Internetsøgemaskiner

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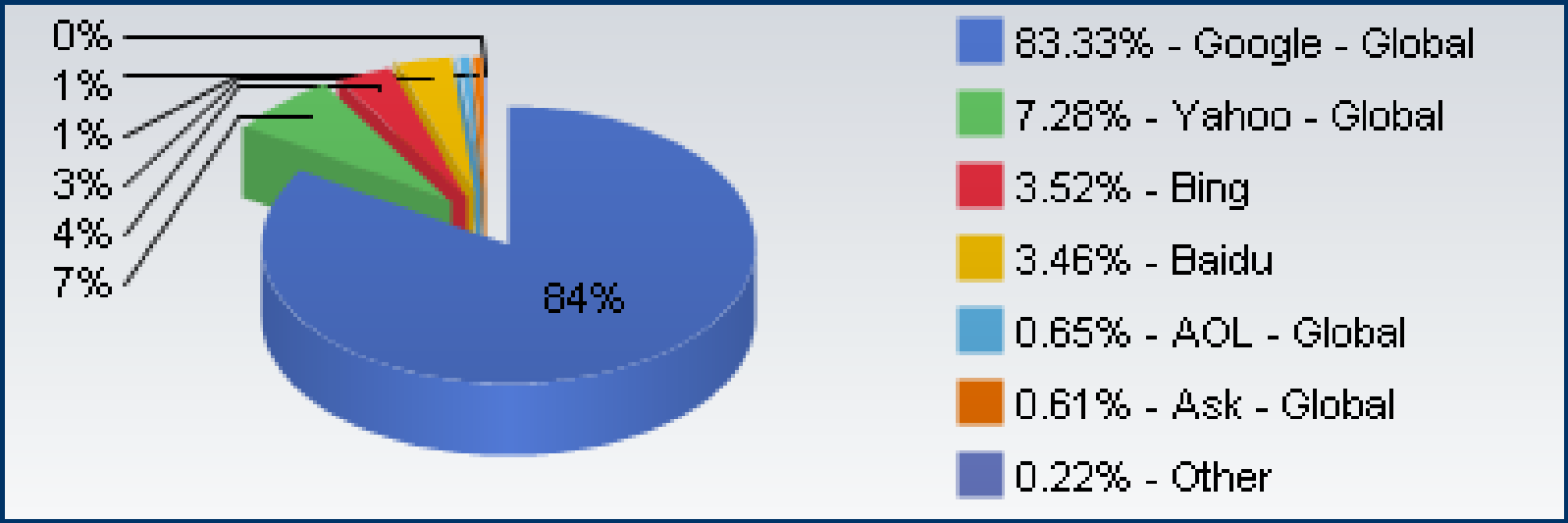
Ungdommens Naturvidenskabelige Forening Ålborg, 22. september 2009

Internetsøgemaskiner

(September 2009)



[Fra: marketshare.hitslink.com]

Overblik

- Historie
- Google facts
- Internetgrafen
- En søgemaskines dele
  - Crawling
  - Indeksering
  - Søgning og ranking
- Afslutning

Historiske Perspektiv

- 1969 første ARPANET forbindelser - starten på internettet
- 1971 Første email
- 1990 HTML sproget defineres
- 1991-1993 få kender til HTML
- 1993 Mosaic web-browser
- 1993 Lycos
- 1994 WebCrawler
- 1995 Yahoo!, Altavista
- 1998 Google
- 2005 YouTube
- ...

Internettet — World Wide Web

- Meget stor mængde ustruktureret information.
- Hvordan finder man relevant info? Søgemaskiner!

94: Lycos,. . .
96: Alta Vista: mange sider.
99: Google: mange sider og god ranking.

Søgemaskinernes Barndom

princess diana

Engine 1

Princess Diana Memorial WebRing
Follow the WebRing for a tour of memorial site
87% http://www.geocities.com/RainForest/Vines/1009/diana
1998
Grouped results from http://www.geocities.com

FOR DIANA, PRINCESS OF HEART - Dr. K
...
Dr. Kate Wachs Comments on Princess Diana T
84% http://www.therelationshipcenter.com/diana.shtml (Si

Princess Diana Editorial Cartoons! Cartoons
The Professional Cartoonists Index is the most
cartoonists o
daily cartoo
82% http://ww

Diana, Princess of Wales
1 July 1961 - 31 August 1997 The BBC Web sit
Camera Press/Snowdon
79% http://www.royal.gov.uk/start.htm (Size 2.3K) Doc
Grouped results from http://www.royal.gov.uk

Relevant and high quality

Engine 2

1. **Re: Lost in the shadow of Princess Diana**
[URL: www.spiceisle.com/talkshop/messages/6232.htm]
The Spicelslander TalkShop. [Follow Ups] [Pos
The Spicelslander TalkShop] Date: September
00:54:03 From: Sno,...
Last modified 12-Sep-97 - page size 4K - in English [Tran

2. **Re: Princess Diana's gown auction**
[URL: www.elle.com/textes/blablabla/forum/messages1/15
Re: Princess Diana's gown auction. [Follow Ups
Followup] [Elle International - Blablabla] Posted
September 07, 1997 at 02:15:26:...
Last modified 30-Mar-98 - page size 2K - in English [Tran

3. **Re: Princess Diana**
[URL: spicyhot.com/gaynet/messages/1053.html]
Re: Prince
Maine Ga
Novembe
Last modifie

4. **Re: Princess Diana - Queen of Hearts**
[URL: www.elle.com/textes/blablabla/forum/messages1/28
Re: Princess Diana - Queen of Hearts. [Follow U
Followup] [Elle International - Blablabla] Posted
on August 31, 1997 at...
Last modified 30-Mar-98 - page size 4K - in English [Tran

Relevant but low quality

Engine 3

1. Free Passwords To Adult Sites ...
99% - Articles & General info: Free Passwords
Sites ..... warez princess diana demi moore
magazine kathy ireland lingerie jennifer aniston cook
warez princess diana demi moore... 03/09/98
Commercial site: http://www.prurient.com /warez

2. SEX CHAT XXX NUDE PORNO PLAYBOY P
[redacted]
Personal page: http://www.connix.com /~wgonzo
/sex/slidesuperall.htm

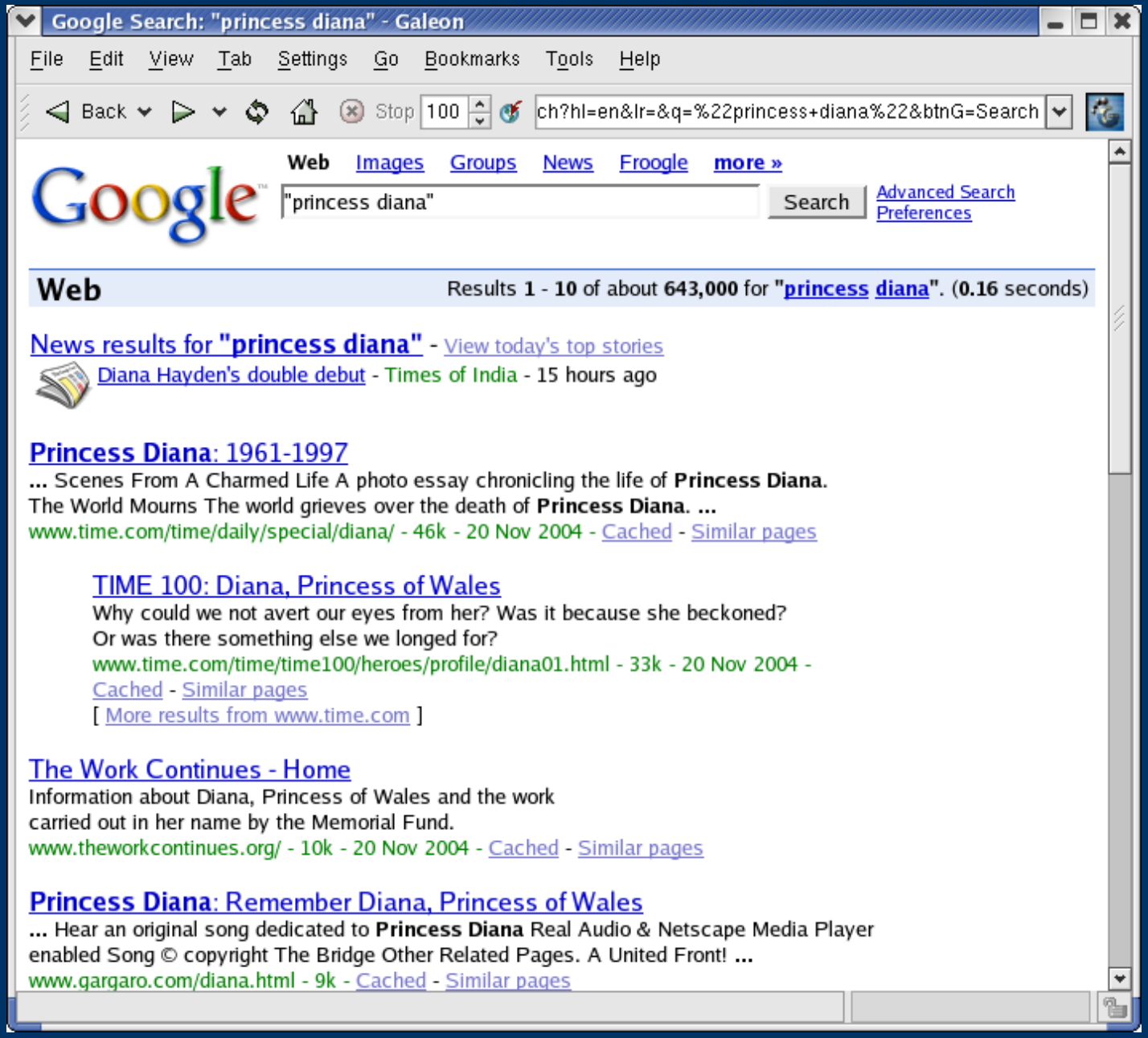
3. Ro
[redacted]
Personal page: http://www.octet.com /~gonzo/jy

