



The Next Generation Web Search and the Demise of the Classic IR model

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Yahoo! Research

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The future of web search technology

http://predictions.astrology.com - Predictions: C...

iVillage

Crystal Ball

The Crystal Ball's reply:
The answer is obvious.

Now find out what the future may hold for you! Explore your [free sample Destiny Reading!](#)

Want to ask the Crystal Ball another question? [Click here.](#)

An illustration of a woman's face with large eyes and a slight smile, appearing inside a glowing crystal ball. The crystal ball is set against a circular background with radiating lines. Below the crystal ball, a blue, draped fabric or robe is visible, decorated with yellow stars and crescent moons.



Interpretation

- The future of search is obvious because it continues current trends
- Advertising is certainly involved
- The web ecosystem allows sites like astrology.com to exist & prosper



The trends

1. Web search trend: from **syntactic matching** to (maybe trivial but effective) **semantic matching**

Next: From query-driven Information Retrieval (IR) to context driven Information Supply (IS)

2. Web use trend: from communication medium to social environment

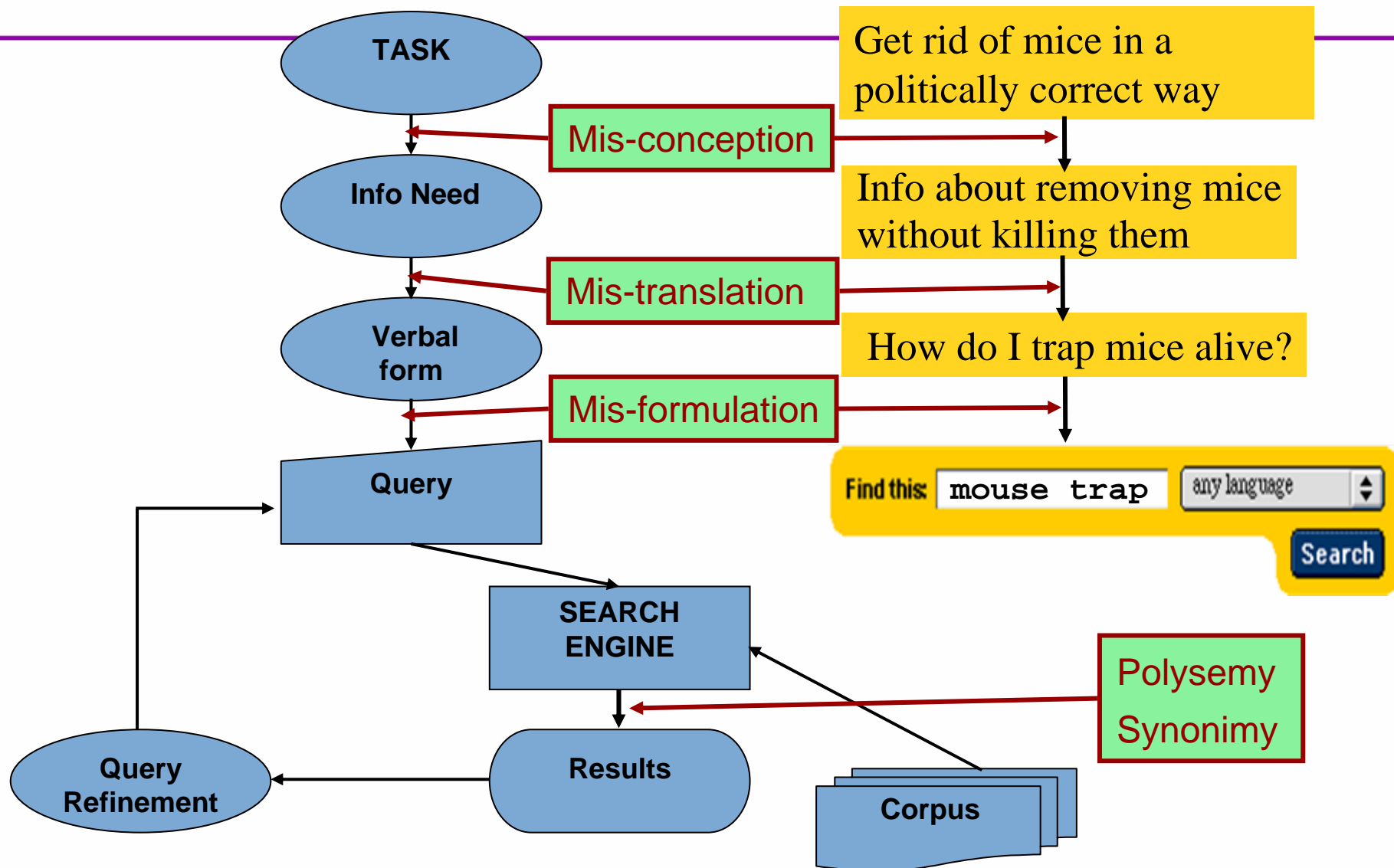
Next: From repository of **documentary knowledge** (+ search tools) to repository of **social & personal knowledge** (+ creation/elicitation tools)

From **web search** to **social search**

⇒ **The demise of the classic IR model ?**



The classic search model





Basic assumptions of Classic Information Retrieval

- **Corpus:** Fixed document collection
- **Goal:** Retrieve documents with information content that is relevant to user's **information need**



Web User Needs

- Need [Brod02, RL04]
 - **Informational** – want to learn about something (~40% / 65%)
 - Bird Flu prevention**
 - **Navigational** – want to go to that page (~25% / 15%)
 - Alitalia US**
 - **Transactional** – want to do something (web-mediated) (~35% / 20%)
 - Access a service **Rome weather**
 - Downloads **Mars surface images**
 - Shop **Nokia mp3 phone**
 - Gray areas
 - Find a good hub **Rome hotels**
 - Exploratory search “see what’s there”



The evolution of commercial web search engines

Syntactic

- **First generation – Syntactic match**

- Use only “on page”, text data, TF/IDF, etc

1994-1997 AV, Excite, Lycos, etc

- **Second generation -- Use off-page, web-specific data**

- Link (or connectivity) analysis
 - Sophisticated mathematical methods
- Click-through data (What results people click on)
- Anchor-text (How people refer to this page)

From 1998. Made popular by Google but everyone now

- **Third generation – Semantic analysis, answer “the need behind the query”**

- Focus on user need, rather than on query
- Integrates multiple sources of data,
- Help the user

Still evolving

- UI, spell checking, query refinement, query suggestion, syntax driven feedback, context help, context transfer, etc

- **Fourth generation – this talk: the move towards information supply**

Semantic

Third generation search examples





Third generation search engine: answering “the need behind the query”

