

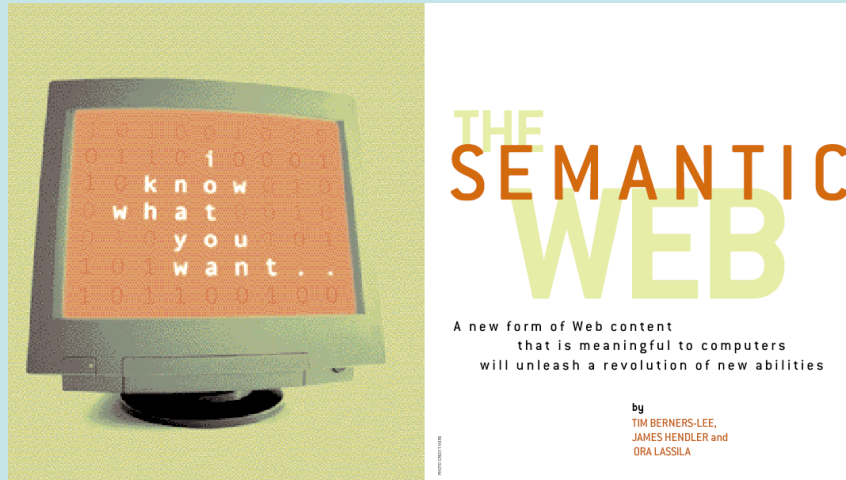
The Policy-Aware Web

Jim Hendler

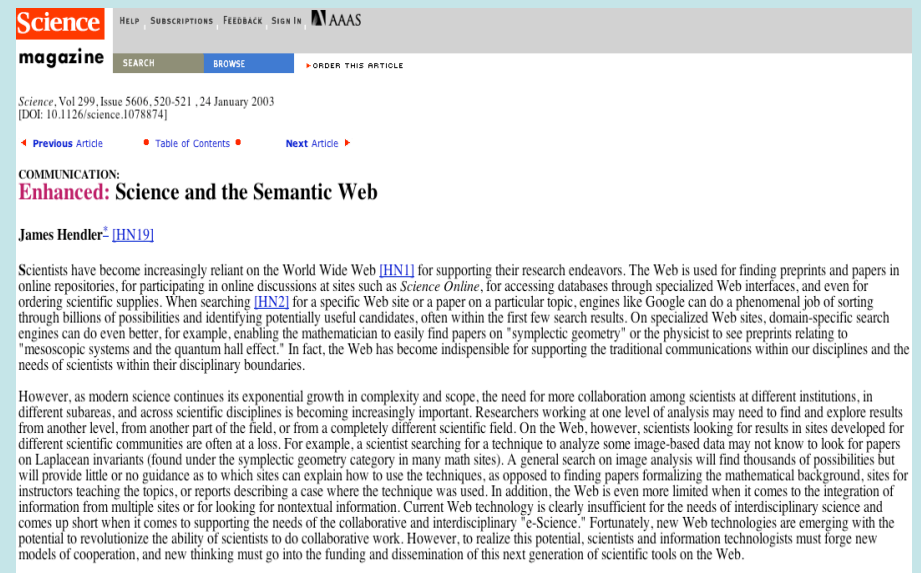
<http://www.cs.umd.edu/~hendler>

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

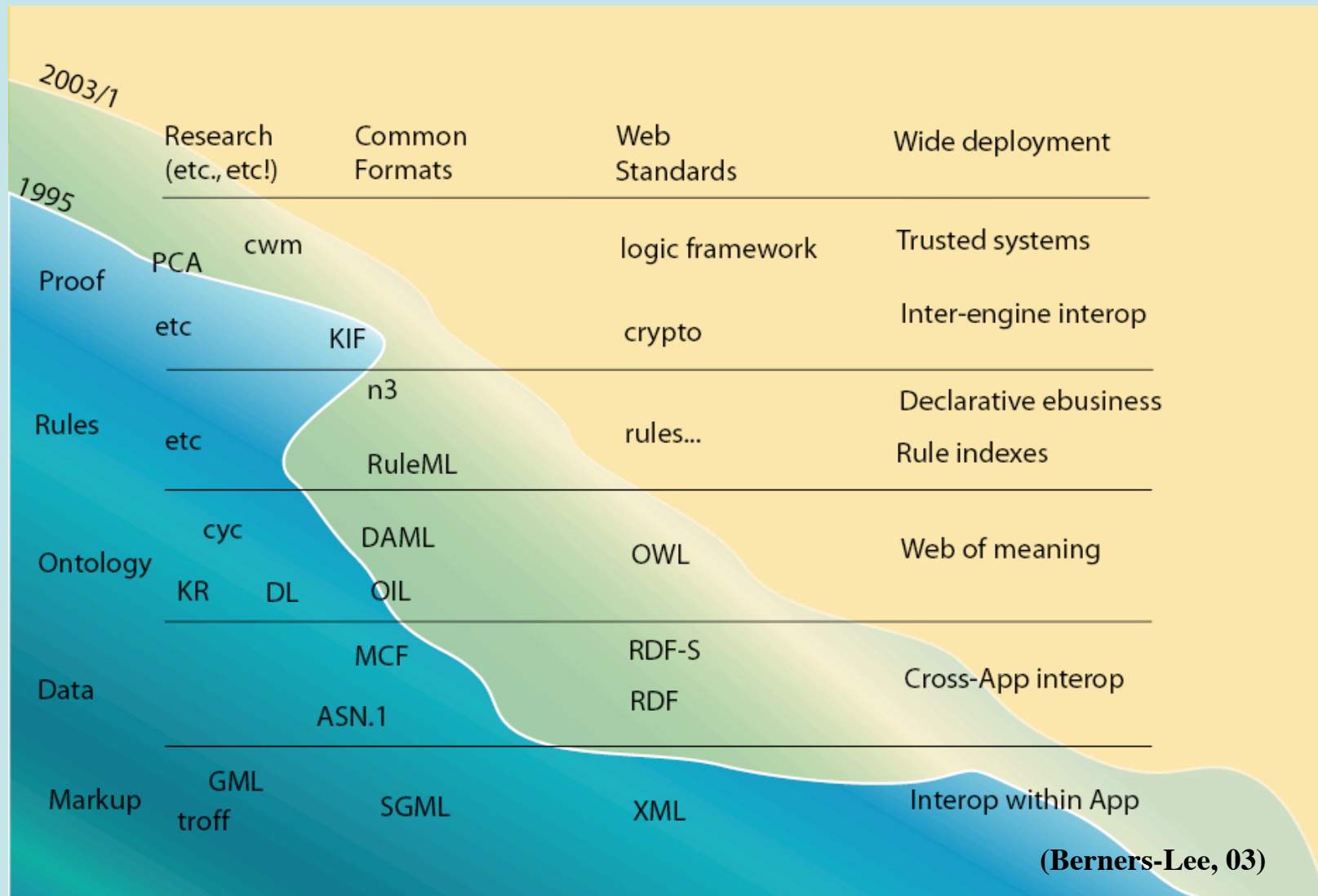
The Semantic Web



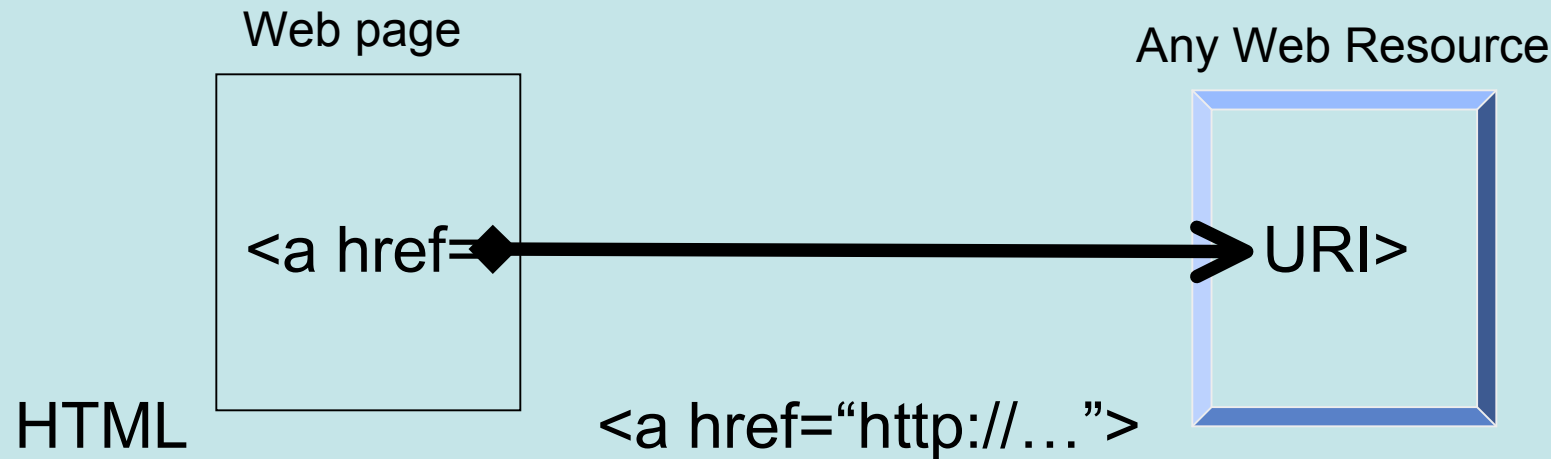
- Lots of papers showing up on the "semantic web" – But what is it?



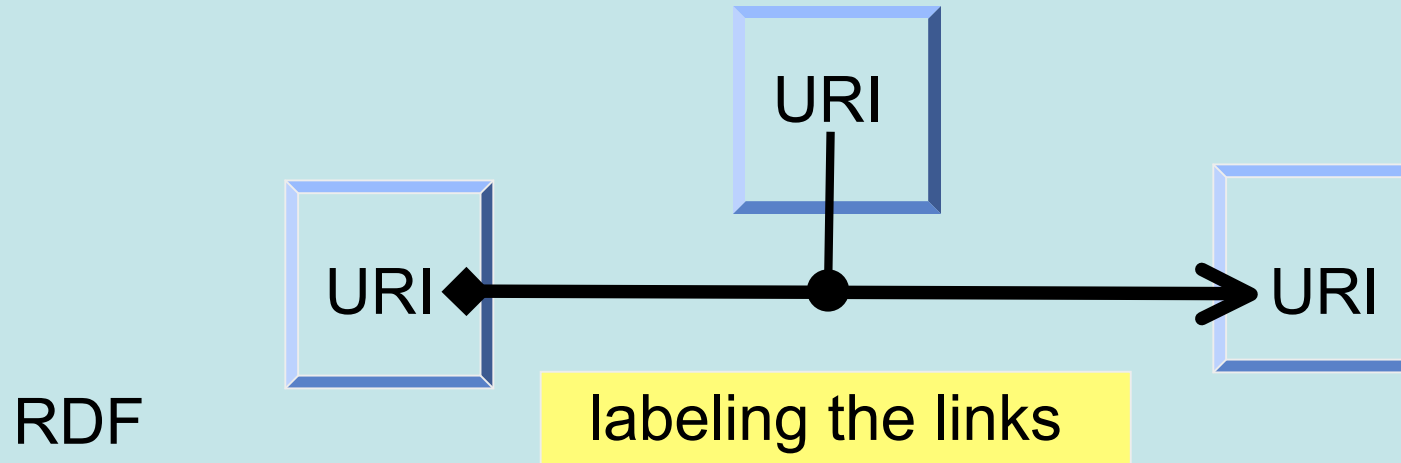
And where is it going?



On the Web -- links are critical!



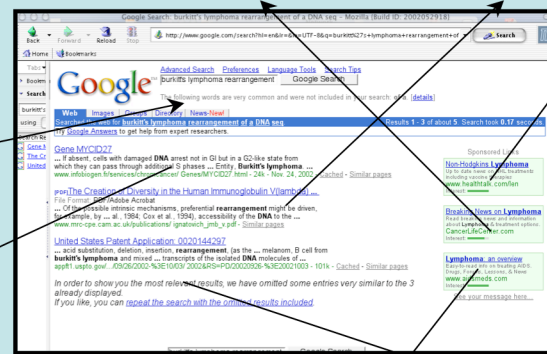
On the Semantic WEB -- links are critical!



“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

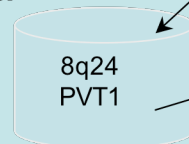
PubMed

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




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)!

<http://www2002.org>



HAWAII

WWW 2002

THE ELEVENTH INTERNATIONAL WORLD WIDE WEB CONFERENCE

Sheraton Waikiki Hotel
Honolulu, Hawaii, USA
7-11 May 2002


Event:WebPage

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

Australia · Canada · Chile
Netherlands · Norway · Singapore

On 7-11 May 2002, Honolulu provides a public forum for the prestigious series of the International World Wide Web Conference. The conference is being organized by the Pacific Telecommunications Council.



Tim Berners-Lee
Founders chair at the Laboratory for Computer Science (LCS) at the Massachusetts Institute of Technology (MIT).

```
<> 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"
...
```

```
