



TWC

Tetherless World Constellation

“Why the Semantic Web will Never Work” (note the quote marks!)

Jim Hendler
RPI

<http://www.cs.rpi.edu/~hendler@jahendler>

(sorry, not in rhyme)



Friends, Romans (& Greeks), Countrymen
Lend me your ears

Tetherless World Constellation

- I have come to bury the semantic web, not to praise it





Does it mean

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- Why our critics were wrong when they said “The Semantic Web will Never Work”

or

- Why the Semantic Web will Never Achieve the Vision we had for it (at least if we don't fix things)



Yes (not Xor)

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- Outline

- Some current Semantic Web Successes
- Revisit the Semantic Web vision
 - What did we say we would do
- Review successes and failures
 - What has worked as well (or better) than we expected
 - What hasn't
- What are some challenges to overcome to achieve the latter?



Revisiting the Vision...

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Tetherless World Constellation

Introducing the Semantic Web

Professor James Hendler
<http://www.cs.umd.edu/~hendler>
Co-Director, Maryland Information and Network Dynamics Laboratory



University of Brighton

2002 Distinguished Lecture
in Artificial Intelligence and Cognitive Science

The Semantic Web

Prof James Hendler

Director for Semantic Web and Agent Technology, University of Maryland

**Teraflops
Petabytes
and
Exalinks**

Science and the Semantic Web

Professor James Hendler
University of Maryland
<http://owl.mindswap.org>

The Semantic Web

Prof. James Hendler
Hendler@cs.umd.edu

Presentations, Downloads and Demos:
<http://www.cs.umd.edu/~hendler>
<http://owl.mindswap.org>

mindswap

What's next on the Semantic Web?

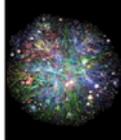
Jim Hendler
<http://www.cs.umd.edu/~hendler>



Semantic Web Slinging

Prof. J. Hendler
Director, JKD
University of Maryland
Hendler@cs.umd.edu

**Taxonomy, Vocabulary and Ontology:
Linnaeus and the World Wide Web**



Jim Hendler
Tetherless World Chair
Rensselaer

The Fellowship of the (Semantic) Web



TWO TOWERS
PROF. J. HENDLER
RPI
HENDLER@CS.RPI.EDU

My Take on the Semantic Web Layercake



Tetherless World Constellation

**Web 3.0, Linked Data, and the Semantic Web:
What's this all about?**

Jim Hendler
Tetherless World Professor of Computer and Cognitive Science
Assistant Dean of Information Technology and Web Science
Rensselaer Polytechnic Institute
<http://www.cs.rpi.edu/~hendler>

Tetherless World Constellation

"Why the Semantic Web will Never Work"

Jim Hendler
RPI
<http://www.cs.rpi.edu/~hendler>
@jahendler

(sorry, not in rhyme)

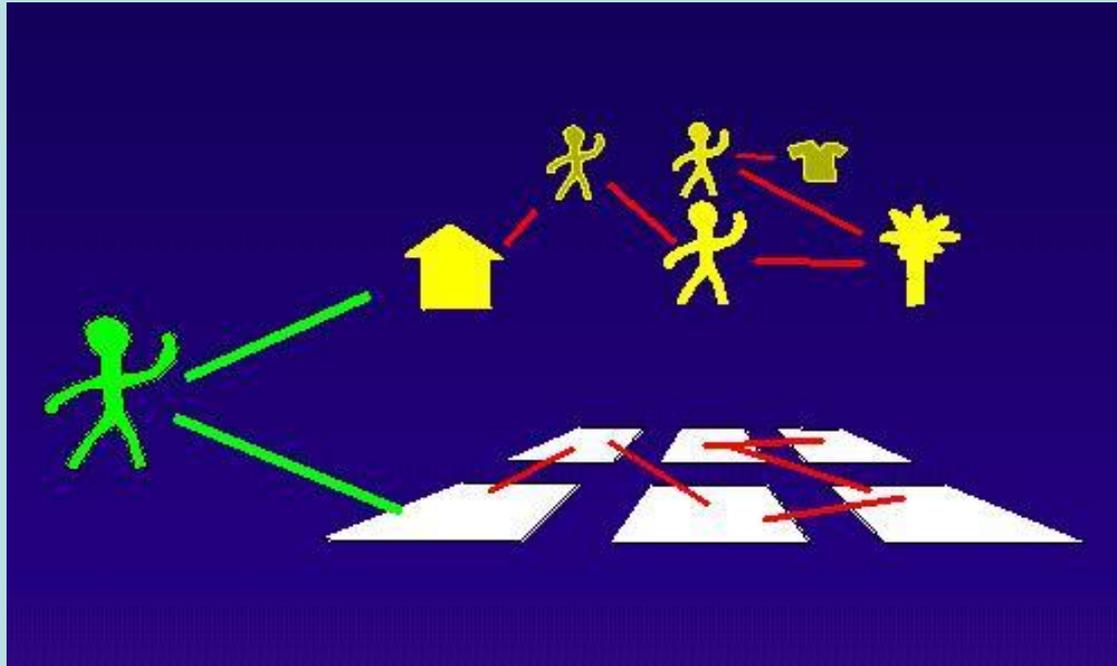
>200 Semantic Web talks since 2000



Pre-History

Who first conceived of the Semantic Web?
Tim Berners-Lee (WWW Geneva, 1994)

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- "This is a pity, as in fact documents on the web describe real objects and imaginary concepts, and give particular relationships between them... For example, a document might describe a person. The title document to a house describes a house and also the ownership relation with a person. ... This means that machines, as well as people operating on the web of information, can do real things. For example, a program could search for a house and negotiate transfer of ownership of the house to a new owner. The land registry guarantees that the title actually represents reality."
 - Tim Berners-Lee plenary presentation at WWW Geneva, 1994

Beyond XML: Agent Semantics

- DARPA will lead the way with the development of Agent markup Language (DAML)
 - a “semantic” language that ties the information on a page to machine readable semantics (ontology)
 - Currently being explored at University level
 - SHOE (Maryland), Ontobroker(Karlsruhe),OWL(Washington Univ)
 - Largely grows from past DARPA programs (I3, ARPI)
 - But not transitioning
 - W3C focused on short-term gain:HTML/XML

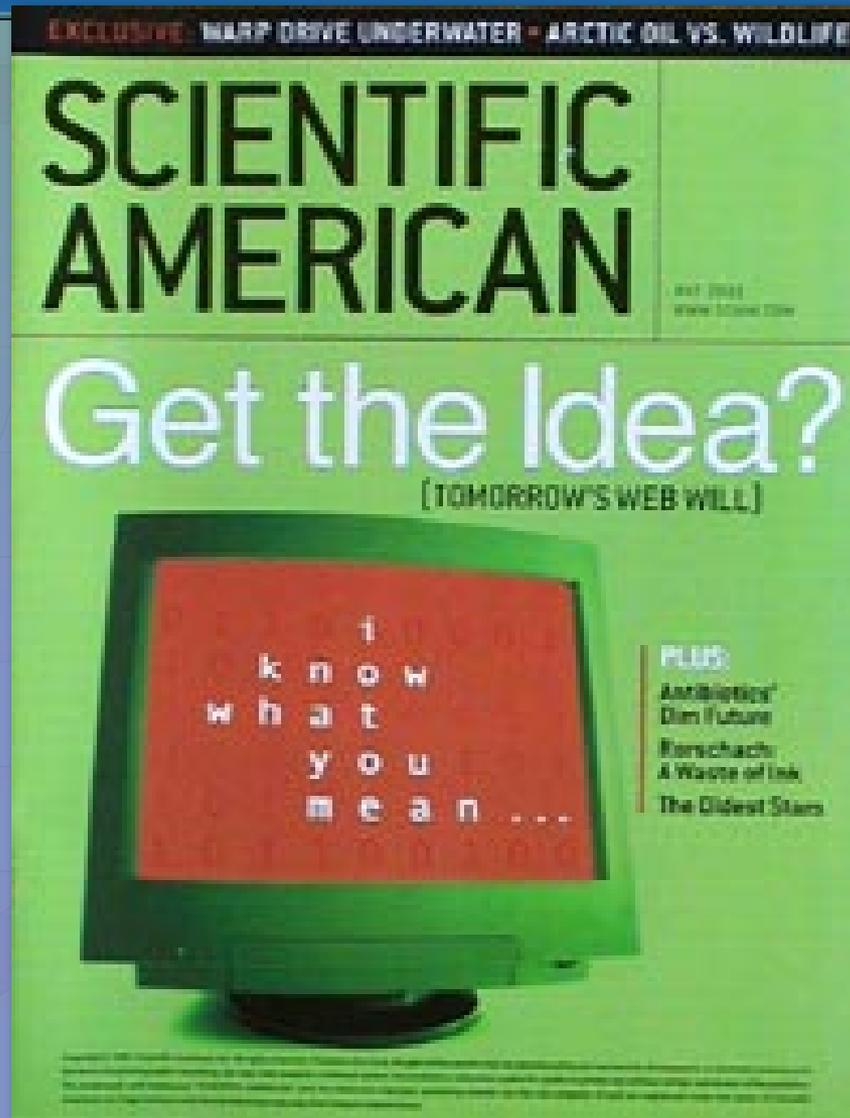
```
<Title> Beyond XML
  <subtitle> agent semantics </subtitle> </title>
<USE-ONTOLOGY ID="PPT-ontology" VERSION="1.0"
PREFIX="PP" URL="http://iw.p.darpa.mil/ppt..html">
<CATEGORY NAME="pp.presentation"
FOR="http://iw.p.darpa.mil/jhendler/agents.html">
<RELATION-VALUE POS1 = "Agents" POS2 = "/jhendler">
```

```
<ONTOLOGY ID="powerpoint-ontology" VERSION="1.0"
DESCRIPTION="formal model for powerpoint presentations">
<DEF-CATEGORY NAME="Title" ISA="Pres-Feature" >
<DEF-CATEGORY NAME="Subtitle" ISA="Pres-Feature" >
<DEF-RELATION NAME="title-of"
SHORT="was written by">
  <DEF-ARG POS=1 TYPE="presentation">
  <DEF-ARG POS=2 TYPE="presenter" >
```