4. Sunday, 18-Jan-98
99% - Articles & General info: Sunday, 18-Jan-
CHAT XXX NUDE PORNO PLAYBOY PAME

Not relevant index pollution

[Fra: Henzinger, 2000]

. . . 2004 . . .


Google Search: "princess diana" - Galeon
File Edit View Tab Settings Go Bookmarks Tools Help
Back Stop 100
ch?hl=en&lr=&q=%22princess+diana%22&btnG=Search
Web Images Groups News Froogle more »
Google
"princess diana"
Search
Advanced Search
Preferences
Web
Results 1 - 10 of about 643,000 for "princess diana". (0.16 seconds)
News results for "princess diana" - View today's top stories
Diana Hayden's double debut - Times of India - 15 hours ago
Princess Diana: 1961-1997
... Scenes From A Charmed Life A photo essay chronicling the life of Princess Diana.
The World Mourns The world grieves over the death of Princess Diana. ...
www.time.com/time/daily/special/diana/ - 46k - 20 Nov 2004 - Cached - Similar pages
TIME 100: Diana, Princess of Wales
Why could we not avert our eyes from her? Was it because she beckoned?
Or was there something else we longed for?
www.time.com/time/time100/heroes/profile/diana01.html - 33k - 20 Nov 2004 -
Cached - Similar pages
[More results from www.time.com]
The Work Continues - Home
Information about Diana, Princess of Wales and the work
carried out in her name by the Memorial Fund.
www.theworkcontinues.org/ - 10k - 20 Nov 2004 - Cached - Similar pages
Princess Diana: Remember Diana, Princess of Wales
... Hear an original song dedicated to Princess Diana Real Audio & Netscape Media Player
enabled Song © copyright The Bridge Other Related Pages. A United Front! ...
www.gargaro.com/diana.html - 9k - Cached - Similar pages

. . . 2009


"princess diana" - Google Search - Mozilla Firefox
File Edit View History Bookmarks Tools Help
"princess diana" - Google Search
Web Images Maps Groups Scholar Blogs Gmail more ▾
Search settings | Sign in
Google
"princess diana"
Search
Advanced Search
Web Show options...
Results 1 - 10 of about 2,350,000 for "princess diana". (0.11 seconds)
Diana, Princess of Wales - Wikipedia, the free encyclopedia
Posthumously, as in life, she is most popularly referred to as "Princess Diana", a title she never held. Still, she is sometimes referred to (according to ...
Early life - Royal descent - Education - Marriage
en.wikipedia.org/wiki/Diana,_Princess_of_Wales - Cached - Similar
Death of Diana, Princess of Wales - Wikipedia, the free encyclopedia
"Prince Charles Implicated in Murder of Princess Diana Logic dictates Princess Di was deliberately frightened into writing the incriminating letter before ...
en.wikipedia.org/wiki/Death_of_Diana,_Princess_of_Wales - Cached - Similar
Princess Diana, Princess of Wales: photos,pictures,facts,news
Facts, photos, news, pictures about Princess Diana, Princess Diana of Wales, Lady Diana Spencer.
www.princess-diana.com/ - Cached - Similar
Image results for "princess diana" - Report images
Video results for "princess diana"
Candle In The Wind: A Princess Diana Tribute
4 min 13 sec
www.youtube.com
Who Killed Princess Diana?
21 min
video.google.com
PRINCESS DIANA Funeral Highlights
2 min 36 sec
www.youtube.com
Panorama interview, Princess Diana Queen Of ...
55 min
video.google.com
Princess Diana: 1961-1997
1 Aug 2004 ... Photos and articles from Time Magazine covering the life and death of the Princess of Wales.
www.time.com/time/daily/special/diana/ - Cached - Similar

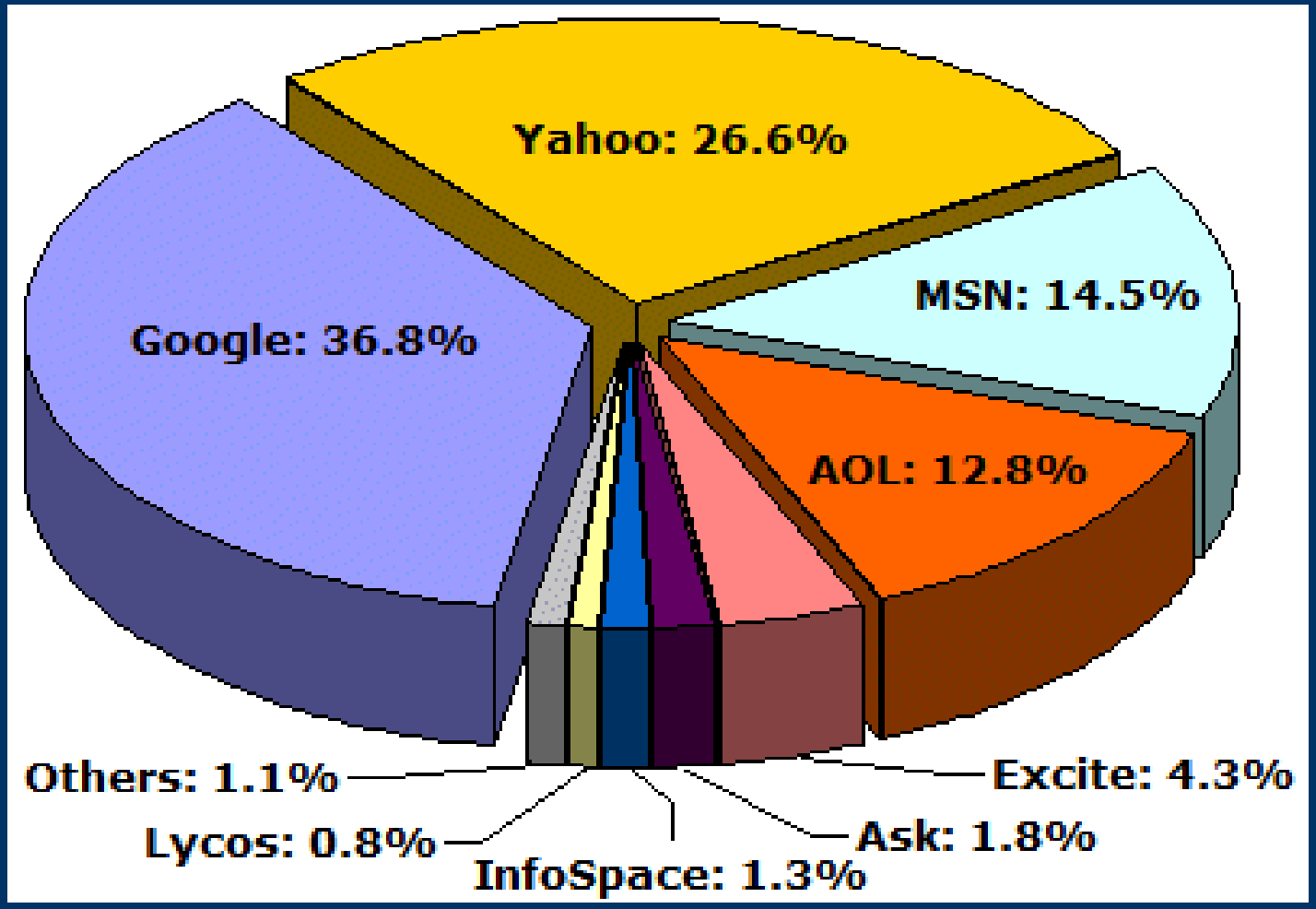
Moderne Søgemaskiner

Imponerende performance.

