



Making the Web searchable

Towards Semantic Search

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Yahoo! Research

Previously in search

- Horizontal search
 - Yahoo...
 - Keyword-based indexing
 - Minimal natural language processing
 - Limited experiments with ontologies (query expansion)
- Vertical search
 - e.g. shopping.com, Kelkoo
 - Faceted search, browsing
 - Fixed ontology
- Combinations
 - Google Base, Google Co-op
 - Web-scale, but fixed ontologies
 - Proprietary technology
- Can we do better with the Semantic Web?
 - Address the long tail of queries (88% of queries)
 - Use standard technology
- Not a new question. But the answer may be new.



Which Semantic Web?

- Two visions
 - Data Web
 - Bringing the content of databases to the Web (linkeddata.org)
 - Rich data, heavyweight semantics
 - Deep Web
 - Annotated Web
 - Annotating the content of Web resources (documents, mm)
 - Simple data, lightweight semantics
 - Shallow Web

- This presentation is about the Annotated Web.

- 3 -

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Brief history of the Annotated Web

- 1995: HTML meta tags
- 1996: Simple HTML Ontology Extensions (SHOE)
- 1998: RDF/XML
 - RDF/XML in HTML
 - RDF linked from HTML
- 2003: Web 2.0
 - Tagging
 - Microformats
 - Metadata in Wikipedia
 - Machine tags in Flickr
- 2005: eRDF
- 2008: RDFa



- 4 -

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HTML meta tags

```
<HTML>
<HEAD profile="http://dublincore.org/documents/dcq-html/">
<META name="DC.author" content="Peter Mika">
<LINK rel="DC.rights copyright"
  href="http://www.example.org/rights.html" />
<LINK rel="meta" type="application/rdf+xml" title="FOAF"
  href= "http://www.cs.vu.nl/~pmika/foaf.rdf">
</HEAD>
...
</HTML>
```

- 5 -

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SHOE example (Hefflin & Hendler, 1996)

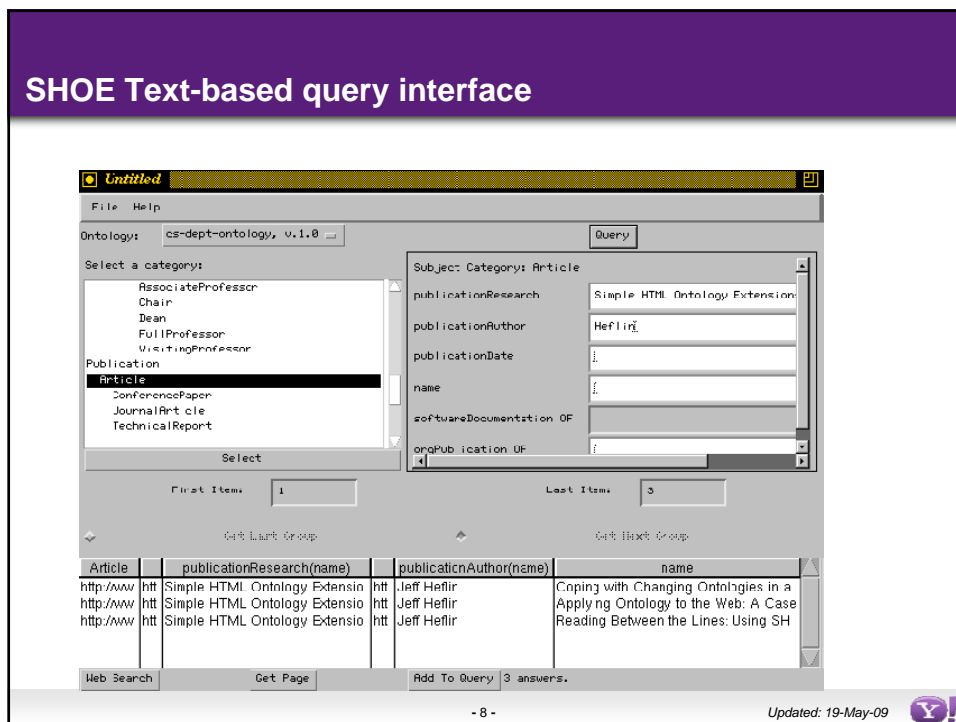
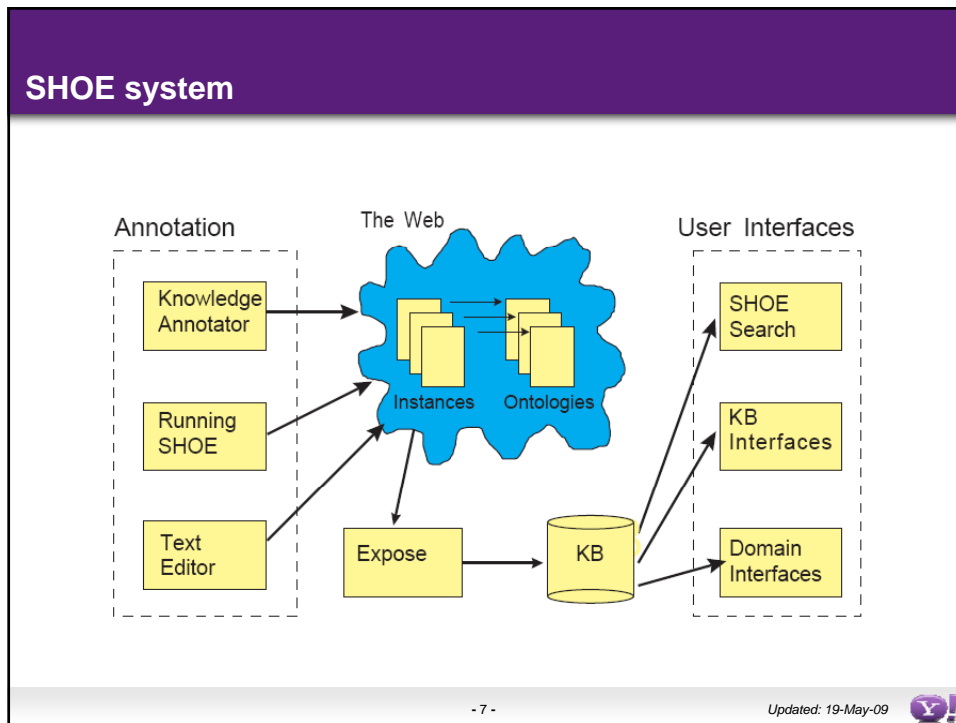
```
<ONTOLOGY "our-ontology" VERSION="1.0">
<ONTOLOGY-EXTENDS "organization-ontology" VERSION="2.1" PREFIX="org"
  URL="http://www.ont.org/orgont.html">
<ONTDEF CATEGORY="Person" ISA="org.Thing">
<ONTDEF RELATION="lastName" ARGS="Person STRING">
<ONTDEF RELATION="firstName" ARGS="Person STRING">
<ONTDEF RELATION="marriedTo" ARGS="Person Person">
<ONTDEF RELATION="employee" ARGS="org.Organization Person">
</ONTOLOGY>
```