- Semantic analysis
 - Query language determination
 - Auto filtering
 - Different ranking (if query in Japanese do not return English)
 - Hard & soft (partial) matches
 - Personalities (triggered on names)
 - Cities (travel info, maps)
 - Medical info (triggered on names and/or results)
 - Stock quotes, news (triggered on stock symbol)
 - Company info
 - Etc.
 - Natural Language reformulation
 - Integration of Search and Text Analysis



Yahoo! britney spears

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britney spears

[My Web BETA](#)

Search Results Results 1 - 10 of about 66,800,000

Also try: [britney spears pictures](#), [britney spears lyrics](#) [More...](#)

Y! [Britney Spears Artist Page](#) - [Downloads](#) - [Videos](#) - [Photos](#) - [Buy CDs](#)
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1. [Britney Spears](#) - [Translate this page](#)
official site with chat, email, tour information, merchandise, and more.
Category: [Rock and Pop > Britney Spears](#)
[www.britneyspears.com](#) - 2k - [Cached](#) - [More from this site](#) - [Save](#) - [Block](#)
2. [Britney.com](#)
Jive Records' official site.
Category: [Rock and Pop > Britney Spears](#)
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new york city

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Showing results 1-10 of 90,280,000



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[NYC & Company: New York City's Official Tourism Website for ...](#)

NYC & Company (formerly known as the **New York** Convention & Visitors Bureau) is **New York City's** official tourism



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YAHOO! SEARCH

Search Results

Y7 Hotels near Sunnyvale - Local Results

[Grand Hotel](#) - ★★★★★ (800) 786-0827 - 865 W El Camino Real, **Sunnyvale**, CA - 0.44mi - [map](#)
[Cozy 8 Hotel](#) - (408) 732-1760 - 170 S **Sunnyvale** Ave, **Sunnyvale**, CA - 0.44mi - [map](#)
[Hotel Sunnyvale](#) - ★★★★★ (408) 736-5689 - 394 E Evelyn Ave, **Sunnyvale**, CA - 0.56mi - [map](#)
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1. [Sheraton Sunnyvale Hotel](#)
Book a **hotel** room at Sheraton **Sunnyvale Hotel**. Make Sheraton **hotel** reservations in **Sunnyvale**, CA. Find info on vacation packages and deals
[starwoodhotels.com/sheraton/property/overview/index.html?...](#) - [More from this site](#)
2. [Radisson Inn in Sunnyvale, Californias and Resorts](#)
Radisson Inn in **Sunnyvale**, California - Official Site - We Guarantee the Best Rate when you book your **hotel** room online at the Radisson Inn in **Sunnyvale** or you'll get...
[www.radisson.com/sunnyvaleca](#) - [More from this site](#)
3. [Sunnyvale Hotels \(California, United States\) - Tripadvisor](#)
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Search

Web

Results 1 - 10 of about 13,200 for [andrei broder new york](#). (0.22 seconds)

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Publisher. ACM Press **New York**, NY, USA ... Aris Anagnostopoulos , **Andrei Z. Broder** , David Carmel, Sampling search-engine results, Proceedings of the 14th ... [portal.acm.org/citation.cfm?id=792552](#) - [Similar pages](#)

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Andrei Broder, IBM Research Division. Michael Mitzenmacher, Harvard University ... John Wiley and Sons. **New York**, 1983. 16 M. Shaked and J.G. Shanthikumar ...



Yahoo! search: amazing grace

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Search Results

Y!  [Theatrical Trailer](#) [Play](#) 

[Amazing Grace \(2007\)](#)
[movies.yahoo.com](#)
[Yahoos B+](#), [Critics B-](#) William Wilberforce led efforts as a member of Parliament in 18th-century England to end slavery and the slave trade in the British empire. Wilberforce was ...

Showtimes

Enter City and State or Zip Code:

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- [Amazing Grace - Wikipedia, the free encyclopedia](#)
"Amazing Grace" is a well-known Christian hymn. The words were written c. ... **Amazing Grace** and other Hymns from 1886 hymnal, played for any browser exactly as ...
Quick Links: [History](#) - [Bagpipes](#) - [Lyrics](#)
en.wikipedia.org/wiki/Amazing_Grace - 52k - [Cached](#) - [More from this site](#)
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Yahoo shortcuts

- Various types of queries that are “understood”

Shortcuts Categories

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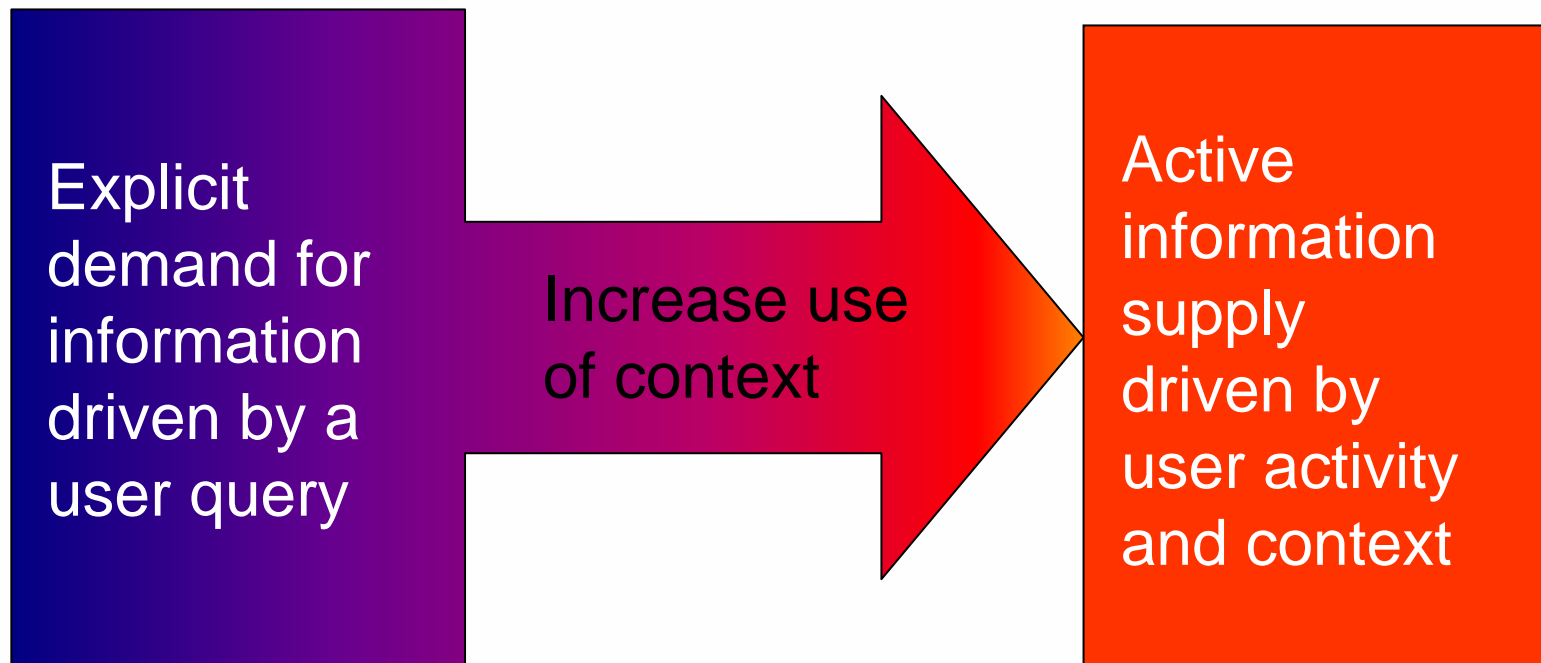
[Open Shortcuts](#)

