How Google* Works

(& why you should care)

*and Yahoo, and MSN, and …

Panagiotis Takis Metaxas

Computer Science Department

Wellesley College

World Usability Day 2006

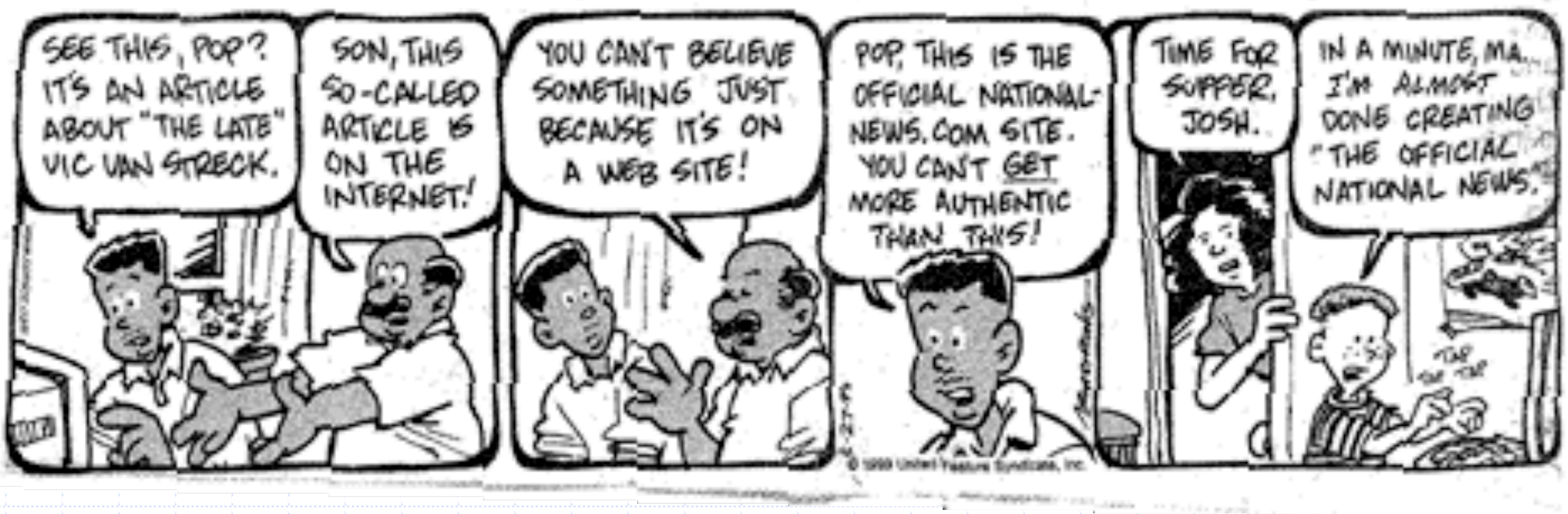
Have you used the Web…

- to get informed?
- to help you make decisions?
  - Financial
  - Medical
  - Political
  - Religious
  - Other?…
- on your computer?
  - Your cell phone?
  - Your PDA?
  - Your thermostat?
  - Your toaster?

- The Web is **huge**
  - >10 **billion** static pages publicly available,
  - …growing every day
  - **Three times** this size, if you count the "**deep web**"
  - **Infinite**, if you count dynamically created pages
- The Web is **omnipresent**

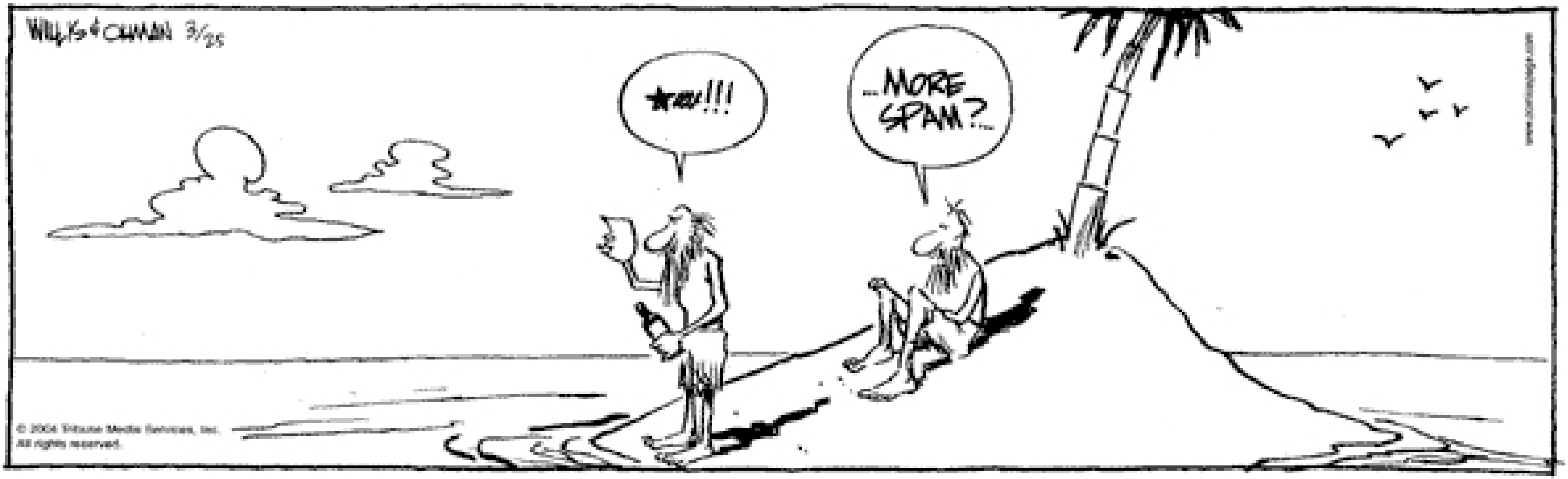
… but it can be unreliable

JUMP START by Robb Armstrong


SEE THIS, POP? IT'S AN ARTICLE ABOUT "THE LATE" VIC VAN STRECK.
SON, THIS SO-CALLED ARTICLE IS ON THE INTERNET!
YOU CAN'T BELIEVE SOMETHING JUST BECAUSE IT'S ON A WEB SITE!
POP, THIS IS THE OFFICIAL NATIONAL-NEWS.COM SITE. YOU CAN'T GET MORE AUTHENTIC THAN THIS!
TIME FOR SUPPER, JOSH.
IN A MINUTE, MA... I'M ALMOST DONE CREATING "THE OFFICIAL NATIONAL NEWS."
TAP TAP TAP
© 1999 United Feature Syndicate, Inc.

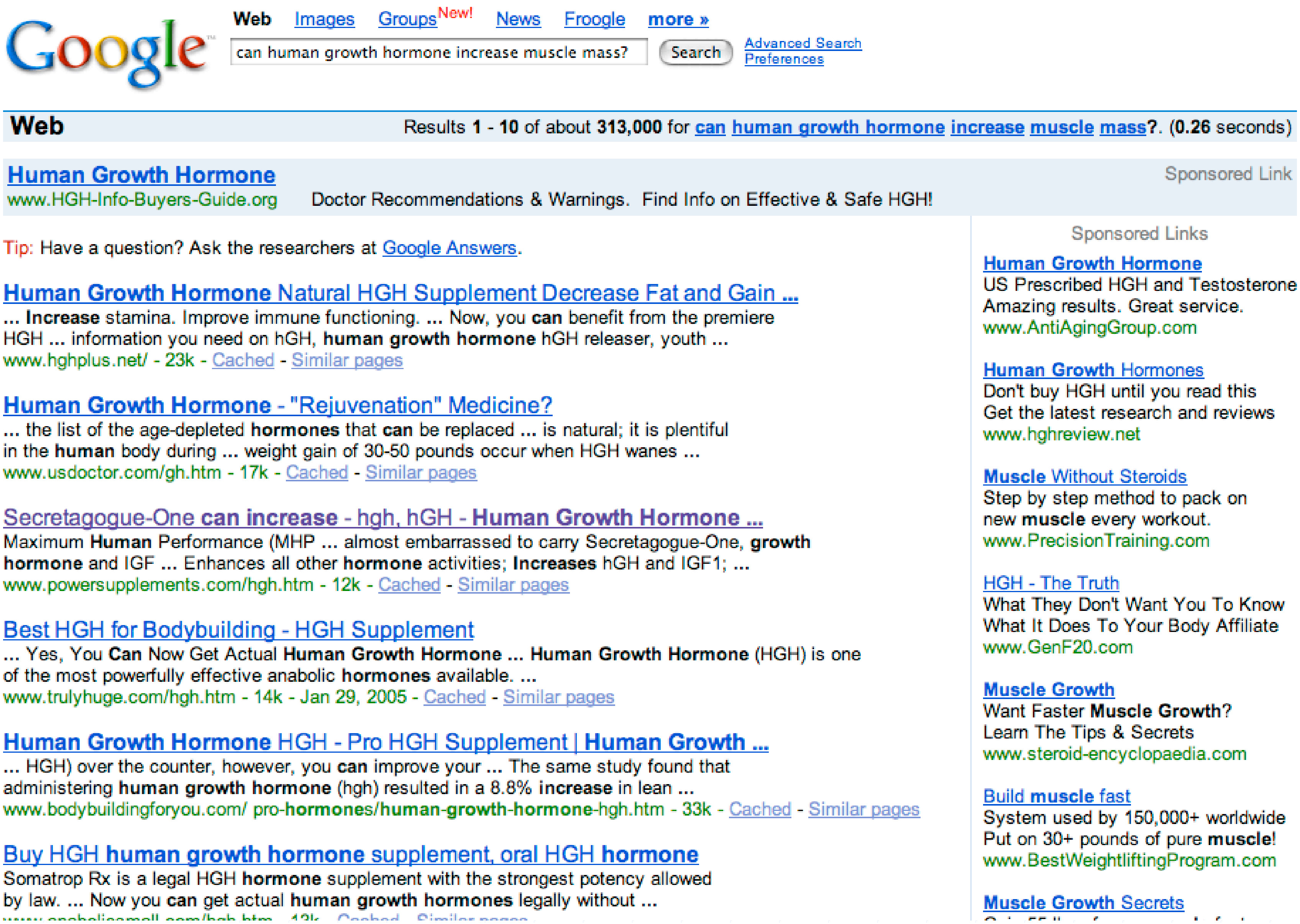
***Anyone* can be an author on the web!**

Email Spam anyone?