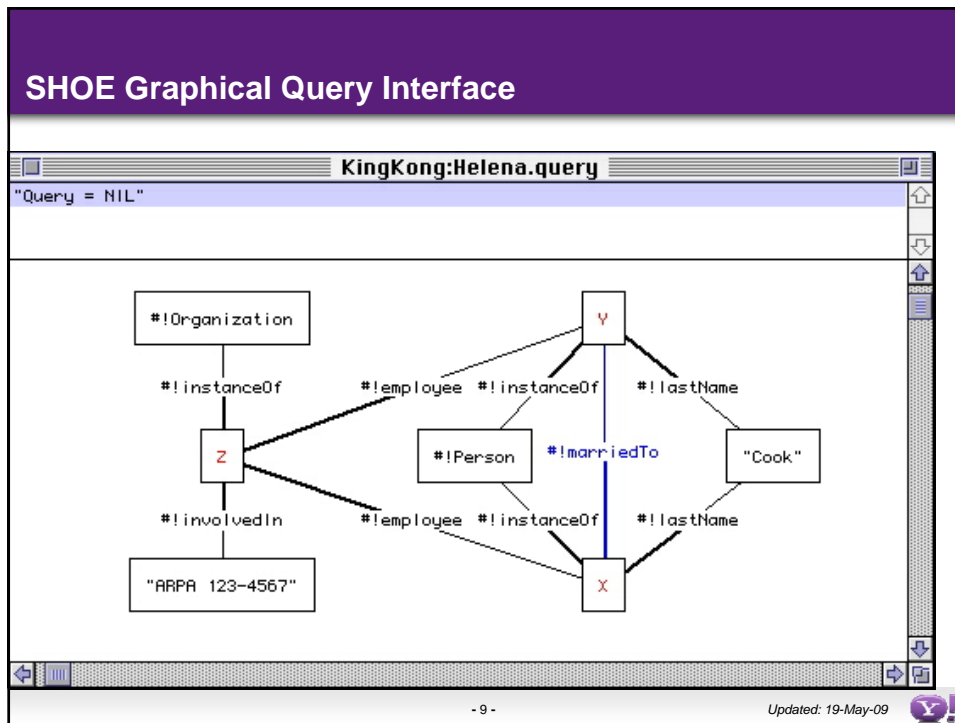
```
<HEAD>
<META HTTP-EQUIV="Instance-Key" CONTENT="http://www.cs.umd.edu/~george">
<USE-ONTOLOGY "our-ontology" VERSION="1.0" PREFIX="our" URL="http://ont.org/our-ont.html">
</HEAD>
<BODY>
<CATEGORY "our.Person">
<RELATION "our.marriedTo" TO="http://www.cs.umd.edu/~helena">
<RELATION "our.employee" FROM="http://www.cs.umd.edu">
My name is
<ATTRIBUTE "our.firstName"> George </ATTRIBUTE>
<ATTRIBUTE "our.lastName"> Cook </ATTRIBUTE> and I live at...
```