Main historical trend in web search

Move from syntactic matching
to (maybe trivial but effective)
semantic matching



What's next? Fourth generation: From Information Retrieval to Information Supply





In the beginning there was only information supply...





From Information Retrieval to Information Supply: Buddy presence

Then...

```
> finger karger@CSAIL.MIT.EDU
[CSAIL.MIT.EDU]
KARGER    David Karger           Theory of Computation           Faculty
          <karger@theory.lcs.mit.edu>
          Project: Analysis of Algorithms and/or Information Retrieval
          Work: NE43-321; 258-6167
          Home: 1600 Mass. Ave., Apt. 407, Cambridge, MA 02138; 4919592
>
```

Now...



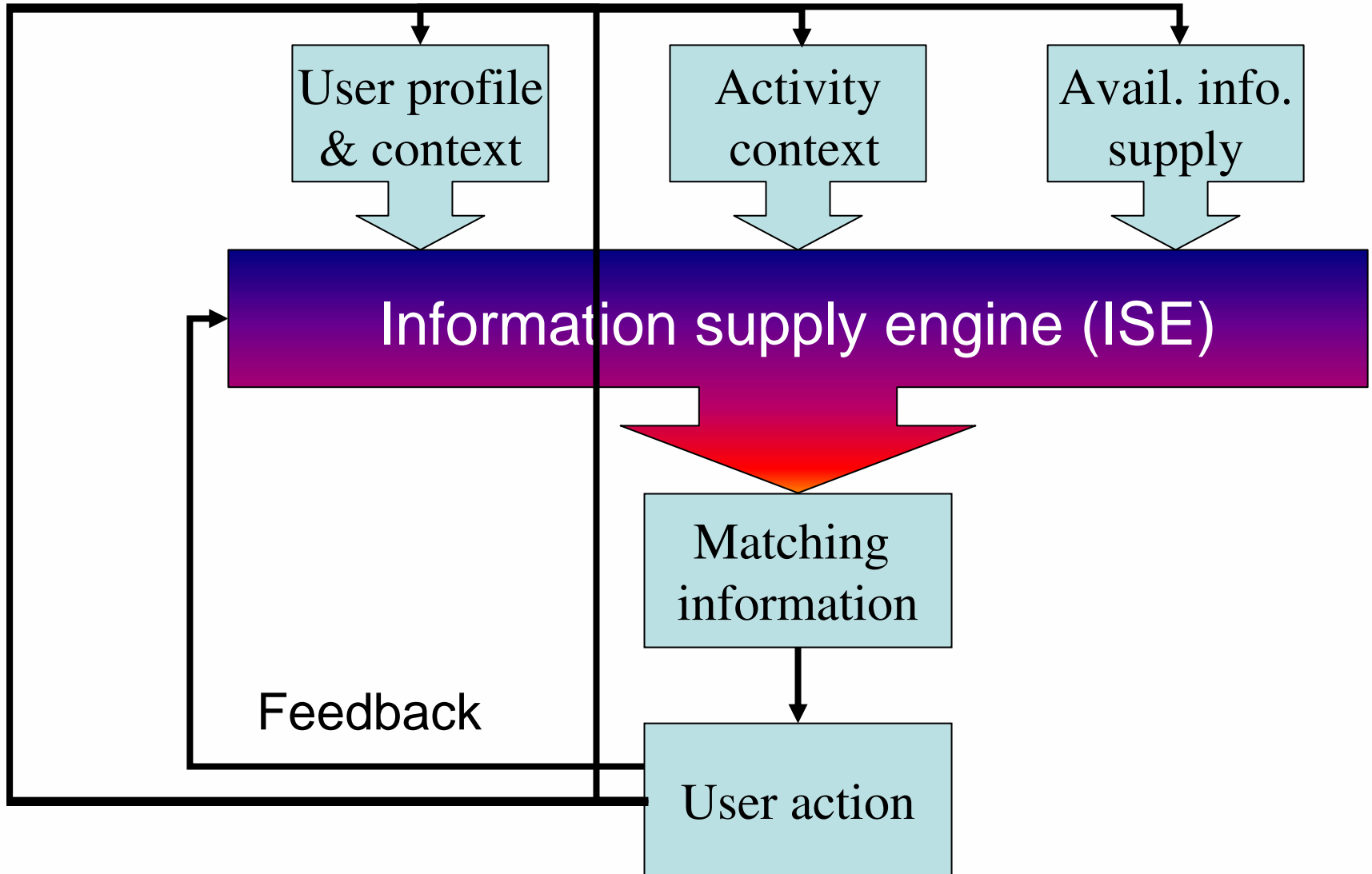


From Information Retrieval to Information Supply: Car Navigation: Maps → GPS





Information supply picture





Some current Web information supply approaches

- Recurrent needs
 - Subscriptions (e-mail, RSS, etc)
 - Alerts – News
- Temporary needs
 - E-commerce sites: accessories, commentaries, related purchases, etc
 - Travel sites: Fly to Rome → Book a hotel, rent a car, etc
 - Contextual help → “You seem to be writing a letter”
 - Automatic annotations
 - ...
 - Contextual ads & search driven ads



Subscriptions examples



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News Results


NEWS STORIES Results 1 - 10 of about 29 for Israel Innovation Summit. Sort Results by: Relevance | [Date](#)

- [World Economic Forum Technology Pioneer in Stem Cell Research Invited to Speak at Israel Innovation Summit 2006](#) 
[\[Press Release\] PR Web - Mar 29 12:25 AM](#)
Dr. Valentin Fulga, CEO of the TheraVitae Group, the producer of VesCell™ -- Adult Stem Cell Therapy for Heart Disease, has been invited to speak at the inaugural **Israel Innovation Summit 2006**. The **Summit** will be held on 4-5 April at the Haifa Congress Center, Haifa, **Israel**. The World Economic Forum recently named Dr. Fulga as one of its 2006 Technology Pioneers for his work in adult stem cell
[Save to My Web](#)
- [Israel Innovation Summit 2006 Opens In April](#) 
[Wireless IQ - Mar 20 9:07 AM](#)
The **Israel Innovation Summit** will be held on April 4-5, 2006. The only...
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Average American Family Income Declines

By MARTIN CRUTSINGER, AP Economics Writer
Thu Feb 23, 6:16 PM ET

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WASHINGTON - After the booming 1990s when incomes and stock prices were soaring, this decade has been less of a thrill ride for most American families.

