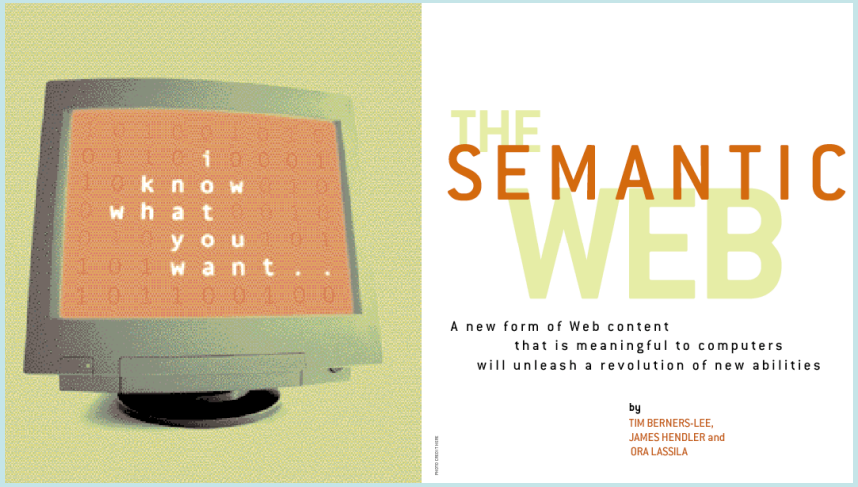
The Policy-Aware Web

Jim Hendler

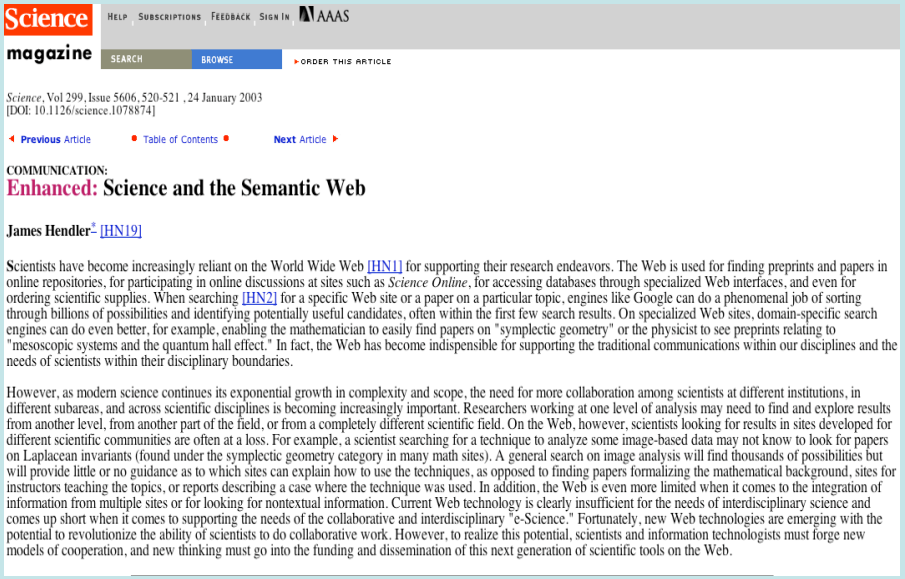
http://www.cs.umd.edu/~hendler

http://www.mindswap.org/people/pages/?person={"link":+"http://owl.mindswap.org/2003/ont/owlweb.rdf%23JimHendler"}

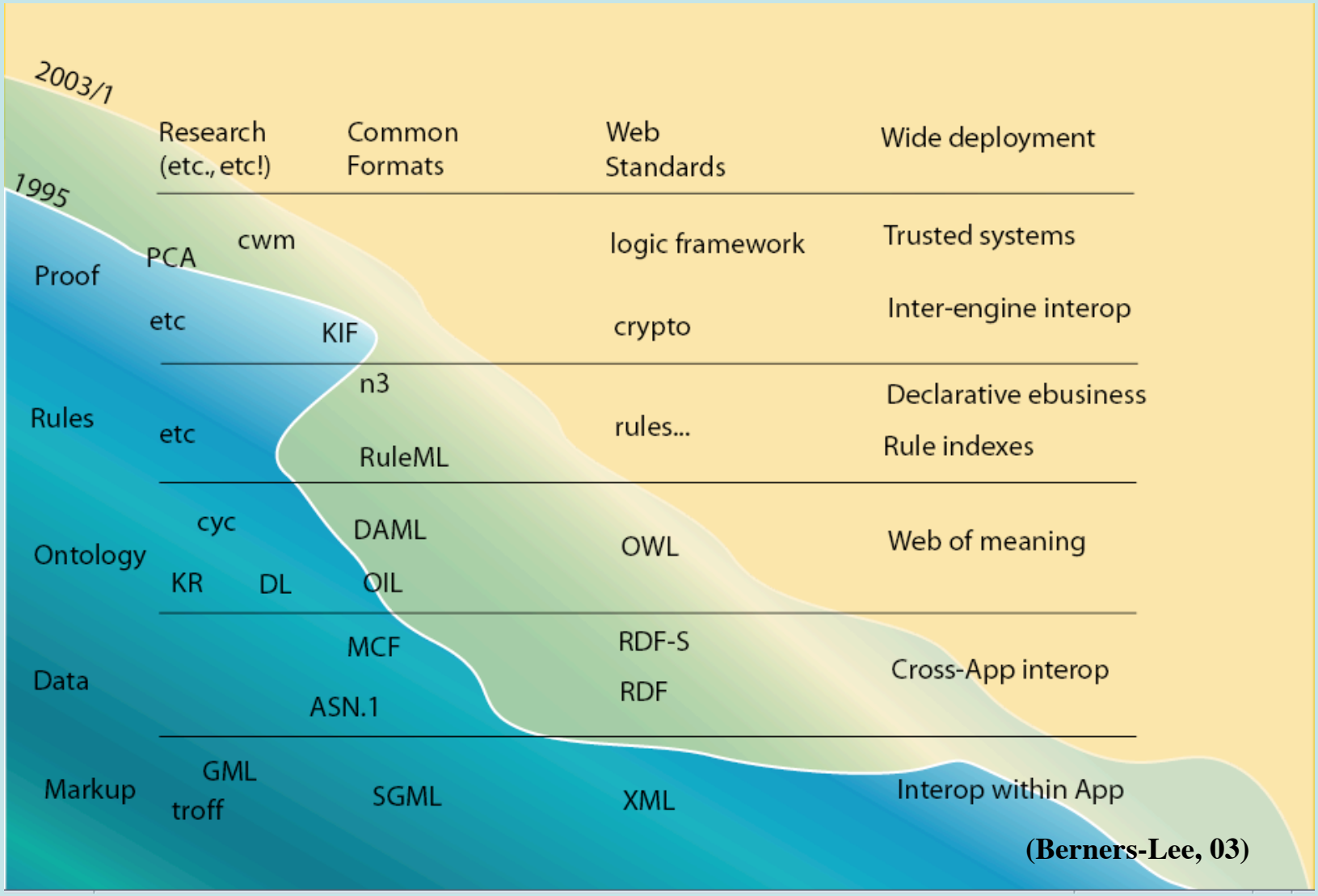
The Semantic Web



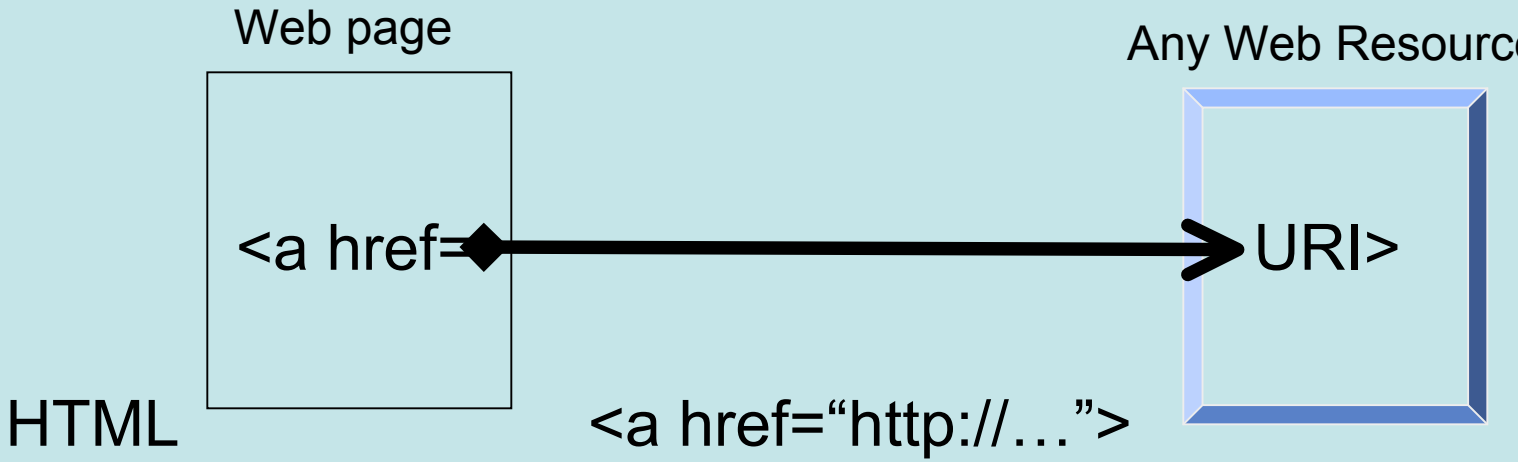
- Lots of papers showing up on the "semantic web"
  - But what is it?