50% of emails received at Wellesley College are spam!

The Web has Spam too!



can human growth hormone increase muscle mass?

Web Results **1** - **10** of about **313,000** for can human growth hormone increase muscle mass?. (**0.26** seconds)

Sponsored Link

Human Growth Hormone
www.HGH-Info-Buyers-Guide.org Doctor Recommendations & Warnings. Find Info on Effective & Safe HGH!

Tip: Have a question? Ask the researchers at Google Answers.

Human Growth Hormone Natural HGH Supplement Decrease Fat and Gain ...
... **Increase** stamina. Improve immune functioning. ... Now, you **can** benefit from the premiere HGH ... information you need on hGH, **human growth hormone** hGH releaser, youth ...
www.hghplus.net/ - 23k - Cached - Similar pages

Human Growth Hormone - "Rejuvenation" Medicine?
... the list of the age-depleted **hormones** that **can** be replaced ... is natural; it is plentiful in the **human** body during ... weight gain of 30-50 pounds occur when HGH wanes ...
www.usdoctor.com/gh.htm - 17k - Cached - Similar pages

Secretagogue-One **can increase** - hgh, hGH - **Human Growth Hormone** ...
Maximum **Human** Performance (MHP ... almost embarrassed to carry Secretagogue-One, **growth hormone** and IGF ... Enhances all other **hormone** activities; **Increases** hGH and IGF1; ...
www.powersupplements.com/hgh.htm - 12k - Cached - Similar pages

Best HGH for Bodybuilding - HGH Supplement
... Yes, You **Can** Now Get Actual **Human Growth Hormone** ... **Human Growth Hormone** (HGH) is one of the most powerfully effective anabolic **hormones** available. ...
www.trulyhuge.com/hgh.htm - 14k - Jan 29, 2005 - Cached - Similar pages

Human Growth Hormone HGH - Pro HGH Supplement | **Human Growth** ...
... HGH) over the counter, however, you **can** improve your ... The same study found that administering **human growth hormone** (hgh) resulted in a 8.8% **increase** in lean ...
www.bodybuildingforyou.com/ pro-**hormones**/**human**-**growth**-**hormone**-hgh.htm - 33k - Cached - Similar pages

Buy HGH **human growth hormone** supplement, oral HGH **hormone**
Somatrop Rx is a legal HGH **hormone** supplement with the strongest potency allowed by law. ... Now you **can** get actual **human growth hormones** legally without ...
www.anabolicsmall.com/hgh.htm - 13k - Cached - Similar pages

Sponsored Links

Human Growth Hormone
US Prescribed HGH and Testosterone
Amazing results. Great service.
www.AntiAgingGroup.com

Human Growth Hormones
Don't buy HGH until you read this
Get the latest research and reviews
www.hghreview.net

Muscle Without Steroids
Step by step method to pack on new **muscle** every workout.
www.PrecisionTraining.com

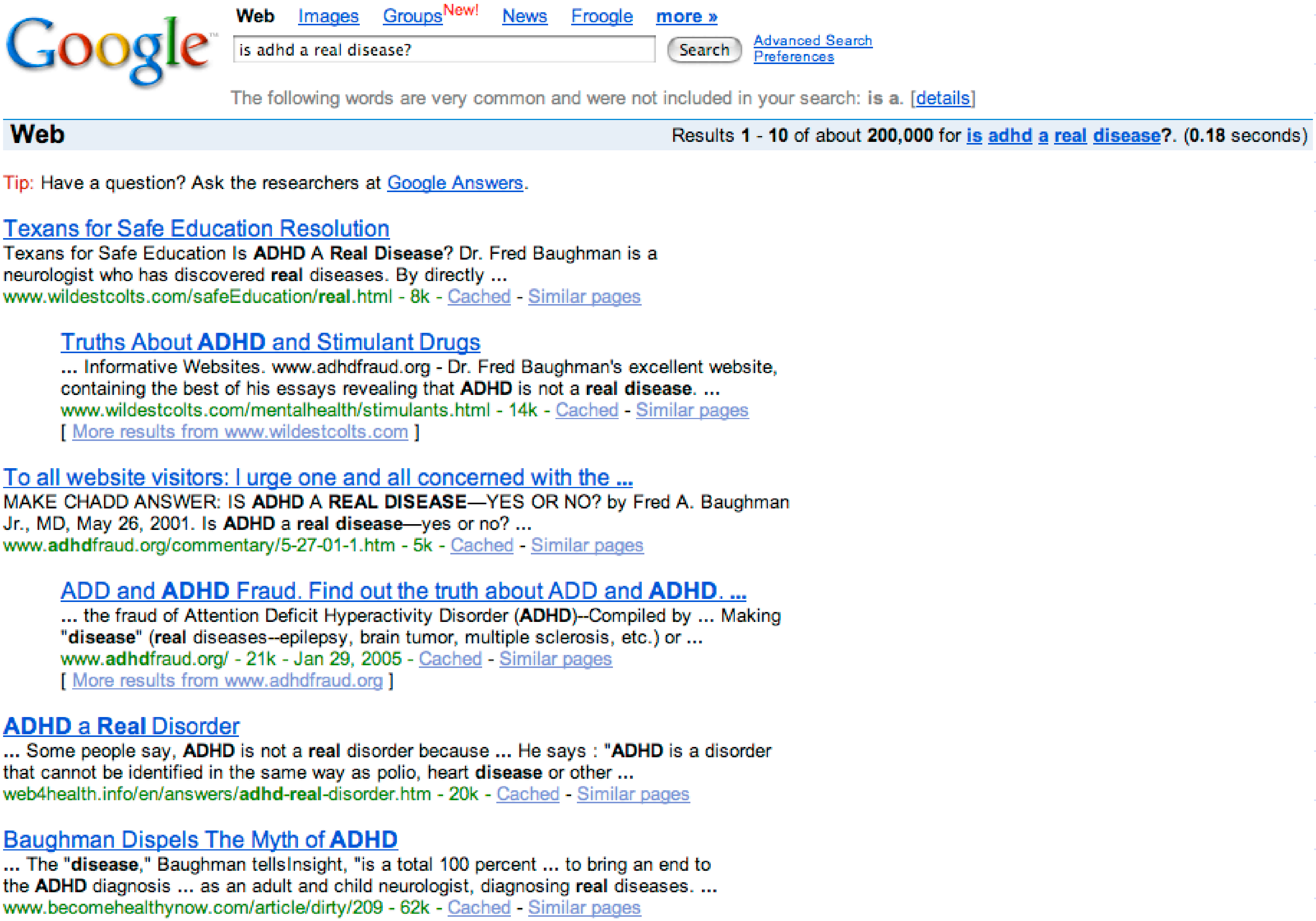
HGH - The Truth
What They Don't Want You To Know
What It Does To Your Body Affiliate
www.GenF20.com

Muscle Growth
Want Faster **Muscle Growth**?
Learn The Tips & Secrets
www.steroid-encyclopaedia.com

Build **muscle** fast
System used by 150,000+ worldwide
Put on 30+ pounds of pure **muscle**!
www.BestWeightliftingProgram.com

Muscle Growth Secrets

Any controversial issue will be spammed!



The following words are very common and were not included in your search: **is a**. [details]

Web Results **1** - **10** of about **200,000** for is adhd a real disease?. (**0.18** seconds)

Tip: Have a question? Ask the researchers at Google Answers.