- 6 -

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Example: Creative Commons

Embedding CC license in HTML (now deprecated):

```
<HTML>
<HEAD>... </HEAD>
<BODY>
...
<!--
<rdf:RDF xmlns="http://creativecommons.org/ns#"
          xmlns:dc="http://purl.org/dc/elements/1.1/"
          xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
<Work rdf:about="http://www.yergler.net/averages/">
<dc:title>The Law of Averages</dc:title>
<dc:description>...because eventually i&apos;ll be right...</dc:description>
<license rdf:resource="http://creativecommons.org/licenses/by-nc/1.0/" />
</Work>
<License rdf:about="http://creativecommons.org/licenses/by-nc/1.0/">
<requires rdf:resource="http://web.resource.org/cc/Notice" />
<permits rdf:resource="http://web.resource.org/cc/Reproduction" />
<permits rdf:resource="http://web.resource.org/cc/Distribution" />
<prohibits rdf:resource="http://web.resource.org/cc/CommercialUse" />
</License>
</rdf:RDF>
-->
```

The code block includes a red arrow pointing to the right at the bottom left. The footer contains "- 10 -", "Updated: 19-May-09", and a Yahoo! logo.

Example: Creative Commons

- Current: rel attribute (HTML4)

This work is licensed under a `Creative Commons Attribution 3.0 United States License`.

- Use of the "rel" attribute for semantic annotation is the birth of the microformat...

- 11 -

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Example: microformats

```
<div class="vcard">
  <a class="email fn" href="mailto:jfriday@host.com">Joe Friday</a>
  <div class="tel">+1-919-555-7878</div>
  <div class="title">Area Administrator, Assistant</div>
</div>
```

```
<cite class="vcard">
  <a class="fn url" rel="friend colleague met"
  href="http://meyerweb.com/">Eric Meyer</a>
</cite> wrote a post (<cite>
  <a href="http://meyerweb.com/eric/thoughts/2005/12/16/tax-relief/">
  Tax Relief</a></cite>) about an unintentionally humorous letter
  he received from the <span class="vcard">
  <a class="fn org url" href="http://irs.gov/">
  Internal Revenue Service</a> </span>.
```

- 12 -

Updated: 19-May-09



microformats

- microformats.org
- Originated by Tantek Celik and others
- Agreements on the way to encode certain kinds metadata in HTML
 - Reuse of semantic-bearing HTML elements
 - Based on existing standards
 - Community process
 - Persons, events, listings etc. but also syntactic metadata: licenses, tags
- Microformats have no shared syntax
 - Each microformat has a separate syntax tailored to the vocabulary
- Microformats are not ontologies
 - No formal descriptions of schema, only text
 - Limited reuse, extensibility of schemas
 - No datatypes
- No namespaces, unique identifiers (URIs)
 - no interlinking
 - mapping between instances is required
- Relationship to page context is unclear
- Widely used in millions of documents
 - User-generated as well as automatically generated

- 13 -

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Example: tags and machine tags

The screenshot shows a Flickr page for a photo of James Morrison. The page includes a navigation bar, a search bar, and a main content area. The photo is titled "James Morrison - (El Rey Theatre, 14th June 2007)". Below the photo, there are two red boxes highlighting specific sections:

- Tags:** A list of tags including James Morrison, live music, concert, Los Angeles, and The El Rey. There is also a section for "Hide machine tags (1)" with the value "upcoming:event=189351".
- Additional Information:** A section containing "All rights reserved", "Taken at James Morrison, Charlotte Sometimes.", and "Taken in Los Angeles, California (map)". It also shows "Taken on June 14, 2007" and "Viewed once".