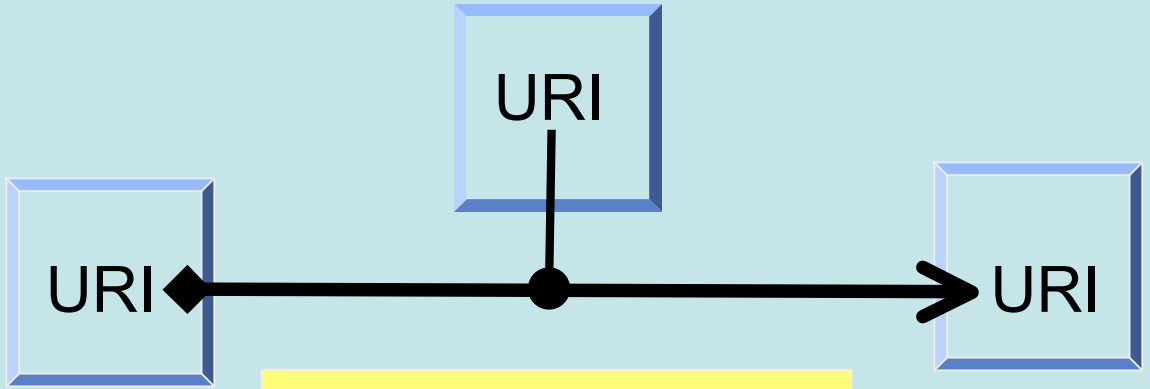
And where is it going?



On the Web -- links are critical!

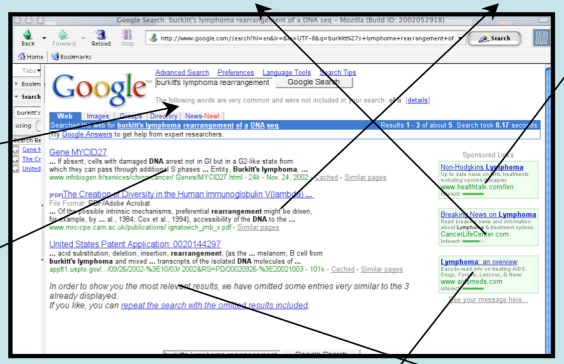


On the Semantic WEB -- links are critical!



"Use the Links"

Burkitt's Lymphoma



Web

PVT
Rearrangement of a DNA sequence homologous to a cell-virus junction fragment in several Moloney murine leukemia virus-induced rat thymomas

PubMed

Semantic Web

Oncogene(MYC):
Found_In_Organism(Human).
Gene_Has_Function(Transcriptional_Regulation).
Gene_Has_Function(Gene_Transcription).
In_Chromosomal_Location(8q24).
Gene_Associated_With_Disease(Burkitts_Lymphoma)

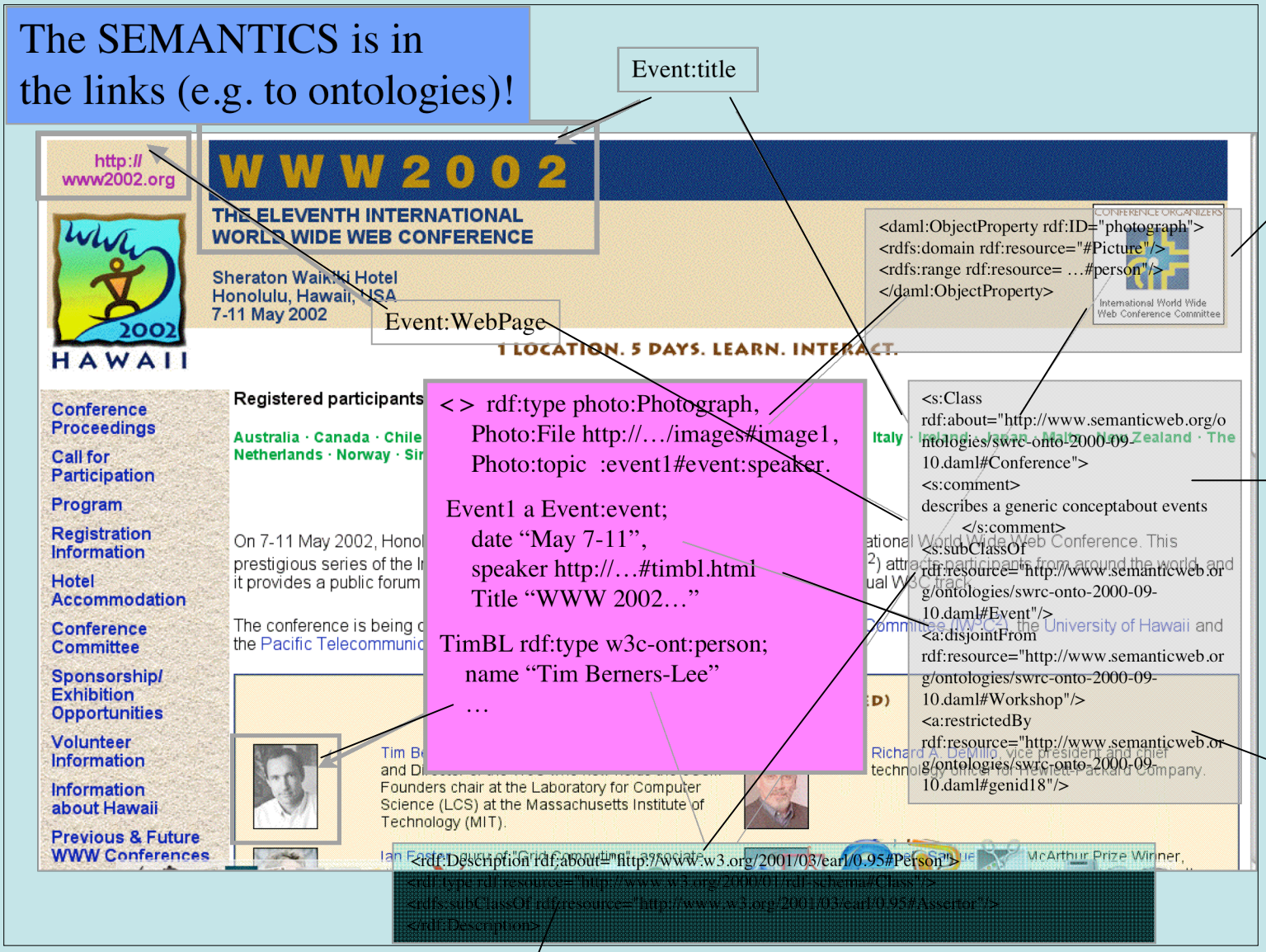
"MODEL"

Burkitt's Lymphoma

8q24
PVT1

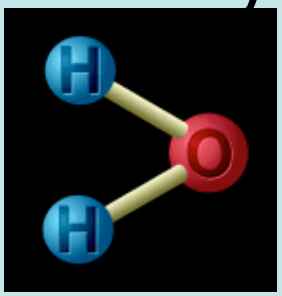
PVT
Rearrangement of a DNA sequence homologous to a cell-virus junction fragment in several Moloney murine leukemia virus-induced rat thymomas

PubMed

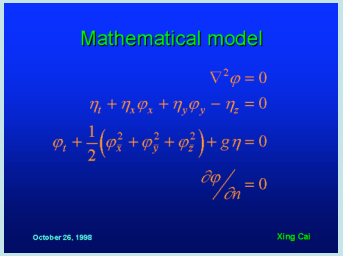

The SEMANTICS is in the links (e.g. to ontologies)!
Event:title
Event:WebPage
http://www2002.org
WWW2002
THE ELEVENTH INTERNATIONAL WORLD WIDE WEB CONFERENCE
Sheraton Waikiki Hotel
Honolulu, Hawaii, USA
7-11 May 2002
HAWAII
1 LOCATION. 5 DAYS. LEARN. INTERACT.
Conference Proceedings
Call for Participation
Program
Registration Information
Hotel Accommodation
Conference Committee
Sponsorship/ Exhibition Opportunities
Volunteer Information
Information about Hawaii
Previous & Future WWW Conferences
Registered participants
<daml:ObjectProperty rdf:ID="photograph">
<rdfs:domain rdf:resource="#Picture"/>
<rdfs:range rdf:resource= …#person"/>
</daml:ObjectProperty>
International World Wide Web Conference Committee
<> rdf:type photo:Photograph,
Photo:File http://…/images#image1,
Photo:topic :event1#event:speaker.
Event1 a Event:event;
date “May 7-11”,
speaker http://…#timbl.html
Title “WWW 2002…”
TimBL rdf:type w3c-ont:person;
name “Tim Berners-Lee”
…
<s:Class rdf:about="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Conference">
<s:comment>
describes a generic conceptabout events
</s:comment>
<s:subClassOf rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Event"/>
<a:disjointFrom rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Workshop"/>
<a:restrictedBy rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#genid18"/>
Founders chair at the Laboratory for Computer Science (LCS) at the Massachusetts Institute of Technology (MIT).
<rdf:Description rdf:about="http://www.w3.org/2001/03/earl/0.95#Person">
<rdf:type rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
<rdfs:subClassOf rdf:resource="http://www.w3.org/2001/03/earl/0.95#Assertor"/>
</rdf:Description>

A very old idea in new clothes

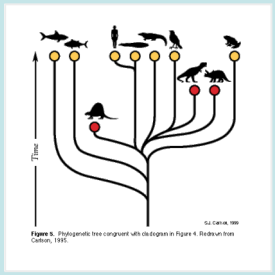
- Scientists communicate by use of models
  - c.f. Physical