Texans for Safe Education Resolution
Texans for Safe Education Is **ADHD** A **Real Disease**? Dr. Fred Baughman is a neurologist who has discovered **real** diseases. By directly ...
www.wildestcolts.com/safeEducation/**real**.html - 8k - Cached - Similar pages

Truths About **ADHD** and Stimulant Drugs
... Informative Websites. www.adhdfraud.org - Dr. Fred Baughman's excellent website, containing the best of his essays revealing that **ADHD** is not a **real disease**. ...
www.wildestcolts.com/mentalhealth/stimulants.html - 14k - Cached - Similar pages
[More results from www.wildestcolts.com]

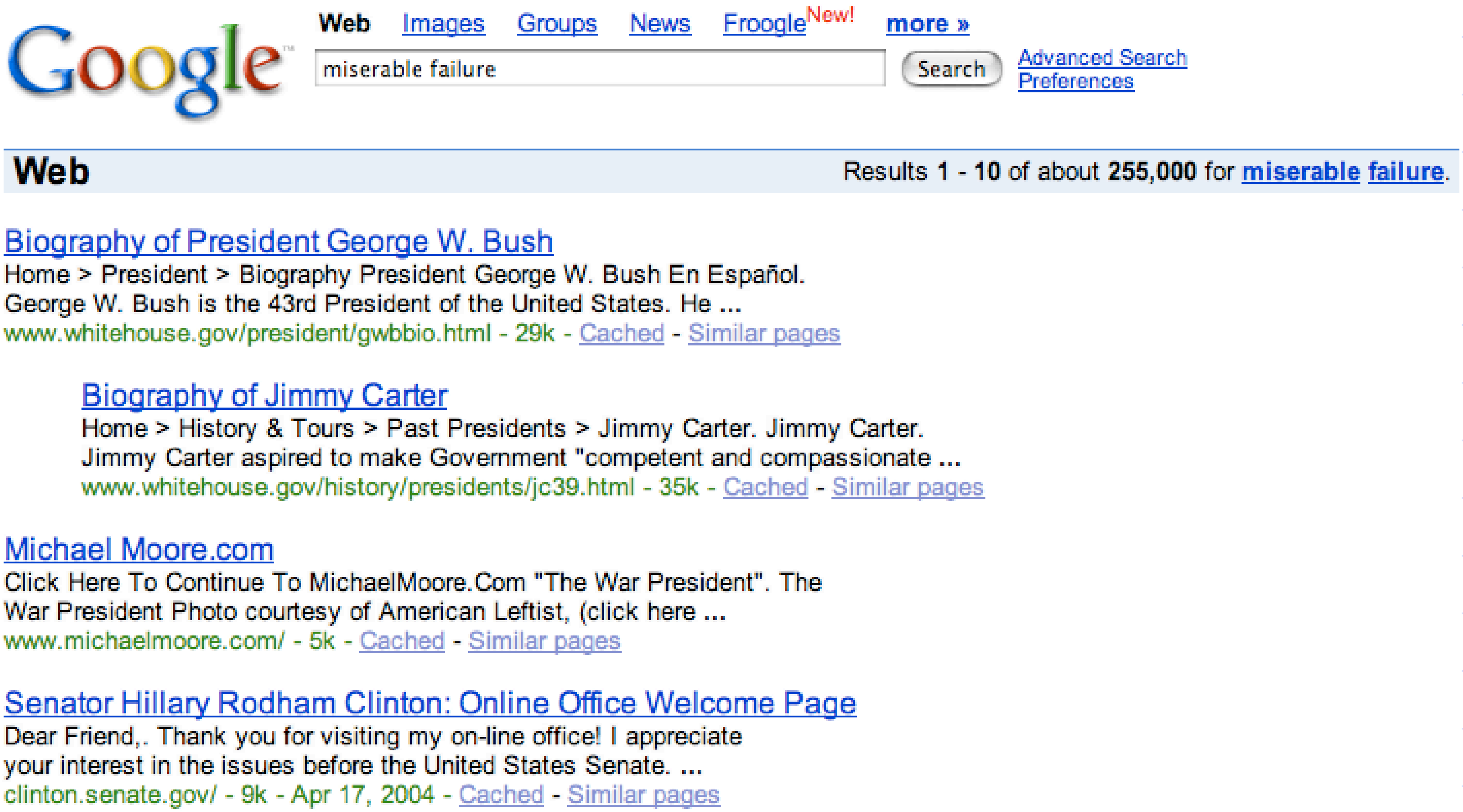
To all website visitors: I urge one and all concerned with the ...
MAKE CHADD ANSWER: IS **ADHD** A **REAL DISEASE**—YES OR NO? by Fred A. Baughman Jr., MD, May 26, 2001. Is **ADHD** a **real disease**—yes or no? ...
www.**adhd**fraud.org/commentary/5-27-01-1.htm - 5k - Cached - Similar pages

ADD and **ADHD** Fraud. Find out the truth about ADD and **ADHD**. ...
... the fraud of Attention Deficit Hyperactivity Disorder (**ADHD**)--Compiled by ... Making "**disease**" (**real** diseases--epilepsy, brain tumor, multiple sclerosis, etc.) or ...
www.**adhd**fraud.org/ - 21k - Jan 29, 2005 - Cached - Similar pages
[More results from www.adhdfraud.org]

ADHD a **Real** Disorder
... Some people say, **ADHD** is not a **real** disorder because ... He says : "**ADHD** is a disorder that cannot be identified in the same way as polio, heart **disease** or other ...
web4health.info/en/answers/**adhd-real**-disorder.htm - 20k - Cached - Similar pages

Baughman Dispels The Myth of **ADHD**
... The "**disease**," Baughman tellsInsight, "is a total 100 percent ... to bring an end to the **ADHD** diagnosis ... as an adult and child neurologist, diagnosing **real** diseases. ...
www.becomehealthynow.com/article/dirty/209 - 62k - Cached - Similar pages

… you like it or not!



miserable failure

Web Results **1** - **10** of about **255,000** for **miserable** **failure**.

Biography of President George W. Bush
Home > President > Biography President George W. Bush En Español. George W. Bush is the 43rd President of the United States. He ...
www.whitehouse.gov/president/gwbbio.html - 29k - Cached - Similar pages

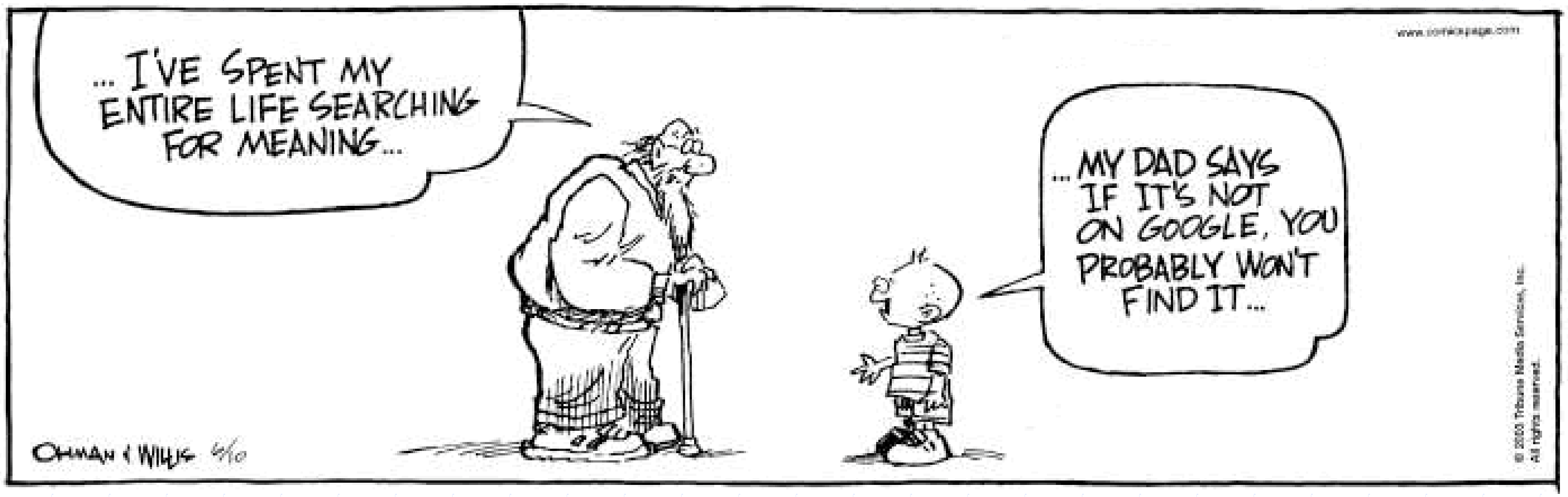
Biography of Jimmy Carter
Home > History & Tours > Past Presidents > Jimmy Carter. Jimmy Carter. Jimmy Carter aspired to make Government "competent and compassionate ...
www.whitehouse.gov/history/presidents/jc39.html - 35k - Cached - Similar pages

Michael Moore.com
Click Here To Continue To MichaelMoore.Com "The War President". The War President Photo courtesy of American Leftist, (click here ...
www.michaelmoore.com/ - 5k - Cached - Similar pages

Senator Hillary Rodham Clinton: Online Office Welcome Page
Dear Friend,. Thank you for visiting my on-line office! I appreciate your interest in the issues before the United States Senate. ...
clinton.senate.gov/ - 9k - Apr 17, 2004 - Cached - Similar pages

**But Google is usually so good in finding info…
Why does it do that?**

Why?


...I'VE SPENT MY ENTIRE LIFE SEARCHING FOR MEANING...
...MY DAD SAYS IF IT'S NOT ON GOOGLE, YOU PROBABLY WON'T FIND IT...
www.comicspage.com
OHMAN & WILLIS 6/10
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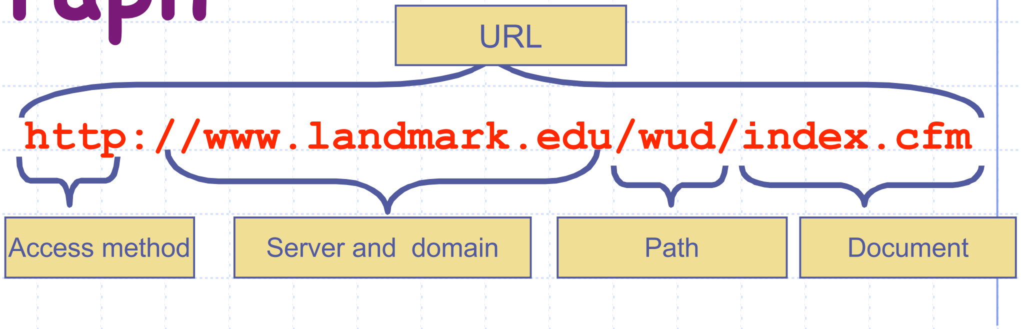
- Web Spam:
  - Attempt to **modify** the web (its structure and contents), and thus **influence** search engine results in ways **beneficial** to web spammers

How do they do it?