- Søger i 10^{10} sider.
- Svartider $\approx$ 0,1 sekund.
- 1000 brugere i sekundet.
- Finder relevante sider.

I'm Feeling Lucky

Internetsøgninger i USA (maj 2004)



[Fra: www.searchenginewatch.com]

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Google

- Startet i 1995 som forskningsprojekt ved Stanford University af ph.d. studerende **Larry Page** og **Sergey Brin**
- Privat firma grundlagt 1998
- +20.000 medarbejdere
- Ansvarlig for ca. halvdelen af alle internet-søgninger
- Hovedsæde i Silicon Valley

$$\text{google} \approx \text{googol} = 10^{100}$$

Google

Søgemaskine

- Hurtig
- Relevante links
- Opdateret
- Cache
- GoogleScout (lignende sider)
- Automatisk stavekontrol
- Interface til WAP og PDA
- Produktsøgninger (froogle)
- Billed søgning
- Aktiekurser, kort, ordbøger, nyheder, telefonbøger ...
- Stemmestyret teknologi

AdWords

- tekstbaseret reklame
- query afhængig

Licenser

- AOL/Netscape, Red Hat, Virgin Group, YAHOO, The Washington Post ...

Web API

Hardware + Software

Google (2004)

- +8.000.000.000 web sider (+20 TB)
- PageRank: +3.000.000.000 sider og +20.000.000.000 links
- +35.000.000 ikke HTML sider
- +845.000.000 USENET beskeder (20 år)
- +880.000.000 billeder
- +2 Terabyte index, opdateres en gang om måneden
- +2.000.000 termer i indeks
- +150.000.000 søgninger om dagen (2000 i sekundet)
- +200 filtyper: HTML, Microsoft Office, PDF, PostScript, WordPerfect, Lotus ...
- +28 sprog

Google (2004)

- Cluster af +10.000 Intel servere med Linux
  - Single-processor
  - 256 MB–1 GB RAM
  - 2 IDE diske med 20-40 Gb
- Fejl-tolerance: Redundans
- Hastighed: Load-balancing

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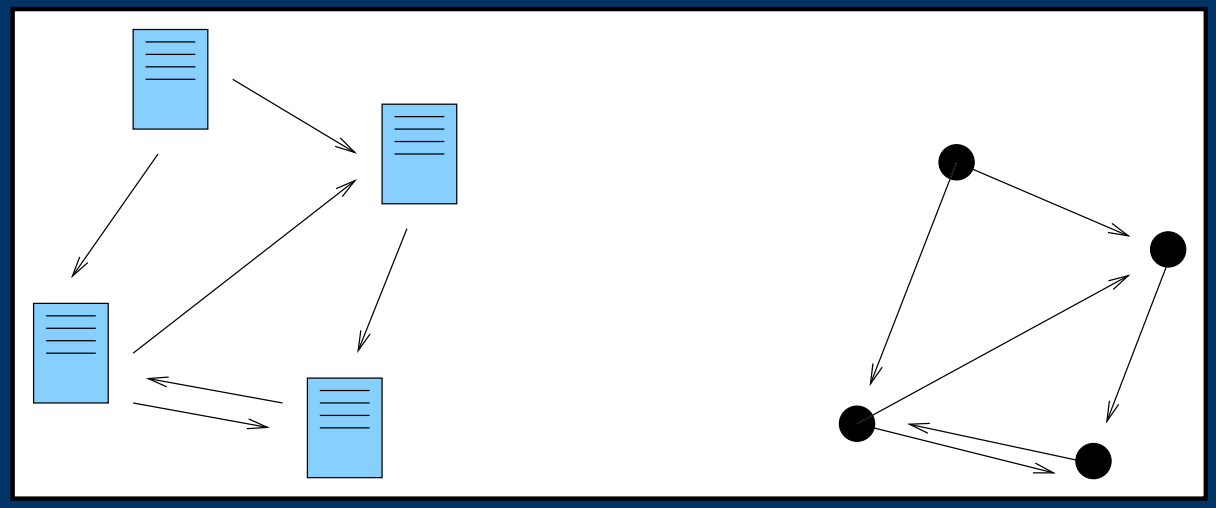
Internetgrafen

knuder = sider (URL'er)

orienterede kanter = links



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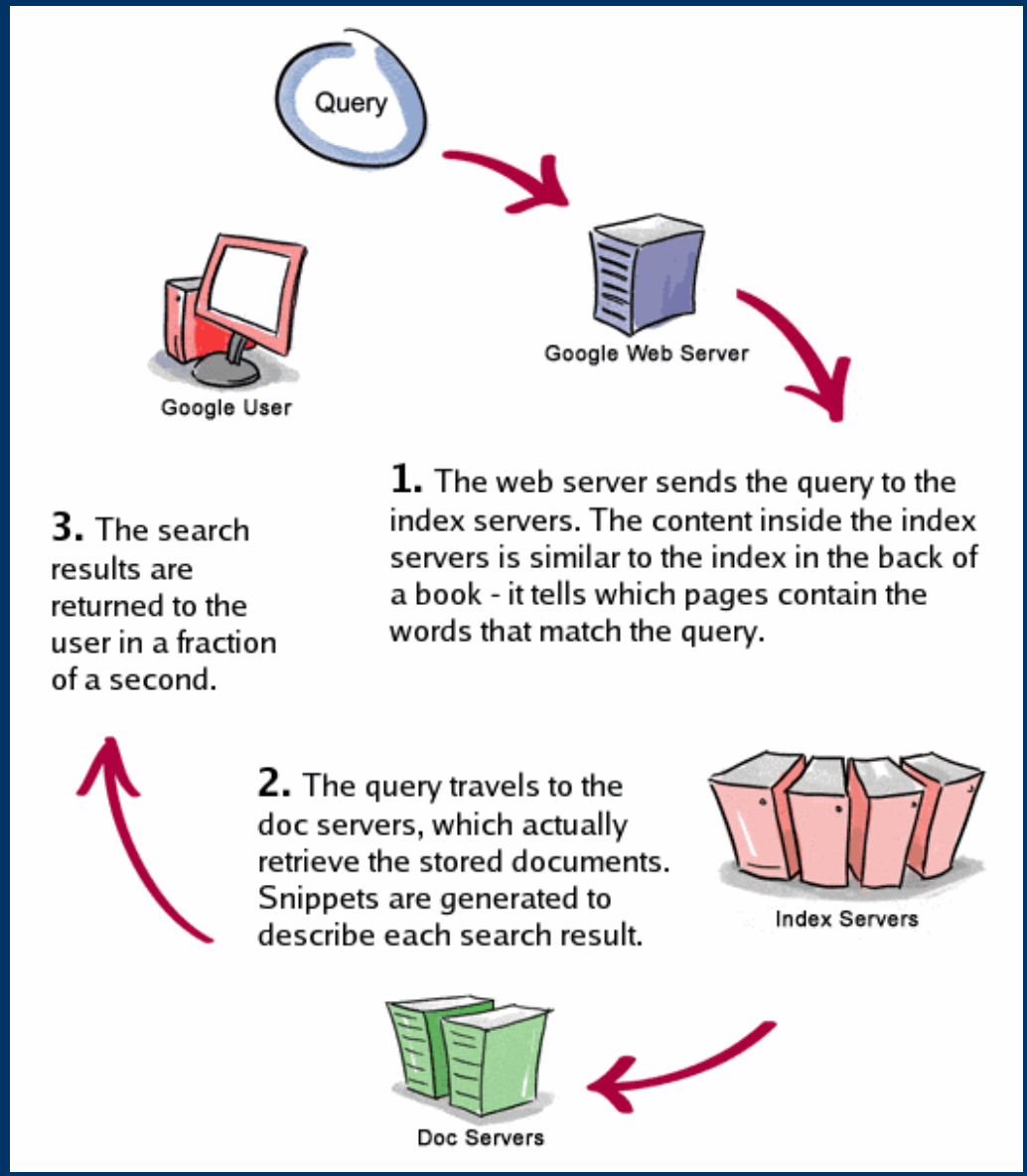
Life of a Google Query



[Fra: http://www.google.com/corporate/tech.html]

En søgemaskines dele

Indsamling af data:

- Webcrawling (gennemløb af internetgrafen).