Average incomes after adjusting for inflation actually fell from 2001 to 2004, and the growth in net worth was the weakest in a decade, the **Federal Reserve** reported Thursday.

Many families were struggling in the aftermath of the 2001 recession and the bursting of the stock market bubble in 2000, the Fed's latest "Survey of Consumer Finances" showed. The comprehensive look at household balance sheets comes every three years.

Average family incomes, after adjusting for inflation, fell to \$70,700 in 2004, a drop of 2.3 percent when compared with 2001. That was the weakest showing since a decline of 11.3 percent from 1989 to 1992, a period that also covered a recession.

The average incomes had soared by 17.3 percent in the 1998-2001 period and 12.3 percent from 1995 to 1998 as the country enjoyed the longest economic expansion in history.

The median family income, the point where half the families made more and half made less, rose a tiny 1.6 percent to \$43,200 in 2004 compared with 2001.

Economists said the weakness in the most recent period was understandable given the loss of 2.7 million jobs from early 2001 through August of 2003, when the country was struggling with sizable layoffs caused by the recession, the terrorist attacks and corporate accounting scandals.

The weak income and the stock market decline in the early part of the decade, which wiped out \$7 trillion of paper wealth, had an adverse impact on family balance sheets.

Net worth, the difference between assets and liabilities such as loans, rose by 6.3 percent in the 2001-2004 period to an average of \$448,200, after adjusting for inflation. That gain was far below the huge increases of 25.6 percent from 1995 to 1998 and 25.6 percent from 1998 to 2001, increases that were fueled by soaring stock prices.

The 2001-2004 performance was the worst since net worth actually declined 1.1 percent in the 1989-1992 period.

The median family net worth, the point where half the families made more and half made less, stood at \$93,100 in 2004, a rise of 1.5 percent after adjusting for inflation from 2001.

The report showed that the slowdown in the growth of net worth would have been even more sizable except for the fact that homeowners have enjoyed big gains in the value of their homes in recent years.

The gap between the very rich and other income groups widened during the period.

The top 10 percent of households saw their net worth rise by 6.1 percent to an average of \$3.11 billion while the bottom 25 percent suffered a decline from a net worth in 2001

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 ABC NEWS Unemployed and Tipping the Scales
 USATODAY.COM Largest teachers union, AFL-CIO, step closer

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Democrats used the new report to blast **President Bush**'s economic policies, contending it would be wrong to make permanent his tax cuts which primarily benefited the wealthy.

"These statistics show why, even though **GDP** is rising, most people do not feel better off," said Sen. Charles Schumer (news, bio, voting record), D-N.Y.



Recommendations as information supply

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[Blink : The Power of Thinking Without Thinking](#)
by Malcolm Gladwell
Publication Date: January 11, 2005

Our Price: \$15.09
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Information supply in context

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List Price: ~~\$549.99~~
Price: **\$439.94**
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With the PowerShot SD550 and SD450 Digital ELPH, Canon has once again stood its stylish ELPH digicams on end, packing ...
- [Canon PowerShot SD550](#) (from [reviews-zdnet.com.com](#))
The Canon PowerShot SD550 is a very well-designed, 7-megapixel snapshot camera. Just don't look for advanced controls. ...
- [DCRP Review: Canon PowerShot SD550 Digital ELPH](#) (from [dcresource.com](#))
Most of those aren't very exciting, and to be honest I don't know why Canon couldn't put the larger screen ...

The background features a large, faint watermark of the Yahoo! logo, consisting of a purple oval with a white 'Y' and a purple exclamation point to its right.

Web advertising

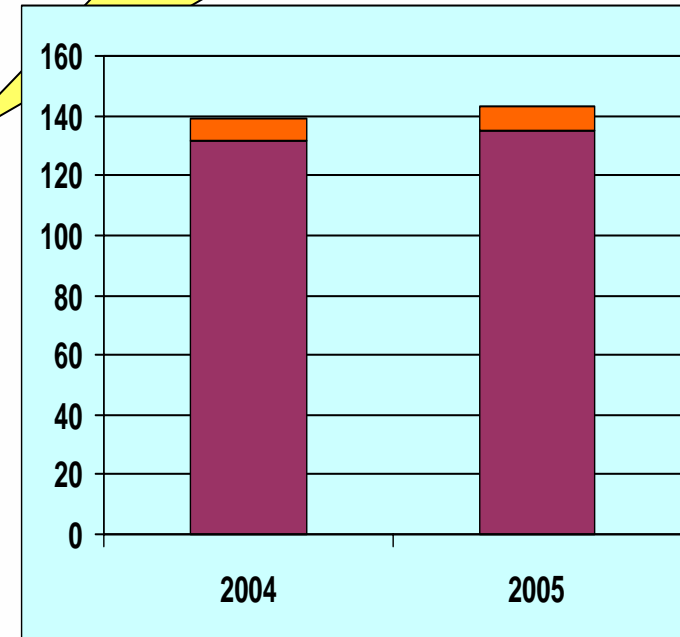


Advertising spend in USA in 2005

Excludes search advertising [TNS Media Intelligence]