The Web is a Graph


URL

http://www.landmark.edu/wud/index.cfm

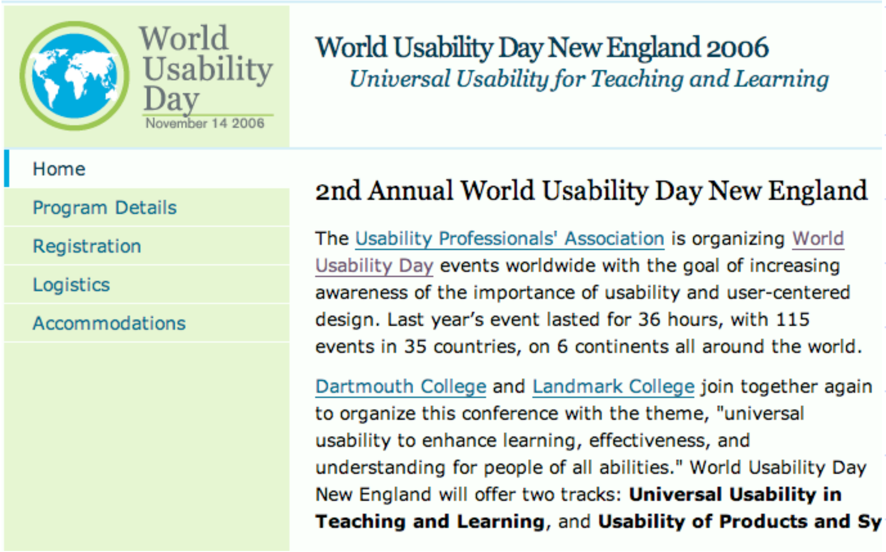
Access method

Server and domain

Path

Document

- Directed Graph of Nodes and Arcs (directed edges)
  - Nodes = web **pages**
  - Arcs = **hyperlinks** from a page to another
- A graph can be **explored**
- A graph can be **indexed**



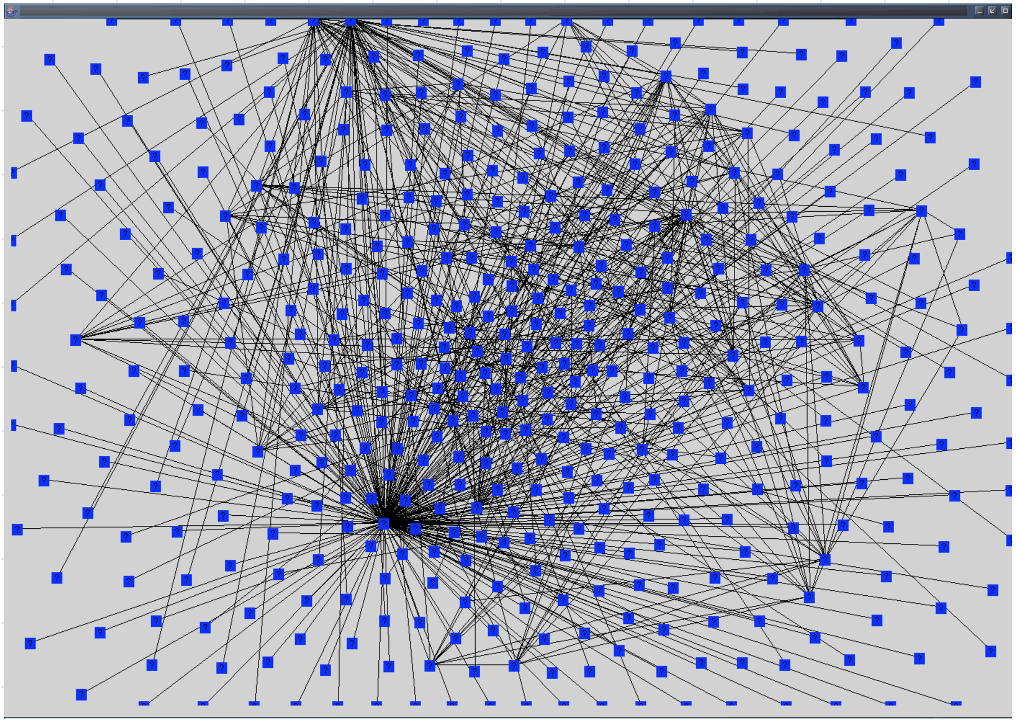
World Usability Day New England 2006

Universal Usability for Teaching and Learning

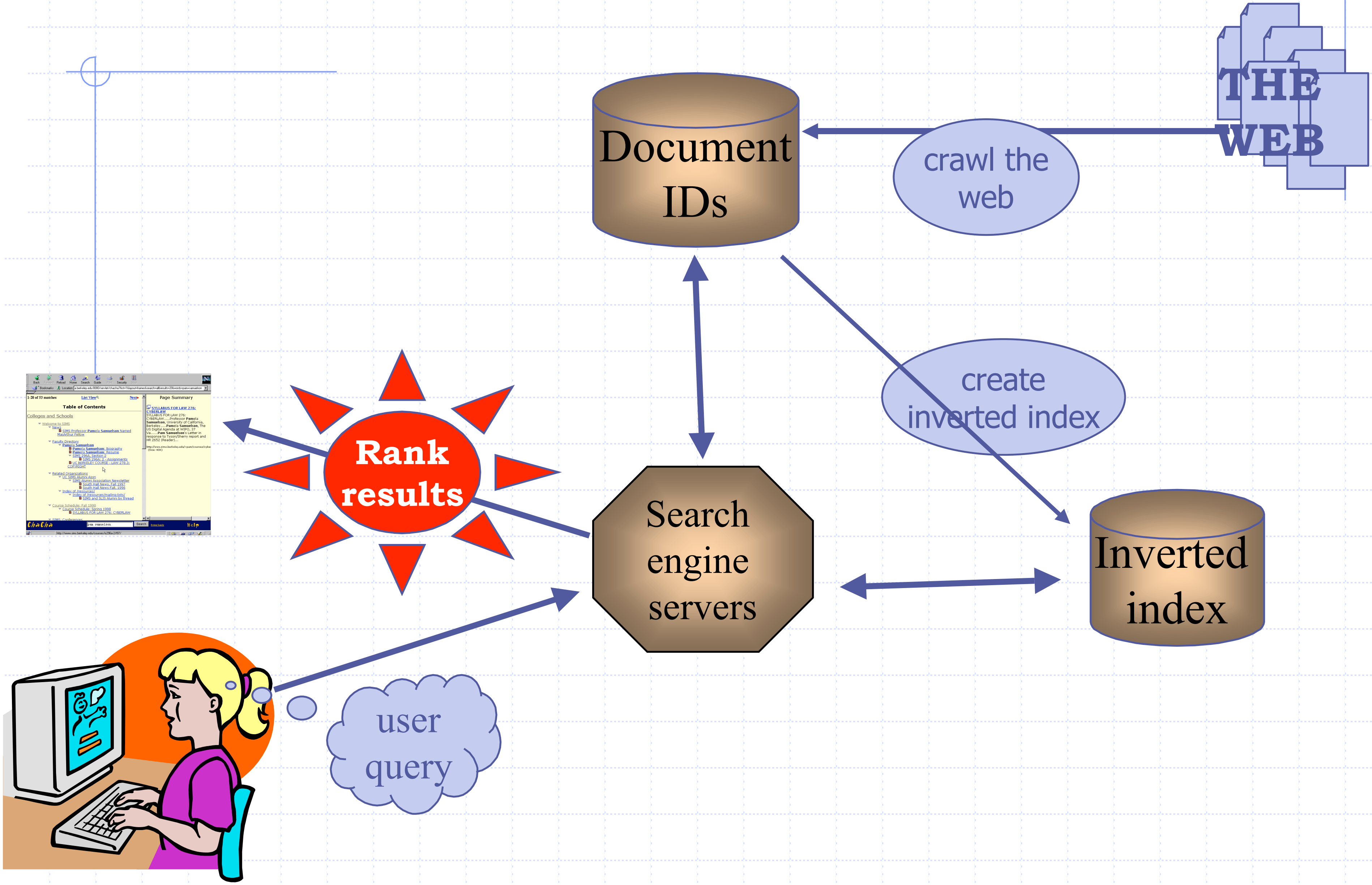
2nd Annual World Usability Day New England

The Usability Professionals' Association is organizing World Usability Day events worldwide with the goal of increasing awareness of the importance of usability and user-centered design. Last year's event lasted for 36 hours, with 115 events in 35 countries, on 6 continents all around the world.