<daml:ObjectProperty rdf:ID="photograph">
<rdfs:domain rdf:resource="#Picture"/>
<rdfs:range rdf:resource="...#person"/>
</daml:ObjectProperty>
```

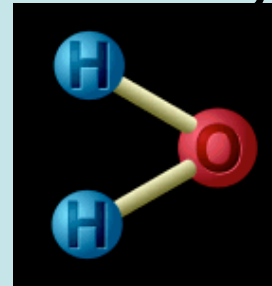
```
<s:Class
rdf:about="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Conference">
<s:comment>
describes a generic concept about events
</s:comment>
<s:subClassOf
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Event"/>
<a:disjointFrom
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Workshop"/>
<a:restrictedBy
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#genid18"/>
```

```
<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#Asserter"/>
</rdf:Description>
```

A very old idea in new clothes

- Scientists communicate by use of models

- c.f. Physical



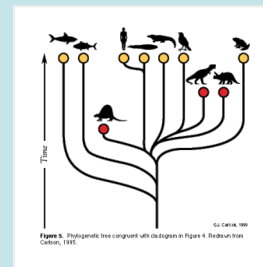
- c.f. Mathematical

Mathematical model

$$\begin{aligned} \nabla^2 \phi &= 0 \\ \eta_t + \eta_x \phi_x + \eta_y \phi_y - \eta_z &= 0 \\ \phi_t + \frac{1}{2}(\phi_x^2 + \phi_y^2 + \phi_z^2) + g\eta &= 0 \\ \frac{\partial \phi}{\partial n} &= 0 \end{aligned}$$

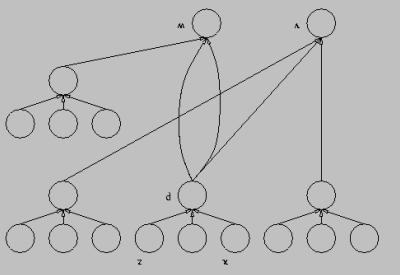
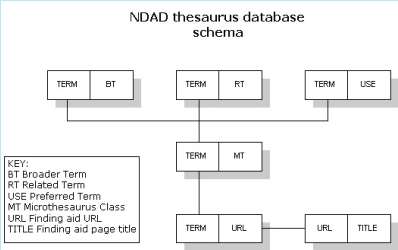
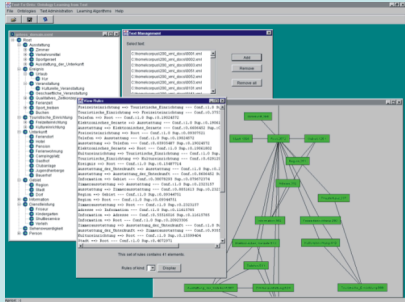
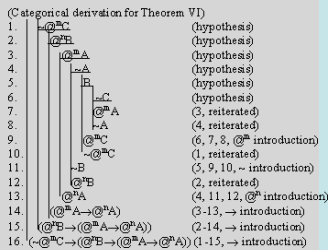
October 26, 1998 Xing Cai

- c.f. Organizational



Models expose semantics

Sem Web Languages

			...	
Graph Data Dictionary (Vocab) Ontology	Labeled graph Data Schema Ontology	Graph + limited logic Ontology	...	Rules/Logic Ontology
RDF	RDF Schema	OWL	...	??