- 14 -

Updated: 19-May-09



Example: Tags and machine tags

- Tags
 - User defined keywords
 - Minimal agreement
 - Is 'rock' on Flickr same as 'rock' on myspace?
 - Is 'rock' by me on Flickr is the same as 'rock' by you on Flickr?
 - Is 'rock' by me on Flickr today the same as 'rock' by me on myspace tomorrow?
- Machine tags
 - User defined values for user defined properties
 - Possibility to define the namespace (but not enforced)
 - Limited use

- 15 -

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RDF-based annotation #1: eRDF

- eRDF
 - Ian Davis (Talis)
 - Embedding RDF in HTML
 - Straightforward mapping to RDF triples (XSLT available)
 - HTML4 compatible
 - More complex than microformats
 - Use any RDF/OWL vocabulary
 - Reuse of semantic-bearing HTML elements is limited
 - More limited than RDF
 - No blank nodes
 - No data types
 - No statements about subjects other than the current document
 - Limited usage

- 16 -

Updated: 19-May-09



RDF-based annotation #2: RDFa

- RDFa
 - World Wide Web Consortium (W3C) last call document
 - Similar intent as eRDF, but full RDF support
 - Requires XHTML
 - Big question: user complexity (→ data quality)

```
<p typeof="contact:info" about="http://example.org/staff/jo">
<span property="contact:fn">Jo Smith</span>.
<span property="contact:title">Web hacker</span> at
<a rel="contact:org" href="http://example.org"> Example.org </a>.
  You can contact me <a rel="contact:email"
    href="mailto:jo@example.org">
via email </a>.
</p> ...
```

- 17 -

Updated: 19-May-09



Metadata is out there

- Question:
 - Just how much data is out there?
 - What is the quality?
- Idea: bring metadata to the surface of search
- How does it work?
 - User enters query
 - Metadata is extracted dynamically
 - Entity reconciliation
 - Metadata is used to display
 - rich abstracts,
 - related pages
 - spatial, temporal visualization
- Microsearch prototype
 - Play at <http://www.yr-bcn.es/demos/microsearch/>

- 18 -

Updated: 19-May-09



Example: ivan herman

The screenshot shows a Yahoo! Search Results page for the query 'ivan herman'. The search results list several items, including a blog, a talk, photos, and technical presentations. A map on the right side of the page shows geolocation data for the search results. Annotations in yellow boxes highlight specific features:

- Rich abstract:** Points to the first search result, 'Ivan's blog'.
- Related pages based on metadata:** Points to the 'Ivan's blog' link within the first search result.
- Geolocation:** Points to a map showing location markers for 'Ivan's blog' and other related pages.
- Events from personal calendar, Conferences, and bio from LinkedIn:** Points to a calendar view below the map, showing events for 'Ivan's BD' and 'David's BD'.

At the bottom of the page, there is a footer with '- 19 -' and 'Updated: 19-May-09'.

Example: peter site:flickr.com

The screenshot shows a Yahoo! Search Results page for the query 'peter site:flickr.com'. The search results list several Flickr profiles, including 'peter-notor', 'peter-brown', 'Peter Ellis', and 'Peter Klaminski'. A map on the right side of the page shows geolocation data for the search results. Annotations in yellow boxes highlight specific features:

- Flickr users named "Peter" by geography:** Points to a map showing location markers for various Flickr users named 'Peter'.

At the bottom of the page, there is a footer with '- 20 -' and 'Updated: 19-May-09'.

Example: san francisco conference

The screenshot shows a Yahoo! search for "san francisco conference". The search results list several events, including the "San Francisco Conference" (April 25-June 26, 1945) and various 2008 conferences. A calendar view on the right shows events for 2007 and 2008. A red box highlights the calendar with the text "Conferences in San Francisco by date".

Search Results

1. **San Francisco Conference** - Encyclopaedia Britannica
 Name: Robert McHenry
San Francisco Conference (April 25-June 26, 1945), international meeting that ... Stalin selected **San Francisco** as the site of a **conference** to take place.
<http://www.britannica.com/eb/article/3065303/San-Francisco-Conference-574> - [Cached](#)

2. **Oracle OpenWorld - San Francisco**
 OpenWorld is the premier Oracle event for business decision-makers, IT ... | Worldwide PRODUCTS AND SERVICES INDUSTRIES SUPPORT PARTNERS COMMUNITIES ABOUT ...
<http://www.oracle.com/openworld/sanfrancisco/conference/index.html> - [Cached](#)

3. **adtech Interactive Media Conference aka San Francisco Events**
 adtech Interactive Media **Conference** hosted in **San Francisco** ... **Conference**: Expo Hall Tuesday, April 15, Wednesday, April 16, Thursday, April 17 ...
<http://www.ad-tech.com/af-144> - [Cached](#)

4. **Only In San Francisco - The Official Visitors Site for San Francisco**
 Only in **San Francisco** is The Official Visitors Site for **San Francisco** ... through the square, and you'll see **San Francisco** in all its meeting-pot glory ...
<http://onlyin.sf.selector.org/> - [Cached](#)

