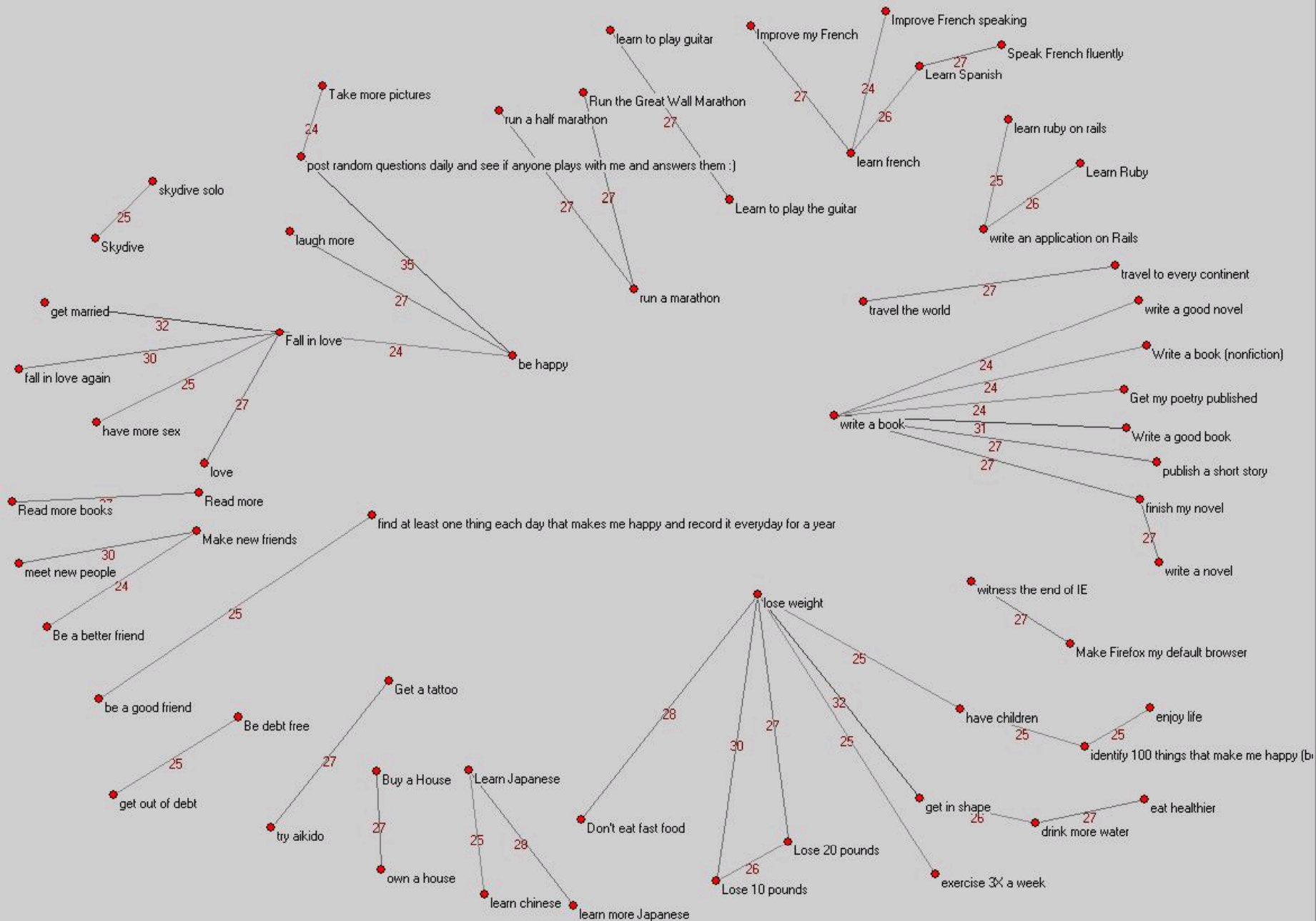
travel	cote, provence, villa, azur, mas, holiday, vacation, tourism, france, heritage
business	venture_capital, enterprise, up, start, venture, newspaper, capital, Segev, pitango, vc
free time	procrastination, info, advice, gtd, life, notes, planning, daily, reading, forums
sex	hot, to, street, pictures, on, photos, free, celeb, adult, lesbian
web design	design, designer, webdesign, premium, logo, logos, dreamweaver, templates, best, good