  - c.f. Mathematical

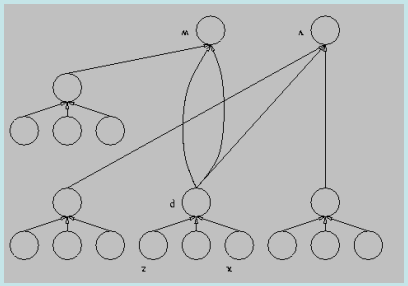
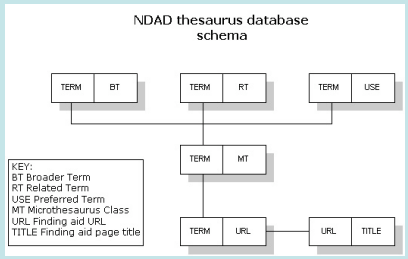
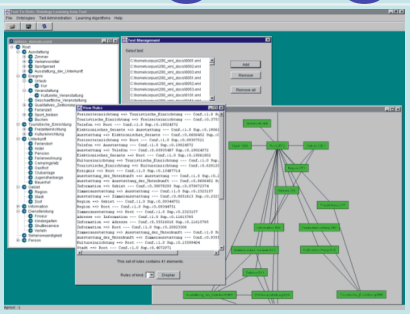
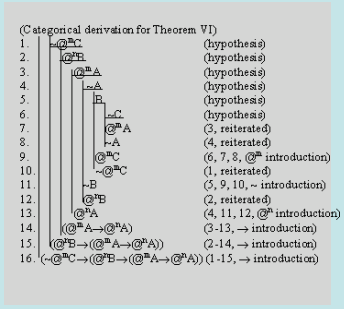


  - c.f. Organizational



Models expose semantics

Sem Web Languages

			. . .	
Graph Ontology	Labeled graph Ontology	Graph + limited logic Ontology	. . .	Rules/Logic Ontology
RDF	RDF Schema	OWL	…	??

Data Dictionary (Vocab)

Data Schema

All of these languages add semantic modeling primitives to XML - so you can "do this in XML" per se, but it is reinventing the wheel.

Web Modeling Languages

- Resource Description Framework (RDF)
  - Few, but important, constraints
  - A basic, extensible assertional language
- RDF Schema (RDFS)
  - Weak structuring of sets of terms (taxonomy-esque)
  - Class and property hierarchies
  - Domain and Range constraints
- The Web Ontology Language, OWL
  - Stronger structuring of sets of terms (ontologies)
  - Everything in RDFS plus
    - Complex Class constructors (unionOf, intersectionOf)
    - Additional property features (inverse, transitive)
    - Class local property type and cardinality constraints
    - And more

Example Sem Web Roadmap

Long-term

"Agent" Focus
learning/modifying, model-based interaction, higher level of automation (less human in the loop)

"Google for information"

Mid-term

"Rule" Focus
Development/ personalization
Access control

Help users explore/analyze relationships in data

Privacy and trust issues

Short-term

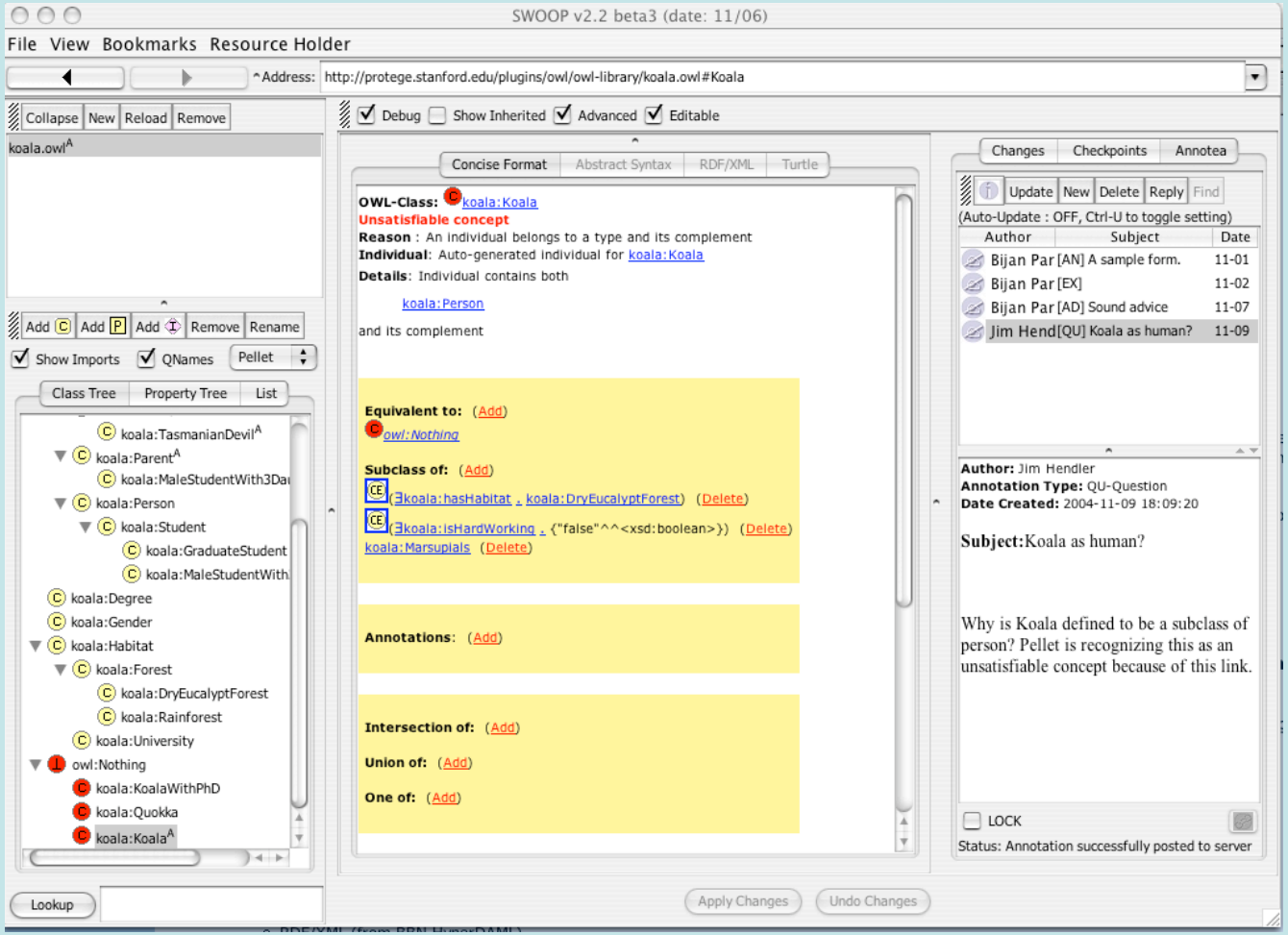
Ontology Focus
Use, creation, tools, editing, collaboration, sharing, learning/modifying
Data and Multimedia applications
Support collaboration/sharing

Now

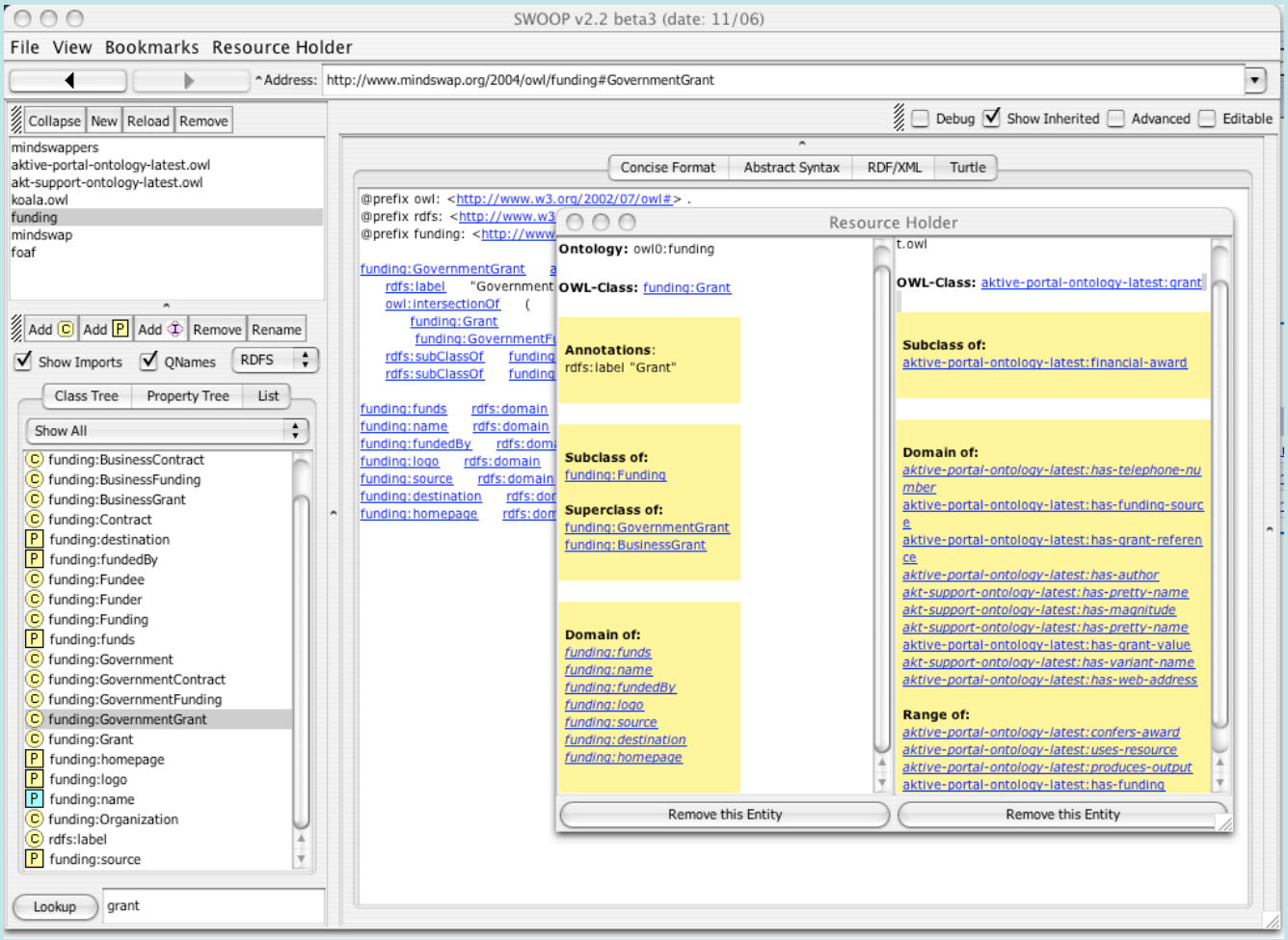
- Companies getting into the act
  - IBM SNObase ontology management system
  - Oracle discusses (some) forthcoming support at W3C Life Science Workshop
  - Licensed versions of a scalable triple store currently for sale
    - First results for 1B triples
    - Many of the features of an RDBMS in TKS
      - Concurrency control
      - Security model
      - Soap and linking tools
    - OWL support coming
  - HP Labs open-source Jena API
- Many open source tools becoming available for experimentation/academic use
  - Kowari, RDFLib, 3Store…