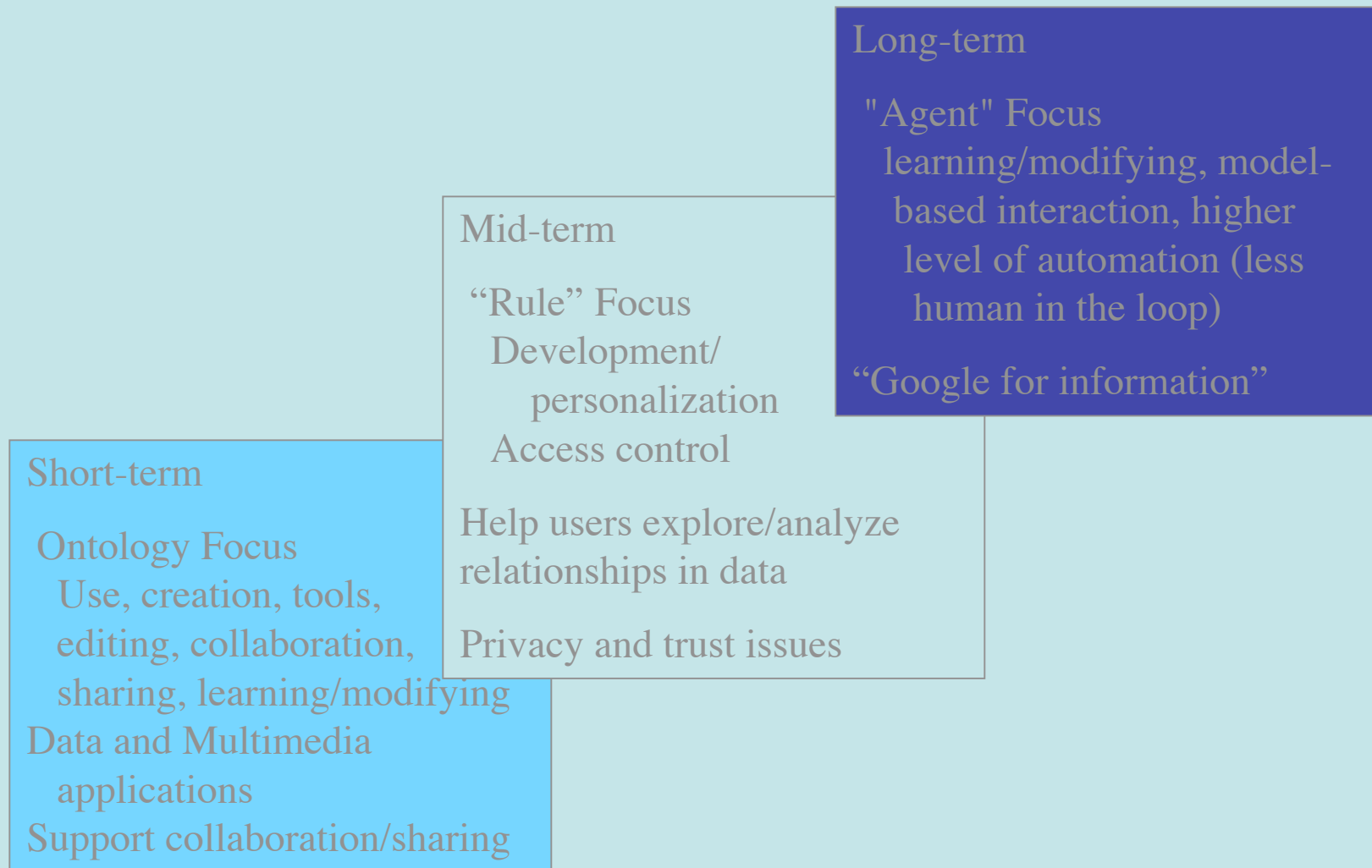
All of these languages add semantic modeling primitives to XML - so you can “do this in XML” per se, but it is reinventing the wheel.

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



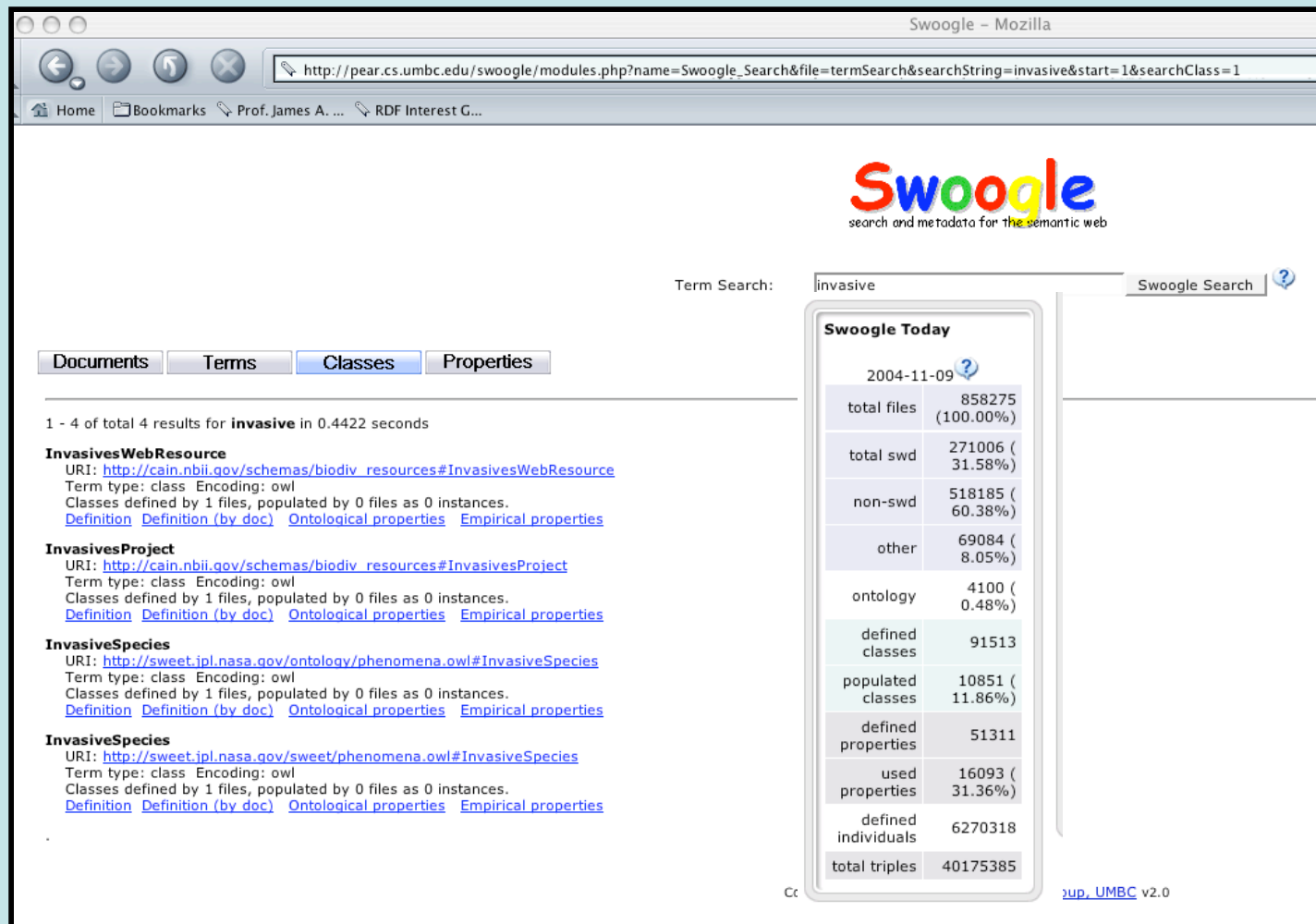
Example Sem Web Roadmap



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



The screenshot shows a Mozilla browser window with the Swoogle search engine interface. The search term 'invasive' has been entered, and the results are displayed under the 'Classes' tab. The results list four classes: InvasivesWebResource, InvasivesProject, InvasiveSpecies, and InvasiveSpecies. Each class entry includes its URI, term type, encoding, and a summary of its defined files and instances. A 'Swoogle Today' sidebar on the right provides a snapshot of the system's statistics as of 2004-11-09.

Term Search: Swoogle Search ?