The Blogosphere as a Network of Blog Posts

In [A model \(framework\) for weblog research](#) it was suggested that one should look at five dimensions to study weblogs. This post shows [that one can](#) obtain a fascinating peek into the blogosphere by looking at just two dimensions [\(links, persons\)](#). Perhaps it is an idea to also add time so that we can see whether the yellow and pink posts occur before (this is possible), during or after the conversation.

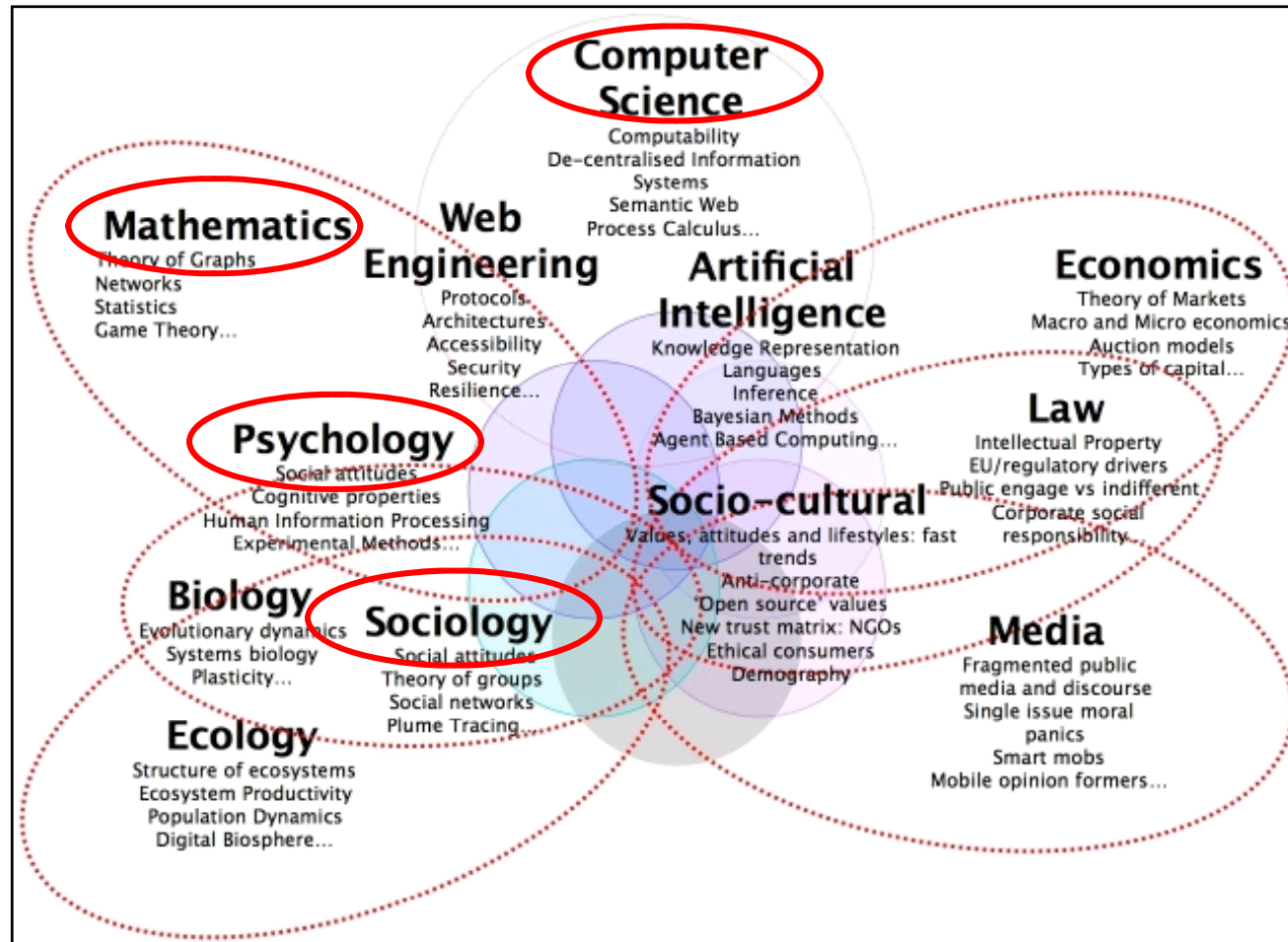


Courtesy of
<http://anjo.blogs.com/>



Web Science

www.webscience.org



Some Course Highlights

An Experimental Study of the Small World Problem [Travers and Milgram 1969]

A Social Network Experiment tailored towards

- Demonstrating
- Defining
- And measuring



Inter-connectedness in a large society (USA)

A test of the modern idea of “six degrees of separation”

Which states that: every person on earth is connected to any other person through a chain of acquaintances not longer than 6