A lot is out there already

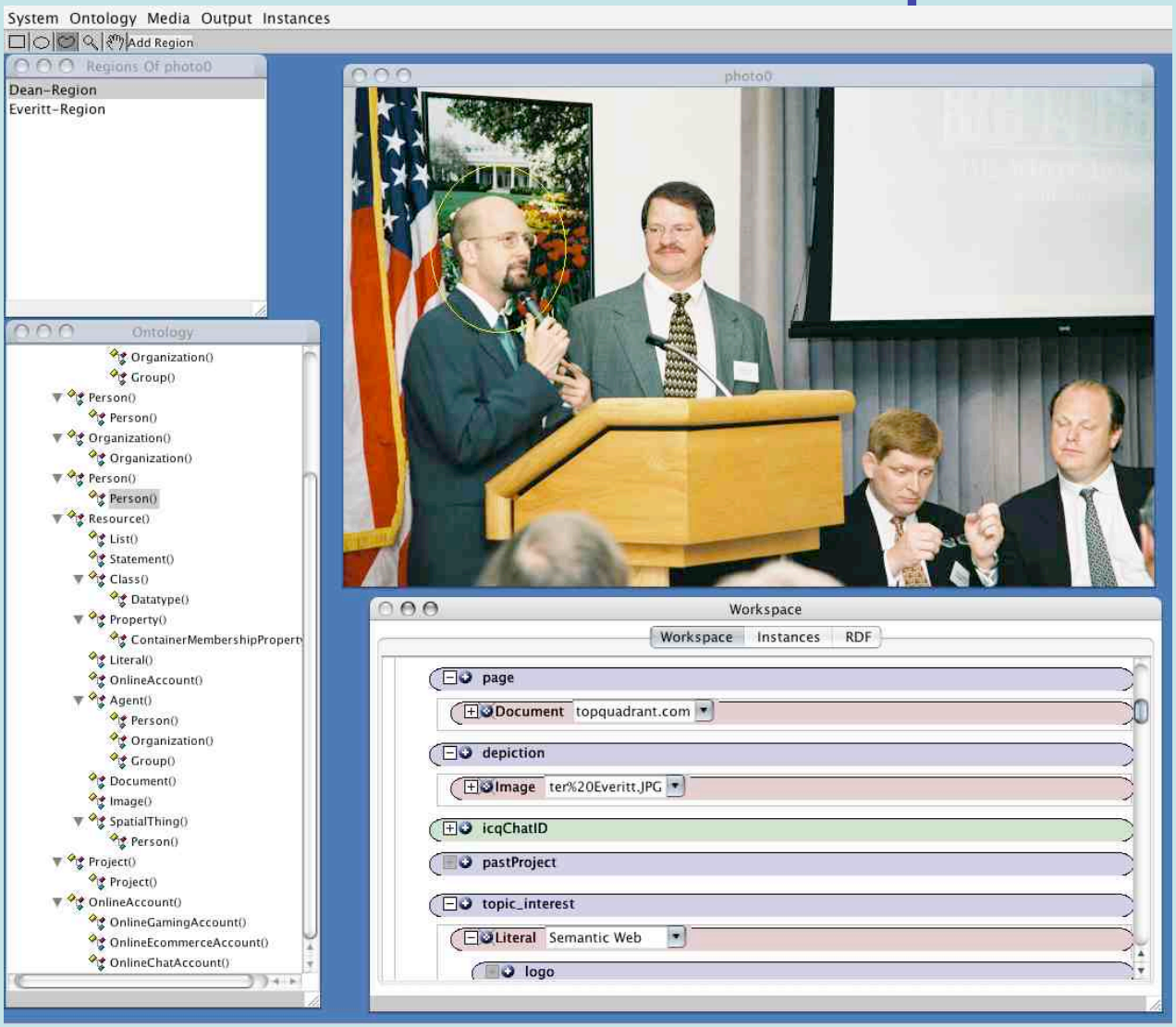
Collaborative Editing



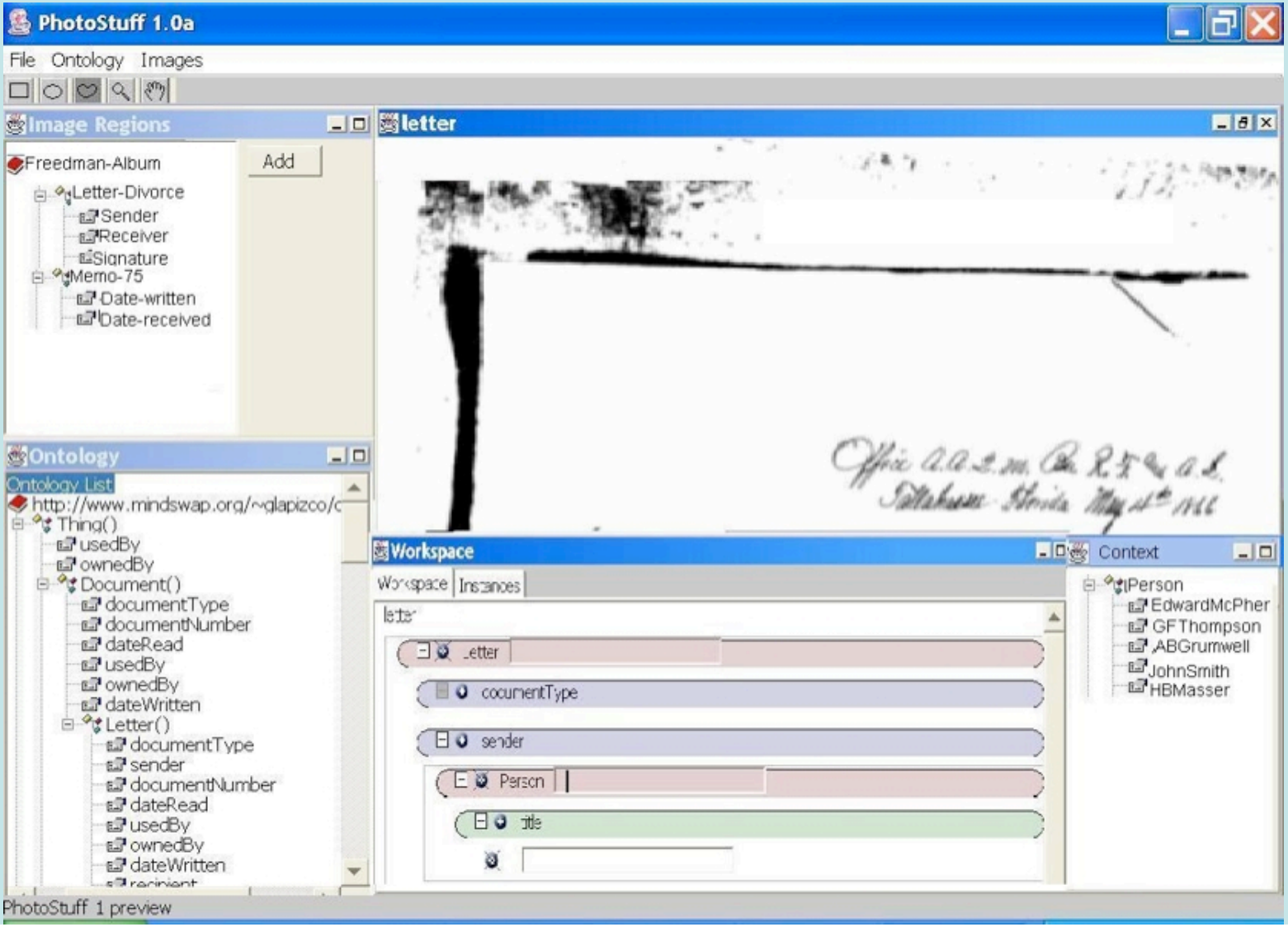
Multi-ontology support



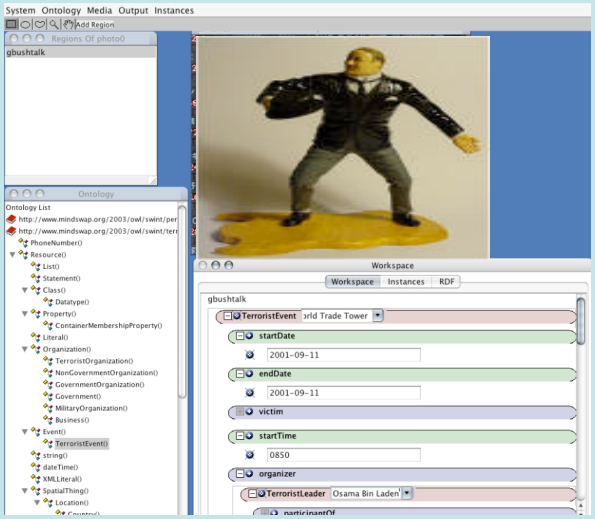
Tools for markup...