Documents **Terms** **Classes** **Properties**

1 - 4 of total 4 results for **invasive** in 0.4422 seconds

InvasivesWebResource
URI: http://cain.nbii.gov/schemas/biodiv_resources#InvasivesWebResource
Term type: class Encoding: owl
Classes defined by 1 files, populated by 0 files as 0 instances.
[Definition](#) [Definition \(by doc\)](#) [Ontological properties](#) [Empirical properties](#)

InvasivesProject
URI: http://cain.nbii.gov/schemas/biodiv_resources#InvasivesProject
Term type: class Encoding: owl
Classes defined by 1 files, populated by 0 files as 0 instances.
[Definition](#) [Definition \(by doc\)](#) [Ontological properties](#) [Empirical properties](#)

InvasiveSpecies
URI: <http://sweet.jpl.nasa.gov/ontology/phenomena.owl#InvasiveSpecies>
Term type: class Encoding: owl
Classes defined by 1 files, populated by 0 files as 0 instances.
[Definition](#) [Definition \(by doc\)](#) [Ontological properties](#) [Empirical properties](#)

InvasiveSpecies
URI: <http://sweet.jpl.nasa.gov/sweet/phenomena.owl#InvasiveSpecies>
Term type: class Encoding: owl
Classes defined by 1 files, populated by 0 files as 0 instances.
[Definition](#) [Definition \(by doc\)](#) [Ontological properties](#) [Empirical properties](#)

Swoogle Today
2004-11-09 ?

total files	858275 (100.00%)
total swd	271006 (31.58%)
non-swd	518185 (60.38%)
other	69084 (8.05%)
ontology	4100 (0.48%)
defined classes	91513
populated classes	10851 (11.86%)
defined properties	51311
used properties	16093 (31.36%)
defined individuals	6270318
total triples	40175385

CC [sup, UMBC](#) v2.0

Collaborative Editing

SWOOP v2.2 beta3 (date: 11/06)

File View Bookmarks Resource Holder

Address: <http://protege.stanford.edu/plugins/owl/owl-library/koala.owl#Koala>

☒ Collapse ☐ New ☐ Reload ☐ Remove

☒ Debug ☐ Show Inherited ☒ Advanced ☒ Editable

koala.owl^A

☒ Add ☐ Add ☐ Add ☐ Remove ☐ Rename

☒ Show Imports ☒ QNames ☐ Pellet

Class Tree Property Tree List

- koala:TasmanianDevil^A
- koala:Parent^A
 - koala:MaleStudentWith3Days
 - koala:Person
 - koala:Student
 - koala:GraduateStudent
 - koala:MaleStudentWith3Days
 - koala:Degree
 - koala:Gender
 - koala:Habitat
 - koala:Forest
 - koala:DryEucalyptForest
 - koala:Rainforest
 - koala:University
 - owl:Nothing
 - koala:KoalaWithPhD
 - koala:Quokka
 - koala:Koala^A

Lookup

Concise Format Abstract Syntax RDF/XML Turtle

OWL-Class: [koala:Koala](#)
Unsatisfiable concept
Reason: An individual belongs to a type and its complement
Individual: Auto-generated individual for [koala:Koala](#)
Details: Individual contains both
[koala:Person](#)
and its complement

Equivalent to: (Add)
[owl:Nothing](#)

Subclass of: (Add)
[\(koala:hasHabitat & koala:DryEucalyptForest\)](#) (Delete)
[\(koala:isHardWorking & {"false"^^xsd:boolean}\)](#) (Delete)
[koala:Marsupials](#) (Delete)

Annotations: (Add)

Intersection of: (Add)

Union of: (Add)

One of: (Add)

Changes Checkpoints Annotate

(Auto-Update : OFF, Ctrl-U to toggle setting)

Author	Subject	Date
Bijan Par [AN]	A sample form.	11-01
Bijan Par [EX]		11-02
Bijan Par [AD]	Sound advice	11-07
Jim Hend [QU]	Koala as human?	11-09

Author: Jim Hendler
Annotation Type: QU-Question
Date Created: 2004-11-09 18:09:20

Subject: Koala as human?

Why is Koala defined to be a subclass of person? Pellet is recognizing this as an unsatisfiable concept because of this link.

☐ LOCK
Status: Annotation successfully posted to server

Multi-ontology support

SWOOP v2.2 beta3 (date: 11/06)

File View Bookmarks Resource Holder

Address: <http://www.mindswap.org/2004/owl/funding#GovernmentGrant>

Debug ☐ Show Inherited ☒ Advanced ☐ Editable ☐

Concise Format Abstract Syntax RDF/XML Turtle

Ontology: owl:funding

OWL-Class: [funding:Grant](#)

Annotations:

rdfs:label "Grant"

Subclass of:

[funding:Funding](#)

Superclass of:

[funding:GovernmentGrant](#)
[funding:BusinessGrant](#)

Domain of:

[funding:funds](#)
[funding:name](#)
[funding:fundedBy](#)
[funding:logo](#)
[funding:source](#)
[funding:destination](#)
[funding:homepage](#)

OWL-Class: [active-portal-ontology-latest:grant](#)

Subclass of:

[active-portal-ontology-latest:financial-award](#)

Domain of:

[active-portal-ontology-latest:has-telephone-number](#)
[active-portal-ontology-latest:has-funding-source](#)
[active-portal-ontology-latest:has-grant-reference](#)
[active-portal-ontology-latest:has-author](#)
[akt-support-ontology-latest:has-pretty-name](#)
[akt-support-ontology-latest:has-magnitude](#)
[akt-support-ontology-latest:has-pretty-name](#)
[active-portal-ontology-latest:has-grant-value](#)
[akt-support-ontology-latest:has-variant-name](#)
[active-portal-ontology-latest:has-web-address](#)

Range of:

[active-portal-ontology-latest:confers-award](#)
[active-portal-ontology-latest:uses-resource](#)
[active-portal-ontology-latest:produces-output](#)
[active-portal-ontology-latest:has-funding](#)