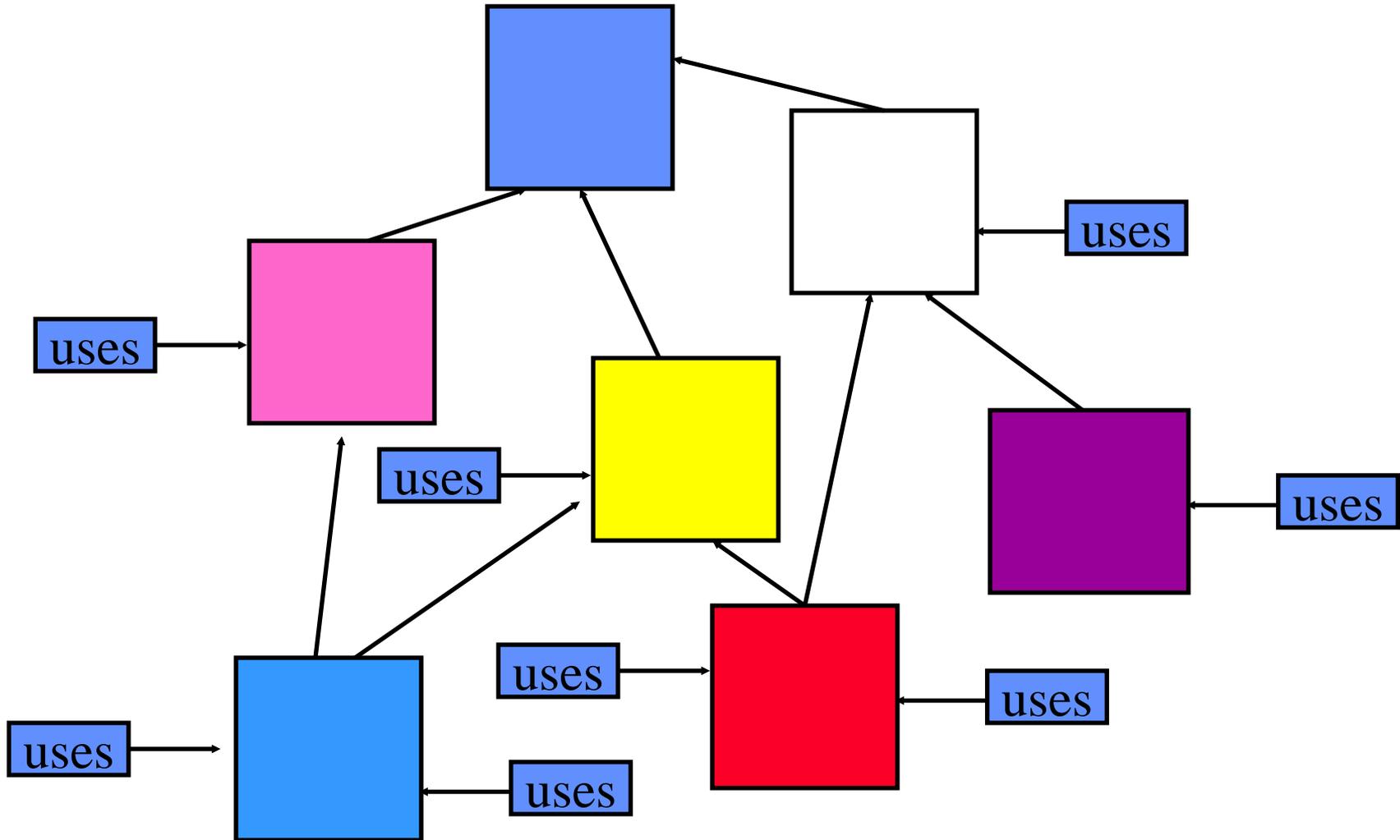
Berners-Lee et al, 2001

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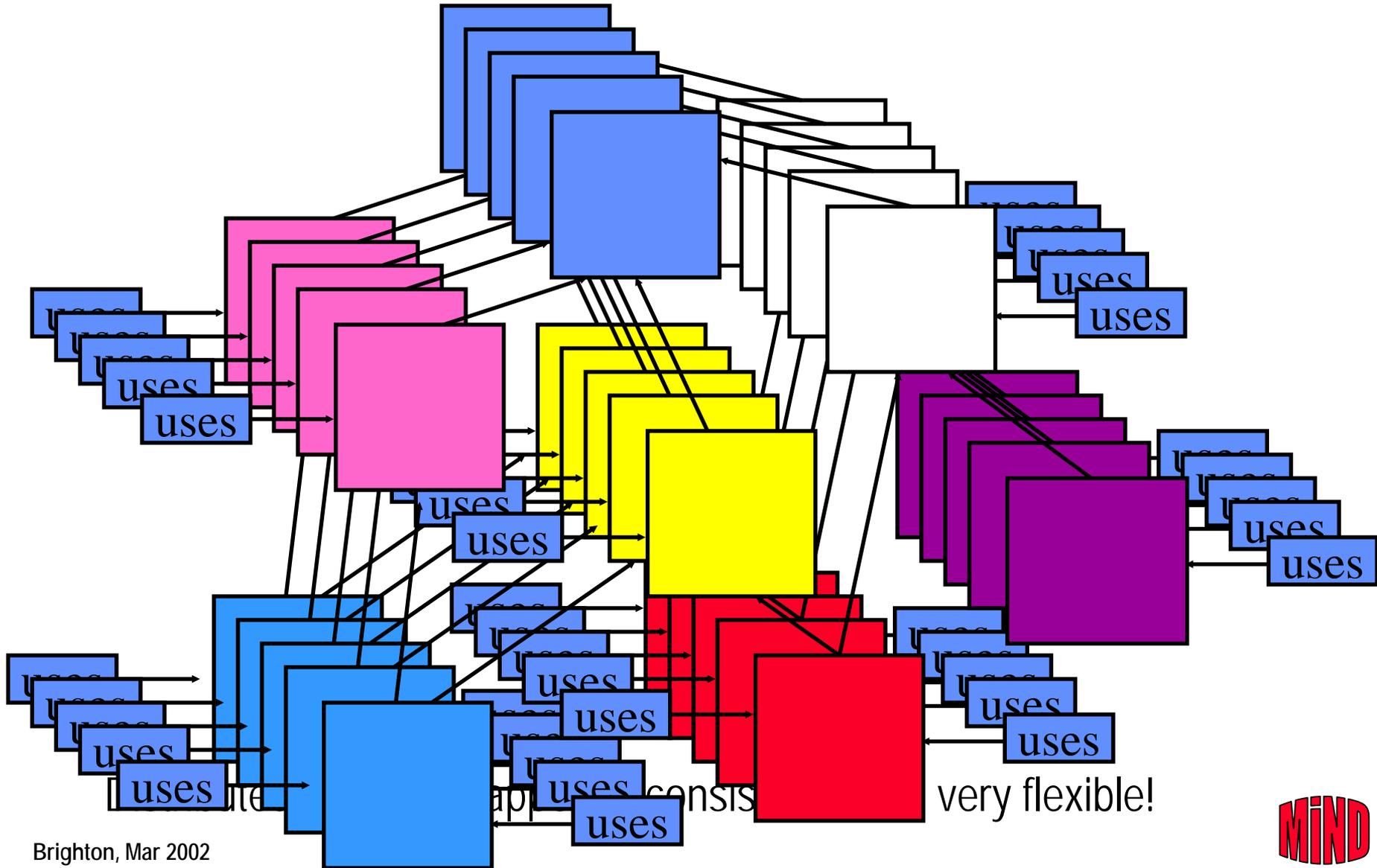
(May 21, 2001)

This leads to a radically new view of interoperation



Distributed, partially mapped, inconsistent -- but very flexible!

This leads to a radically new view of interoperation



But, like the web...



Semantic Error 409- Ontology Not Found

You've encountered a "Ontology Not Found" error while trying to access a semantic term grounded on the [University of Maryland Computer Science Department](#) semantic web server.