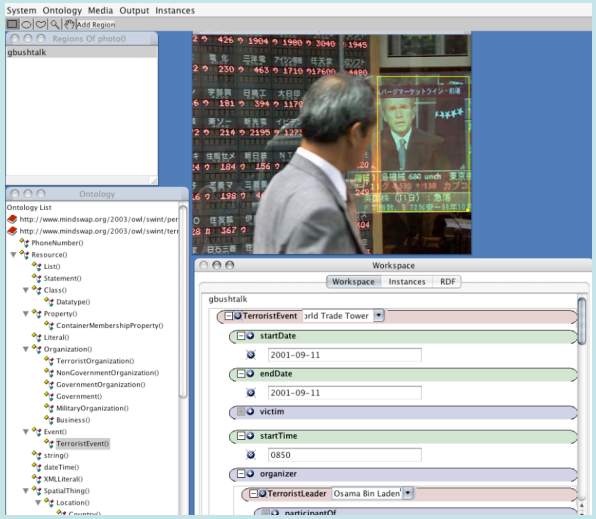
Of different media and types



Of different media and types

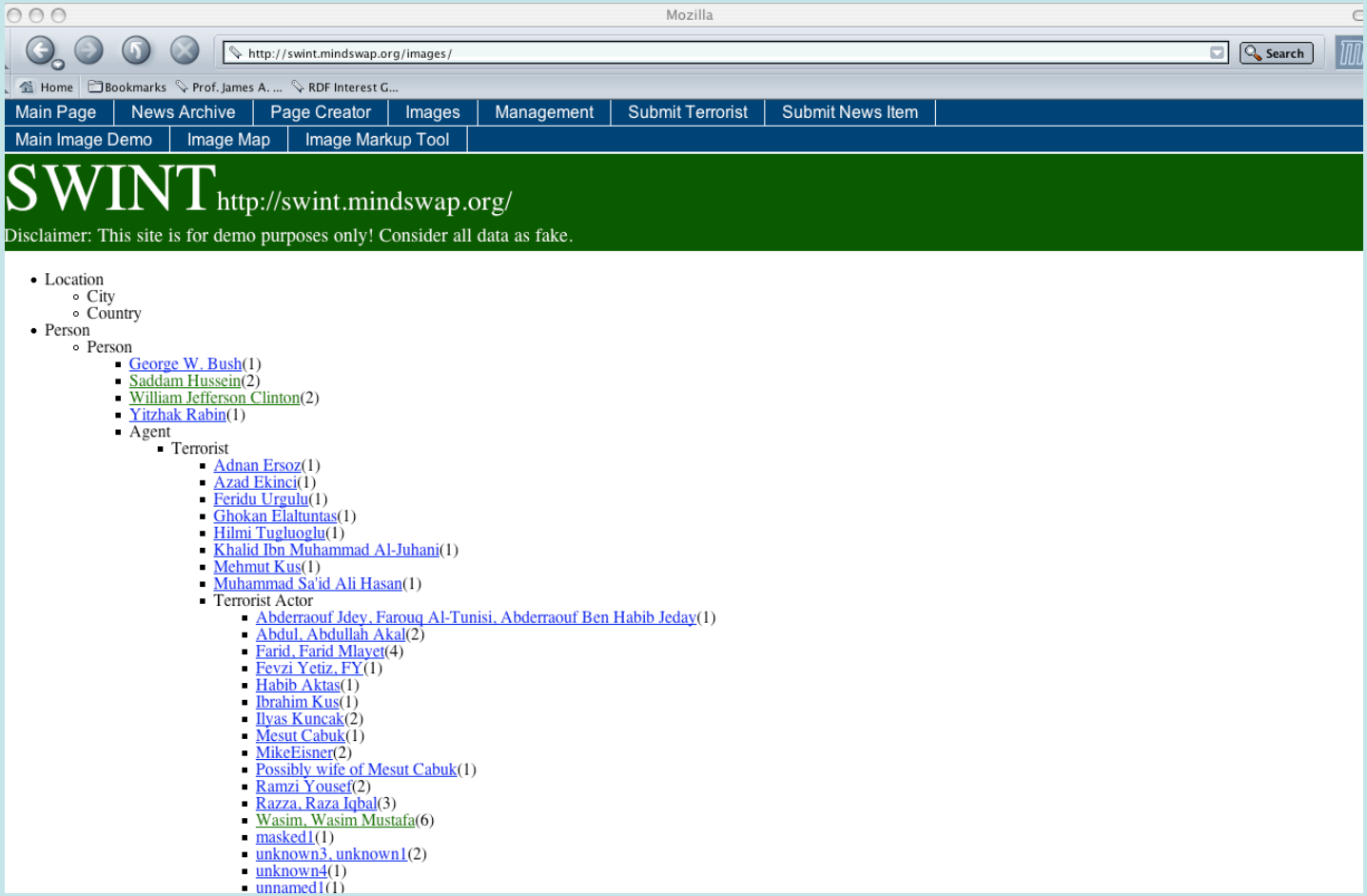


The scene from the James Bond movie where the guy throws his hat at a statue



The story that ran on NHK television from 0847-0903 on 2001-09-11 (GMT + 9)

Semantic Web Application Portals



Info views…

Mozilla
http://swint.mindswap.org/rdf/instance/?resource=%7B%27link%27%3A+%27http%3A%2F%2Fswint.mindswap.org%2F2003%2Fsubmit-rdf%2F13.rdf%23AymanZawahiri%27
Search
Home
Bookmarks
Prof. James A. ...
RDF Interest G...
Main Page
News Archive
Page Creator
Images
Management
Submit Terrorist
Submit News Item
SWINT http://swint.mindswap.org/
Disclaimer: This site is for demo purposes only! Consider all data as fake.
Abu Muhammad, Ayman al-Zawahiri
Depictions:
Abu Muhammad, Ayman al-Zawahiri | Physical Feature | Male, Olive
Member Of | Al Jihad, Egyptian Islamic Jihad
Citizenship | Egypt
Location | Afghanistan
Knows | Osama Bin Laden
Al Jihad, Egyptian Islamic Jihad | Member | Abu Muhammad, Ayman al-Zawahiri
Osama Bin Laden | Knows

Not tied to specific domains

http://bio.flacp.fujitsulabs.com/rdf/instance/?resource=%7B%27link%27%3A+%27http%3A%2F%2Fbioswint.flacp.fu

Apple .Mac Amazon eBay Yahoo! News

Main Page | News Archive | Page Creator | Images | Management | Submit Data | Submit News Item

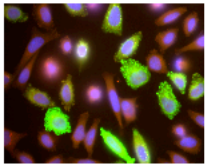
Bio-Central

Disclaimer: This is a demonstration website! Consider all information as contrived and unfounded.

We would like to extend our thanks to the MINDSWAP group at University of Maryland, for the use of their software, valuable ideas and indispensable help in putting this site together.

leukemia

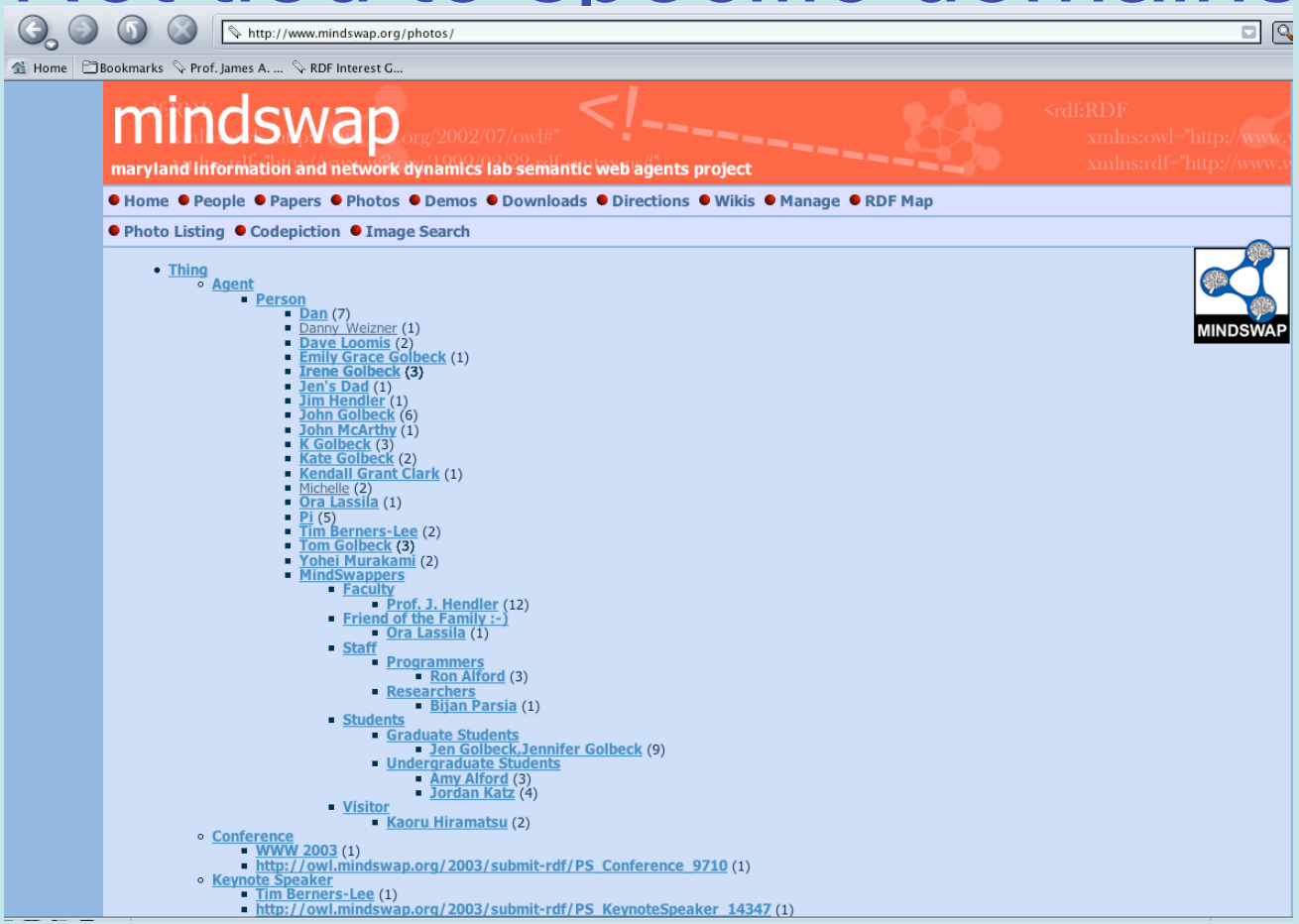
Depictions:



leukemia	type	Feeding_Event, Behavioural_Event
	http://www.mindswap.org/~glapizco/technical.owl#depiction	http://www.cs.umd.edu/~nada/pic1.tif
	information_content	badCell
	has_hypothetical_explanation	cancer

http://www.cs.umd.edu/~nada/pic1.tif	http://www.mindswap.org/~glapizco/technical.owl#depicts	**leukemia**

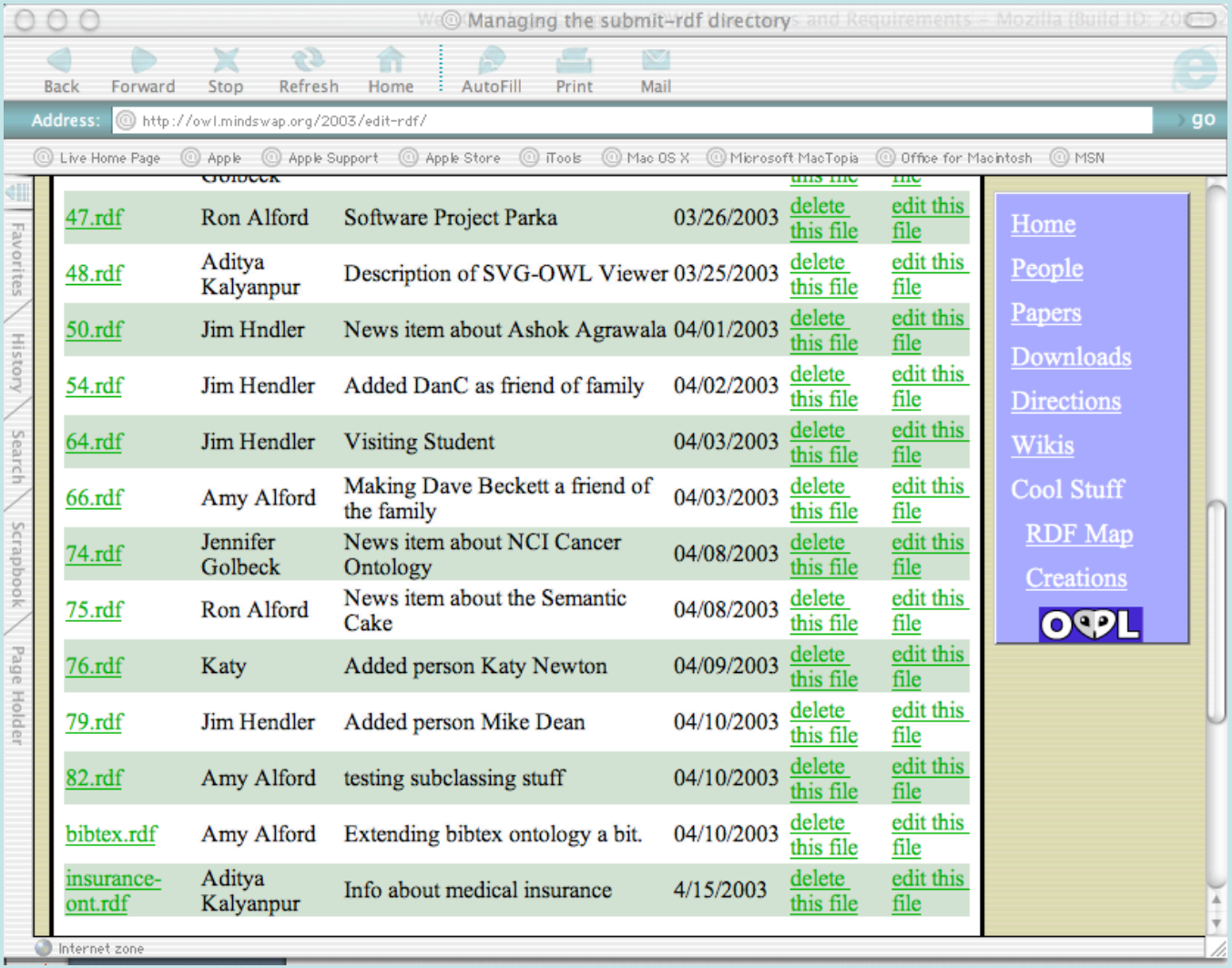
Not tied to specific domains



http://www.mindswap.org

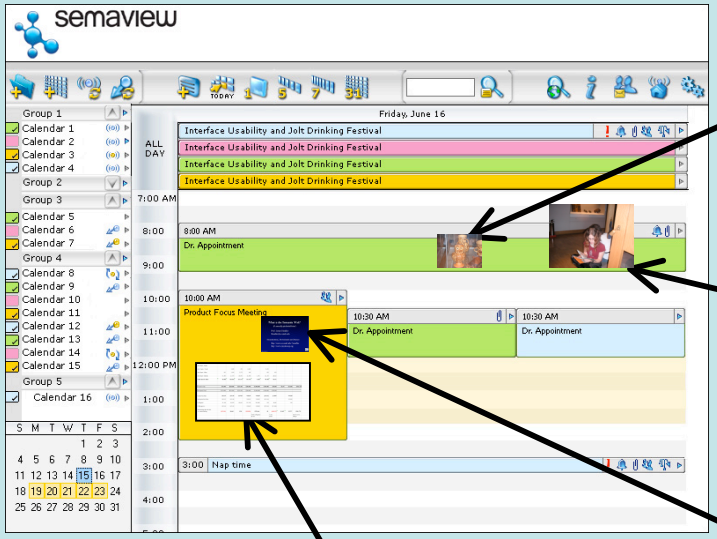
(Semantic Web - 24/7)

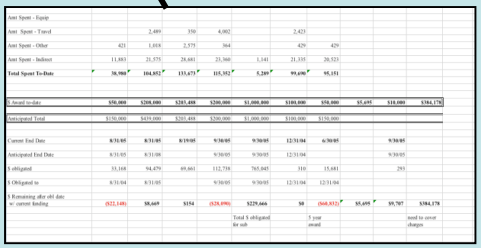
With Info Contexts

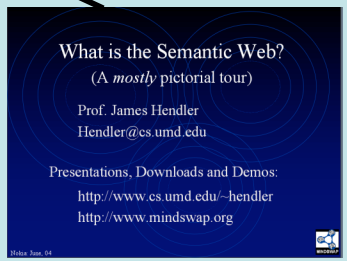


47.rdf	Ron Alford	Software Project Parka	03/26/2003	delete this file	edit this file
48.rdf	Aditya Kalyanpur	Description of SVG-OWL Viewer	03/25/2003	delete this file	edit this file
50.rdf	Jim Hndler	News item about Ashok Agrawala	04/01/2003	delete this file	edit this file
54.rdf	Jim Hendler	Added DanC as friend of family	04/02/2003	delete this file	edit this file
64.rdf	Jim Hendler	Visiting Student	04/03/2003	delete this file	edit this file
66.rdf	Amy Alford	Making Dave Beckett a friend of the family	04/03/2003	delete this file	edit this file
74.rdf	Jennifer Golbeck	News item about NCI Cancer Ontology	04/08/2003	delete this file	edit this file
75.rdf	Ron Alford	News item about the Semantic Cake	04/08/2003	delete this file	edit this file
76.rdf	Katy	Added person Katy Newton	04/09/2003	delete this file	edit this file
79.rdf	Jim Hendler	Added person Mike Dean	04/10/2003	delete this file	edit this file
82.rdf	Amy Alford	testing subclassing stuff	04/10/2003	delete this file	edit this file
bibtex.rdf	Amy Alford	Extending bibtex ontology a bit.	04/10/2003	delete this file	edit this file
insurance-ont.rdf	Aditya Kalyanpur	Info about medical insurance	4/15/2003	delete this file	edit this file