Remove this Entity Remove this Entity

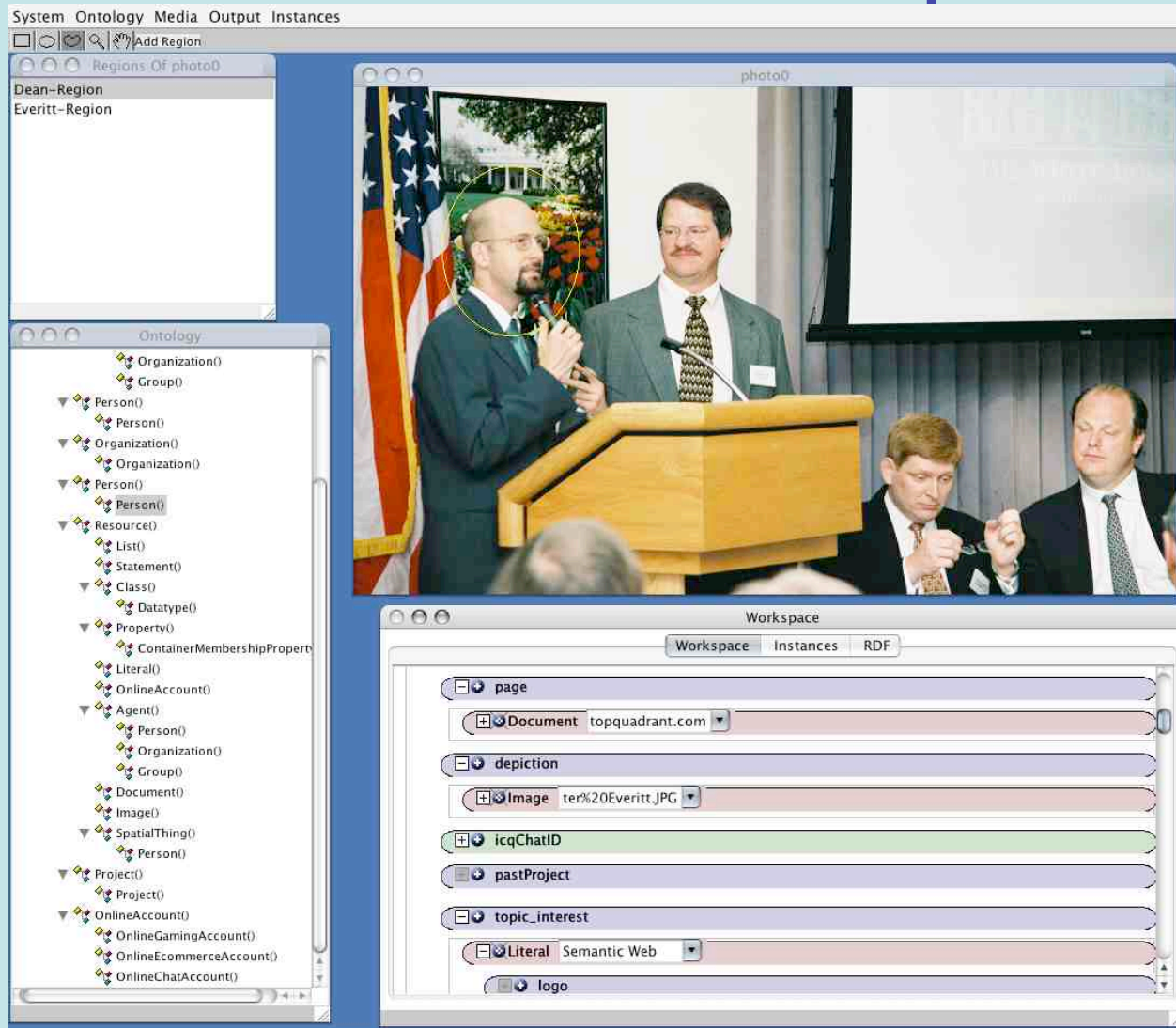
Class Tree Property Tree List

Show All

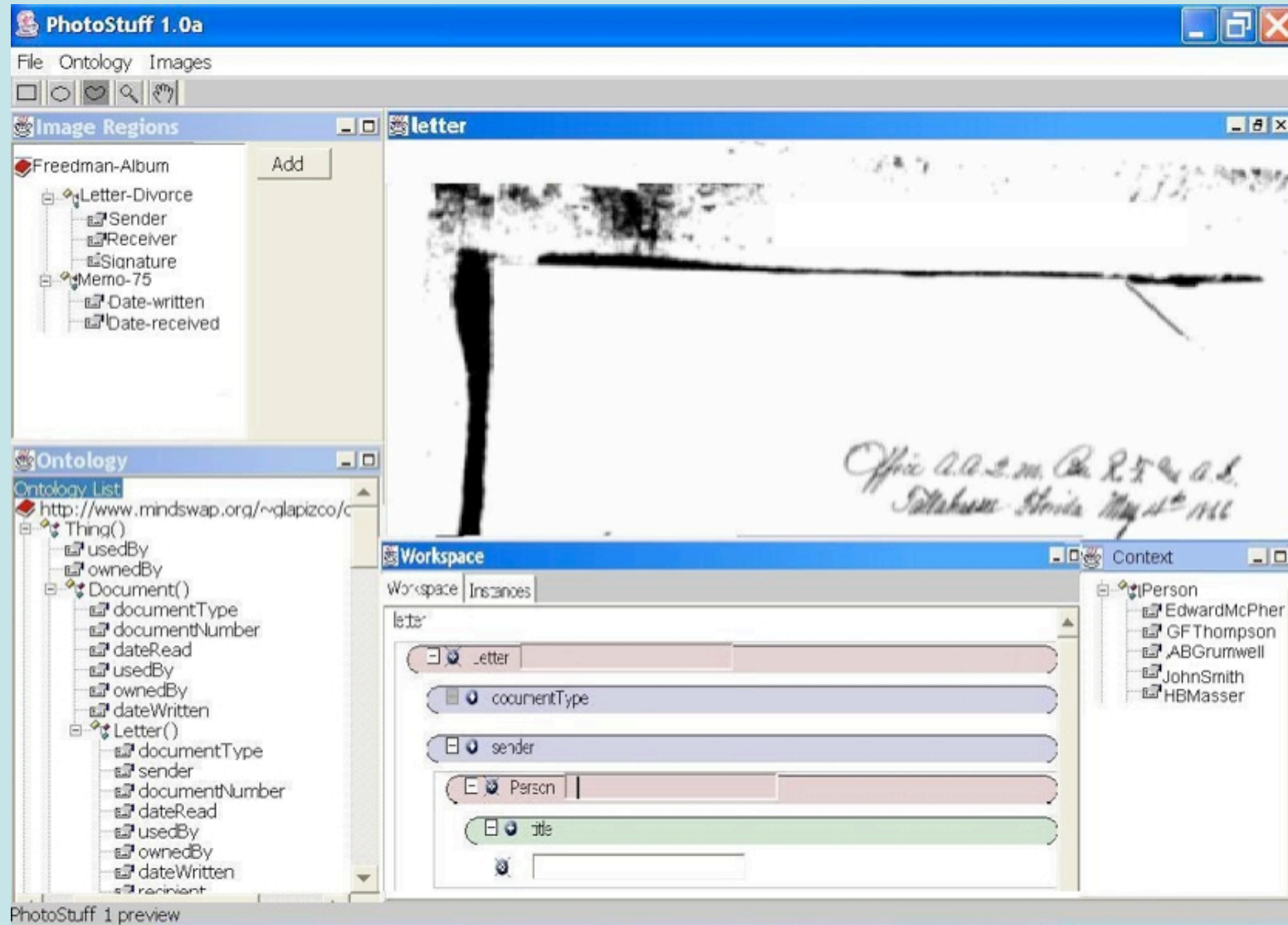
- funding:BusinessContract
- funding:BusinessFunding
- funding:BusinessGrant
- funding:Contract
- funding:destination
- funding:fundedBy
- funding:Fundee
- funding:Funder
- funding:Funding
- funding:funds
- funding:Government
- funding:GovernmentContract
- funding:GovernmentFunding
- funding:GovernmentGrant
- funding:Grant
- funding:homepage
- funding:logo
- funding:name
- funding:Organization
- rdfs:label
- funding:source

Lookup grant

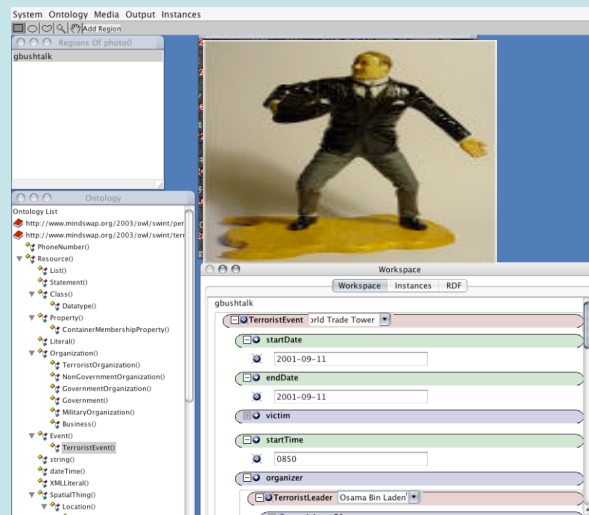
Tools for markup...