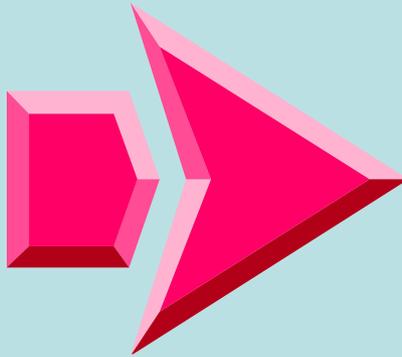
DAML

Notional Schedule

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Now



Later

2001: We will change the world!

Web “travel agents”



How many cows are there in Texas?

Query processed: 73 answers found

- ◆ [Google](#) document search finds 235,312 possible page hits.
- ◆ [Http://www.../CowTexas.html](http://www.../CowTexas.html) claims the answer is 289,921,836
- ◆ A database entitled “[Texas Cattle Association](#)” can be queried for the answer, but you will need “authorization as a state employee.”
- ◆ A computer program that can compute that number is offered by the State of Texas Cattleman’s Cooperative, [click here](#) to run program.
- ◆ ...
- ◆ The “sex network” can answer anything that troubles you, [click here](#) for relief...
- ◆ The “UFO network” claims the “all cows in Texas have been replaced by aliens



Making Markup Easier



The screenshot displays the RDF Editor application with several panes:

- Text.RDF:** A news release titled "Research Shows Why More Species Are Better For Ecosystems" from the University of Maryland Biology department. It includes a photo of Professor Margaret Palmer and doctoral student Bradley J Cardinale. The text discusses their research on caddisfly larvae in a stream and the ecological consequences of species extinction.
- Ontology Browser:** A window showing the "DAML Ontology Library: Class Names Containing 'aquatic'" search results. The results list "AquaticOrganism", "Fresh-or-frozen-aquatic-invertebrates-and-their-byproducts", and "Shellfish-and-aquatic-invertebrates". A "New Query" section includes a text input field for "Class name substring:" and a "submit" button.
- Local Ontology Information:** A panel with buttons for "Add Ontology", "Export Ontology", and "Export Property". It shows a selected ontology: "refOnt6 = 'http://www.cs.umd.edu/projects/plus/DAML/onts/univ1.0.daml'". Below are "Swap Class", "Swap Object", "Swap Property", and "Swap Value" buttons. A list of ontology terms is visible on the right, including "advisor", "affiliateOf", "affiliatedOrganization", "alumnus", "containedIn", and "doctoralDegreeFrom".
- Textual Semantics:** A table with four columns: CLASSES, OBJECTS, PROPERTIES, and VALUES. The CLASSES column lists: 1:refOnt9 = "http://www.cs.umd.edu", 2:refOnt6 = "http://www.cs.umd.edu", 3:AquaticOrganism, 4:doctoral student, 5:Foundation, 6:image. The OBJECTS column lists: 1:caddisfly larvae. The PROPERTIES column lists: 1:behavior. The VALUES column lists: 1:live together in a stream, they g. Below the table are buttons for "Insert Class", "Del Class", "Insert Object", "Del Object", "Insert Property", "Del Property", "Insert Value", and "Del Value".

Animal ontology



photo-v1015 Protégé-2000 (I:\Apes-ontology\photo-v1015.pprj)

Project Edit Window Help

Classes Slots Forms Instances Queries

Relationship Superclass

orang-utan (Phylum)

Name: orang-utan

Constraints: [V] [C] [+]

Documentation:

Role: Concrete

Geographical Range: [V] [+]

- Indonesia

Typical Habitats: [V] [+]

- Rain_forest

Color Features: [V] [+]

- Orange

Life-stage Terminology: [V] [+]

- child
- grown-up
- parent
- big

Group Terminology: [V] [+]

- family
- community
- small_group
- troop

Gender Terminology: [V] [+]

Other Characteristics: [V] [+]

- Herbivor

Superclasses: [V] [+]

- Great_ape

Class Hierarchy (Left Panel):

- Medium-related_term
- Medium_features
- Photo-related_term
- Photo_annotation
- Photo_features
- Setting_description
- Species
 - Chordata
 - Mammalia
 - Primates
 - Ape
 - Great_ape
 - chimpanzee
 - bonobo
 - central_chimpanzee
 - gorilla
 - eastern_lowland_gorilla
 - gorilla_gorilla_gorilla
 - mountain_gorilla
 - orang-utan
 - Lesser_ape
 - Lemur
 - Monkey
 - Ursidae

- Subject_matter_description

Use that markup in query/portal interfaces

Query Database

Subject matter | Photo features | Medium features

Create:

Passive agent

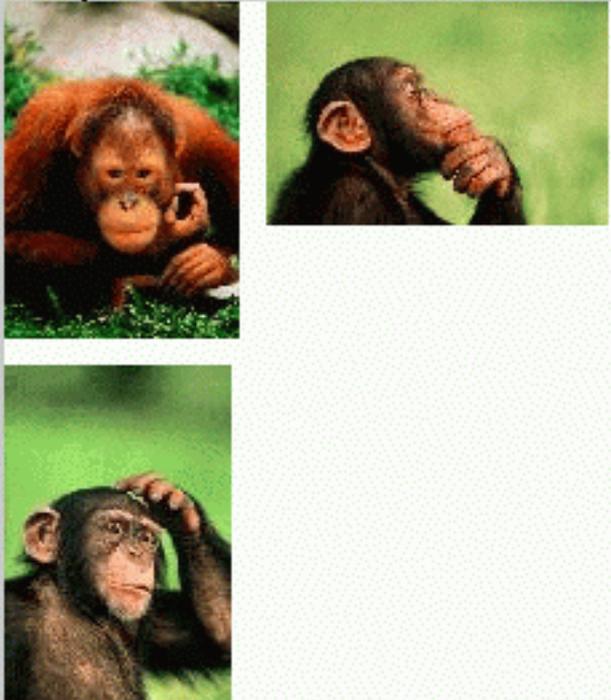
Agent 

With

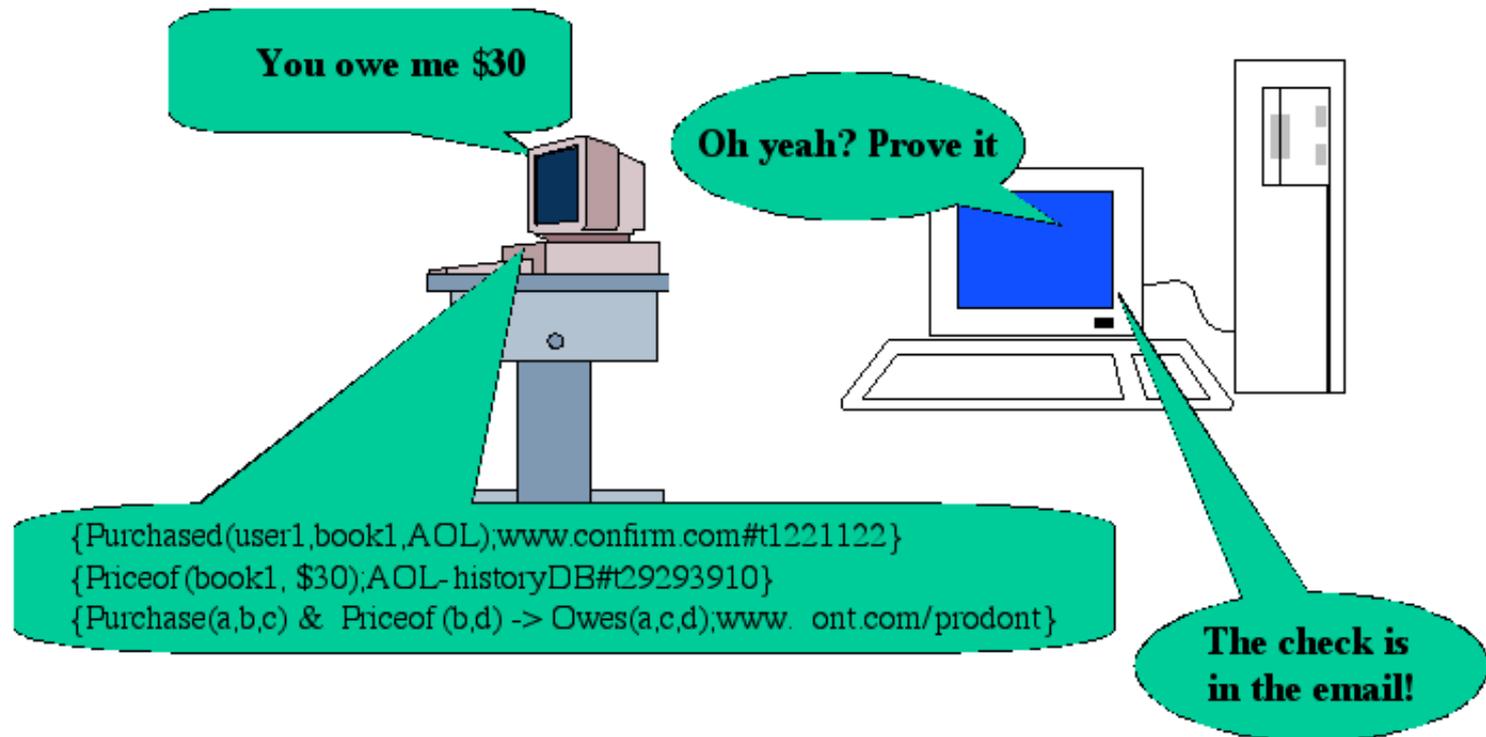
Posture  

Setting

Query results



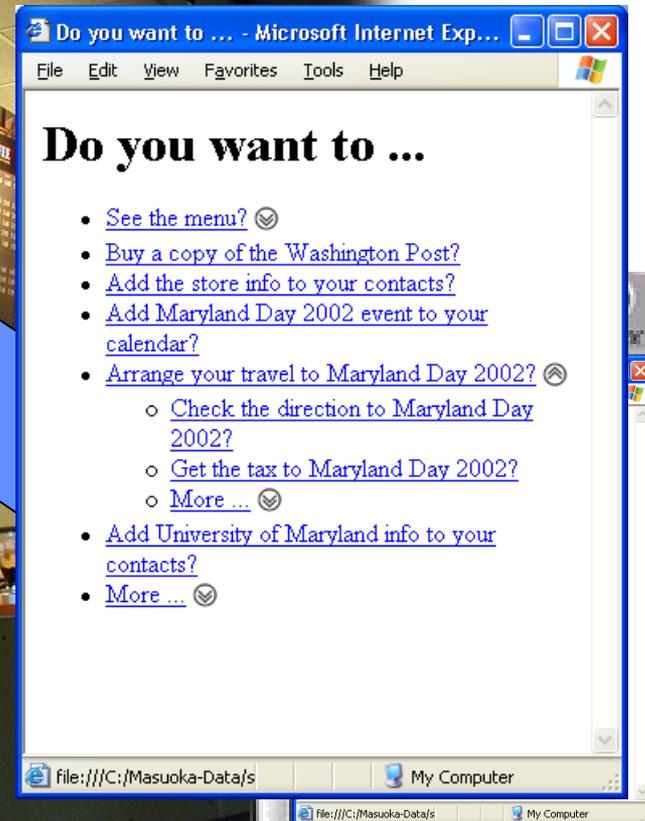
Services need Web Logics



Services off the desktop



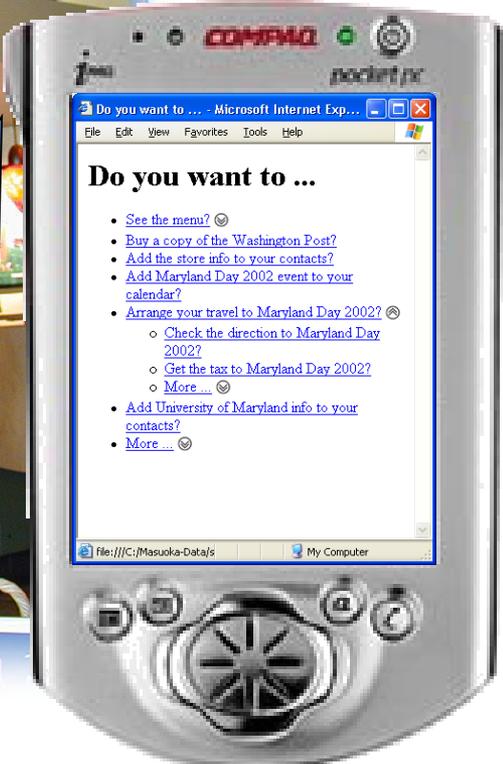
Services off the desktop



PANAMA LA



Services off the desktop



Do you want to ... - Microsoft Internet Exp...

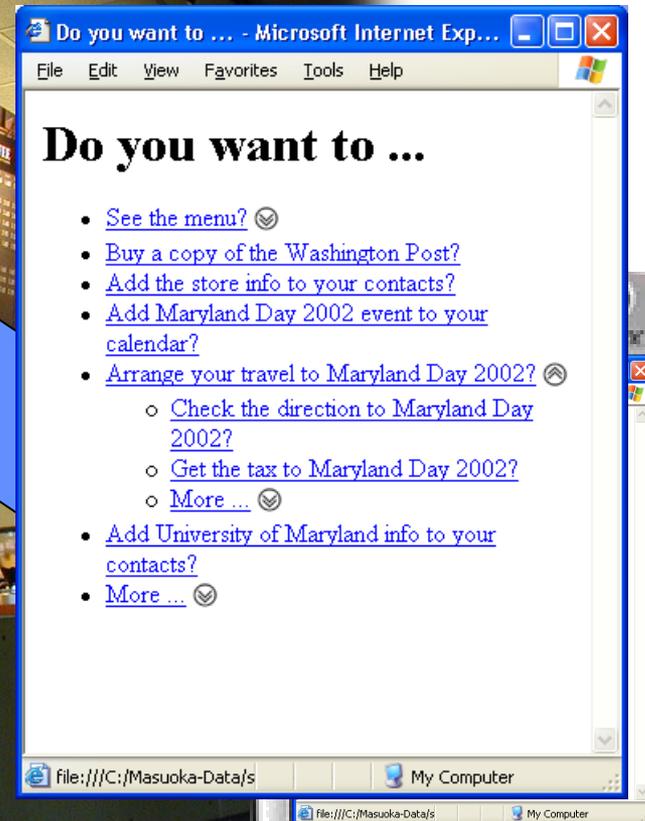
File Edit View Favorites Tools Help

Do you want to ...

- [See the menu?](#)
- [Buy a copy of the Washington Post?](#)
- [Add the store info to your contacts?](#)
- [Add Maryland Day 2002 event to your calendar?](#)
- [Arrange your travel to Maryland Day 2002?](#)
 - [Check the direction to Maryland Day 2002?](#)
 - [Get the tax to Maryland Day 2002?](#)
 - [More ...](#)
- [Add University of Maryland info to your contacts?](#)
- [More ...](#)

File:///C:/Masuoka-Data/s My Computer

Services off the desktop





So where have we got to

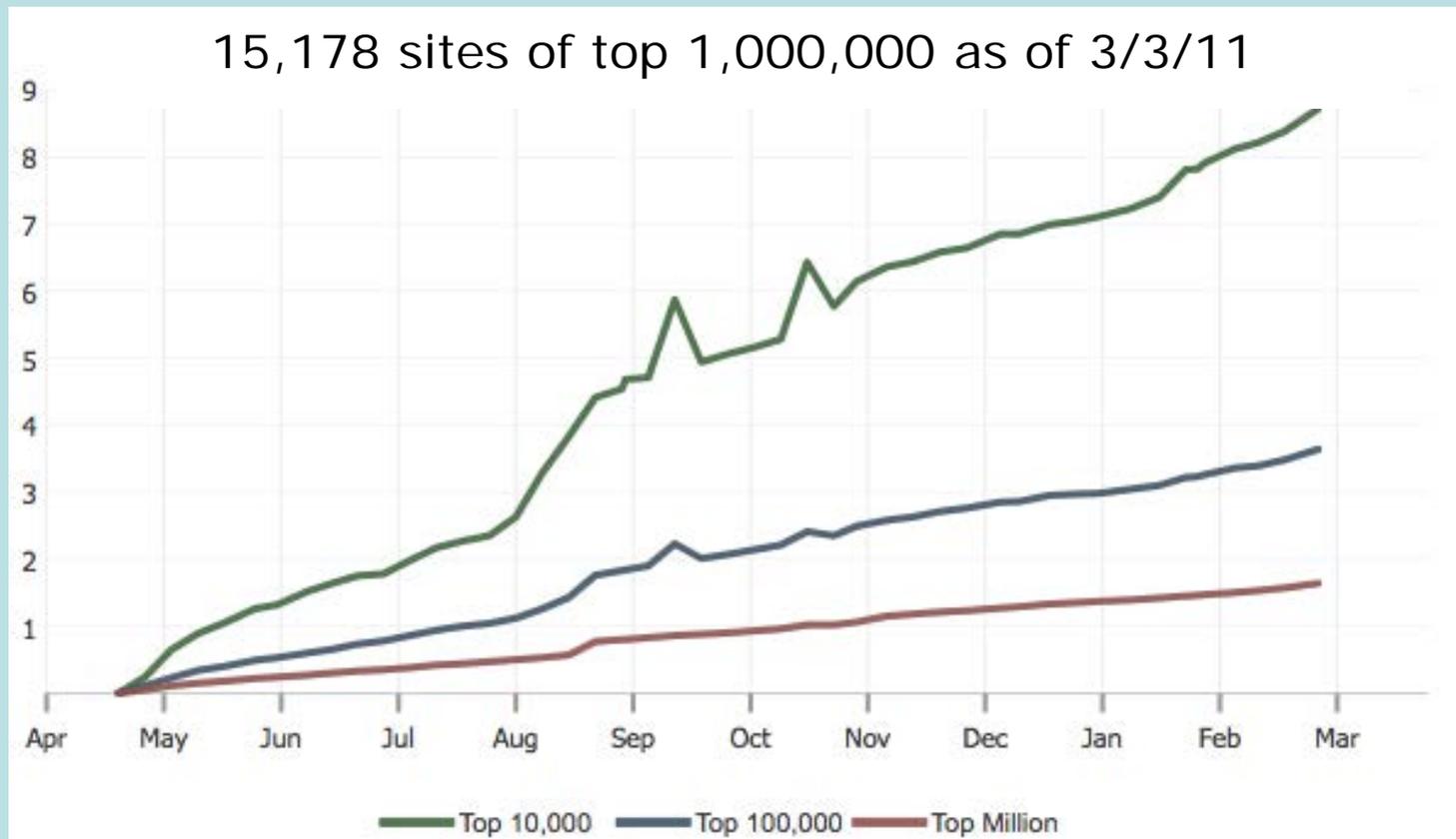
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- Semantic Web technology use has exceeded even *my* wildest expectations
 - What is different now?
 - Semantic Search
 - All the big kids are playing!
 - Advertising drives Web markets
 - “Markets are created by disaggregating the producer and the consumer”
 - “Buzz” around data on the Web
 - esp. Open Government Data