Dartmouth College and Landmark College join together again to organize this conference with the theme, "universal usability to enhance learning, effectiveness, and understanding for people of all abilities." World Usability Day New England will offer two tracks: **Universal Usability in Teaching and Learning**, and **Usability of Products and Sy**



How Google (and the other search engines) Work



a.berkeley.edu:8080/servlet/chacha?first=1&layout=frames&search=all&results=20&words=pam+samuelson

1-20 of 53 matches List View Next

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    - Pamela Samuelson
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      - Pamela Samuelson: Resume
      - SIMS 296A, Section 2
        - SIMS 296A: 2 - Assignments
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Page Summary

SYLLABUS FOR LAW 276: CYBERLAW

SYLLABUS FOR LAW 276: CYBERLAW......Professor **Pam**ela **Samuelson**, University of California, Berkeley......**Pamela Samuelson**, The US Digital Agenda at WIPO, 37 Va.......**Pam Samuelson**'s Letter in response to Tyson/Sherry report and HR 2652 (Reader)...

http://www.sims.berkeley.edu/~pam/courses/cyber (Size: 40K)

ChaCha pam samuelson Search Power Search Help

http://www.sims.berkeley.edu/courses/is296a-2/f97/

A Brief History of Search Engines

Rank results

- **1st Generation (ca 1994):**
  - AltaVista, Excite, Infoseek…
  - Ranking based on **Content**:
    - Pure Information Retrieval
- **2nd Generation (ca 1996):**
  - Lycos
  - Ranking based on **Content + Structure**
    - Site Popularity
- **3rd Generation (ca 1998):**
  - Google, Teoma, Yahoo
  - Ranking based on **Content + Structure + Value**
    - Page Reputation
- **In the Works**
  - Ranking based on "the need behind the query"

1st Generation: Content Similarity

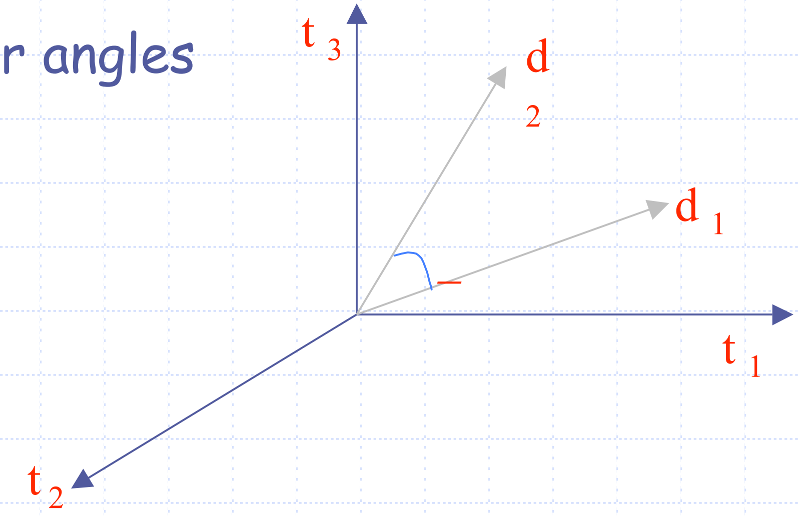
- *Content Similarity Ranking*:
  The more rare words two documents share, the more similar they are

- Documents are treated as "**bags of words**" (no effort to "understand" the contents)

- Similarity is measured by vector angles

- Query Results are ranked by sorting the angles between query and documents

- **How To Spam?**



1st Generation: How to Spam

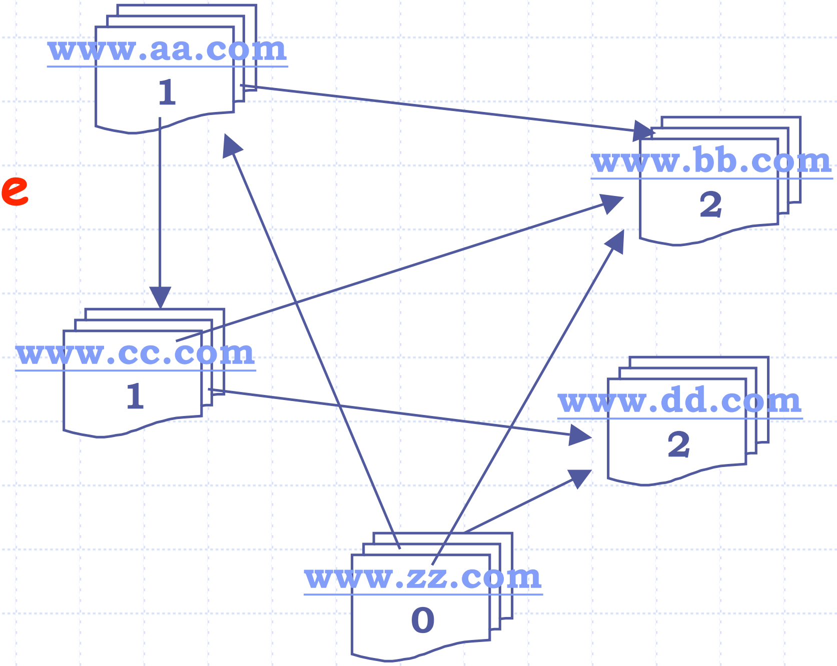
- *“Keyword stuffing”:*
  Add keywords, text, to increase content similarity

- Searching for Jennifer Aniston?

SEX SEXY MONICA LEWINSKY JENNIFER LOPEZ CLAUDIA SCHIFFER CINDY CRAWFORD **JENNIFER ANNISTON** GILLIAN ANDERSON MADONNA NIKI TAYLOR ELLE MACPHERSON KATE MOSS CAROL ALT TYRA BANKS FREDERIQUE KATHY IRELAND PAM ANDERSON KAREN MULDER VALERIA MAZZA SHALOM HARLOW AMBER VALLETTA LAETITA CASTA BETTIE PAGE HEIDI KLUM PATRICIA FORD DAISY FUENTES KELLY BROOK SEX SEXY MONICA LEWINSKY JENNIFER LOPEZ CLAUDIA SCHIFFER CINDY CRAWFORD **JENNIFER ANNISTON** GILLIAN ANDERSON MADONNA NIKI TAYLOR ELLE MACPHERSON KATE MOSS CAROL ALT TYRA BANKS FREDERIQUE KATHY IRELAND PAM ANDERSON KAREN MULDER VALERIA MAZZA SHALOM HARLOW AMBER VALLETTA LAETITA CASTA BETTIE PAGE HEIDI KLUM PATRICIA FORD DAISY FUENTES KELLY BROOK SEX SEXY MONICA LEWINSKY JENNIFER LOPEZ CLAUDIA SCHIFFER CINDY CRAWFORD **JENNIFER ANNISTON** GILLIAN ANDERSON MADONNA NIKI TAYLOR ELLE MACPHERSON KATE MOSS CAROL ALT TYRA BANKS FREDERIQUE KATHY IRELAND PAM ANDERSON KAREN MULDER VALERIA MAZZA SHALOM HARLOW AMBER VALLETTA LAETITA CASTA BETTIE PAGE HEIDI KLUM PATRICIA FORD DAISY FUENTES KELLY BROOK SEX SEXY MONICA LEWINSKY JENNIFER LOPEZ CLAUDIA SCHIFFER CINDY CRAWFORD **JENNIFER ANNISTON** GILLIAN ANDERSON MADONNA NIKI TAYLOR ELLE MACPHERSON KATE MOSS CAROL ALT TYRA BANKS FREDERIQUE KATHY IRELAND PAM ANDERSON KAREN MULDER VALERIA MAZZA SHALOM HARLOW AMBER VALLETTA LAETITA CASTA BETTIE PAGE HEIDI KLUM PATRICIA FORD DAISY FUENTES KELLY BROOK

2nd Generation: Add Popularity

- A hyperlink
  from a page in site A
  to some page in site B
  is considered a **popularity vote**
  from site A to site B