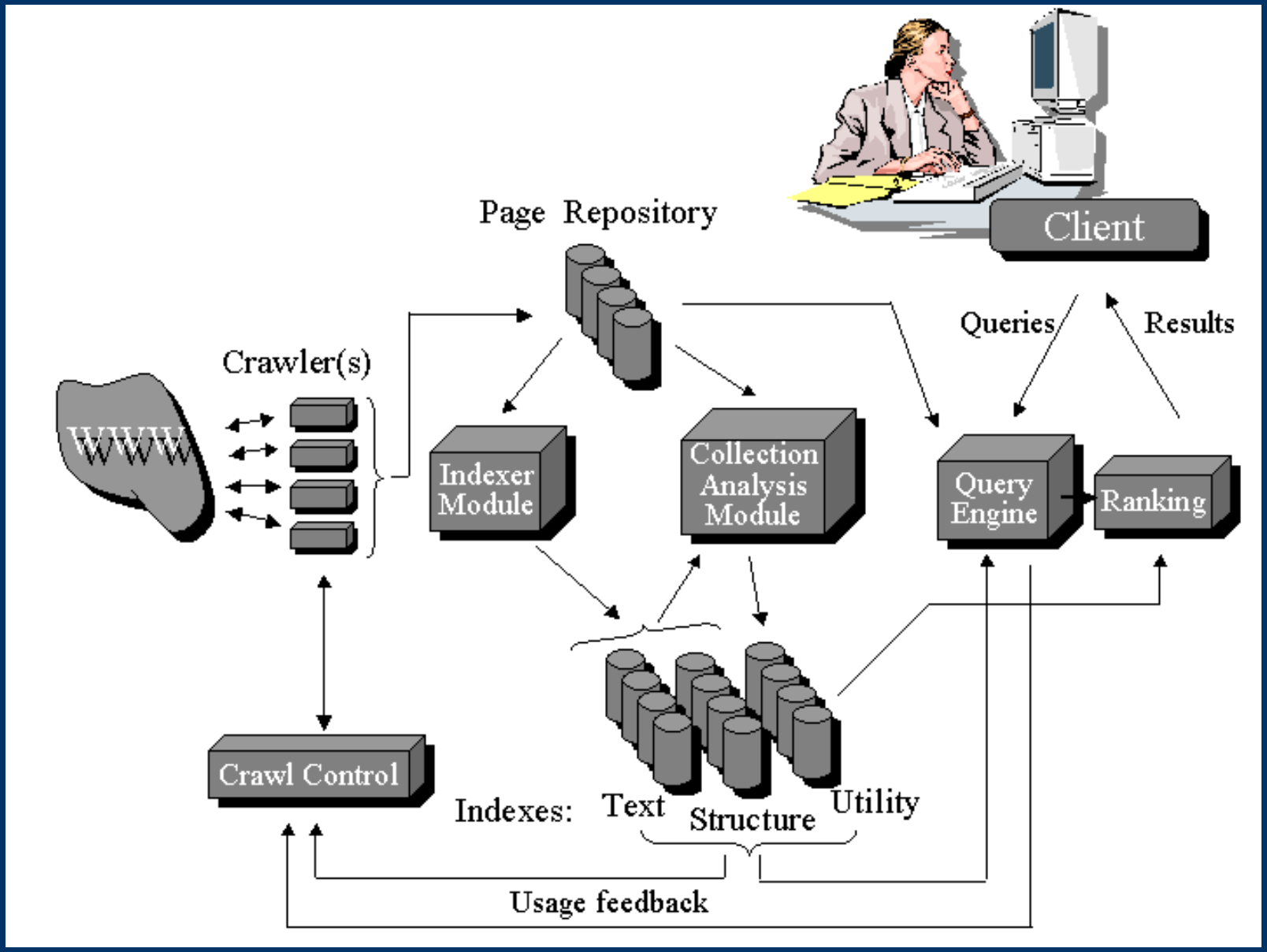
Indeksering data:

- Parsning af dokumenter.
- Lexicon: indeks (ordbog) over alle ord mødt.
- Inverted file: for alle ord i lexicon, angiv i hvilke dokumenter de findes.

Søgning i data:

- Find alle dokumenter med søgeordene.
- Rank dokumenterne.

Opbygning af en Søgemaskine



[Fra: Arasu et al., 2001]

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Crawling

Webcrawling = Grafgennemløb

S = {startside}
repeat
    fjern en side s fra S
    parse s og find alle links (s, v)
    foreach (s, v)
        if v ikke besøgt før
            indsæt v i S

Designovervejelser

- Startpunkt (initial S).
- Crawl-strategi (valg af s).
- Mærkning af besøgte sider.
- Robusthed.
- Ressourceforbrug (egne og andres ressourcer).
- Opdatering. Kontinuert vs. periodisk crawling.

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Output: DB med besøgte dokumenter.
DB med links i disse (kanterne i Internetgrafen)
DB med DokumentID–URL mapning

Crawl-strategier

- Breath First Search
- Depth First Search
- Random
- Priority Search

Mulige prioriteter:

- Sider som opdateres ofte (kræver metode til at estimatere opdateringsfrekvens).
- Efter vigtighed (kræver metode til at estimere vigtighed, f.eks. PageRank).

BFS virker godt

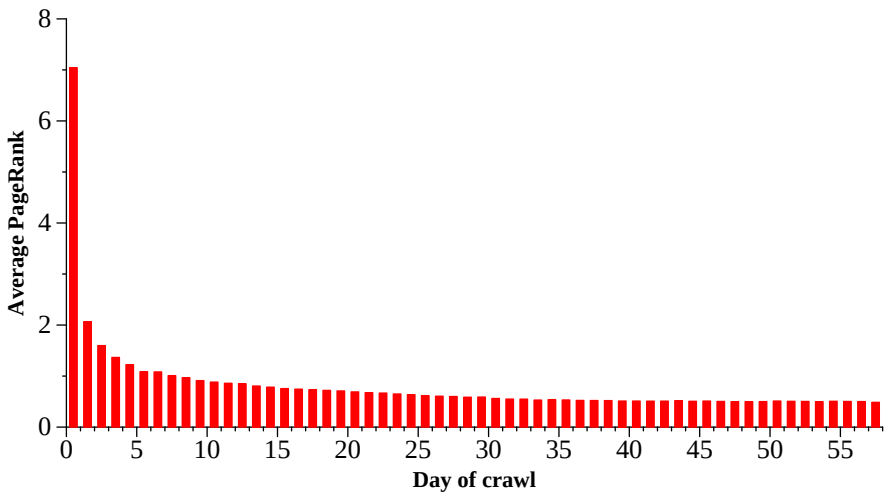

Figure 1: Average PageRank score by day of crawl

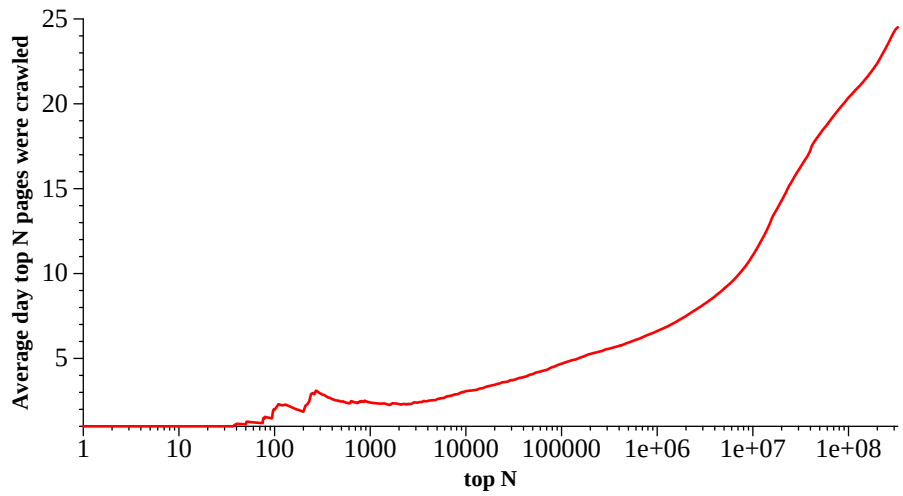

Figure 2: Average day on which the top N pages were crawled

[Fra: Najork and Wiener, 2001]

Fra et crawl af 328 millioner sider.

PageRank prioritet er endnu bedre

(men mere beregningstung. . .)