Example: OGP use growing quickly
Facebook incentivizing use of RDFa like buttons

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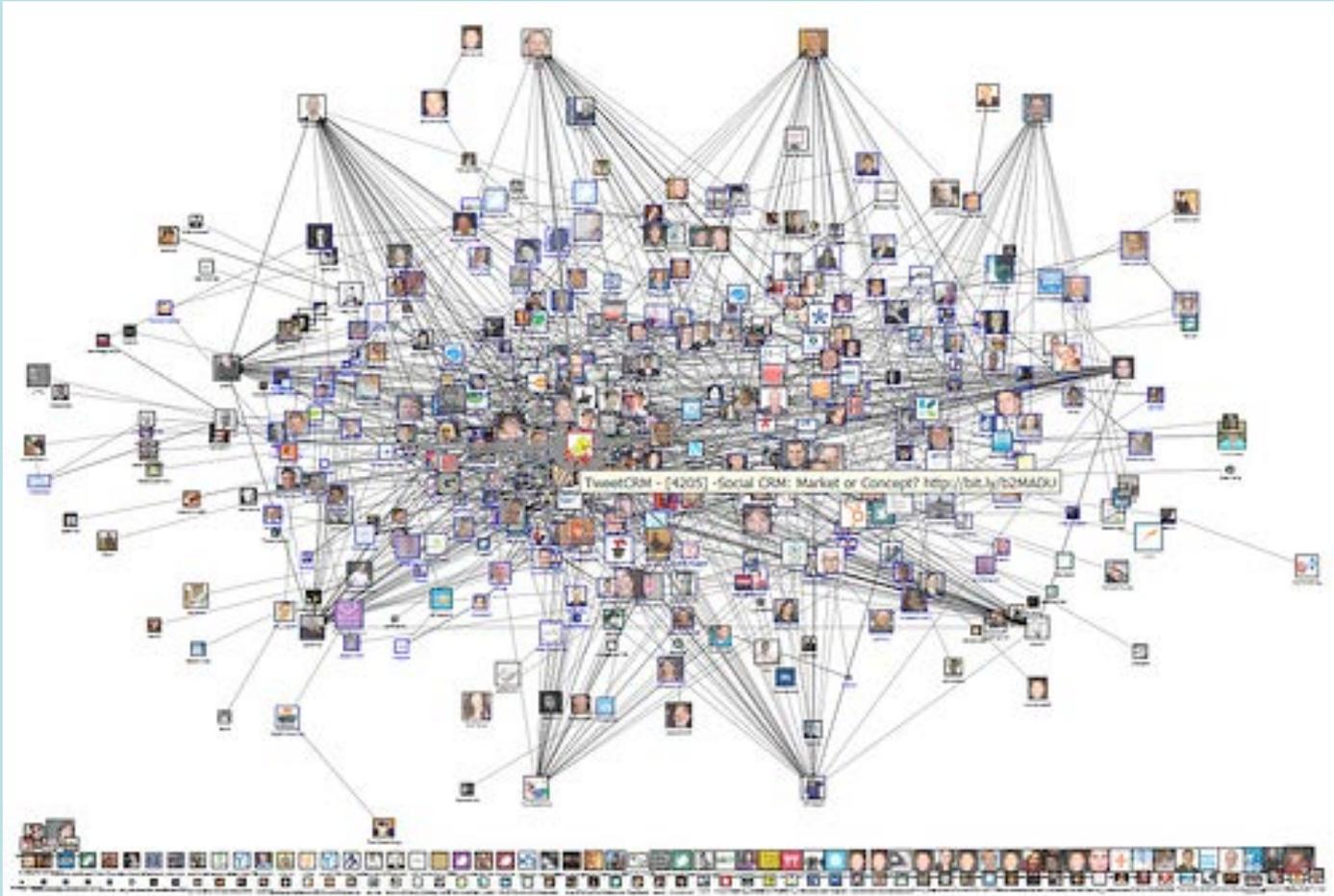
Oct 2010: FB reports RDFa is ~ 10-15% of > 3,000,000 likes per day!

Facebook is encouraging developers to use the RDFa version



Because they want the links!

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The network is where their money is made!
(predicted >\$5B of advertising in next two years)



Creates a platform for SW-powered apps

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SocialWire

facebook

Powered Recommendation Engine for E-Commerce



PERSONALIZE

Instantly personalizes on-site shopping experience via socially engaging product recommendations.



ENGAGE

Shoppers get birthday reminders, discover gift ideas, recommend, ask and compare products with their friends.



RETARGET

Retargets shoppers and their friends on Facebook via personalized, product level advertising.

Truly Plug and Play

Step 1 - Update Header

```
<head>
...
<meta property="og:title"
<meta property="sw:price"
...
</head>
```

Step 2 - Paste Javascript



Step 3 - Drop Plugins



Compatible with Facebook Open Graph



Integrating **SocialWire** is as simple as adding a Facebook Like Button to your pages.



They said it couldn't be done

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- Common Criticisms



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The Shirky fallacy

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- Folksonomy will win
 - Tagging the technology of choice
- Tagging has largely failed to meet its promise
 - Tagging doesn't achieve goals without "social context"
 - Example: Flickr tag "James"; Amazon tag "My-..."

The Network effect requires links (Hendler & Golbeck, JWS, 2008)



The database community fallacy

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- The semantic web will never scale, 1,000,000 triples and things go to heck

Scalable Reduction of Large Datasets to Interesting Subsets

Gregory Todd Williams, Jesse Weaver, Medha Atre, and James A. Hendler
Tetherless World Constellation, Rensselaer Polytechnic Institute, Troy, NY, USA

Winner of the 2009 Billion Triples Challenge



Winner of the 2009 Billion Triples Challenge

Web Scale Reasoning

Current reasoning systems do not scale to the requirements of their hottest applications.

LarKC: platform for scalable Semantic Web Reasoning

Just plain wrong!!

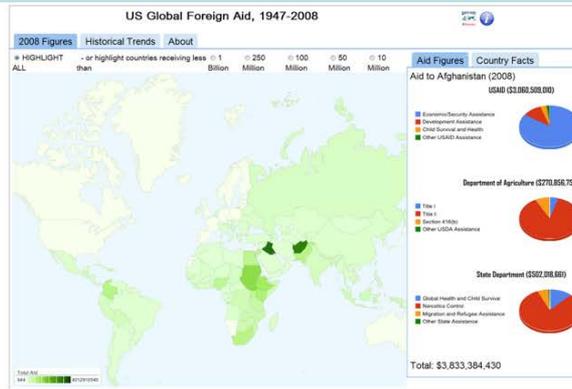


"ad hoc" data integration example: Linked Open Govt Data

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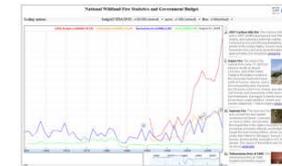
(a) White House visitor search



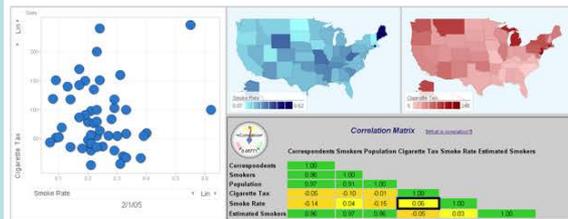
(b) US-UK Foreign Aid Comparison



(c) Agency Budget and NYTimes



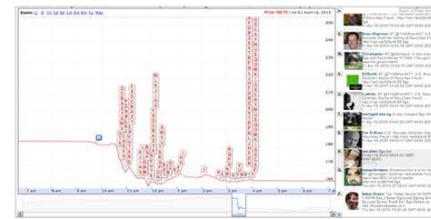
(d) Wildland fire and DBpedia



(e) [Health] Tobacco Prevalence and Correlated Factors



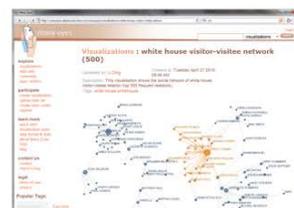
(f) [Policy] About Supreme Court Justices