5. **Gilbane San Francisco 2008**
 Gilbane Content Management Technologies **conference** at the Palace Hotel **San Francisco**, June 18 - 20, 2008 information ... **Conference** Events: Gilbane San ...
<http://gilbanesf.com/> - [Cached](#)

6. **South San Francisco Conference Center**
 Choice for your next product launch, **conference**, convention, trade show, seminar, reception or banquet.
<http://www.ssfconf.com/> - [Cached](#)

7. **5th Annual Conference on Arteriosclerosis, Thrombosis and Vascular Biology**
<http://www.arteriosclerosis.org/> - [Cached](#)

Calendar view: 2007, @media 2007 America, Workshop: Transcending CSS, Open Source Convention, phony, @media 2007 Europe, Future of Web Design Europe, 2007, 2008.

- 21 - Updated: 19-May-09

Example: greater st. peter

The screenshot shows a Yahoo! search for "greater st. peter". The search results list several churches. A red box highlights the first result with the text "Call phone number". Another red box highlights the phone number "+1-770-210-4100" with the text "Save to address book". A third red box highlights the text "(other actions)" with the text "(other actions)".

Search Results

1. **Greater St. Peter @ River's Edge**
 Name: Senior Pastor: Isaiah J. Waddy, M. Div.
 Address: 9540 Fayetteville Road, Jonesboro, GA 30213
 tel: +1-770-210-4100
<http://www.stpeterame.org/> - [Cached](#)

2. **Greater St. Peter Missionary Baptist Church**
 a good church, a church you can learn the word of God, Rev. Jesse King is the Pastor ...
<http://www.petersbaptist.org/> - [Cached](#)

3. **Greater Saint Peter**
 Christian congregation
<http://www.greaterstpete.org/>

4. **St Peter's RC Sub**
 reach for greater in
 Buffalo, Campus Outreach
<http://www.stpeters.org/>

5. **Jobs at The YMCA**
 jobs at The YMCA of a
 angeles ... ymca of ge
<http://www.ymca.org/>

6. **St. Peter's Episcopal**
 The Homeage of St. P
 community, to work for
<http://www.stpeters.org/>

7. **St. Louis, Florida de**
 St. Louis Florida de
 www.Honda & Used Car
<http://www.stpeters.org/>

8. **Greater St. Peter**
 God reveals in Greater
 user reviews & editorial
<http://www.stpeters.org/>

Call phone number

Save to address book

(other actions)

- 22 - Updated: 19-May-09

Lessons

- More metadata than we expected
 - 53% of unique queries have at least one metadata-enabled page in top 10 (n=7848)
- Performance is poor
 - Metadata needs to come from the index for performance
- Metacrap does exist
 - Users have to see metadata to spot mistakes in their markup, warn others
- RDF templating is hard
 - Adds extra complexity
- Scalability

- 23 -

Updated: 19-May-09



SearchMonkey




- Creating an ecosystem of publishers, developers and end-users
 - Motivating and helping publishers to implement semantic annotation
 - Providing tools for developers to create compelling applications
 - Focusing on end-user experience
- Rich abstracts as a first application
- Addressing the long tail of query and content production
- Standard Semantic Web technology
 - dataRSS = Atom + RDFa
 - Industry standard vocabularies


- 24 -

Updated: 19-May-09



What is SearchMonkey?





an open platform for using structured data to build more useful and relevant search results

Before


[Topics for Getting Pregnant - BabyCenter](#)
Find out how to boost your chances of getting pregnant, what you can do if you're having a problem conceiving, and more ... do before you try to get pregnant ...
[www.babycenter.com/getting-pregnant - 31k - Cached](#)


[WebMD Allergies Health Center - Find allergy information and latest...](#)
Information and articles on the diagnosis, symptoms, treatment, and the prevention of allergies.
[www.webmd.com/diseases_and_conditions/allergies.htm - 132k - Cached](#)


[Italy Travel Guide and Travel Information - Lonely Planet](#)
Lonely Planet Italy includes information on events, attractions, activities, and transportation for the independent traveler.
[www.lonelyplanet.com/worldguide/destinations/europe/italy - 57k - Cached](#)