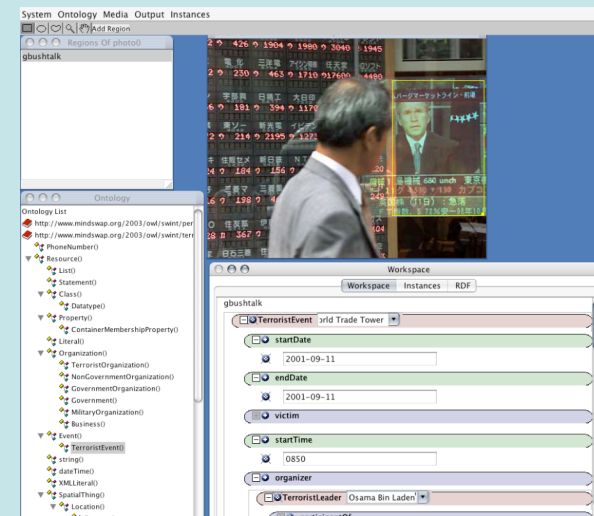
Of different media and types



Of different media and types

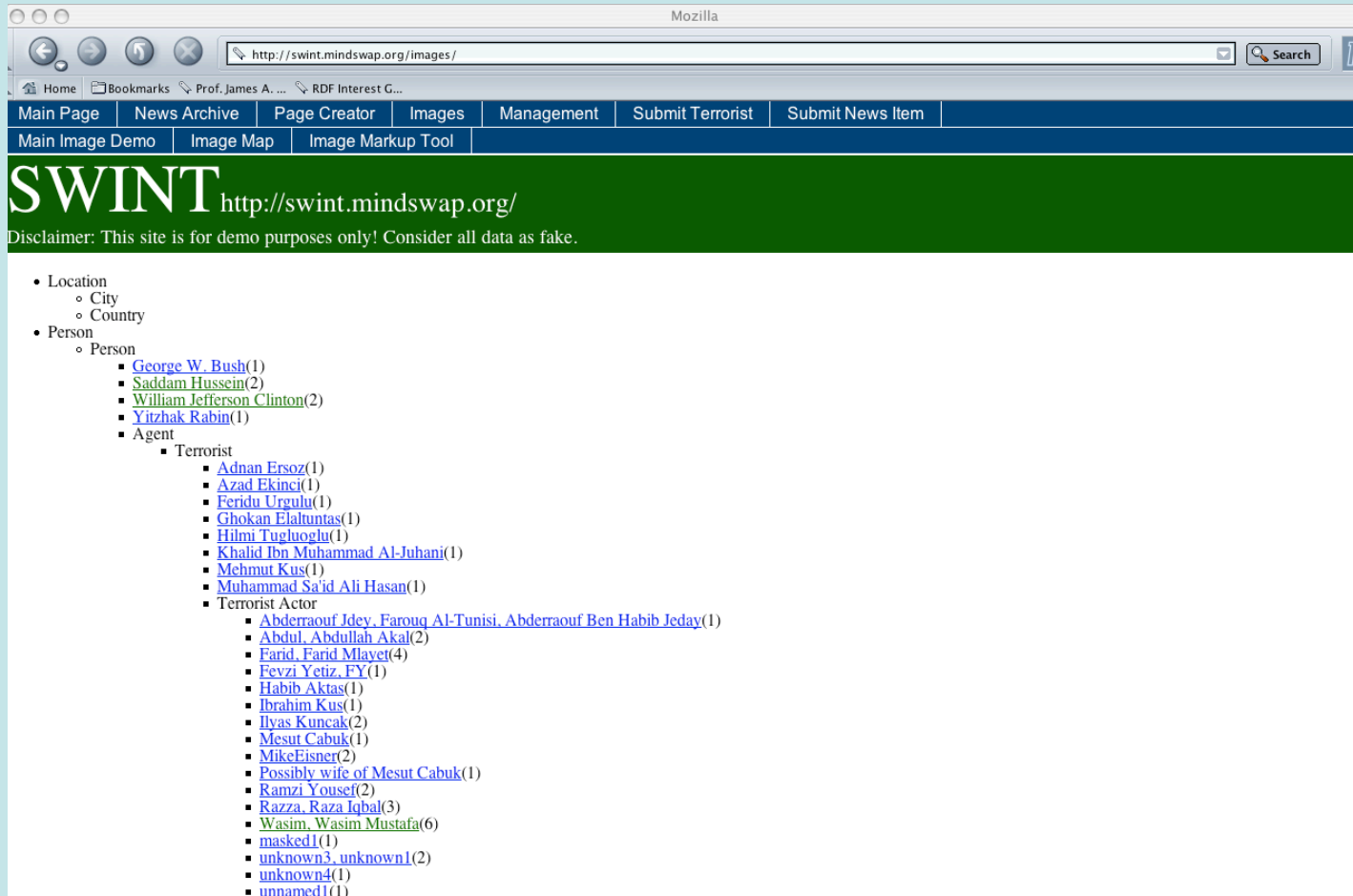


The scene from the James Bond movie where the guy throws his hat at a statue



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

Semantic Web Application Portals



The screenshot shows a Mozilla browser window displaying the SWINT web application. The address bar shows the URL <http://swint.mindswap.org/images/>. The browser's menu bar includes Home, Bookmarks, Prof. James A..., and RDF Interest G... The toolbar contains buttons for Main Page, News Archive, Page Creator, Images, Management, Submit Terrorist, and Submit News Item. Below the toolbar, there are links for Main Image Demo, Image Map, and Image Markup Tool. The main content area features the SWINT logo and the URL <http://swint.mindswap.org/>. A disclaimer states: "Disclaimer: This site is for demo purposes only! Consider all data as fake." The application displays a hierarchical list of entities:

- Location
 - City
 - Country
- Person
 - Person
 - [George W. Bush](#)(1)
 - [Saddam Hussein](#)(2)
 - [William Jefferson Clinton](#)(2)
 - [Yitzhak Rabin](#)(1)
 - Agent
 - Terrorist
 - [Adnan Ersoz](#)(1)
 - [Azad Ekinci](#)(1)
 - [Feridu Urgulu](#)(1)
 - [Ghokan Elaltuntas](#)(1)
 - [Hilmi Tugluoglu](#)(1)
 - [Khalid Ibn Muhammad Al-Juhani](#)(1)
 - [Mehmut Kus](#)(1)
 - [Muhammad Sa'id Ali Hasan](#)(1)
 - Terrorist Actor
 - [Abderraouf Jdey, Farouq Al-Tunisi, Abderraouf Ben Habib Jeday](#)(1)
 - [Abdul Abdullah Akal](#)(2)
 - [Farid, Farid Mlayet](#)(4)
 - [Fevzi Yetiz, FY](#)(1)
 - [Habib Aktas](#)(1)
 - [Ibrahim Kus](#)(1)
 - [Ilyas Kuncak](#)(2)
 - [Mesut Cabuk](#)(1)
 - [Mike Eisner](#)(2)
 - [Possibly wife of Mesut Cabuk](#)(1)
 - [Ramzi Yousef](#)(2)
 - [Razza, Raza Iqbal](#)(3)
 - [Wasim, Wasim Mustafa](#)(6)
 - [masked1](#)(1)
 - [unknown3, unknown1](#)(2)
 - [unknown4](#)(1)
 - [unnamed1](#)(1)

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%7D

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... Google


Apple .Mac Amazon eBay Yahoo! News ▾

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

Bio-Central

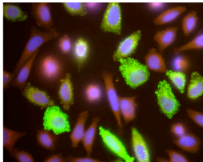
Disclaimer: This is a demonstration website! Consider all information as contrived and unfounded.