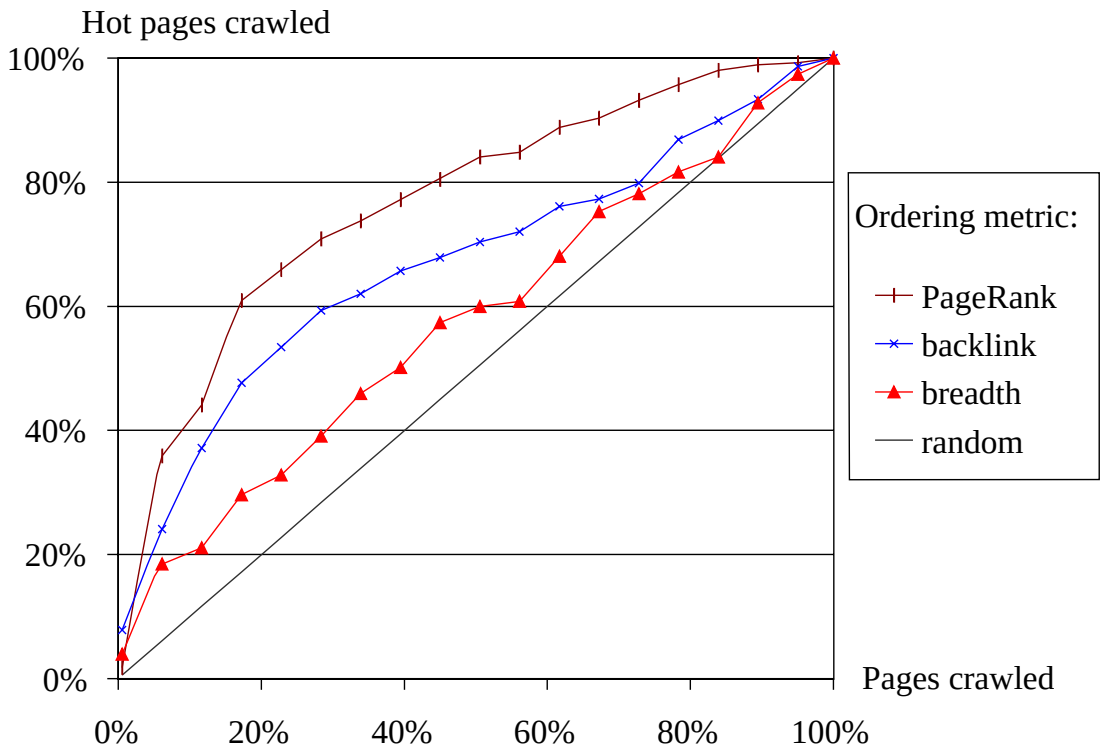

Figure 2: The performance of various ordering metrics for $IB(P)$; $G = 100$

[Fra: Arasu et al., 2001]

Fra et crawl af 225.000 sider på Stanford University.

Robusthed

- Normalisering af URLer.
- Parsning af malformet HTML.
- Mange filtyper.
- Forkert content-type fra server.
- Forkert HTTP response code fra server.
- Enorme filer.
- Uendelige URL-løkker (crawler traps).

⋮

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- ⋮

Vær konservativ – opgiv at finde alt.
Crawling tager måneder – brug checkpoints.

Ressourceforbrug

Egne ressourcer

- Båndbredde (global request rate)
- Lagerplads (brug kompakte representationer)
- Distribuér på flere maskiner (opdel f.eks. rummet af ULR’er)

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Andres ressourcer (politeness)

- **Båndbredde** (lokal request rate). Tommelfingerregel: 30 sekunder mellem request til samme site.
- Robots Exclusion Protocol (`www.robotstxt.org`).
- Giv kontakt info i HTTP-request.

Erfaringer ang. effektivitet

- Brug caching (DNS opslag, `robots.txt` filer, senest mødte URL'er).
- Flaskehals er ofte I/O under tilgang til datastrukturerne
- CPU cycler er ikke flaskehals (Java og scripting languages er OK).
- En tunet crawler (på een eller få maskiner) kan crawle

200-400 sider/sek $\sim$ 35 mio sider/dag.

Statistik

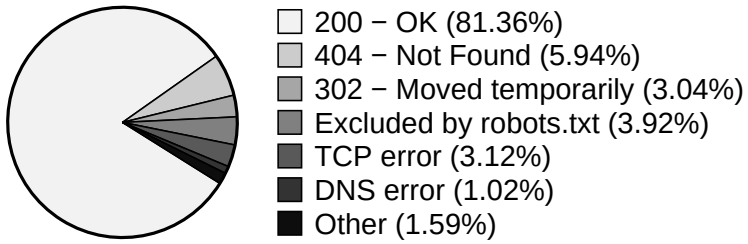

Figure 6: Outcome of download attempts

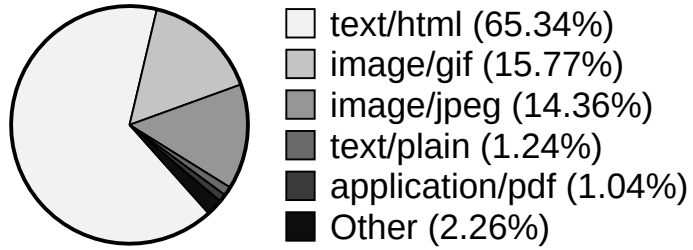

Figure 7: Distribution of content types

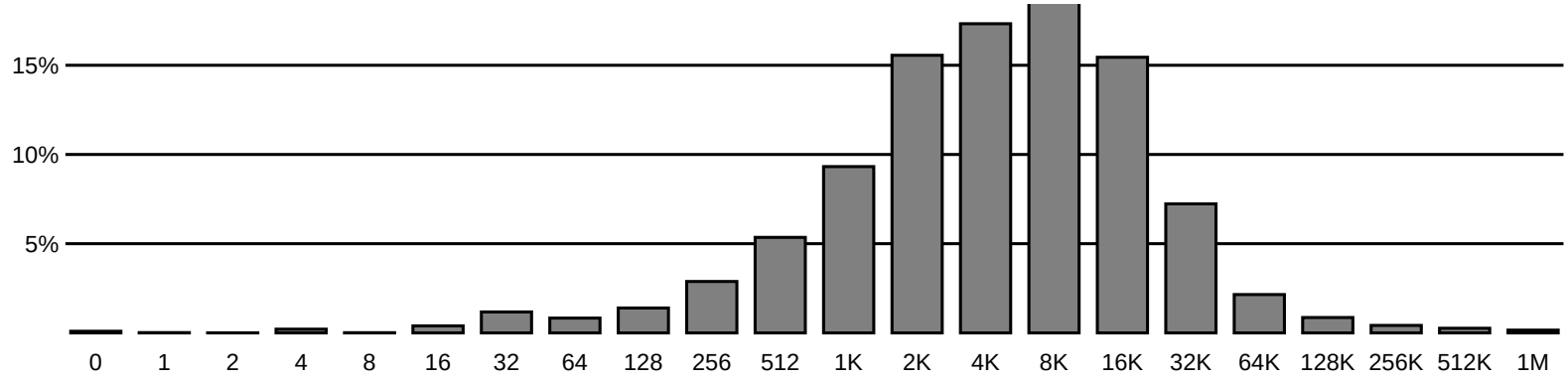

Figure 8: Distribution of document sizes

[Fra: Najork and Heydon, 2001]

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Indeksering af dokumenter

Opgave:

> Preprocessér en dokumentsamling så dokumenter med et givet søgeord kan blive returneret hurtigt.

Input: dokumentsamling.

Output: søgestruktur.

Indeksering: Inverted file + lexicon

- Inverted file = for hvert ord w en liste af dokumenter indeholdende w.
- Lexicon = ordbog over alle ord i dokumentsamlingen.

  (key = ord, value = pointer til liste i inverted file + evt. ekstra info for ordet, f.eks. længde af listen)

For en milliard dokumenter:

Inverted file $\sim$ totalt antal ord $\geq$ 100 mia	Disk
Lexicon $\sim$ antal forskellige ord $\sim$ 2 mio	RAM

Bygning af index

foreach dokument D i samlingen
    Parse D og identificér ord
    foreach ord w
        Udskriv (DocID, w)
        if w ikke i lexicon
            indsæt w i lexicon

$\Downarrow$

$(1,2),(1,37),\ldots,(1,123)$, $(2,34),(2,37),\ldots,(2,101)$, $(3,486),\ldots$

Disk sorting $\Downarrow$

$(22,1),(77,1),\ldots,(198,1)$, $(1,2),(22,2),\ldots,(345,2)$, $(67,3),\ldots$

$\approx$ inverted file

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Søgning og Ranking

Query: computer AND science:

1. Slå computer og science op i lexicon. Giver adresse på disk hvor deres lister starter.
2. Scan disse lister og "flet" dem (returnér DocID'er som er med i begge lister).

   computer: 12, 15, 117, 155, 256,. . .
   science: 5, 27, 117, 119, 256,. . .

3. Udregn rank af fundne DocID'er. Hent de 10 højst rank'ede i dokumentsamling og returnér URL samt kontekst fra dokument til bruger.

OR og NOT kan laves tilsvarende. Hvis lister har ord-positioner kan frase-søgninger ("computer science") og proximity-søgningner ("computer" tæt på "science") også laves.

Tekstbaseret ranking

Vægt forekomsten af et ord med f.eks.