→

After

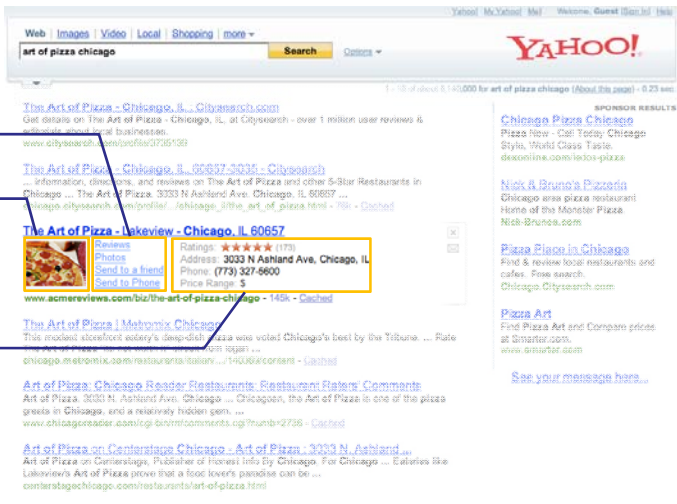
[Topics for Getting Pregnant - BabyCenter](#)
 BabyCenter's getting pregnant tools and information can boost your chances of conception by helping you chart your cycle, read your cervical mucus, and pinpoint ovulation.
[www.babycenter.com/getting-pregnant - 7k - Cached](#)

[WebMD Allergies Health Center - Find allergy information and latest...](#)
 Allergies are an abnormal response of the immune system. People who have allergies have an immune system that reacts to a usually harmless substance in the environment. This substance (pollen, mold, dander, etc.) is called an allergen.
[www.webmd.com/allergies - 111k - Cached](#)

[Italy Travel Guide - Overview - Lonely Planet WorldGuide](#)
 When to go: Italy is at its best in spring (April-May) and autumn (October-November). During these seasons, the scenery is beautiful, the temperatures are pleasant and are relatively low crowds.
[www.lonelyplanet.com/worldguide/destinations/europe/italy - 4k - Cached](#)

→

Enhanced Result




Annotations on the screenshot:

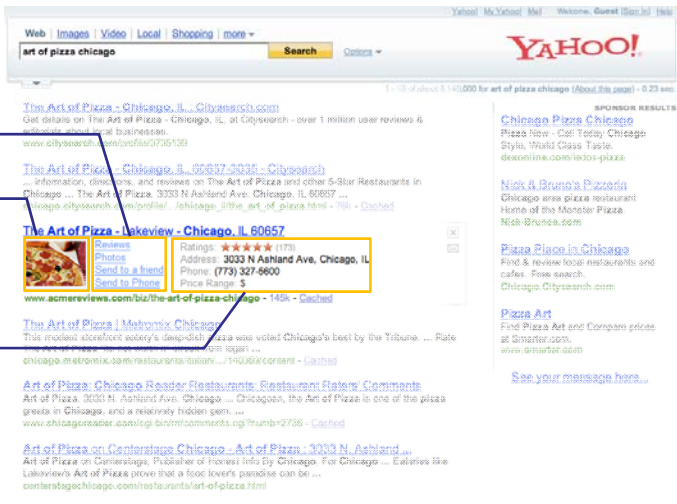
- deep links:** Points to the title and URL of the first search result.
- image:** Points to the image thumbnail of 'The Art of Pizza'.
- name/value pairs or abstract:** Points to the structured data fields like 'Ratings', 'Address', and 'Phone'.

- 25 -

Updated: 19-May-09

Enhanced Result





Annotations on the screenshot:

- deep links:** Points to the title and URL of the first search result.
- image:** Points to the image thumbnail of 'The Art of Pizza'.
- name/value pairs or abstract:** Points to the structured data fields like 'Ratings', 'Address', and 'Phone'.

- 26 -

Updated: 19-May-09

13

Infobar

SearchMonkey


- 1 site owners/publishers share structured data with Yahoo!.
- 2 site owners & third-party developers build SearchMonkey apps.
- 3 consumers customize their search experience with Enhanced Results or Infobars

Developer tool

Yahoo! | My Yahoo! | Mail | More ▾ Make Y! Your Home Page Welcome, Peter ▾ Sign Out | Help

YAHOO! APPLICATION PLATFORM SearchMonkey **WEB SEARCH**


Application Dashboard



Presentation Applications

Presentation Applications are small PHP apps that display enhanced search results using data services. You can use an existing data service or create a custom service below.

[Create a New Application](#) | [Start with a sample application](#) | [Import application](#)

SearchMonkey  **LinkedIn: Presentation Application (SAMPLE)**

A sample presentation application for LinkedIn. Displays hResume data directly from profile pages, using a previously-created sample LinkedIn custom data service.

Created: **May 20th, 2008, 3:49pm**

[Edit](#) [Delete](#) [Export](#)


Custom Data Services

Data Services provide structured information to display in Yahoo! Search results. You can create a custom data service by calling an API or by extracting structured data from web pages.