Extending the Portal Technology
Shared Calendar + photos + talks + …







Semantic Web Portal

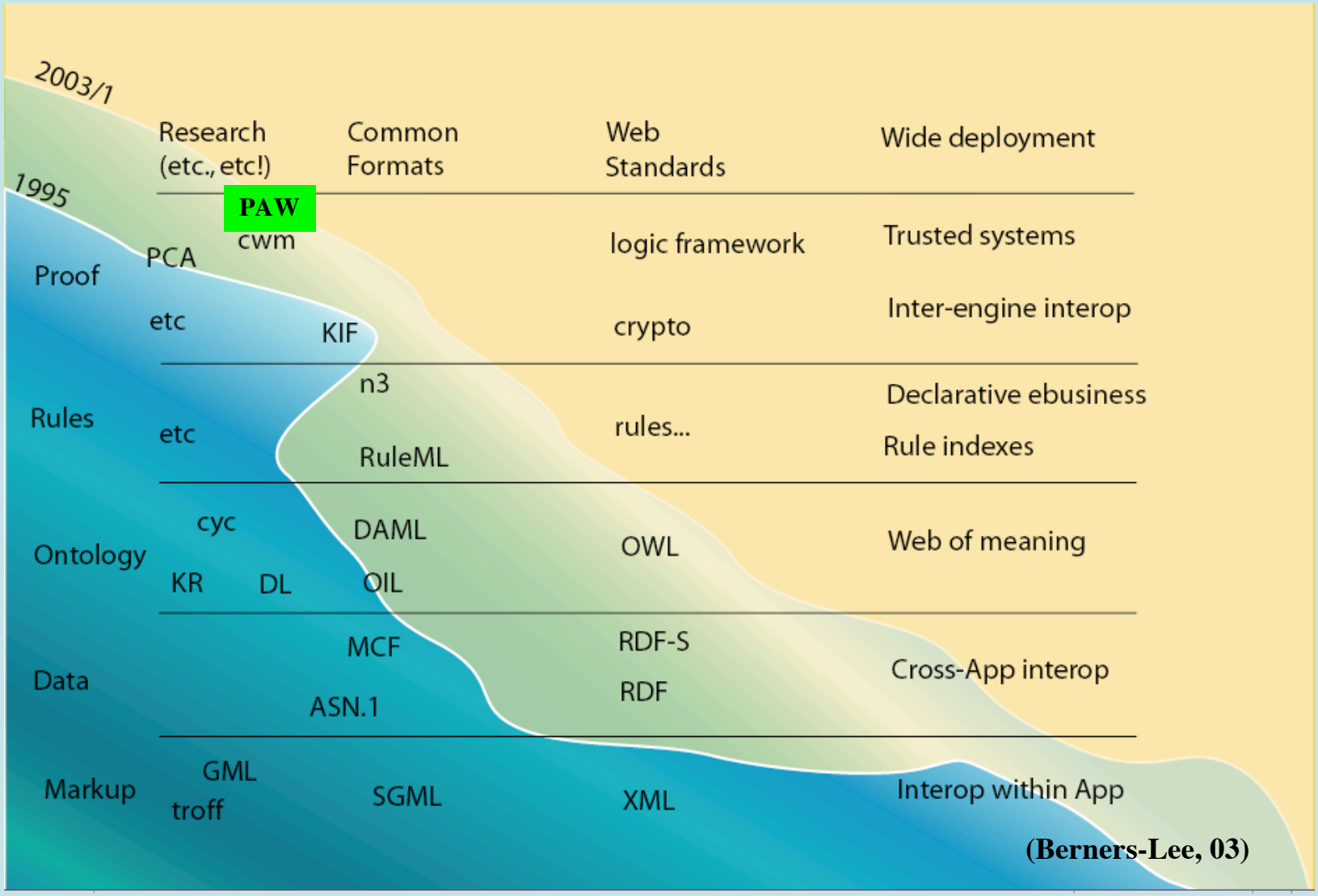
Project goals

- Connecting unstructured inputs to rich metadata
- Bringing in information from "open" sources – provenance
  - tracking who entered the information
  - tracking where the information came from
- Using (multiple) ontologies in OWL
  - To help with annotation
  - To organize information display
  - To manage import/export of unstructured and semi-structured data
- Image and subimage annotation and display
- Demonstrating new information portal management tools enabled by the Semantic Web

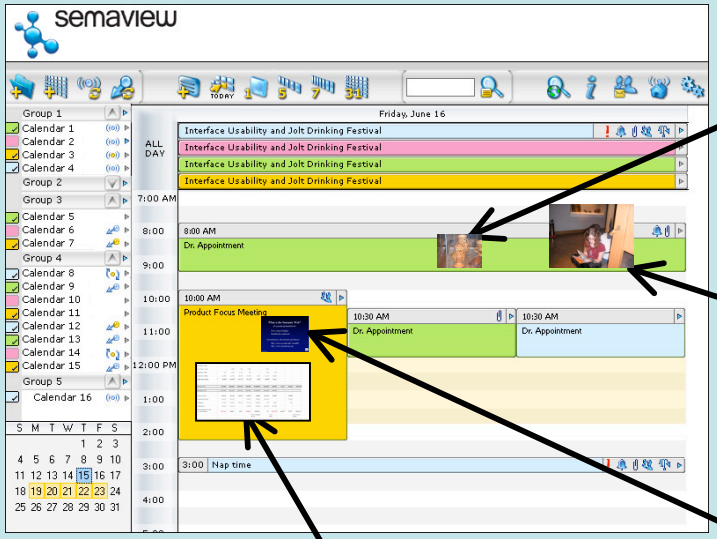
Technologies demoed

- The Web Ontology Language OWL
- RDF Query for page generation
  - Equivalence and inverse inferencing
  - Limited classification (OWL DL)
  - RDF/XML syntax for data exchange
  - RDF/N3 syntax for human readability
- Sem Web Integration w/standard Web tools
  - HTTP protocol based (standard server software)
  - Universal Resource Identifiers for web-based access
  - XSLT and Perl for portal presentation (HTML-like view)

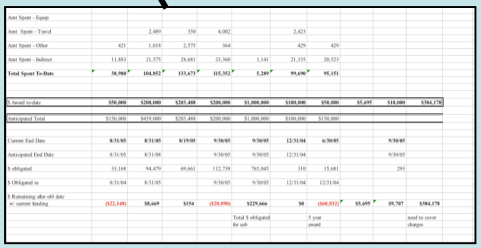
Sem Web status

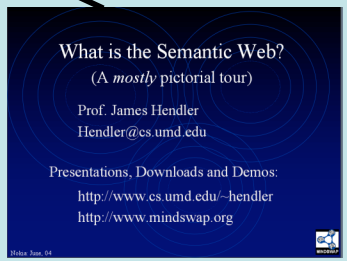


Extending the Portal Technology
Shared Calendar + photos + talks + …



Who can see What??





Who can see What??

Motivation: Access and Privacy Control

URI variable

1) If X is AC rep of Y, X can delegate W3C member access rights in Y.
2) *Kari* is AC rep of *Elisa* .

1) If X is employee of *Elisa*, X has W3C member access rights.
2) *Tiina* is employee of *Elisa*.

Tiina: I have W3C member access rights
Proof: Alan 1, Alan 2, Kari 1, Kari 2

W3C MEMBER site

2004 NSF National Priorities ITR to UMCP and MIT (Hendler, Berners-Lee, Weitzner- PIs)

So what was hard about OWL?

Q. How is OWL different from earlier ontology languages?

A. OWL is a *Web* Ontology language. Where earlier languages have been used to develop tools and ontologies for specific user communities (particularly in the sciences and in company-specific e-commerce applications), they were not defined to be compatible with the architecture of the World Wide Web in general, and the Semantic Web in particular.

OWL rectifies this by providing a language which uses the linking provided by RDF to add the following capabilities to ontologies:

- Ability to be distributed across many systems
- Scalable to Web needs
- Compatible with Web standards for accessibility and internationalization.
- Open and extensible

- Challenge in OWL was to make the ontologies "live on the Web"
  - Descriptions (Class, properties, etc.) must be 1st Class citizens of the WWW
    - i.e.must use URIs
  - OWL without RDF would just be yet another KR language

Open, Distributed Rules Challenges

- Common Notation
  - "Small matter of standardization"
    - N3, SWRL, RuleML
- Identity vs. privacy
  - How do you identify yourself w/o violating the very privacy concerns we hope to address?
    - Current identity schemes are centralized and universal
    - Can we do a distributed ID model (maybe email based)?
- Inconsistency
  - In logic "P ^ -P => Q"
    - On Web it better not!

      (Supported(Bush) ^ --Supported(Bush)) => you owe me $1000
    - Can we use a paraconsistent logic solution?