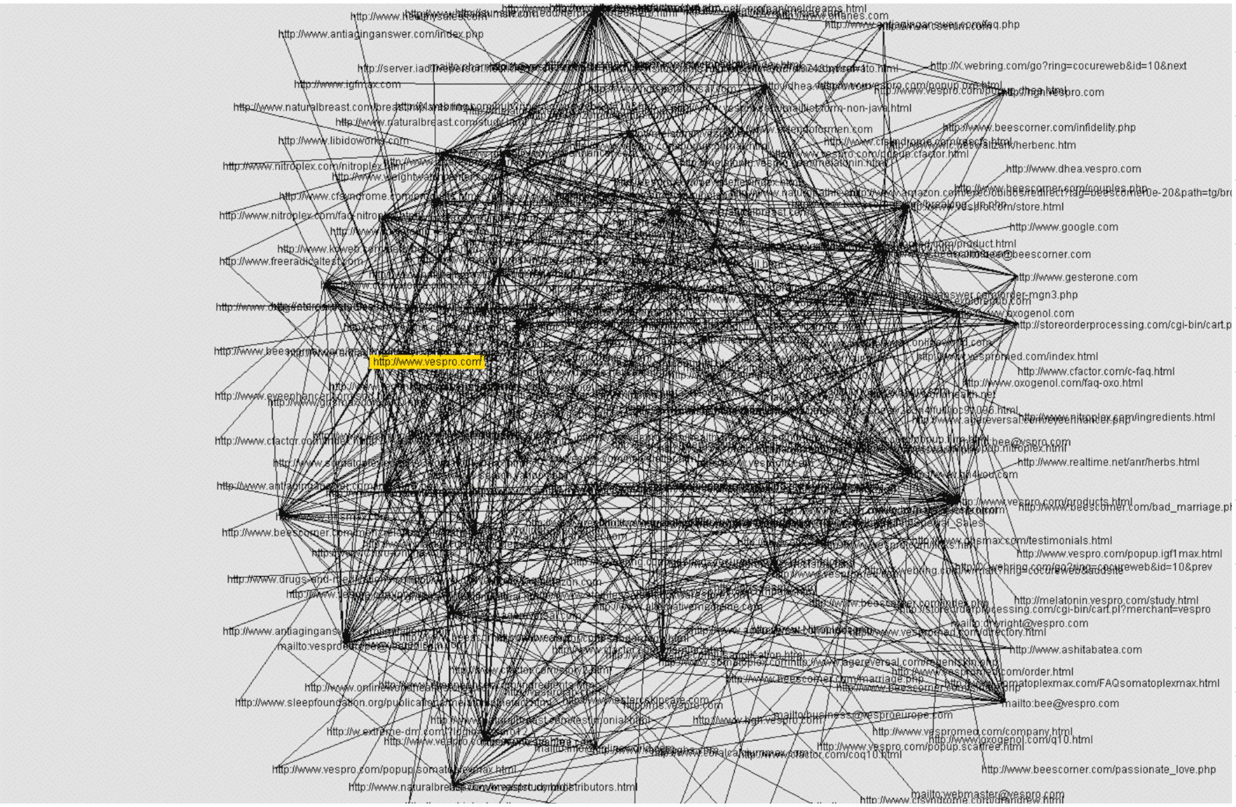


- Rank similar documents according to popularity

- **How To Spam?**

2nd Generation: How to Spam

- ***Create "Link Farms":***
  Heavily interconnected sites spam popularity

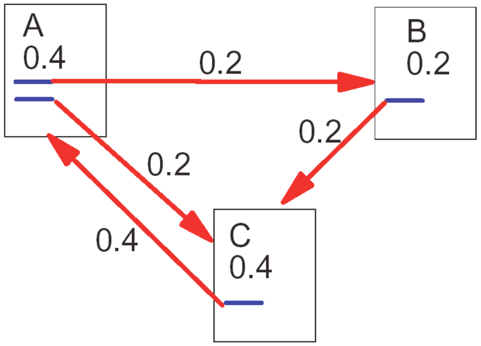

http://www.vespro.com/
http://www.antiaginganswer.com/index.php
http://www.healthysites.com
http://X.webring.com/go?ring=cocureweb&id=10&next
http://www.dhea.vespro.com
http://www.igf1max.com
http://www.naturalbreast.com
http://www.libidoworks.com
http://www.nitroplex.com/nitroplex.html
http://www.beescorner.com/infidelity.php
http://www.google.com
http://www.gesterone.com
http://www.freeradicaltest.com
http://storeorderprocessing.com/cgi-bin/cart.p
http://www.cfactor.com/c-faq.html
http://www.oxogenol.com/faq-oxo.html
http://www.realtime.net/anr/herbs.html
http://www.beescorner.com/bad_marriage.p
http://www.vespro.com/popup.igf1max.html
http://melatonin.vespro.com/study.html
http://www.ashitabatea.com
mailto:bee@vespro.com
http://www.vespromed.com/company.html
http://www.beescorner.com/passionate_love.php
http://www.sleepfoundation.org/publications
http://www.vespro.com/popup.somato
http://www.drugs-and-health
http://www.antiagingans
http://www.beescorner.com
http://www.cfactor.com
http://www.eyeenhancements
mailto:webmaster@vespro.com

3rd Generation: Add Reputation

- The **reputation** “PageRank” of a page P_i = the sum
  of a fraction of the reputations
  of all pages P_j that point to P_i

$$Pi = (1-d) + d \bullet \sum_{j->i} \frac{Pj}{Cj}$$

- Idea similar to academic **co-citations**



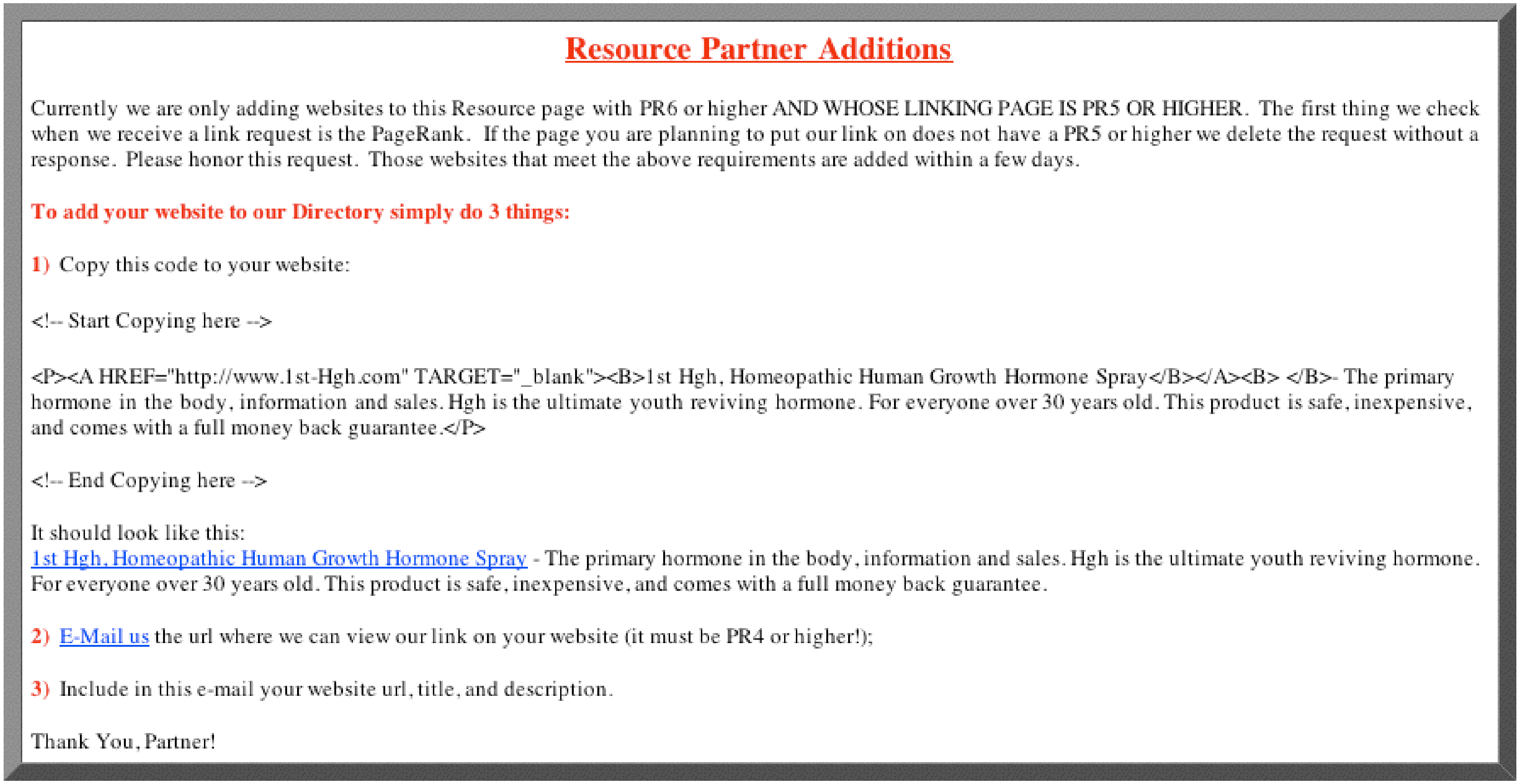
Simplified PageRank Calculation

- Beautiful Math behind it
  - PR = principal eigenvector of the web’s link matrix
  - PR equivalent to the chance of randomly surfing to the page

- **How To Spam?**

3rd Generation: How to Spam

- *Organize Mutual Admiration Societies:*
  “link farms” of irrelevant reputable sites



Resource Partner Additions

Currently we are only adding websites to this Resource page with PR6 or higher AND WHOSE LINKING PAGE IS PR5 OR HIGHER. The first thing we check when we receive a link request is the PageRank. If the page you are planning to put our link on does not have a PR5 or higher we delete the request without a response. Please honor this request. Those websites that meet the above requirements are added within a few days.

To add your website to our Directory simply do 3 things:

1) Copy this code to your website:

```
<!-- Start Copying here -->

<P><A HREF="http://www.1st-Hgh.com" TARGET="_blank"><B>1st Hgh, Homeopathic Human Growth Hormone Spray</B></A><B> </B>- The primary hormone in the body, information and sales. Hgh is the ultimate youth reviving hormone. For everyone over 30 years old. This product is safe, inexpensive, and comes with a full money back guarantee.</P>

<!-- End Copying here -->
```

It should look like this:
1st Hgh, Homeopathic Human Growth Hormone Spray - The primary hormone in the body, information and sales. Hgh is the ultimate youth reviving hormone. For everyone over 30 years old. This product is safe, inexpensive, and comes with a full money back guarantee.