- Antal forekomster i dokumentet.
- Ordets typografi (fed skrift, overskrift,. . .)
- Forekomst i META-tags.
- Forekomst i tekst ved links som peger på siden

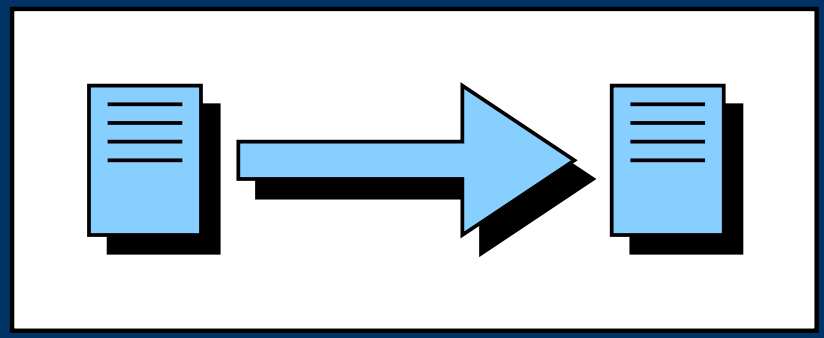
Forbedring, men ikke nok på Internettet (rankning af f.eks. 100.000 relevante dokumenter).

Let at spamme (fyld siden med søge-ord).

Linkbaseret ranking

Idé 1: Link til en side $\approx$ anbefaling af den.

Idé 2: Anbefalinger fra vigtige sider skal vægte mere.



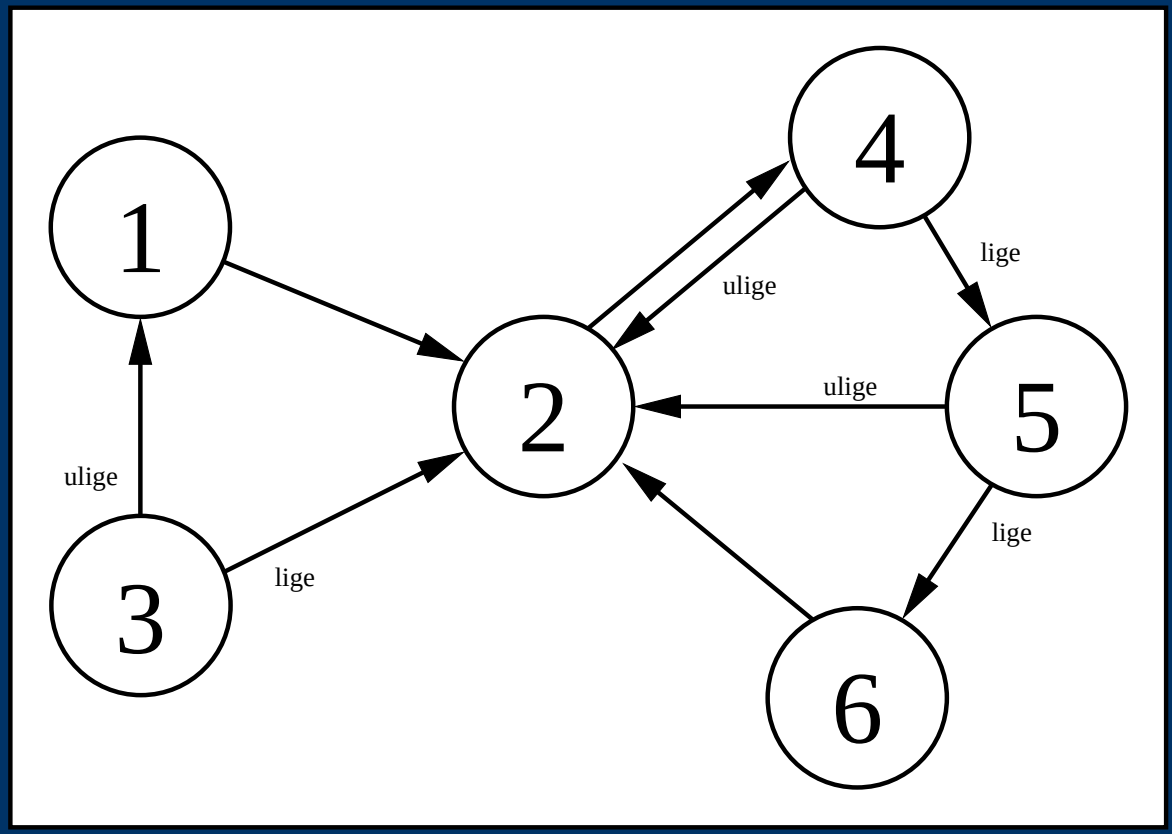
Google PageRank™ $\approx$ websurfer

PageRank beregning kan opfattes som en websurfer som (i uendelig lang tid) i hver skridt

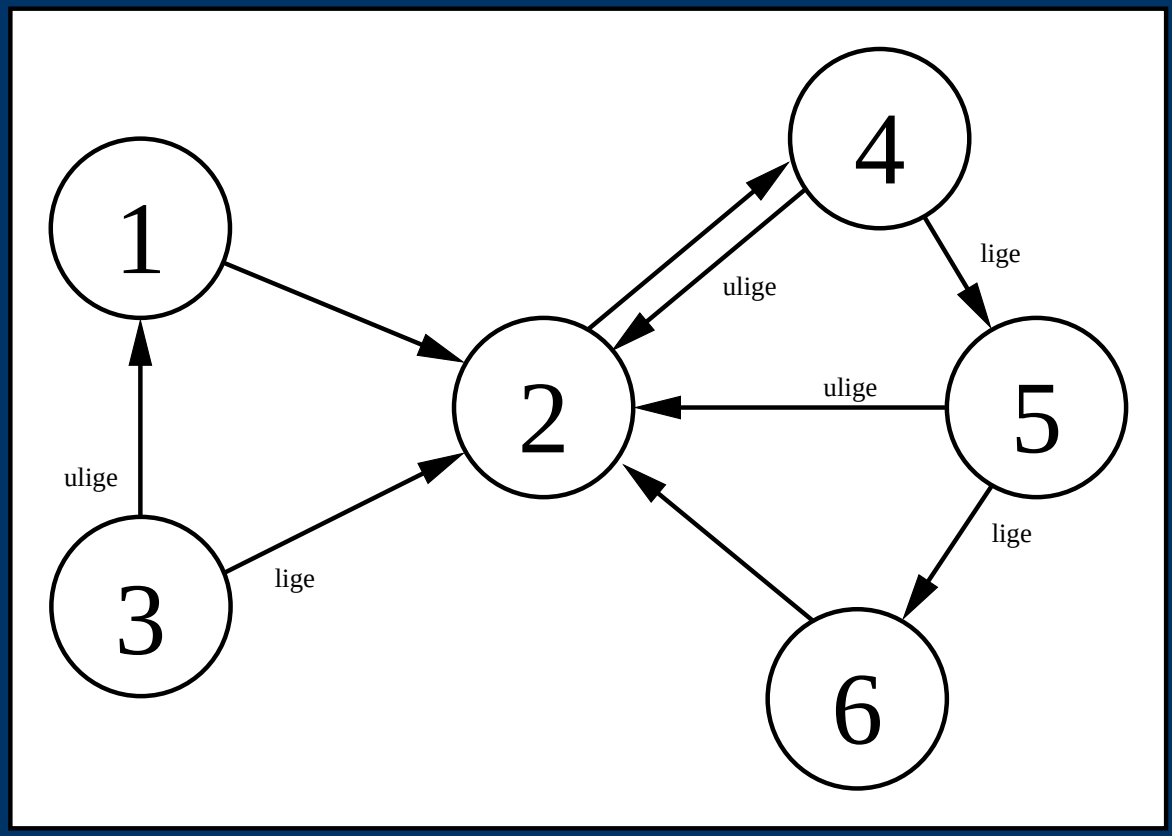
- med 85% sandsynlighed vælger at følge et tilfældigt link fra nuværende side,
- med 15% sandsynlighed vælger at gå til en tilfældig side i hele internettet.

PageRank for en side x er lig den procentdel af hans besøg som er til side x.