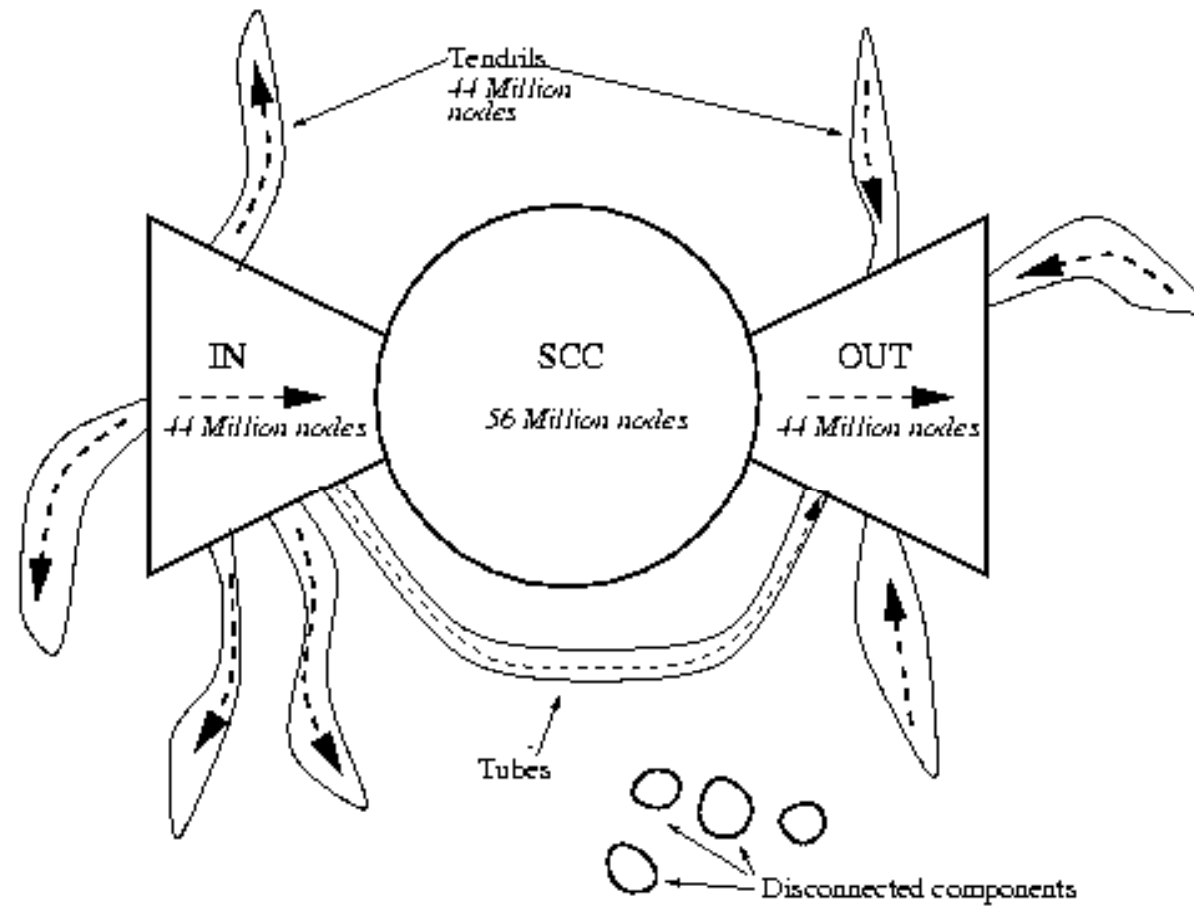
Some Course Highlights

A reported number of 900 Mio people (that is roughly one out of seven people on earth!) watched a video of a previously unknown, video amateur, teenage starwars fan.

How is this possible? How does information spread on the web? How can we model this? What are the effects on individuals and society?