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

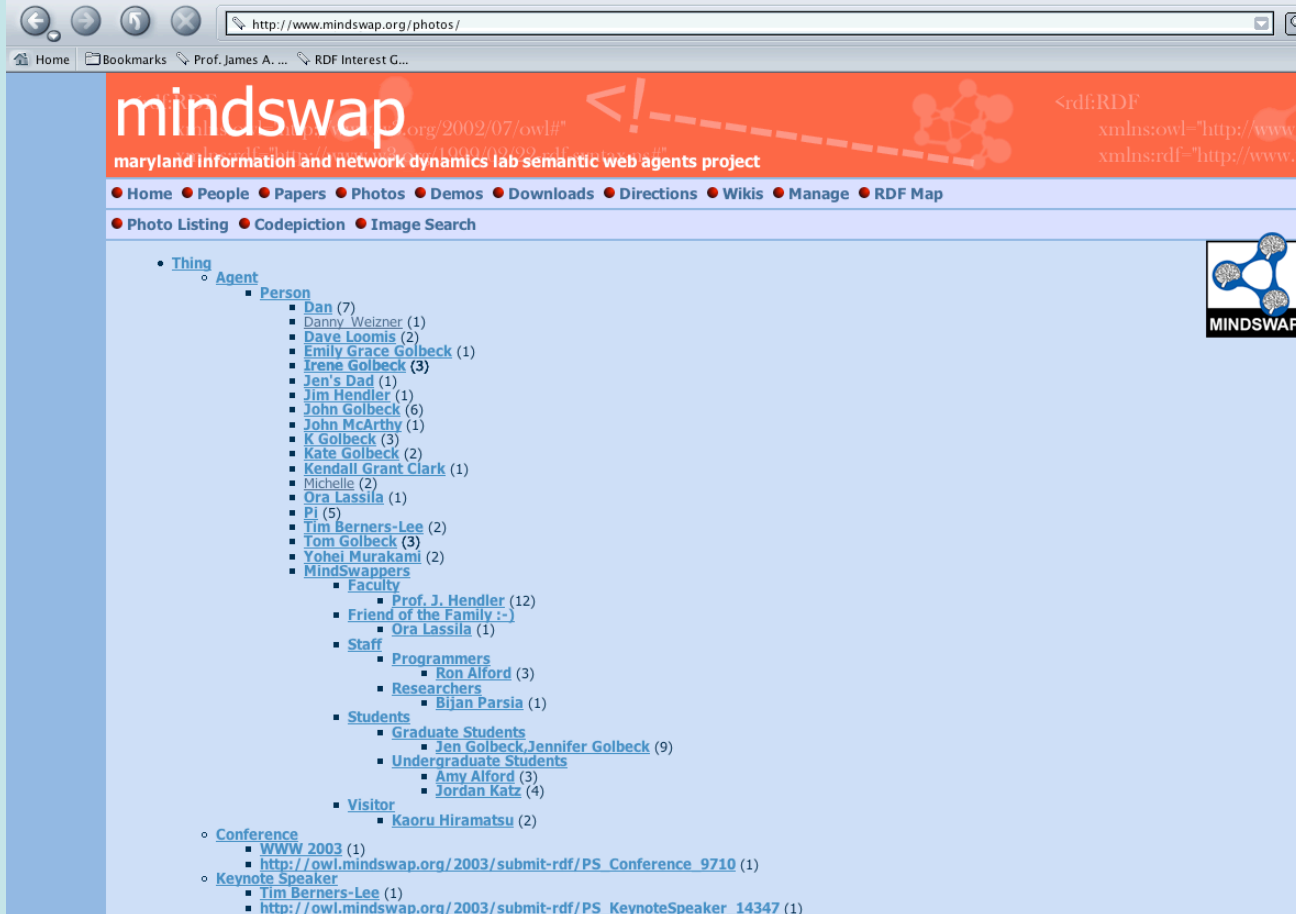
Depictions:



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

Demo Button

Not tied to specific domains



The screenshot shows a web browser window with the URL <http://www.mindswap.org/photos/>. The page features the mindswap logo and navigation links: Home, People, Papers, Photos, Demos, Downloads, Directions, Wikis, Manage, RDF Map, Photo Listing, Codepiction, and Image Search. The main content area displays a hierarchical tree structure of agents and their associated resources.

- Thing
 - Agent
 - Person
 - Dan (7)
 - Danny Weizner (1)
 - Dave Loomis (2)
 - Emily Grace Golbeck (1)
 - Irene Golbeck (3)
 - Jen's Dad (1)
 - Jim Hendler (1)
 - John Golbeck (6)
 - John McCarthy (1)
 - K Golbeck (3)
 - Kate Golbeck (2)
 - Kendall Grant Clark (1)
 - Michelle (2)
 - Ora Lassila (1)
 - Pi (5)
 - Tim Berners-Lee (2)
 - Tom Golbeck (3)
 - Yohei Murakami (2)
 - MindSwappers
 - Faculty
 - Prof. J. Hendler (12)
 - Friend of the Family :-)
 - Ora Lassila (1)
 - Staff
 - Programmers
 - Ron Alford (3)
 - Researchers
 - Bijan Parsia (1)
 - Students
 - Graduate Students
 - Jen Golbeck, Jennifer Golbeck (9)
 - Undergraduate Students
 - Amy Alford (3)
 - Jordan Katz (4)
 - Visitor
 - Kaoru Hiramatsu (2)

- Conference
- WWW 2003 (1)
- http://owl.mindswap.org/2003/submit-rdf/PS_Conference_9710 (1)
- Keynote Speaker
- Tim Berners-Lee (1)
- http://owl.mindswap.org/2003/submit-rdf/PS_KeynoteSpeaker_14347 (1)

<http://www.mindswap.org>

(Semantic Web - 24/7)

With Info Contexts

Managing the submit-rdf directory and Requirements - Mozilla (Build ID: 20020901)

Back Forward Stop Refresh Home AutoFill Print Mail

Address: <http://owl.mindswap.org/2003/edit-rdf/> go

Live Home Page Apple Apple Support Apple Store iTools Mac OS X Microsoft MacTopia Office for Macintosh MSN

File	Author	Description	Date	delete this file	edit this file
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

Home
People
Papers
Downloads
Directions
Wikis
Cool Stuff
RDF Map
Creations

Internet zone

	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
Non-Spent - Expense											
Non-Spent - Travel		2,489	330	6,902		2,423					
Non-Spent - Other	431	1,818	3,375	364		429	429				
Non-Spent - Indirect	11,351	25,375	20,401	26,366	1,140	21,310	28,521				
Total Non-Spent Expense	36,782	30,622	24,107	33,632	5,249	24,162	39,451				
2. Asset Write-Down	\$20,000	\$200,000	\$200,000	\$200,000	\$1,000,000	\$200,000	\$200,000	\$2,000	\$2,000	\$200,000	\$200,000
Unrecognized Travel	\$20,000	\$200,000	\$200,000	\$200,000	\$1,000,000	\$200,000	\$200,000	\$2,000	\$2,000	\$200,000	\$200,000
Current Fuel Cost	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000	\$735,000
Unrecognized Fuel Cost	\$735,000	\$735,000					\$235,000				
1. Oilfield	33,158	94,479	69,801	112,758	765,840	391	13,841				285
1. Oilfield to 1	33,158	94,479	69,801	765,840	391	13,841					
2. Remaining after oil sale to current holding	\$232,190	\$64,689	\$324	\$235,000	\$235,000	\$235,000	\$235,000	\$2,000	\$2,000	\$200,000	\$200,000
				Total 1. Oilfield to 1	3 year period						need to correct charges