(g) [Financial] Stock price and Twitter events



(h) [Yahoo! Pipes] World Earthquake Map



(i) [IBM ManyEyes] White House visitor network



(j) [RDFa] semantic search



(k) [RSS] data.gov updates

More than 50 of these at <http://logd.tw.rpi.edu>
See also <http://data.gov> and <http://data.gov.uk>



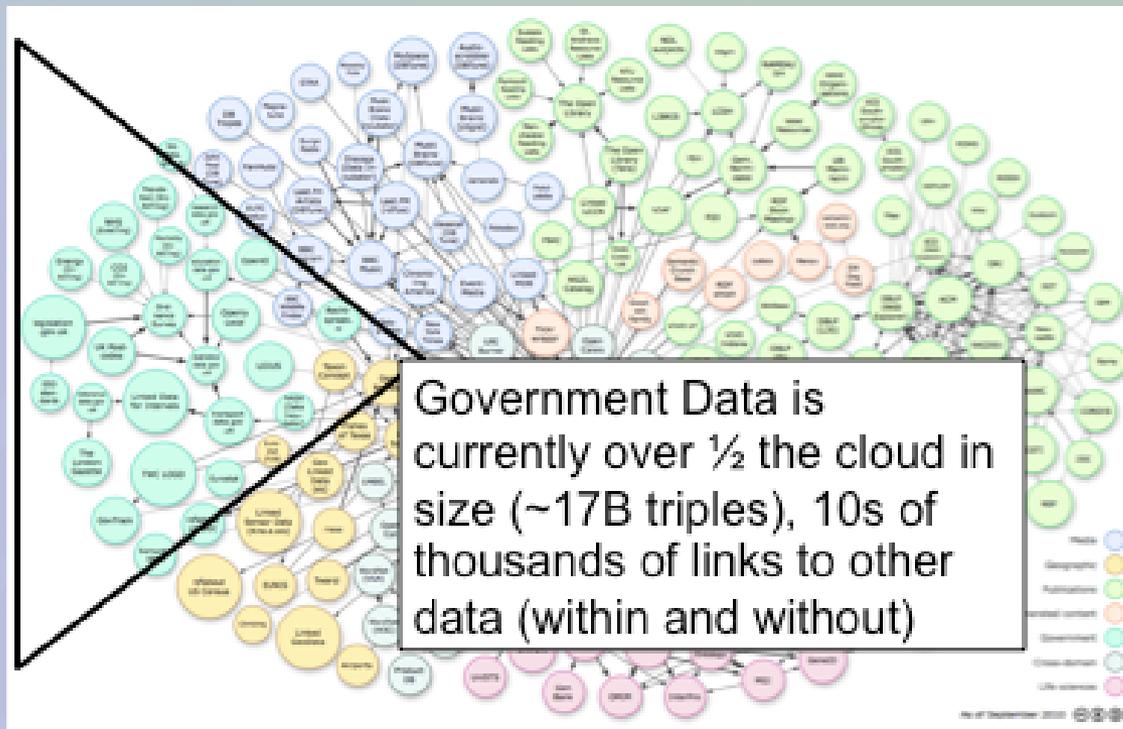
And we do things the
DB community struggles with

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Linked Open Data goes beyond govt

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<http://linkeddata.org/>



Another Shirky criticism

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- This is just a make-work program to keep AI scientists busy doing what they've always done
 - Cannot create an ontology at Web Scale
 - AI never works so it won't this time
 - Logic and reasoning will not work on the Web because people disagree and because logic isn't powerful enough for what is needed
 - (ok, he called it syllogism, but we know what he meant)



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Tracking change and innovation in the enterprise software development community

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Facebook's Graph API: The Future Of Semantic Web?

Posted by Dilip Krishnan on Apr 24, 2010
Community SOA Topics REST Tags Social Networking , Semantic Web , Facebook

Share

"There are two important themes behind everything we're delivering today." says Bret Taylor, head of Facebook's platform products [in the facebook developer blog](#), about the recent announcements at the f8 conference in San Francisco. Facebook introduced Open Graph protocol, and the Graph API as the next evolution in the Facebook platform.

First, the Web is moving to a model based on the connections between people and all the things they care about. Second, this connections-based Web is well on its way to being built and providing value to both users and developers — the underlying graph of connections just needs to be mapped in a way that makes it easy to use and interoperable.

Facebook introduced three new components of Facebook Platform two of which the Open Graph protocol, and the Graph API. The API provides access to Facebook objects like people, photos, events etc. and the connections between them like friends, tags, shared content etc. via a uniform and consistent URI to access the representation. Every object can be accessed using the the URL <https://graph.facebook.com/ID>, where ID stands for the unique ID for the object in the social graph. Every connection (CONNECTION_TYPE) that the facebook object supports can be examined using the URL https://graph.facebook.com/ID/CONNECTION_TYPE.



The New York Times

Technology

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION

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  Warren Brown
Founder of CakeLove,
and recipient of Dell's
IT Makeover.

Ultra-secure Dell re
Protect your data with the
team of Dell, Intel® and Tr
[TakeYourOwnPath.com](#)

How Best Buy Is Using The Semantic Web

By RICHARD MACMANUS of [ReadWriteWeb](#)
Published: July 1, 2010

Yesterday we wrote about the increasing usage of [Semantic Web technologies by large commercial companies](#) like Facebook, Google and Best Buy. The [Semantic Web](#) is a Web of added meaning, which ultimately enables smarter and more personalized web apps to be built. In this post we explore how a leading U.S. retailer, [Best Buy](#), is using a Semantic Web markup language called RDFa to add semantics to its webpages.

[E-MAIL](#)
[SEND TO PHONE](#)
[PRINT](#)

CONVICTION
Watch The Trailer

More News From ReadWriteWeb

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- [Google's Semantic Web Push: Rich Snippets Usage Growing](#)
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- [Can Augmented Reality Help Save the Planet?](#)
- [From Your Mouth to a Thousand Ears, New Apps Make Mobile Podcasting Easy](#)

[Technologies](#)

This is not just an academic exercise for Best Buy. As we will see, semantic technology has already led to increased traffic and better service to its customers. We spoke to [Jay Myers](#), Lead Web Development Engineer at BestBuy.com, to find out how.

ReadWriteWeb's Guide to The Semantic Web:

1. [It's All Semantics: Open Data, Linked Data & The Semantic Web](#)
2. [The State of Linked Data in 2010](#)
3. [Top 10 Semantic Web Products of 2009](#)
4. [ReadWriteWeb Interview With Tim Berners-Lee](#)
5. [Semantic Web Patterns: A Guide to Semantic](#)

Myers told us that the primary goal of using semantic technologies was to increase the visibility of its products and services. And with data such as store name, address, store hours and GEO data being marked up using RDFa, search engines are now able to identify each of those data components more easily and put them into context.



Google, Twitter and Facebook build the semantic web

› 02 August 2010 by [Jim Giles](#)
› Magazine issue 2771. [Subscribe and save](#)

A TRULY meaningful way of interacting with the web may finally be here, and it is called the [semantic web](#). The idea was proposed over a decade ago by Tim Berners-Lee, among others. Now a triumvirate of internet heavyweights - Google, Twitter and Facebook - are making it real.

The defining characteristic of the semantic web is that information should be stored in a machine-readable format. Crucially, that would allow computers to handle information in ways we would find more useful, because they would be processing the concepts within documents rather than just the documents themselves.

Imagine bookmarking a story about Barack Obama: your computer will store the URL, but it has no way of knowing whether the content relates to politics or, say, cookery. If, however, each web page were to be tagged with information about its content, we can ask the web questions and expect sensible answers.

...





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REALTIME IT NEWS Search N

Hardware Software Mobility Web Content **Search** Government Developer Business Storage

Free Download: BlackBerry® Enterprise Server Express. It works with any Internet-enabled BlackBerry data plan & enables organizations to deploy the BlackBerry solution without software or licensing costs.

[InternetNews.com](#) >> [Search](#)

Google Snaps Up Metaweb in Semantic Web Play

Acquisition of firm offering a free, open source database of real-world information figures to inform smarter search as Google builds out semantic technology.

July 19, 2010
By Kenneth Corbin: [@ More stories by this author:](#)



Google's shopping spree doesn't show any signs of letting up, as the Web behemoth continues to open its wallet to acquire firms with niche technologies that can augment its developing business lines.

The latest target is Metaweb, a firm specializing in semantic Web technology that Google has acquired to improve its search engine. Specifically, Google thinks that Metaweb's database of real-world items can help it produce ordered and accurate results in response to specific, complex search queries. DevX has the details.

In the latest in a string of acquisitions, Google has unveiled plans to purchase Metaweb, a firm that maintains a vast open source database of information about objects in the real world.

Through the acquisition, Google (NASDAQ: GOOG) aims to provide a smarter search engine that will be able to retrieve more specific answers to complex queries.