Media	Full Year 2005 (Millions)	Full Year 2004 (Millions)	% Change
NEWSPAPERS (LOCAL)	\$25,090.50	\$24,814.40	1.10%
NETWORK TV	\$22,455.20	\$22,523.40	-0.30%
CONSUMER MAGAZINES	\$21,688.00	\$20,167.40	7.50%
CABLE TV	\$15,874.10	\$14,248.80	11.40%
SPOT TV ²	\$15,529.20	\$17,158.70	-9.50%
INTERNET³	\$8,322.70	\$7,343.00	13.30%
LOCAL RADIO ⁴	\$7,364.90	\$7,273.40	1.30%
B-TO-B MAGAZINES	\$4,471.00	\$4,364.60	2.40%
SYNDICATION - NATIONAL	\$4,222.50	\$3,930.90	7.40%
SPANISH LANGUAGE MEDIA ⁵	\$4,219.20	\$3,976.10	6.10%
OUTDOOR	\$3,528.80	\$3,213.00	9.80%
NATIONAL NEWSPAPERS	\$3,466.70	\$3,303.50	4.90%
NATIONAL SPOT RADIO	\$2,604.10	\$2,616.50	-0.50%
SUNDAY MAGAZINES	\$1,619.50	\$1,497.40	8.20%
FSIs ⁶	\$1,441.50	\$1,391.90	3.60%
NETWORK RADIO	\$1,009.90	\$1,027.80	-1.70%
LOCAL MAGAZINES	\$385.50	\$317.70	21.30%
TOTAL⁷	\$143,293.40	\$139,168.60	3.00%

Internet 2005: \$ 8.3B
(+13.3% vs 2004)



Total US 2005: \$ 143.3B
(+3% vs 2004)

Source: TNS Media Intelligence

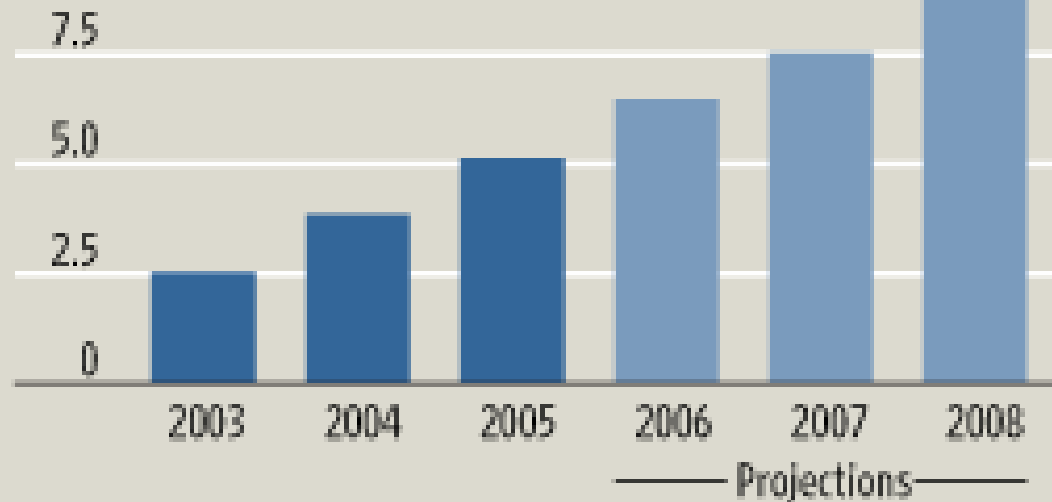


Search advertising spending

Click Costs

Spending on search advertising in the U.S.

\$10.0 billion



Source: eMarketer



A sponsored search ad

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[WWW2006](#)
World Wide Web Conference. Edinburgh, Scotland. 22-26 May 2006.
[www2006.org/](#) - 15k - May 5, 2006 - [Cached](#) - [Similar pages](#)

[WWW2006 - Workshops](#)
The role of the workshop track in **WWW2006** is to further research, development and ...
Additional questions about the **WWW2006** Workshops can be emailed to ...
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WWW2006 3rd Annual Workshop on the. Weblogging Ecosystem: Aggregation,
Analysis and Dynamics · Call for Papers · Workshop Program. Important Dates ...
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[WWW2006](#)
WWW2006. 14 Mar 2006. Volume 9, Issue 29. Developers, start your engines! ... #The
dev-track program at [http://www2006.org/developers/](#) has now been updated ...

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Foundations and challenges of web
advertising -- Edinburgh, May 24
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A content match ad