Simpel graf



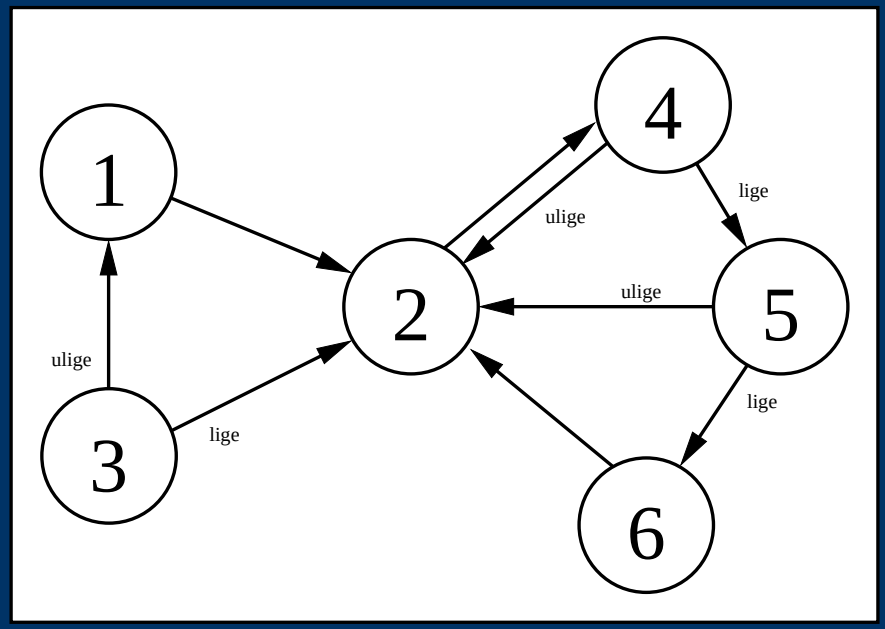
Simpel graf



Metode RandomWalk

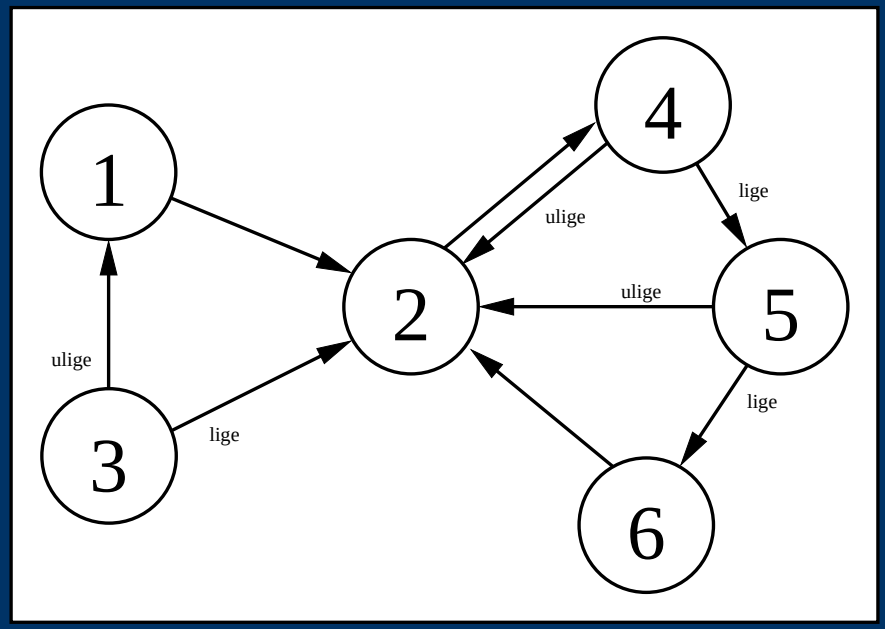
Start på knude 1
Gentag **25** gange:
    Kast en terning:
        Hvis den viser 1-5:
            Vælg en tilfældig pil ud fra knuden
            ved at kaste en terning hvis ≥ 2 udkanter
        Hvis den viser 6:
            Kast terningen igen og spring hen til den
            knude som terningnen viser

Simpel graf — Sandsynlighedsfordeling



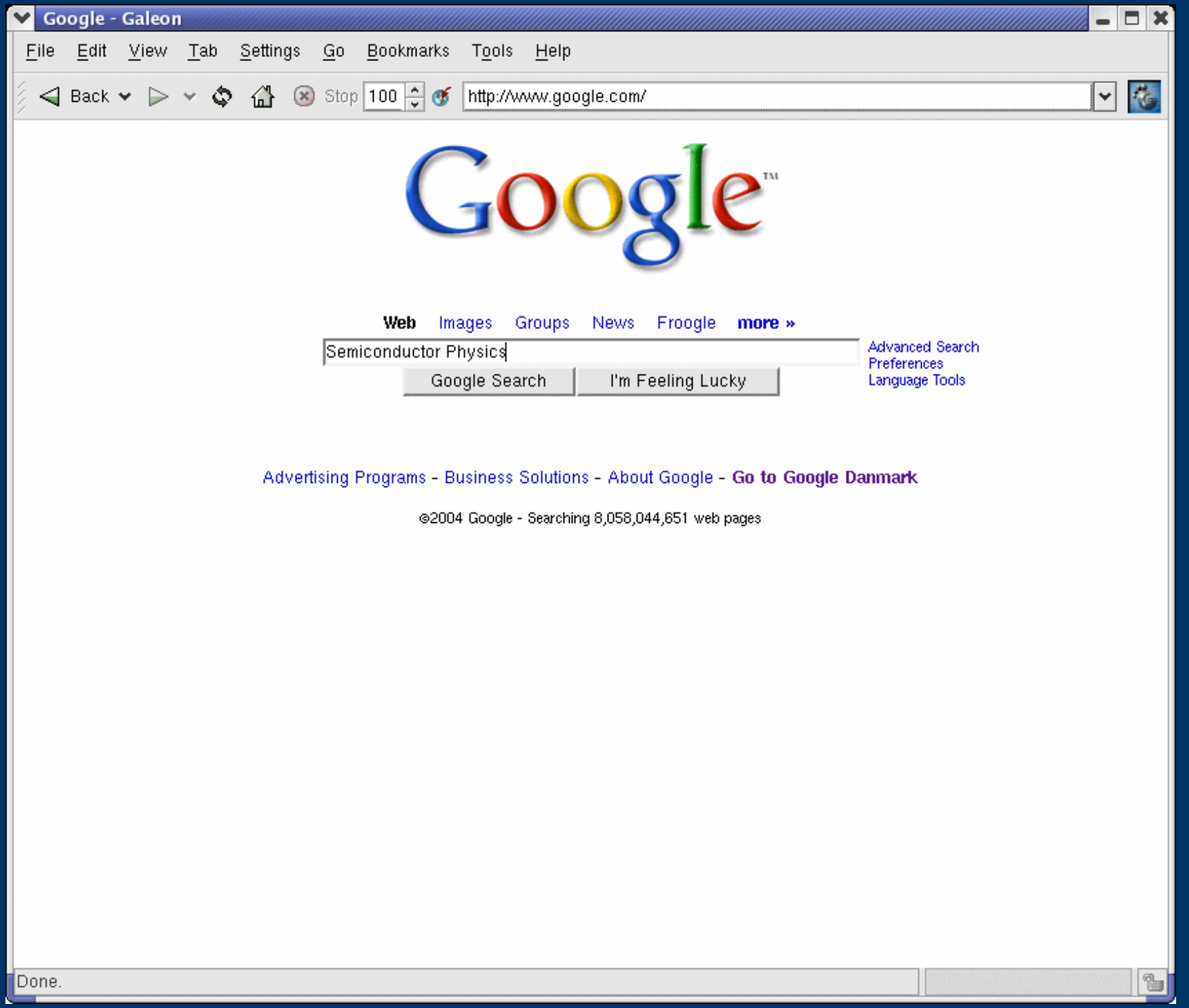
Skridt	1	2	3	4	5	6
0	1.000	0.000	0.000	0.000	0.000	0.000
1	0.028	0.861	0.028	0.028	0.028	0.028
2	0.039	0.109	0.028	0.745	0.039	0.039
3	0.039	0.432	0.028	0.118	0.338	0.044
4	0.039	0.299	0.028	0.388	0.077	0.169
5	0.039	0.406	0.028	0.277	0.189	0.060
6	0.039	0.316	0.028	0.366	0.143	0.107
7	0.039	0.373	0.028	0.291	0.180	0.087
8	0.039	0.342	0.028	0.339	0.149	0.103
9	0.039	0.361	0.028	0.313	0.169	0.090
10	0.039	0.348	0.028	0.329	0.158	0.098
11	0.039	0.357	0.028	0.318	0.165	0.094
12	0.039	0.351	0.028	0.325	0.160	0.096
13	0.039	0.355	0.028	0.320	0.163	0.094
14	0.039	0.352	0.028	0.323	0.161	0.096
15	0.039	0.354	0.028	0.321	0.163	0.095
16	0.039	0.353	0.028	0.323	0.162	0.095
17	0.039	0.354	0.028	0.322	0.162	0.095
18	0.039	0.353	0.028	0.322	0.162	0.095
19	0.039	0.353	0.028	0.322	0.162	0.095
20	0.039	0.353	0.028	0.322	0.162	0.095
21	0.039	0.353	0.028	0.322	0.162	0.095
22	0.039	0.353	0.028	0.322	0.162	0.095
23	0.039	0.353	0.028	0.322	0.162	0.095
24	0.039	0.353	0.028	0.322	0.162	0.095
25	0.039	0.353	0.028	0.322	0.162	0.095