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

Semantic Web Portal

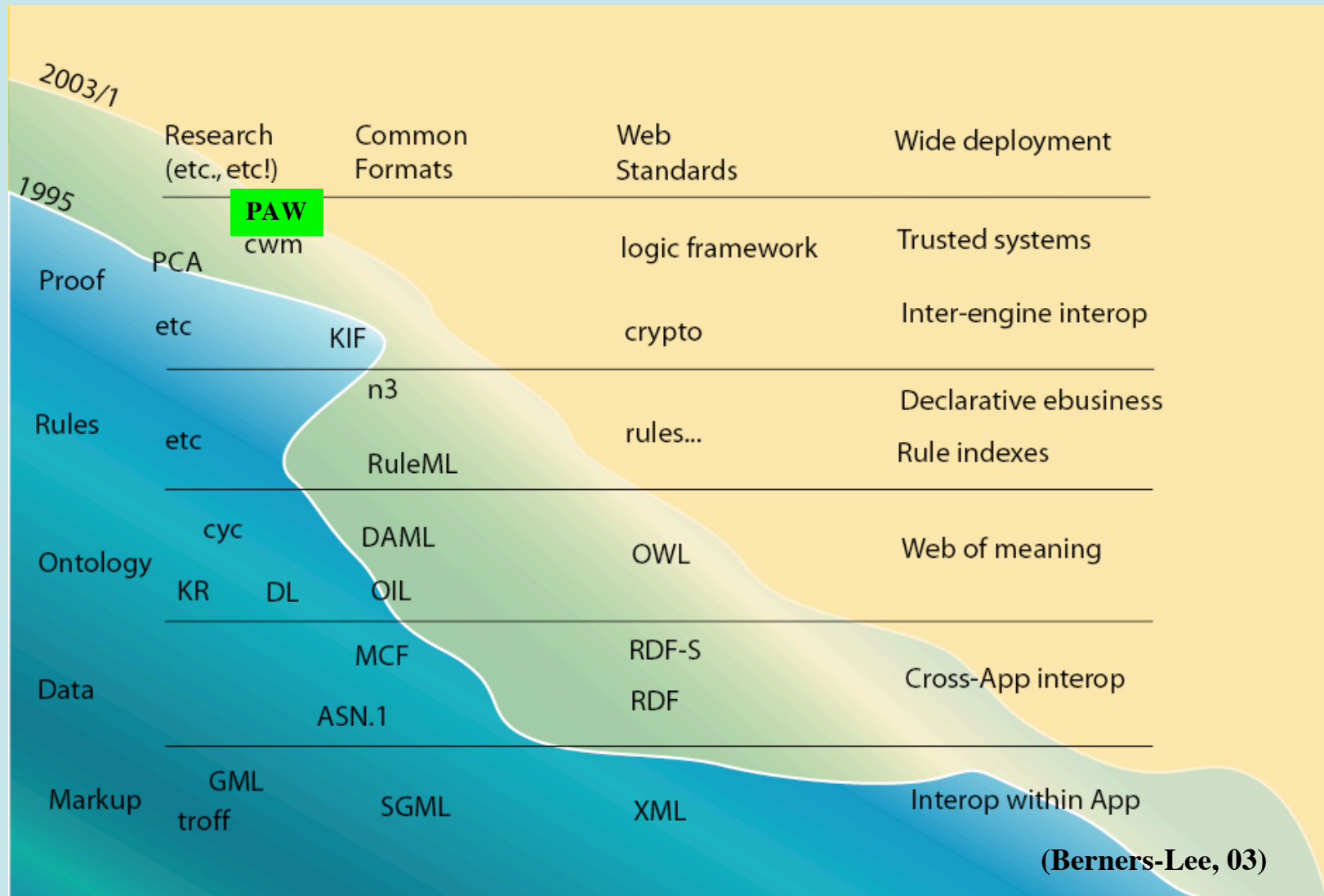
Project goals

- 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



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


MEMBERsite

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 " $P \wedge \neg P \Rightarrow Q$ "
 - On Web it better not!
(Supported(Bush) \wedge --Supported(Bush)) \Rightarrow you owe me \$1000
 - Can we use a paraconsistent logic solution?

Annotated Paraconsistent Logic (in 25 words or less)

- Traditional Logic
 - $P \ \& \ \neg P \Rightarrow Q$ (P and $\neg P$ are inconsistent)
- Annotated Logic
 - $P;X \ \& \ \neg P;Y$ are not inconsistent
 - $P;X \ \& \ \neg P;X \Rightarrow Q;X$ but not $Q;Y$
 - $P;X \ \& \ \neg(P;X)$ 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...

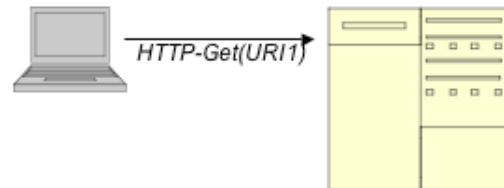
Truth on Web Pages [based on Heflin et al, 1998]

- 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

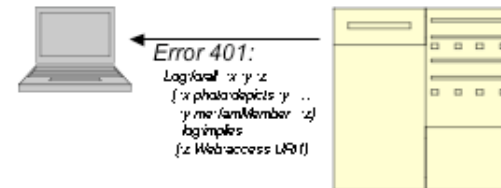
Rule Sets could be shared

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

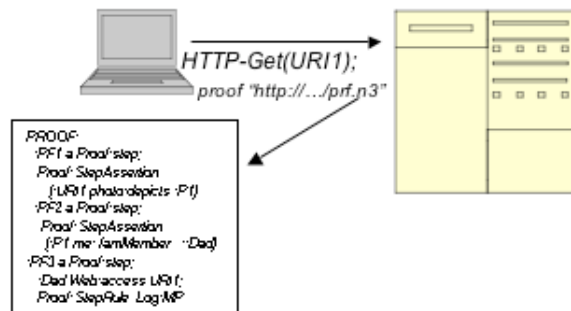
Policy Aware WEB



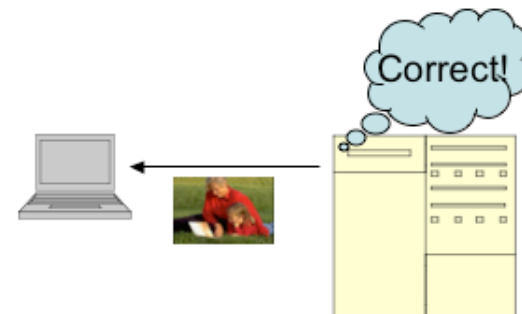
(A) User requests a resource.



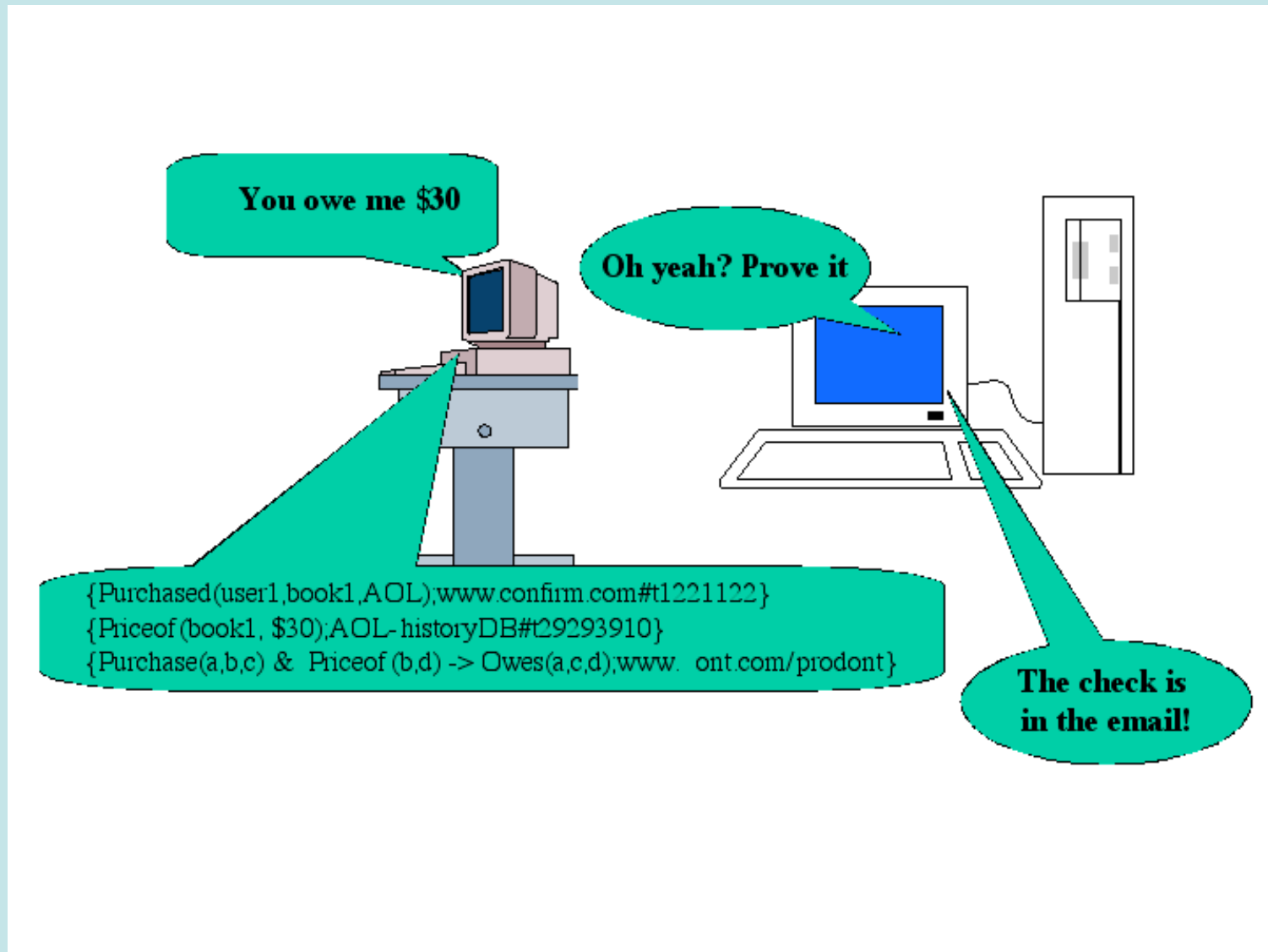
(B) 401 error provides access rules.



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



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



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, grounding, 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)
 - OGS/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
Jen Golbeck	Chris Halaschek	Michael Grove	Chris Testa
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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)