Annotated Paraconsistent Logic (in 25 words or less)

- Traditional Logic

  P & -P => Q (P and -P are inconsistent)

- Annotated Logic
  - P;X & -P;Y are not inconsistent
  - P;X & -P;X => Q;X but not Q;Y
  - P;X & -(P;X) is inconsistent and must be avoided (but this is easily checked if inference of RHS is restricted)

On the Web

```
<foaf:Person>
  <foaf:name>Jim Hendler</foaf:name>
  <foaf:title>Dr</foaf:title>
  <foaf:firstName>Jim</foaf:firstName>
  <foaf:surname>Hendler</foaf:surname>
  <foaf:mbox_sha1sum>
   be972c7a602683f7cf3c7a1fd0949c565debe4d3
  </foaf:mbox_sha1sum>
  <foaf:homepage rdf:resource="http://www.cs.umd.edu/~hendler"/>
  <foaf:depiction rdf:resource="http://www.semanticgrid.org/q-iantbljim.jpg"/>
  <foaf:workplaceHomepage rdf:resource="http://owl.mindswap.org"/>
</foaf:Person>
```

http://www.cs.umd.edu/~hendler/2003/foaf.rdf

==

<foaf:name>Jim Hendler</foaf:name>;
http://www.cs.umd.edu/~hendler/2003/foaf.rdf

- Annotations represent document contexts

  X;Y and -(X;Y) cannot co-occur
  (unless Web is broken)

  (modulo temporal change, but that's another talk)

Another Cool thing…

- What is a rule of logic?
  - In traditional philosophy it relates to "Truth"
    - What is truth on the Web?
      - Ex: How many cows are in Texas?
  - On the Web, we could use an idea of agreed upon rules, grounded at URI
    - Social definition of truth via shared contexts
      - Ex: Because Mom said so…

Truth on Web Pages [based on Heflin etal, 1998]

- Inference rules could be used to determine the credibility of claims
  - I might believe the claims made by a reliable Newspaper
    - **Trustable(x) :- x; reliableNewspaper.**
  - And I could establish the Washington Post as reliable...
    - i.e. I assert:

      http://www.washingtonpost.com owl:class reliableNewspaper.
  - or if I infer it
    - **ReliableNewspaper(X) :->**

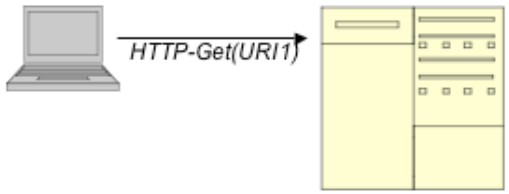
      X owl:class ReliableNewspaper;http://MediaWatchList.
    - **(?) reliableNewspaper(X) :-**

      X owl:class ReliableNewspaper; src ^ trusted(src).
- **The rules are "grounded" in a testable way**
  - **If I can HTTP-get the fact, then it is asserted**

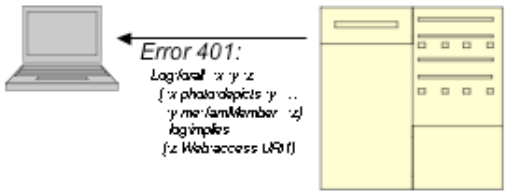
Rule Sets could be shared

- You can ground your sources
  - X :- X; src ^ src owl:class TrustedSource; http://…/myMomSet.rdf
- Or infer trusted sources based on other rule sets
  - X :- X; src ^ src owl:class TrustedSource; http://ex.com/RushLimbaughSet.rdf
  - X :- X; src ^ src owl:class TrustedSource; http://ex.com/UnabomberRules.rdf
    ^ --(X;http://www.rushLimbaugh.com/truths.rdf)

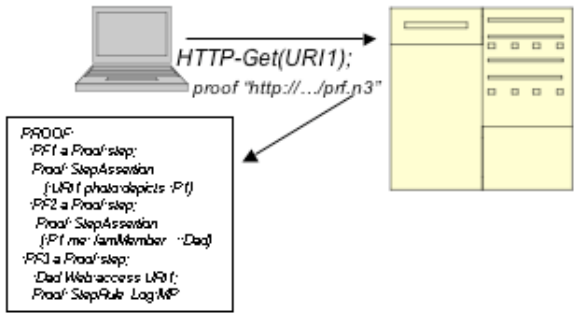
Policy Aware WEB



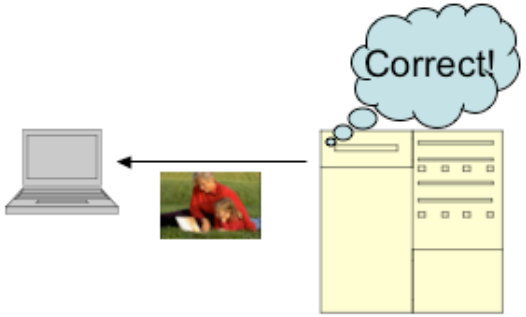
(A) User requests a resource.



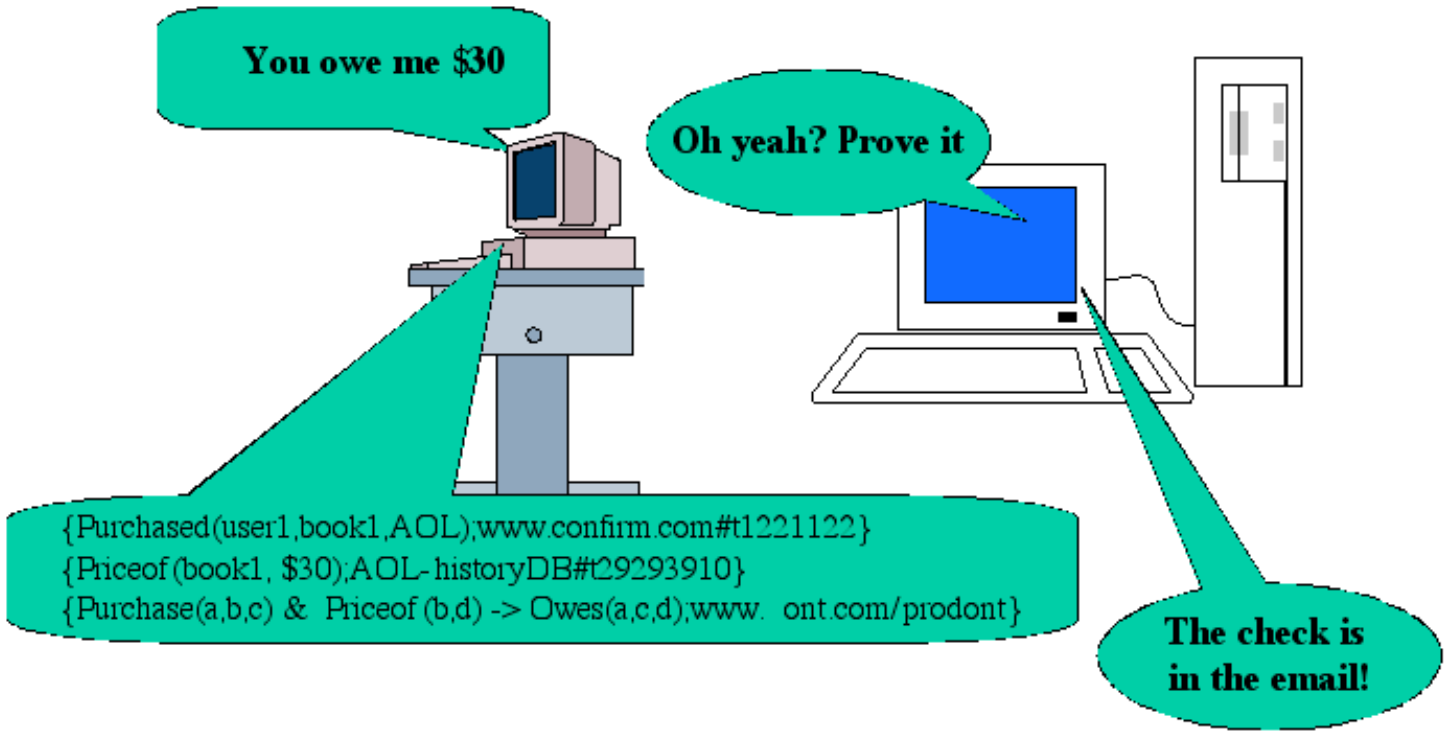
(B) 401 error provides access rules.



(C) Proof is generated and pointer is sent in new HTTP-Get request.



(D) Proof is checked, and confirmed, and the transaction succeeds.


You owe me $30
Oh yeah? Prove it
{Purchased(user1,book1,AOL);www.confirm.com#t1221122}
{Priceof(book1, $30);AOL-historyDB#t29293910}
{Purchase(a,b,c) & Priceof(b,d) -> Owes(a,c,d);www. ont.com/prodont}
The check is in the email!

Conclusions

- Information lives in specific contexts
  - The Semantic Web helps us place information into these (multiple) contexts.
- Control of information requires control of contexts
  - Explication of policies
    - Linked in a Web-like way
  - Integrated directly into the Web
    - With extensions for rules and proofs
  - Is really hard
    - Issues of identity, inconsistency, grouding, change over time
  - But holds great potential
    - Personal Control of your information spaces
- "Policy-Aware" Web project (joint between UMCP and MIT)
  - Goal: make this real!

http://www.mindswap.org/~hendler/2004/PAW.html

Other projects

- Today I didn't talk about:
  - Semantic Grid (Scientific computing)
    - OGSI/OWL hybrid
  - Distributed ontology creation
    - Global federated ontology
    - SWOOP/Annotea
    - Distributed DL's: e-connection framework
  - Semantic Markup for Science
    - NASA Missionsdocuments: http://semspace.mindswap.org
    - Eco-informatics (NSF ITR)
    - Scientific publishing
  - Semantic Web Services
    - Distributed Workflow creation
    - AI planning and SWS
    - OWL-S API
  - Semantic Web tool kit
    - Ontology editor/browser
    - OWL DL Reasoning
    - OWL back-end support
    - OWL blogging tools
    - Multimedia markup (beyond images)
  - Database Interoperability using semantics
    - OWL-DB

See http://www.mindswap.org/papers for a list (OWL/RDF generated, of course)

MIND SWAP

- Maryland Information and Network Dynamics Laboratory,

Semantic Web and Agents Project

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Bijan Parsia	Taowei Wang	Ron Alford	Daniel Hewlett
Bernardo Cuenca-Grau	Vladimir Kolovski	Kendall Clark	Meem Mahmoud
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- Corporate Research Partners:
  - **Fujitsu Laboratory of America, College Park**
  - Lockheed Martin Advanced Technology Laboratories
  - NTT Corp
  - SAIC Corp., Kevric Corp, Top Quadrant
- Govt Funding:
  - NSF, NGA, US Army Research Laboratory, DARPA, DoD, NIST

http://www.mindswap.org

(OWL-powered Semantic Web page)