Simpel graf — Sandsynlighedsfordeling



Skridt	1	2	3	4	5	6
0	1.000	0.000	0.000	0.000	0.000	0.000
1	0.028	0.861	0.028	0.028	0.028	0.028
2	0.039	0.109	0.028	0.745	0.039	0.039
3	0.039	0.432	0.028	0.118	0.338	0.044
4	0.039	0.299	0.028	0.388	0.077	0.169
5	0.039	0.406	0.028	0.277	0.189	0.060
6	0.039	0.316	0.028	0.366	0.143	0.107
7	0.039	0.373	0.028	0.291	0.180	0.087
8	0.039	0.342	0.028	0.339	0.149	0.103
9	0.039	0.361	0.028	0.313	0.169	0.090
10	0.039	0.348	0.028	0.329	0.158	0.098
11	0.039	0.357	0.028	0.318	0.165	0.094
12	0.039	0.351	0.028	0.325	0.160	0.096
13	0.039	0.355	0.028	0.320	0.163	0.094
14	0.039	0.352	0.028	0.323	0.161	0.096
15	0.039	0.354	0.028	0.321	0.163	0.095
16	0.039	0.353	0.028	0.323	0.162	0.095
17	0.039	0.354	0.028	0.322	0.162	0.095
18	0.039	0.353	0.028	0.322	0.162	0.095
19	0.039	0.353	0.028	0.322	0.162	0.095
20	0.039	0.353	0.028	0.322	0.162	0.095
21	0.039	0.353	0.028	0.322	0.162	0.095
22	0.039	0.353	0.028	0.322	0.162	0.095
23	0.039	0.353	0.028	0.322	0.162	0.095
24	0.039	0.353	0.028	0.322	0.162	0.095
25	0.039	0.353	0.028	0.322	0.162	0.095

I praksis: 20-50 iterationer er nok for hele internetgrafen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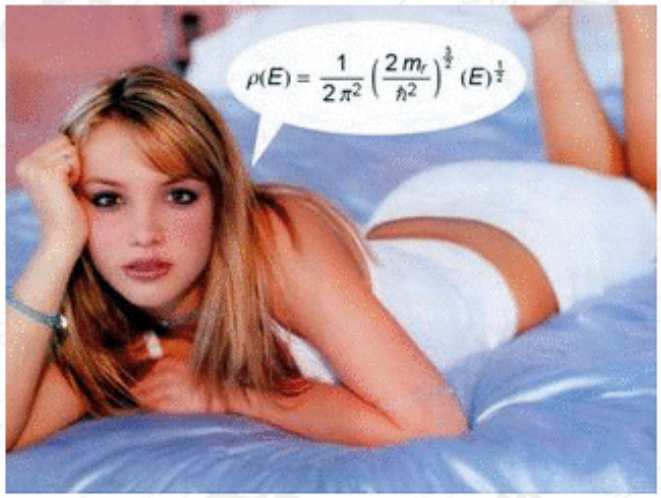

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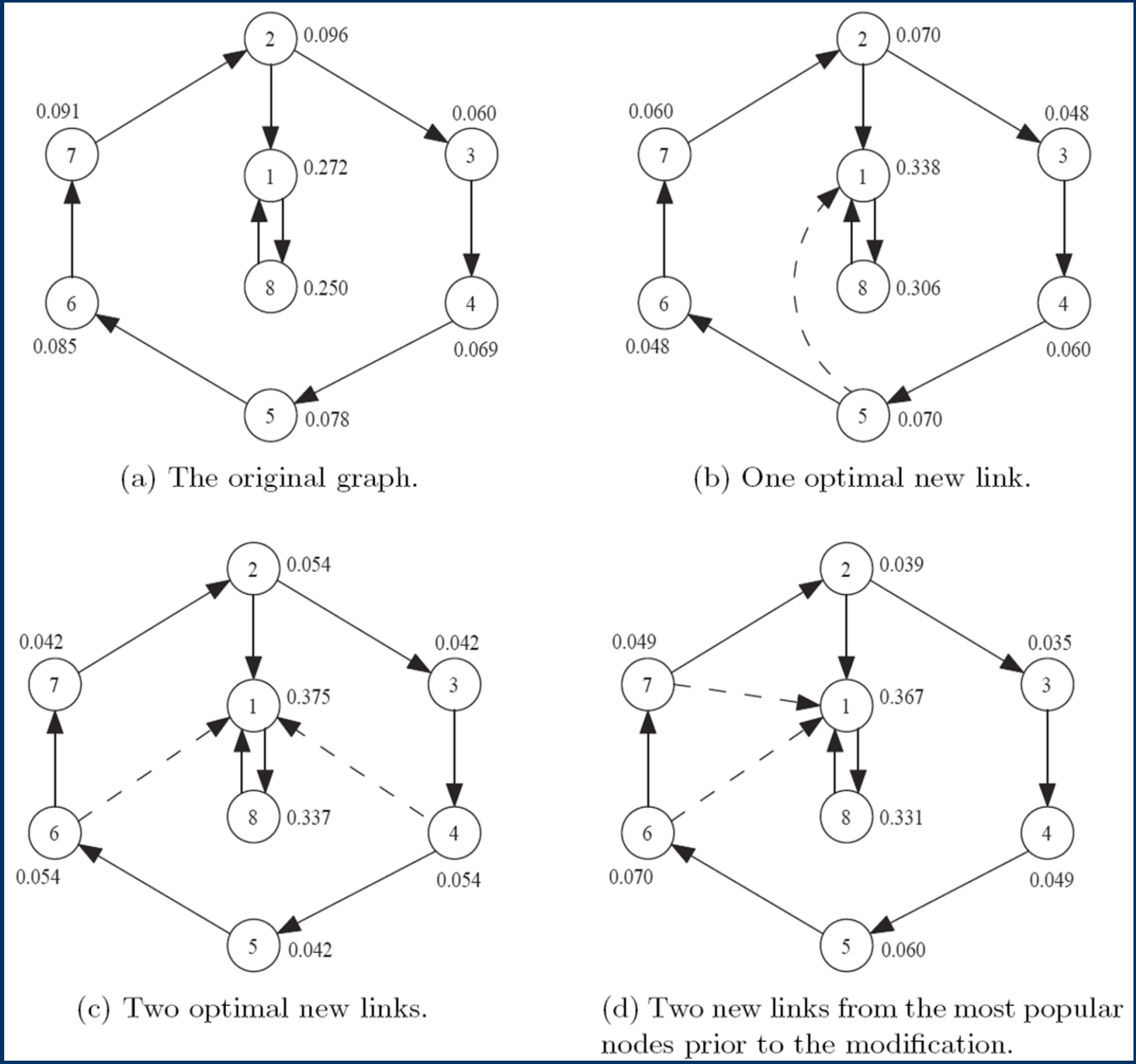
the hungersite

It is a little known fact, that Ms Spears is an expert in semiconductor physics. Not content with just singing and acting, in the following pages, she will guide you in the fundamentals of the vital laser components that have made it possible to hear her super music in a digital format.

* Introduction
* The Basics of Semiconductors
* Semiconductor Crystal Structures
* Semiconductor Junctions
* Photonic Crystals
* Crystal Growth, Fabrication and Processing
* Photolithography
* Semiconductor and

Done.

Søgemaskine Optimering



[Fra: Martin Olsen, ph.d. afhandling, august 2009]

Søgemaskine Optimering (SEO)

- Mål: Optimer websider til at ligge højt på søgemaskiner
- Metoder: Lav nye websider der peger på en side, bytte links, købe links, lave blog indlæg, meta-tags, ...
- SEO: Milliard industri
- Søgemaskiner: Blacklisting, fjernelse af dubletter, ...

Overblik

- √ Historie
- √ Google facts
- √ Internetgrafen
- √ En søgemaskines dele
  - √ Crawling
  - √ Indeksering
  - √ Søgning og ranking
- Afslutning

SAS-hoteller sortlistet efter Google-fusk

Verdens mest populære søgemaskine, Google, har boykottet SAS-koncernens nordiske hoteller og konferencecentre, efter de har brugt skjulte websider til at opnå en god placering i søgeresultaterne. Metoden er udviklet af danske Netpointers, som risikerer en bombe under sit forretningsgrundlag.

[Fra: www.computerworld.dk, 9. november 2004]

Gør-det-selv

Programmeringsprojekt i kurset Algorithms for Web Indexing and Searching (Gerth S. Brodal, Rolf Fagerberg), efteråret 2002.

- Opgave: lav en søgemaskine for domæne `.dk` .
- 15 studerende.
- 4 parallelt arbejdende grupper (crawling, indexing, PageRank, søgning/brugergrænseflade).
- Erfaring: Rimmelig vellykket søgemaskine, hvor rankningen dog kræver yderligere finjustering...

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- Monika Rauch Henzinger, *Web Information Retrieval*. Proceedings of the 16th International Conference on Data Engineering, 2000.
- Marc Najork and Allan Heydon, *High-Performance Web Crawling*. Compaq SRC Research Report 173.
- Marc Najork and Janet L. Wiener, *Breadth-First Search Crawling Yields*. In Proceedings of the Tenth Internal World Wide Web Conference, 114-118, 2001.
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