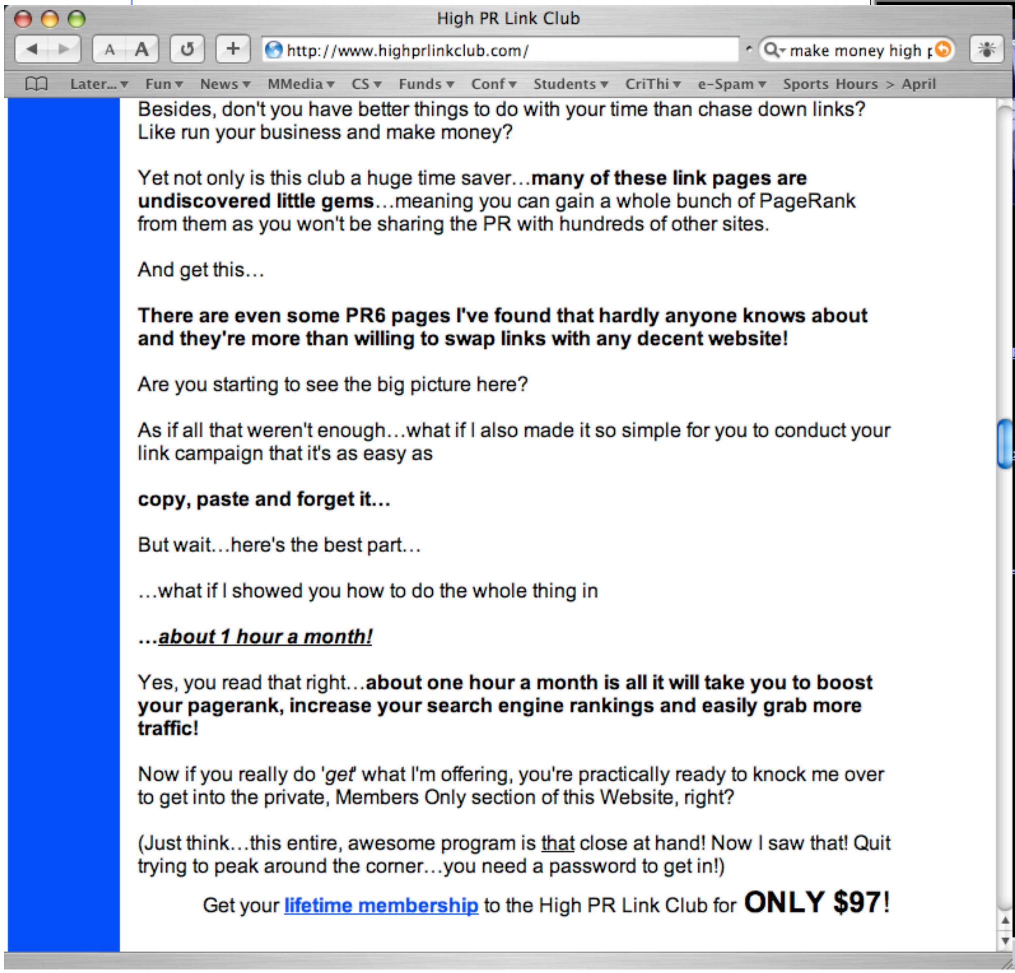
2) E-Mail us the url where we can view our link on your website (it must be PR4 or higher!);

3) Include in this e-mail your website url, title, and description.

Thank You, Partner!

An Industry is Born

- "Search Engine Optimization" Companies
- Advertisement Consultants
- Conferences


High PR Link Club
http://www.highprlinkclub.com/
make money high p
Later... Fun News MMedia CS Funds Conf Students CriThi e-Spam Sports Hours > April

Besides, don't you have better things to do with your time than chase down links? Like run your business and make money?

Yet not only is this club a huge time saver…**many of these link pages are undiscovered little gems**…meaning you can gain a whole bunch of PageRank from them as you won't be sharing the PR with hundreds of other sites.

And get this…

There are even some PR6 pages I've found that hardly anyone knows about and they're more than willing to swap links with any decent website!

Are you starting to see the big picture here?

As if all that weren't enough…what if I also made it so simple for you to conduct your link campaign that it's as easy as

copy, paste and forget it…

But wait…here's the best part…

…what if I showed you how to do the whole thing in

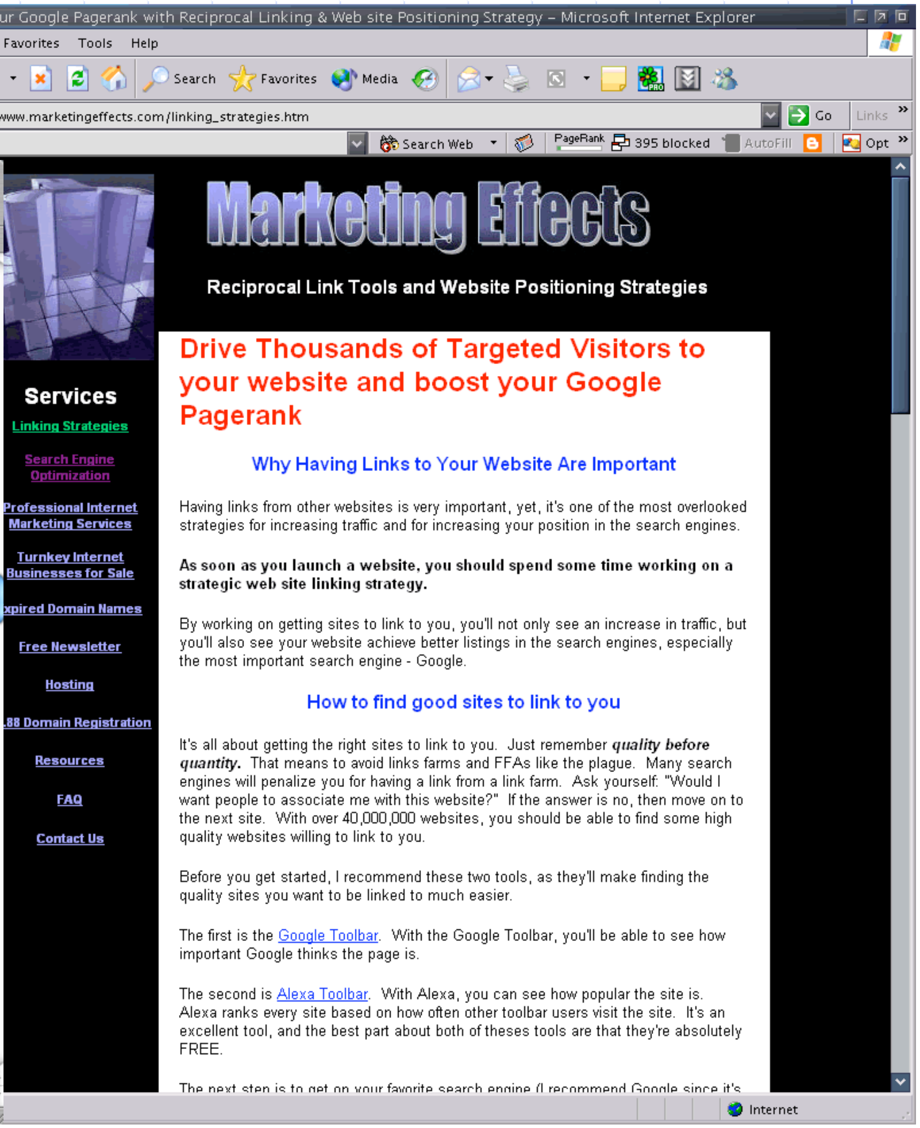
…*about 1 hour a month!*

Yes, you read that right…**about one hour a month is all it will take you to boost your pagerank, increase your search engine rankings and easily grab more traffic!**

Now if you really do '*get*' what I'm offering, you're practically ready to knock me over to get into the private, Members Only section of this Website, right?

(Just think…this entire, awesome program is that close at hand! Now I saw that! Quit trying to peak around the corner…you need a password to get in!)

Get your lifetime membership to the High PR Link Club for **ONLY $97!**


Boost your Google Pagerank with Reciprocal Linking & Web site Positioning Strategy – Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.marketingeffects.com/linking_strategies.htm Go Links
Google Search Web PageRank 395 blocked AutoFill Opt
Marketing Effects
Internet

Reciprocal Link Tools and Website Positioning Strategies

Services

Linking Strategies
Search Engine Optimization
Professional Internet Marketing Services
Turnkey Internet Businesses for Sale
xpired Domain Names
Free Newsletter
Hosting
.88 Domain Registration
Resources
FAQ
Contact Us

Drive Thousands of Targeted Visitors to your website and boost your Google Pagerank

Why Having Links to Your Website Are Important

Having links from other websites is very important, yet, it's one of the most overlooked strategies for increasing traffic and for increasing your position in the search engines.

As soon as you launch a website, you should spend some time working on a strategic web site linking strategy.

By working on getting sites to link to you, you'll not only see an increase in traffic, but you'll also see your website achieve better listings in the search engines, especially the most important search engine - Google.

How to find good sites to link to you

It's all about getting the right sites to link to you. Just remember ***quality before quantity.*** That means to avoid links farms and FFAs like the plague. Many search engines will penalize you for having a link from a link farm. Ask yourself: "Would I want people to associate me with this website?" If the answer is no, then move on to the next site. With over 40,000,000 websites, you should be able to find some high quality websites willing to link to you.

Before you get started, I recommend these two tools, as they'll make finding the quality sites you want to be linked to much easier.

The first is the Google Toolbar. With the Google Toolbar, you'll be able to see how important Google thinks the page is.

The second is Alexa Toolbar. With Alexa, you can see how popular the site is. Alexa ranks every site based on how often other toolbar users visit the site. It's an excellent tool, and the best part about both of theses tools are that they're absolutely FREE.

The next step is to get on your favorite search engine (I recommend Google since it's

Unanswered Spam Attacks

- Business weapons
  - "more evil than satan"
- Political weapon in pre-election season
  - "miserable failure"
  - "waffles"
  - "Clay Shaw" (+ 50 Republicans)
- Misinformation
  - Promote hGH
  - Discredit AD/HD research
- Activism / online protest
  - "Egypt"
  - "Jew"
- Other "Google bombs" we do not know?
  - "…views expressed by the sites in your results are not in any way endorsed by Google…"

Is there a pattern on how to spam?