Content match ad

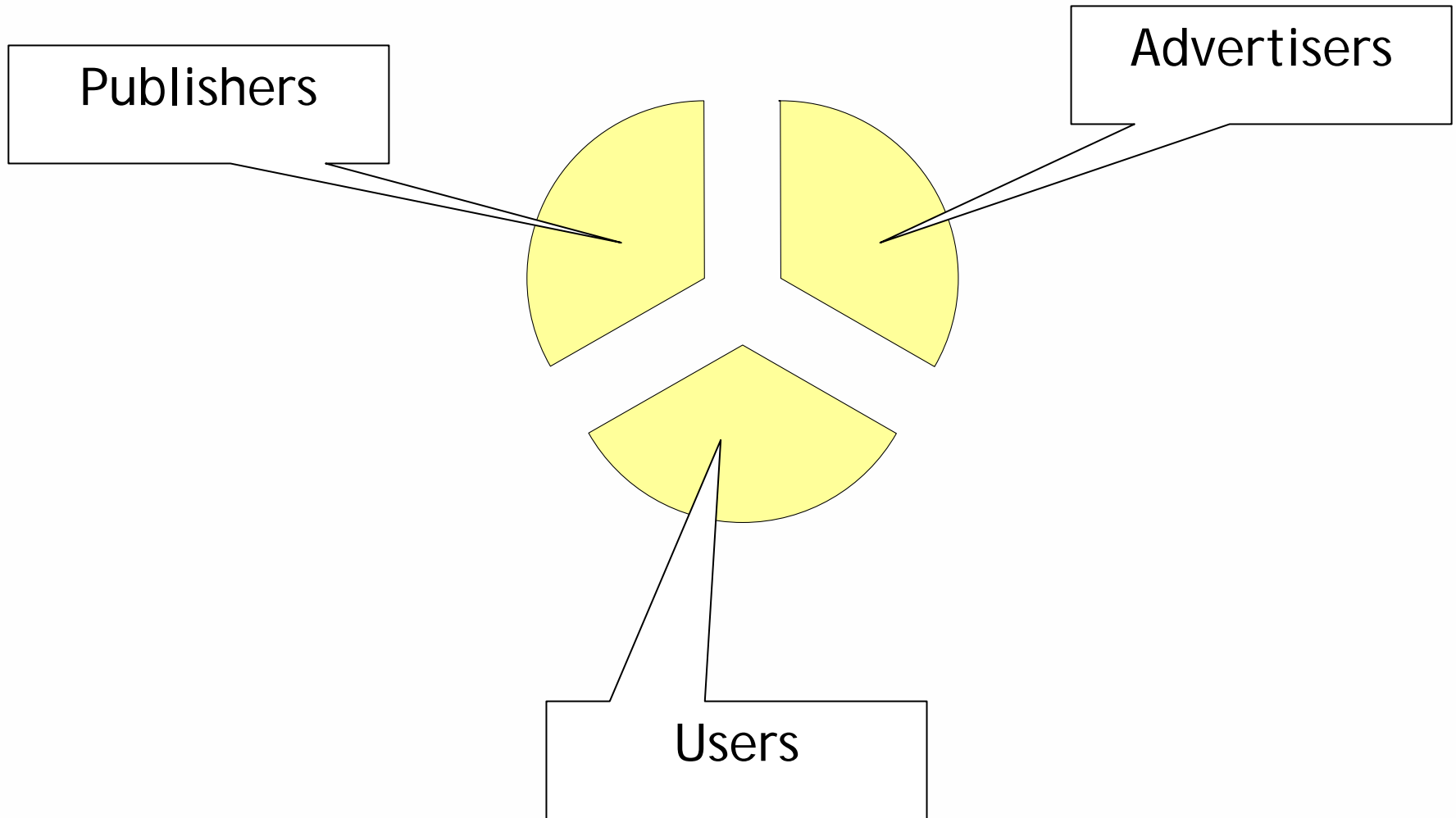
Photographer's Stop    

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Olympus Digital Cameras - Official... Visit the official Olympus Web site for comprehensive information about our digital cameras and... www.olympusamerica.com		Welcome - come on in! Hi - are you new? Come in and let everyone here know about you. Moderator shanky_pec	29	123
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		Photography		
		Forum	Topics	Posts
		General Discussion General photography discussions Moderator shanky_pec	64	284
		Photo Album Discussion, tips-tricks, suggestions regarding photo gallery Moderator shanky_pec	26	129



Contextual ads = meeting of Publishers, Advertisers, Users





Not at easy problem ...

WORLD U.S. N.Y. / N.J. BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPL

1
B
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1

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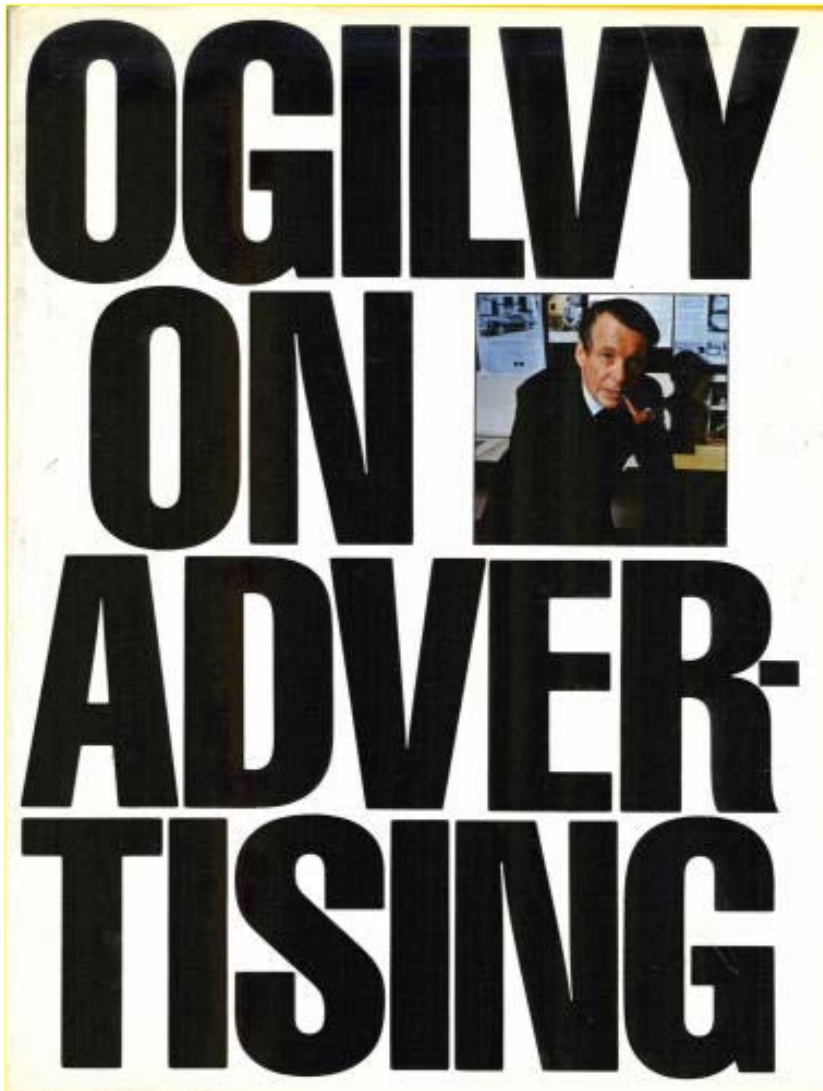
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Libby Shoes
Great deals on everything Libby Shoes themed.
[eBay.com](#)

Say No to Troop Surge
Nationwide petition to stop escalation of Iraq War
[TrueMajority.org](#)



Famous book:



**by David Ogilvy of
Ogilvy & Mather
[1983]**

Recently in paperback!



Ads as information supply

- “I do not regard advertising as entertainment or an art form, but as a medium of information....” [David Ogilvy, 1985]
- “Advertising as Information” [Nelson, 1974]
- Irrelevant ads are annoying; relevant ads are interesting
 - Vogue, Skiing, etc are mostly ads and advertorials
- Even for keyword ads context is more than the keyword
 - User profile
 - Query stream
 - Location
 - Previous impressions