Read the full story at DevX:
[Google Snags Semantic Web Firm Metaweb](#)

TAGS: Google, semantic Web, acquisition, search engine, Metaweb



0 Comments ([click to add your comment](#))



Semantic Web

Semantic Web
SUMMIT

Semantic Web
100

Semantic Enterprise: What Are The Gorillas Doing? (Oracle, IBM, HP, Cisco, Microsoft and SAP)

By Bernard Lunn on Aug 03, 2010 07:00 AM



In [Crossing The Chasm](#) terminology, "gorillas" are the dominant vendors. Simple message for start-ups - don't mess with them!

In this post, we want to understand what the gorillas are doing to apply semantic web technology to the enterprise. The gorillas in this market are: Oracle, IBM, HP, Cisco, Microsoft and SAP.

Oracle: Embrace & Extend

Oracle is active in the semantic web. This matters to them. They cannot afford another database management system based on RDF to replace Oracle and MySQL. Oracle look at RDF as just another thing to store - like objects. The saw off the threat from object management systems and they aim to see off any threat from RDF triples.



ORACLE DATABASE SEMANTIC TECHNOLOGIES

SEMANTIC DATABASE FEATURES

NEW IN ORACLE SPATIAL 11.2

- Triple-level security with Virtual Private Database and Label Security support
- Semantic indexing for documents based on popular natural language tools
- Change management to version triples within an RDF graph
- Parallel and incremental inference, and owl:sameAs optimization
- Support for the NIH SNOMED comprehensive clinical ontology
- W3C SKOS inference support
- More OWL constructs: union, intersection, oneOf, OWL 2 property chains, disjoint

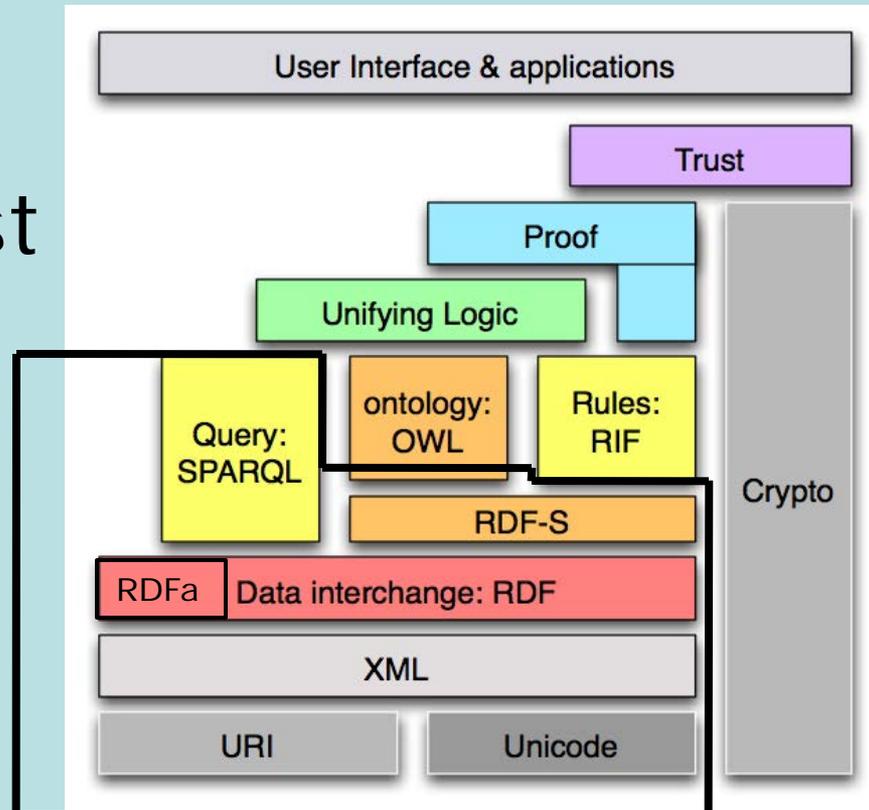
As part of Oracle Spatial 11g, an option for Oracle Database 11g Enterprise Edition, Oracle delivers an advanced semantic data management capability not found in any other commercial or open source triple store. With native support for RDF/RDFS/OWL/SKOS standards, this semantic data store enables application developers to benefit from an open, scalable, secure, integrated, efficient platform for RDF and OWL-based applications. These semantic database features enable storing, loading, and DML access to RDF/OWL data and ontologies, inference using RDFS, OWL and SKOS semantics and user-defined rules, querying of RDF/OWL data and ontologies using SPARQL-like graph patterns embedded in SQL, and ontology-assisted querying of enterprise (relational) data



The "bottom" of the Semantic Web

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- What is seeing the most use??





- Maturation of RDF technologies
 - SPARQL endpoints
 - Fits Web development models
 - RDFa
 - Works well with current search paradigms
 - A little semantics goes a long way
 - BUT WHAT IS STUNNING IS JUST HOW LITTLE!
 - Equality via same URI
 - RDFa mostly w/DBMS not triple store
 - Not only no reasoning, but hardly any “principled” inferencing!



The bad news...

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- The ontology story is still confused

The Fellowship of the (Semantic) Web

THE TWO TOWERS
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SemTech 2007

Ontology: the OWL DL view



- Ontology as Barad-Dur (Sauron's tower):

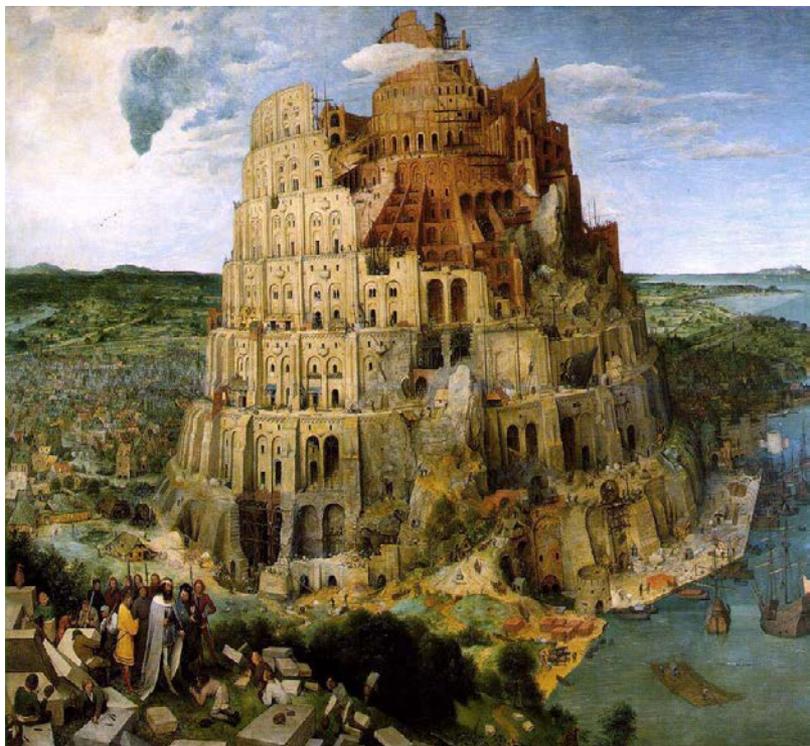
- Extremely powerful!

- ~~Patrolled by Orcs~~
 - Let one little ~~hobbit~~ in, and the whole thing could come crashing down

Decidable Logic basis

inconsistency

ontology: the linked-data view



- **ontology and the tower of Babel**
 - We will build a tower to reach the sky
 - We only need a little ontological agreement
 - Who cares if we all speak different languages?



ontology: the linked-data view



Genesis 11:7 Let us go down, and there confound their language, that they may not understand one another's speech. So the Lord scattered them abroad from thence upon the face of all the earth: and they left off to build the city.

- ontology is the tower of Babel
- Who cares if we all speak different languages?





OWL has had successes

Tetherless World Constellation

- Examples from Clark and Parsia (2011)
 - Decision-support tool for sales people to automate policy driven cross-selling recommendations at very large US bank built out of RDF integrated data, OWL reasoning, and Pellet
 - At global 25 company (another bank) OWL and Pellet form the core of a bank-wide Entitlements service to represent, analyze, and query every access control policy for the entire bank, globally, in 50+ legal jurisdictions
- And many other companies could claim similar
 - But most of these sorts of systems are still just coming out of prototype phase
 - And most are still more “expert” system than Web app



- OWL is succeeding to a large degree as a KR standard
 - Building “expert systems” as a business has never gone away; OWL improves tooling
- But it is largely failing in bringing representation to the WWW
 - cf. “misuse” of owl:sameAs >> “proper” use
 - cf. rdf:class >> owl:class
 - cf. it is rare that ontologies link to others



The gap is growing

Tetherless World Constellation

- Linked-Data-based applications are growing in size, number and importance on the Web
 - But the “vocabulary” story is still unclear
- Ontology research is turning OWL into a usable KR standard,
 - But the linking story is still unclear

No linking without vocabularies
No network effect without links



What I think we MUST do

Tetherless World Constellation

- Bridging the gap between the linked-data and ontology views requires some key research challenges to be addressed
 - DL (and FOL) are useful formalisms for KR&R, but do not address the needs of the Web!
 - Empirical comparisons are useful in scaling systems, but do not address the needs of an academic community!