- Search Engine's Action
- 1st Generation: **Similarity**
  - Content
- 2nd Generation: + **Popularity**
  - Content + Structure
- 3rd Generation: + **Reputation**
  - Content + Structure + Value
- In the Works
  - Ranking based on "the need behind the query"

- Web Spammers Reaction
- **Add keywords** so as to increase content similarity
- + Create "**link farms**" of heavily interconnected sites
- + Organize "**mutual admiration societies**" of irrelevant reputable sites
- ??

Can you guess what they will do?

And Now For Something Completely(?) Different

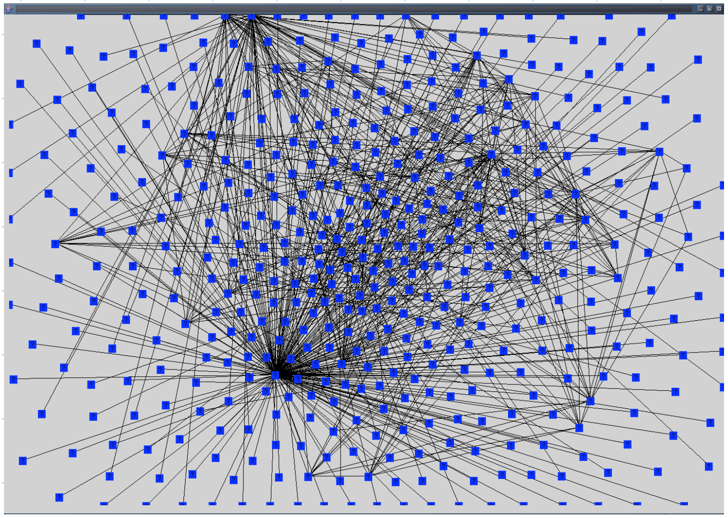
- Propaganda:
  - Attempt to **modify** human behavior,
    and thus **influence** people's actions
    in ways **beneficial** to propagandists

- Theory of Propaganda
  - Developed by the Institute for Propaganda Analysis 1938-42

- Propagandistic Techniques (and ways of detecting propaganda)
  - Word games - associate good/bad concept with social entity
    - Glittering Generalities — Name Calling
  - Transfer - use special priviledges (e.g., office) to breach trust
  - Testimonial - famous non-experts' claims
  - Plain Folk - people like us think this way
  - Bandwagon - everybody's doing it, jump on the wagon
  - Card Stacking - use of bad logic

Societal Trust is (also) a Graph

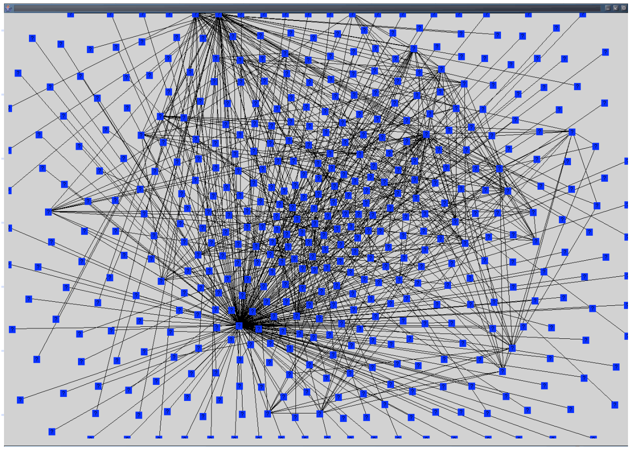
- Weighted Directed Graph of Nodes and Weighted Arcs
  - Nodes = Societal Entities (People, Ideas, …)
  - Arcs = Trust recommendation from an entity to another
  - Arc weight = Degree of entrustment
- Then what is Propaganda?
  - Attempt to modify the Societal Trust Graph in ways beneficial to propagandist
- How to modify the Trust Graph?



Propaganda in Graph Terms

- Word Games
  - Name Calling
  - Glittering Generalities
- Transfer
- Testimonial
- Plain Folk
- Card stacking
- Bandwagon

- Modify Node weights
  - Decrease node weight
  - Increase node weight
- Modify Node content & keep weights
- Insert Arcs b/w irrelevant nodes
- Modify Arcs
- Misdirect Arcs
- Modify Arcs & generate nodes



Web Spammers as Propagandists

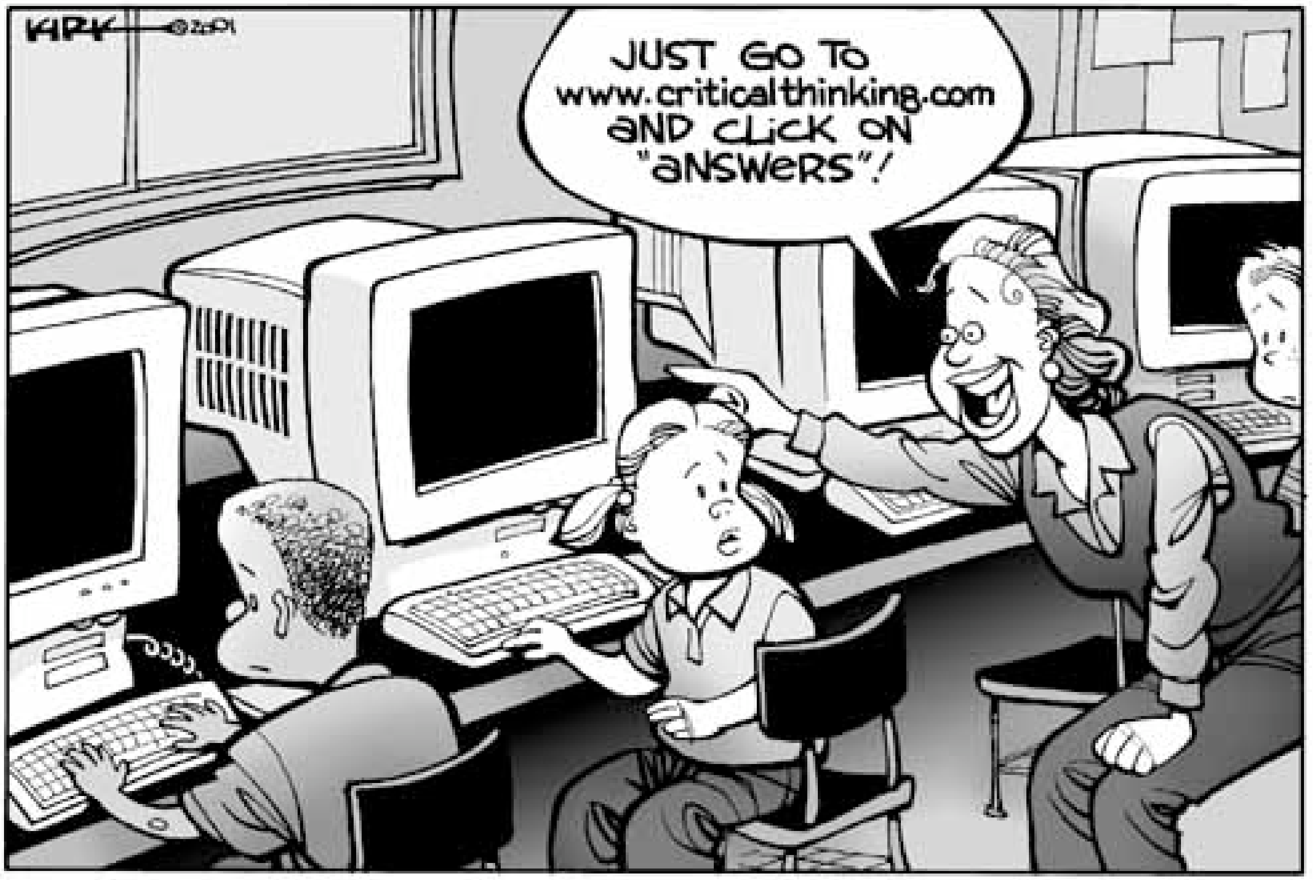
- Web Spammers can be seen as employing propagandistic techniques in order to modify the Web Graph
- **There is a pattern on how to spam!**

1st Gen	"keyword stuffing" to increase content similarity	Word Games
2nd Gen	Create "link farms" of heavily interconnected sites	Band wagon
3rd Gen	Organize "mutual admiration societies" of irrelevant reputable sites	Testimonials
?	Create Google-bombs	Card-stacking

Cognitive Hacking and Cyber Trust

- Gaining Access or Breaking into a computer system
  for the purpose of modifying certain behaviors of a human user
  in a way that violates the integrity of the overall system
- Does not necessarily aim to fool a search engine
- Famous examples:
  - Pump & Dump stock schemes
  - The Emulex case
  - Word Games
  - Transfer

How (not) To Solve The Problem



Living in Cyberspace

- Critical Thinking, Education
  - Realize how do we know what we know
  - "Of course it's true; I saw it on the Internet!"
- Cyber-social Structures that mimic Societal ones
  - Know **why** to trust or distrust
  - **Who** do you trust on **a particular** subject?
- A Search Engine per Browser
  - Easier to fool one search engine than to fool millions of readers
  - Enable readers to keep track of their trust network
  - Personalized tools of cyber trust

Thank You!

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