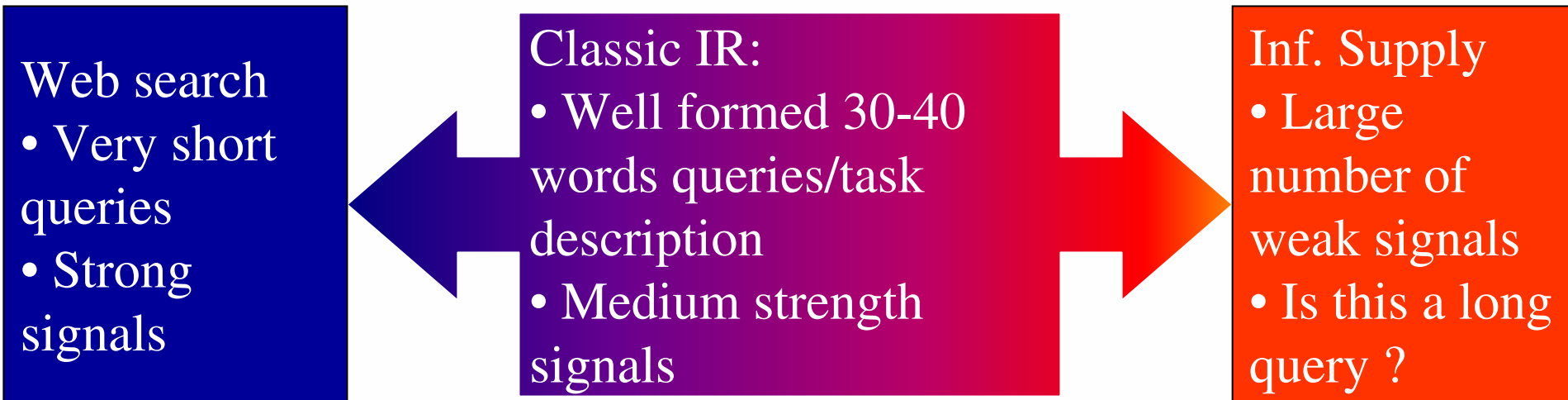


Technical challenges to the transition to information supply

- A theory of information supply
- Representation of context
 - Vector model with lots of parameters?
- Representation of information
 - Certainly bag of words is not enough ...
- Representation of user
 - Probabilistic data
- Matching the three above



Moving to the extremes





The trends

1. Web search trend: from syntactic matching to (maybe trivial but effective) semantic matching

Next: From query-driven Information Retrieval (IR) to context driven Information Supply (IS)

2. Web use trend: from communication medium to social environment

Next: From repository of documentary knowledge (+ search tools) to repository of social & personal knowledge (+ creation/elicitation tools)

From web search to social search

⇒ The demise of the classic IR model ?



Social aspects of the web

1. The web is now both a technology artifact and a social environment
 - “The Web has become the “new normal” in the American way of life; those who don’t go online constitute an ever-shrinking minority.” – [Pew Foundation report, January 2005]
2. Search engines make aggregation of interest possible:
 - Isolated participants can find each other
 - Create incentives for very specialized niche players
 - Economical – specialized stores, providers, etc
 - Social – narrow interests, specialized communities, etc



What is Web 2.0 ?

[Tim O'Reilly]

Web 1.0		Web 2.0
DoubleClick	-->	Google AdSense
Ofoto	-->	Flickr
Akamai	-->	BitTorrent
mp3.com	-->	Napster
Britannica Online	-->	Wikipedia
personal websites	-->	blogging
evite	-->	upcoming.org and EVDB
domain name speculation	-->	search engine optimization
page views	-->	cost per click
screen scraping	-->	web services
publishing	-->	participation
content management systems	-->	wikis
directories (taxonomy)	-->	tagging ("folksonomy")
stickiness	-->	syndication

Source:

What Is Web 2.0
Design Patterns and Business Models for the Next
Generation of Software

by Tim O'Reilly
09/30/2005



What characterizes Web 2.0?

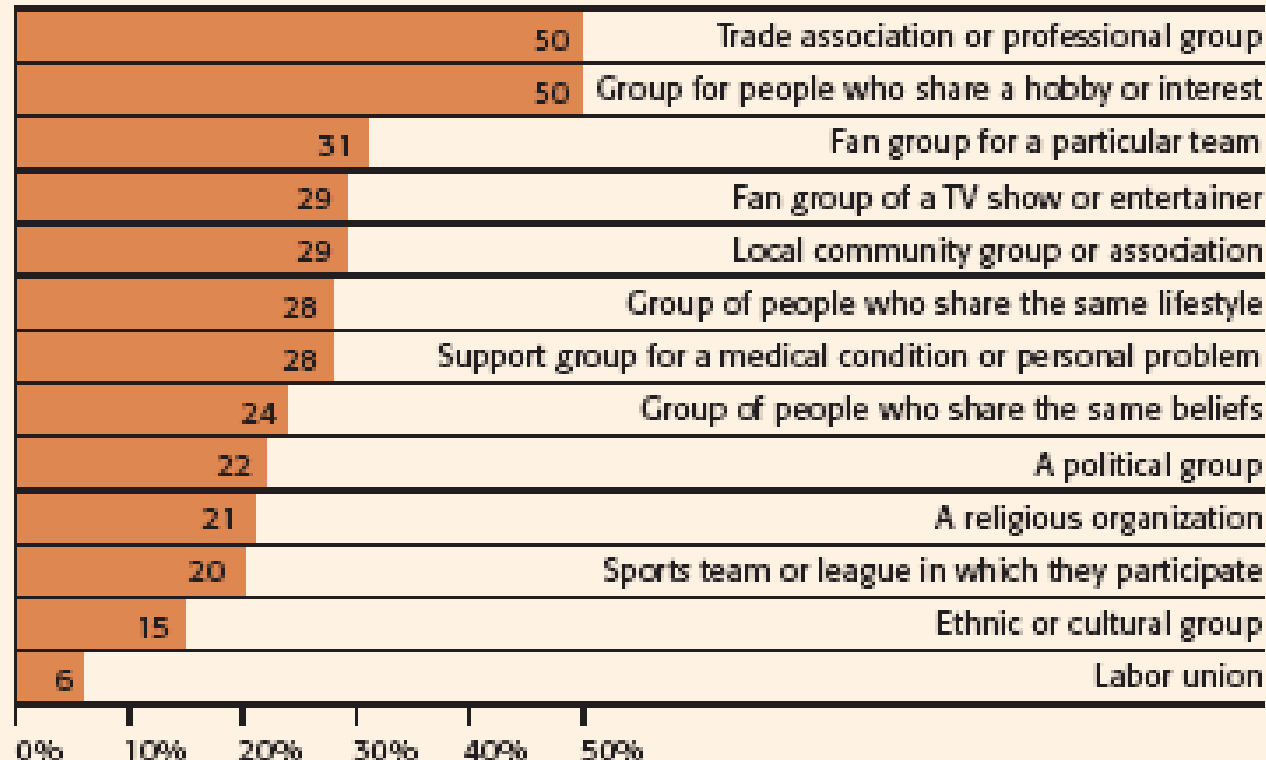
- The web has changed from a communication medium to a social arena:
 - People “live” on the web
 - There are millions of (intersecting) communities driven by common interests and the availability of enabling tools
 - These communities have shared knowledge, documents, or even language, and acceptable manners