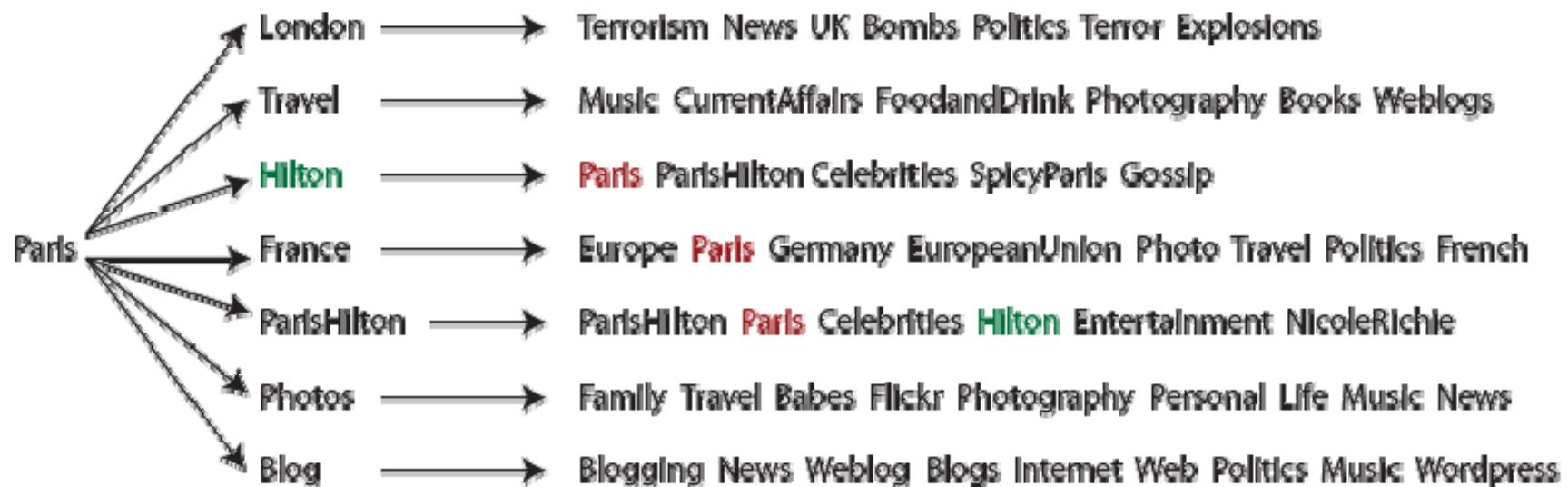
http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/tv_and_radio/article650932.ece

Some Course Highlights



Some Course Highlights

Folksonomy Analysis



Check

- Is there anything else you want to know w.r.t. this course?

Any further questions?

Have a good start in the new semester!
- See you next week