[Create a new data service](#) | [Start with a sample data service](#) | [Import data service](#)

Helpful Links

- [Welcome Page](#)
- [Application Gallery](#)
- [Developer Guide](#)
- [Submit Your Feedback](#)

- 29 - Updated: 19-May-09 

Developer tool

Yahoo! | My Yahoo! | Mail | More ▾ Make Y! Your Home Page Welcome, Peter ▾ Sign Out | Help

YAHOO! APPLICATION PLATFORM SearchMonkey **WEB SEARCH**

Application Dashboard / LinkedIn: Presentation Application (SAMPLE)

Basic Info | **URLs** | **Data Services** | **Appearance** | **Confirmation**

Step 1: Specify your application's name, type, and description.

Name:
 The external name of your app. (* Required)

Type:

Enhanced Result (reconfigures a result) **Infobar** (provides more info under a result)

Acme Movies Dr. Seuss' Horton Hears a Who (2008) Movie Info

Movie Details Critic Reviews: **★★★★☆** (172)
 Synopsis & Tickets MPA Rating: **G**
 Trailers & Clips Running Time: **1 hr. 28 min.**
 Critic Scores Release Date: **March 14th, 2008 (old)**

[movies.acme.com/movies/1309736203info-2416 - Cached](#)

Dr. Seuss' Horton Hears a Who - Acme Movies

Collection of critical reviews for the 2008 movie Horton Hears a Who! that have been compiled to formulate a "fresh!" or "stale!" rating.


[movies.acme.com/movies/horton_hears_a_who - Web - Cached](#)

Reviews: **★★★★☆** (172) [Add a Crit](#) [Recommendations](#)

Description:

A sample presentation application for LinkedIn. Displays hResume data directly from profile pages, using a previously-created sample LinkedIn custom data service.

Category:

- 30 - Updated: 19-May-09 

Developer tool

[Yahoo!](#) | [My Yahoo!](#) | [Mail](#) | [More](#) | [Make Y! Your Home Page](#) | [Welcome, Peter](#) | [Sign Out](#) | [Help](#)

APPLICATION PLATFORM
SearchMonkey

WEB SEARCH

[Application Dashboard](#) / [Linkedin: Presentation Application \(SAMPLE\)](#)

[File a bug](#) | [Feedback](#)

Basic Info
URLs
Data Services
Appearance
Confirmation

Step 3: Choose your data services.

Data Service

Select one or more Data Services to supply your presentation application with interesting information to display. For example, the default Yahoo! Index contains data gathered by the Yahoo! Search Crawler, such as the page's title and file size. You will specify how to display this data on the next screen.

Default: Available from the Yahoo! Index
+ Contains 46 data fields

Feed: com.yahoo.uf.hcard
- Contains 6 data fields

```

                    com.yahoo.uf.hcard/rel:Card.2/vcard:fn
                    com.yahoo.uf.hcard/rel:Card.2/vcard:org
                    com.yahoo.uf.hcard/rel:Card.3/vcard:fn
                    com.yahoo.uf.hcard/rel:Card.3/vcard:org
                    com.yahoo.uf.hcard/rel:Card/vcard:fn
                    com.yahoo.uf.hcard/rel:Card/vcard:photo
                
```

Feed: sm031-LinkedIn
+ Contains 12 data fields

Updated: 19-May-09

Developer tool

[Yahoo!](#) | [My Yahoo!](#) | [Mail](#) | [More](#) | [Make Y! Your Home Page](#) | [Welcome, Peter](#) | [Sign Out](#) | [Help](#)

APPLICATION PLATFORM
SearchMonkey

WEB SEARCH

[Application Dashboard](#) / [Linkedin: Presentation Application \(SAMPLE\)](#)

Basic Info
URLs
Data Services
Appearance
Confirmation

Step 4: Map your data services to your presentation layer.

Modify Appearance with PHP:

Use PHP to map data from your data services to different components of your presentation application. Clicking one of the **Link** to the right inserts a short PHP snippet that retrieves the specified data. Once you have mapped your data, click **Save and Refresh** to check your work in the **Preview Pane** at the bottom of the screen.

```

                public static function getOutput() {
                    $ret = array();

                    // Image
                    $ret['image']['src'] =
                    Data::get('com.yahoo.uf.hcard/rel:Card/vcard:photo');
                    $ret['image']['alt'] = "linkedin image";
                    $ret['image']['allowResize'] = TRUE;

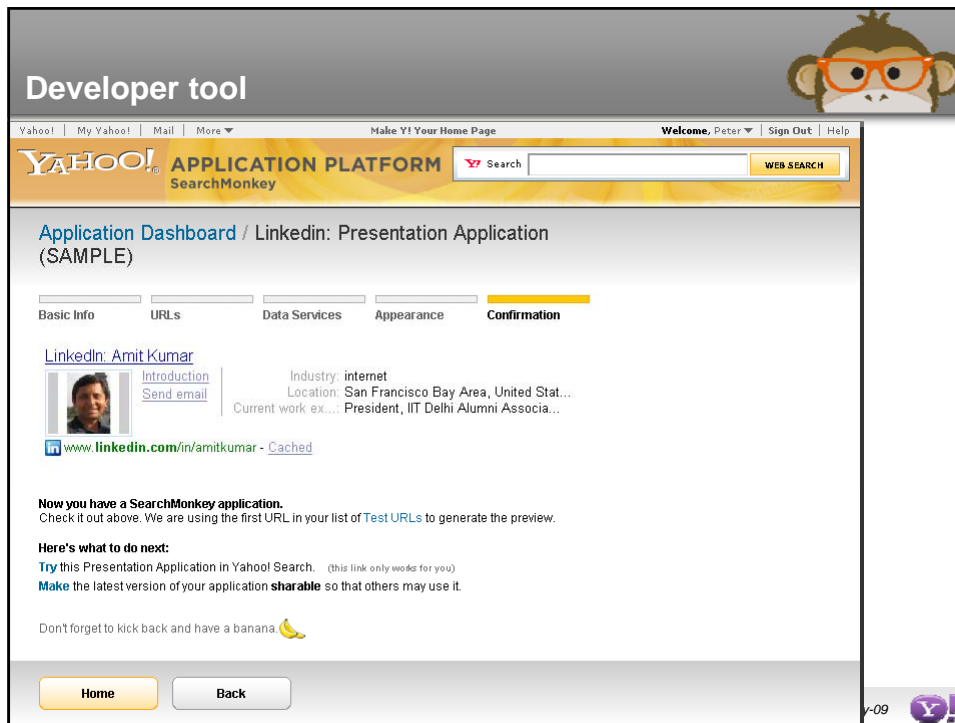
                    // Key Value pairs - up to 4
                    $ret['dict'][0]['key'] = "Summary";
                    $ret['dict'][0]['value'] =
                    Data::get('sm031-LinkedIn/rel:Profile/reference:summary');
                    $ret['dict'][1]['key'] = "Industry";
                    $ret['dict'][1]['value'] =
                    Data::get('sm031-LinkedIn/rel:Profile/job:industry');
                    $ret['dict'][2]['key'] = "Location";
                
```

Data Inputs. Click the **Link** to paste the data into your PHP at the cursor.

- [yahoo:index](#)

- dc:identifier
- media:fileSize
- dc:format
- dc:language
- finance:stockTickers
- rel:Posting
 - o dc:type
 - o context:position
 - o dc:title
 - o dc:description
 - o dc:date
 - o rel:link

ay-09



Developer tool


Yahoo! | My Yahoo! | Mail | More ▾ | Make Y! Your Home Page | Welcome, Peter ▾ | Sign Out | Help

YAHOO! APPLICATION PLATFORM SearchMonkey

Application Dashboard / [LinkedIn: Presentation Application \(SAMPLE\)](#)

Basic Info | URLs | Data Services | Appearance | **Confirmation**

[LinkedIn: Amit Kumar](#)

 [Introduction](#) [Send email](#)

Industry: internet
Location: San Francisco Bay Area, United Stat...
Current work ex...: President, IIT Delhi Alumni Associa...


www.linkedin.com/in/amitkumar - [Cached](#)

Now you have a SearchMonkey application.
Check it out above. We are using the first URL in your list of [Test URLs](#) to generate the preview.

Here's what to do next:
[Try](#) this Presentation Application in Yahoo! Search. (this link only works for you)
[Make](#) the latest version of your application [sharable](#) so that others may use it.

Don't forget to kick back and have a banana. 🍌

[Home](#) [Back](#)

09 

Future Work

- Encouraging reception from publishers and developers
- Next steps
 - Increasing relevance through better understanding of query intent
 - Focusing on task completion instead of single results
 - Opening up more of search, other parts of Yahoo!
 - Increasing the complexity of applications
- Get engaged
 - Help in bringing metadata to the Semantic Web, preserving quality
 - Talk to us about applications you foresee
 - Facilitate the creation of industry standard vocabularies
- Contact
 - developer.yahoo.com/searchmonkey/
 - mailing lists
 - searchmonkey-developers@yahoogroups.com
 - searchmonkey-siteowners@yahoogroups.com
 - forums
 - <http://suggestions.yahoo.com/searchmonkey>
 - <http://suggestions.yahoo.com/datarss>





SearchMonkey

the monkey is out!