Communal activities

About 100 Million Internet Users Say They Belong to Online Communities

PERCENTAGE OF ONLINE COMMUNITY PARTICIPANTS WHO BELONG TO THIS TYPE OF GROUP



Source: Pew Internet Project January-February 2001



Typical web community participation

- 1-10% content creators (creating, sharing)
 - For blogs often just one main author
- 10-20% content synthesizers (tagging, reviewing, rating, etc)
- 100% of content consumers (consuming)



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		Brokeback Mountain DVD + Free Book @ BestBuy			8	186
		Pioneer DVR-K05 Slot Loading Notebook 8X DVD Burner \$73.30			0	150
		Dell E510 + 2007WFP \$851.74 Shipped			5	248
		Very Hungry Caterpillar plus other stories (DVD) @ DDD \$5.99			0	187
		10% purchases of \$199 and up @ circuitcity.com though techbargains.com expires Today			0	222

(All examples edited for clarity)



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- AC = After coupon
- B&M = Brick & mortar → “deal” can not be done online



Forum	Last Post	Threads	Posts
General Flashlight			
<u>General Flashlight Discussion</u> (37 Viewing)	<u>Modding a Solitaire</u> by slinco Today 06:35 PM	13,548	160,096
<u>LED</u> (52 Viewing)	<u>LED Lamp MR16 how much light...</u> by winny Today 06:48 PM	13,722	160,181



Flickr: Social creation of image metadata

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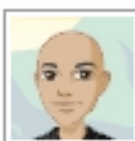
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Social search

- The web now supports specialized sharing on a mass scale
 - Millions of communities driven by common interests and the availability of enabling tools
- “Social search” = satisfy people information needs by combining
 1. What people know -- “the wisdom of the crowds”
 2. The power of “human computing”
 - People are much better than computers at pattern recognition, norms knowledge, etc.
 3. Increasingly sophisticated Web technology and user experience design to facilitate 1 and 2

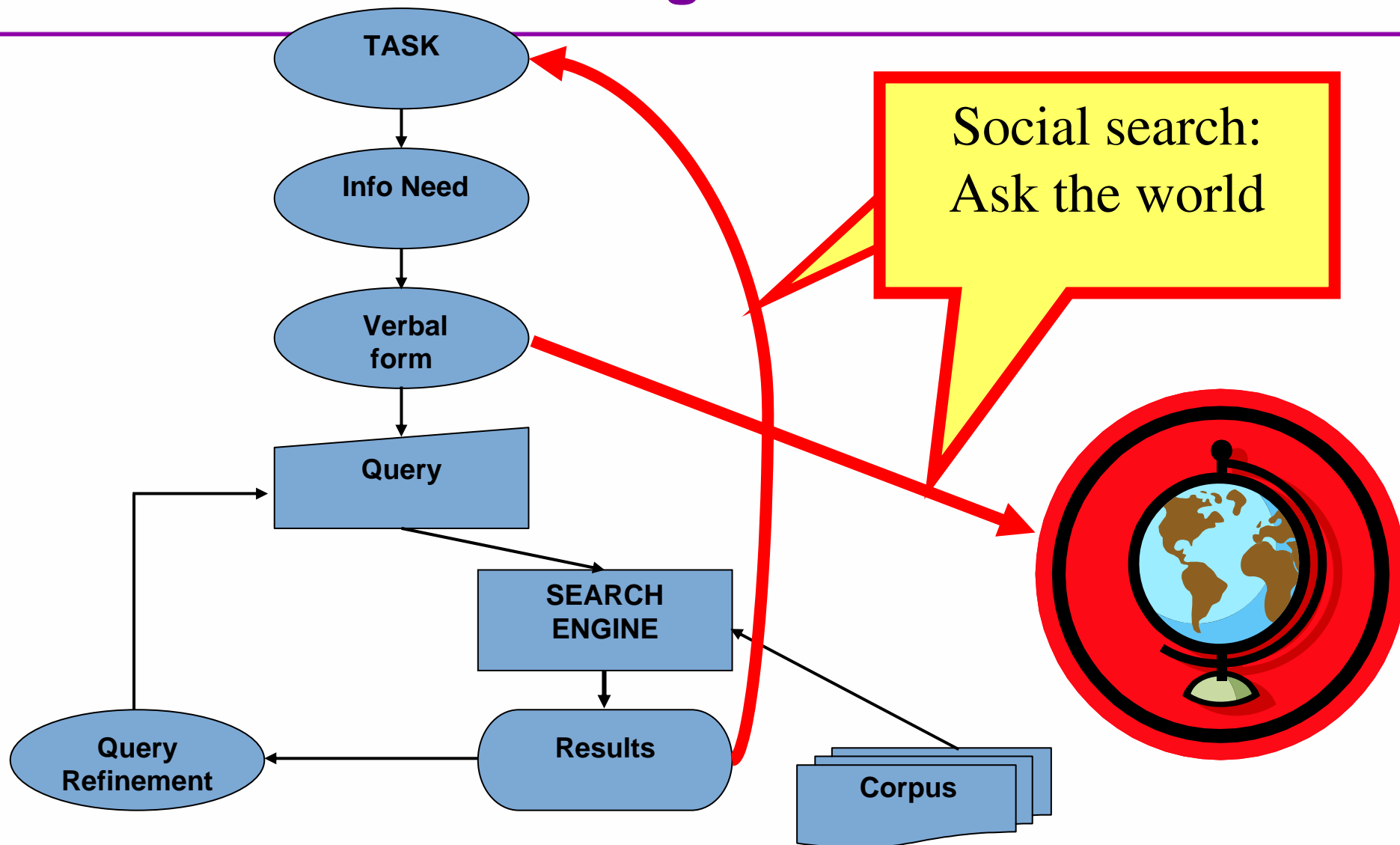


Technical challenges of “social search”

- Enable & leverage the “human computers” that power social search
 - Support metadata/user-generated content in the form of tagging, sharing, connections, reviews, etc
 - Flickr, Delicious, Blogs, Groups, Explicit Social Networks, etc
 - Social engineering/tools to stimulate HC: ESP game, MySpace, Human Experts, etc
 - Technical & UI aspects: how do we incorporate people’s opinion in search results? How do we “understand” a community?
 - Recommender systems, reputation, networks, faq extraction, etc.
 - Business & economics model, incentives, etc



Can the classic model help our understanding?





Last words

- Web mediated information interactions takes now many forms
 - Information retrieval
 - Information supply
 - Social search

and is powered by many scientific disciplines:

- IR, Machine learning, Statistics & data mining, Computer Science, UED, Advertising, Micro-economics, Auction theory, Mechanism design, Sociology, etc, etc.
- There are lots of new & exciting problems waiting for **YOU** to solve them!



Thank you!

For questions:
broder@yahoo-inc.com