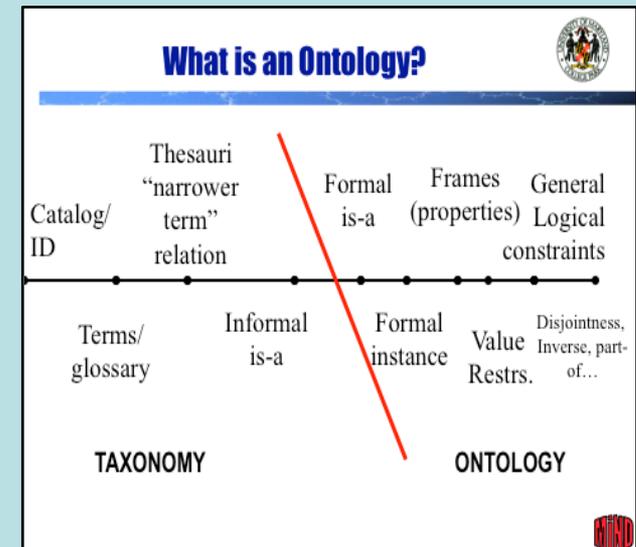
My Challenge to you

Tetherless World Constellation

- A sufficient formalism for Semantic Web applications must
 - Provide a model that accounts for linked data
 - What is the equivalent of a DB calculus?
 - Provide a means for evaluating incomplete reasoners
 - In practice we must be able to model A-box effects as formally as T-box technologies

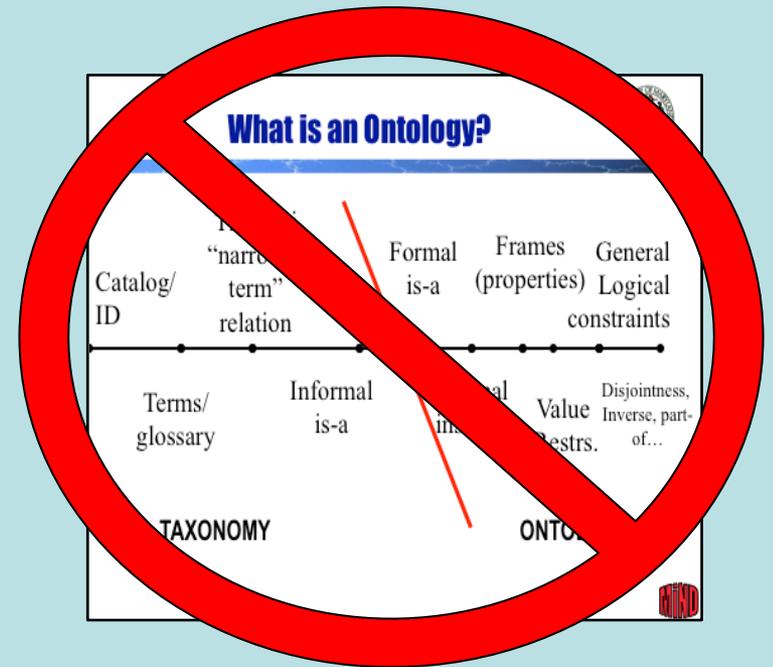


- A sufficient formalism for Semantic Web applications must also
 - Define what ~~an ontology~~ is ontologies really are
 - Including ~~external referents~~ linking between terms
 - Including ~~ontology alignment~~ partial mapping
 - Including ~~non-expressive formalisms~~ real-world "errors"





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It just might work...

Tetherless World Constellation

- One idea on how to get there
 - Define common problems that offer features of interest to both communities
 - Compare approaches with respect to performance
 - Develop hybrids that have best features of both as necessary
 - Repeat

Summary

- The infrastructure needs of intelligent systems are now being met by a combination of Semantic Web, Linked Data, Web Services and Rule-based systems
 - Knowledge engineering can be jumpstarted from existing terminologies/ontologies, semi-structured systems, and other Web resources
 - Web Services (esp WSDL, SAWSDL) provide "wrappers" and other methods to let "legacy" systems play with agents
 - Reasoners and rule-based systems are scaling in new ways, and receiving some standardization
- So where are all the agents???



Conclusion: “Why the Semantic Web will never work”?

Tetherless World Constellation

- No reason at all
 - The Semantic Web is here, it is working, and it will continue to do so
- But, for it to move to the next level and be all that we as a community have aspired for
 - We must revisit and update the early visions for the modern web
 - We must unify the “competing” models of linked-data and machine-readable vocabularies
 - We must step up to some critical *research* challenges



TWIC

Appendix

Tetherless World Constellation

- Research Challenges (ca. 2008)

Research Challenges

- What is the Web culture?
 - Design/use/analysis are connected to "cultural stereotypes" (Think HSBC ads)
 - What are the cultural stereotypes in the emerging online community?
- What level of "knowledge" is needed by Web users?
 - Is this dependent on application? User community?
 - Is expressivity a plus, minus, non-issue?
 - Especially in an open system (previous AI systems were "closed")



Research Challenges

- Computational challenges as "end user" support
 - Scaling
 - Semantic Web HCI (What do we show "real users"?)
- What are the trade-offs in use
 - Virtually all AI literature assumes a high-cost, high-value model
 - The Semantic Web is showing us alternative models
 - What are the trade-offs, analyses
- If more and more of what we see includes integrated data from multiple sources, will that change the trust models
 - Do we need to expose provenance? Will "provider" model be changed?

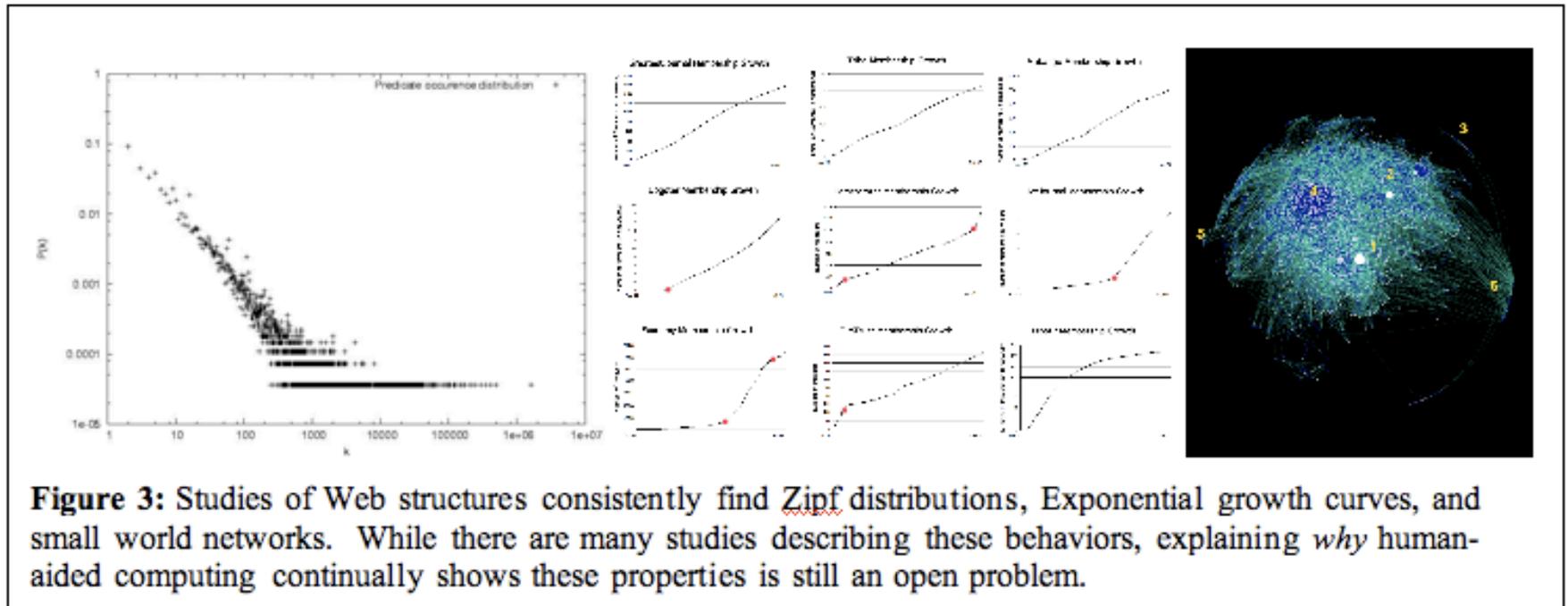


Research Challenges

- Who are the "experts"
 - What level of expertise is needed to become "dangerous" with this new technology?
 - What is the "ecosystem" (what is the equivalent of Web developer/web master/web user?)
- If more and more of what we see includes integrated data from multiple sources, will that change the trust models
 - Do we need to expose provenance? Will "provider" model be changed?
- Formal vs. informal models of ontology
 - I didn't discuss "folksonomy" but a key aspect is "social context" (Hendler & Golbeck, 08)
 - Can social contexts use



Research Challenges



The Biggie

