Semantic Web @ 5

Current Status and Future Promise of the Semantic Web

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March 2006

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Before We Get Started…

- **Two views of the Semantic Web:**
  - implementing SEMANTIC applications using web technologies
  - using semantic technologies to support new WEB applications
- **Exploring the relationship (and *tension*) between the two over time**
- **This talk is**
  - a retrospective, a status report
  - an “interpretation”
  - a vision for the future

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1990's: "Pre-history"

- **Rebirth of Artificial Intelligence (end of "AI Winter")**
  - "big" AI applications
    - Deep Blue, Mars Rover, Deep Space 1, …
    - embedded vs. stand-alone
  - Web AI
    - IR, statistical NLP, machine learning
    - lots of data!
- **Emergence of the Web**
  - new ways of doing things
    - new business models (even new *social* models)
    - new technology
  - "dot-com" boom
- **Early forays into "meta-content"**

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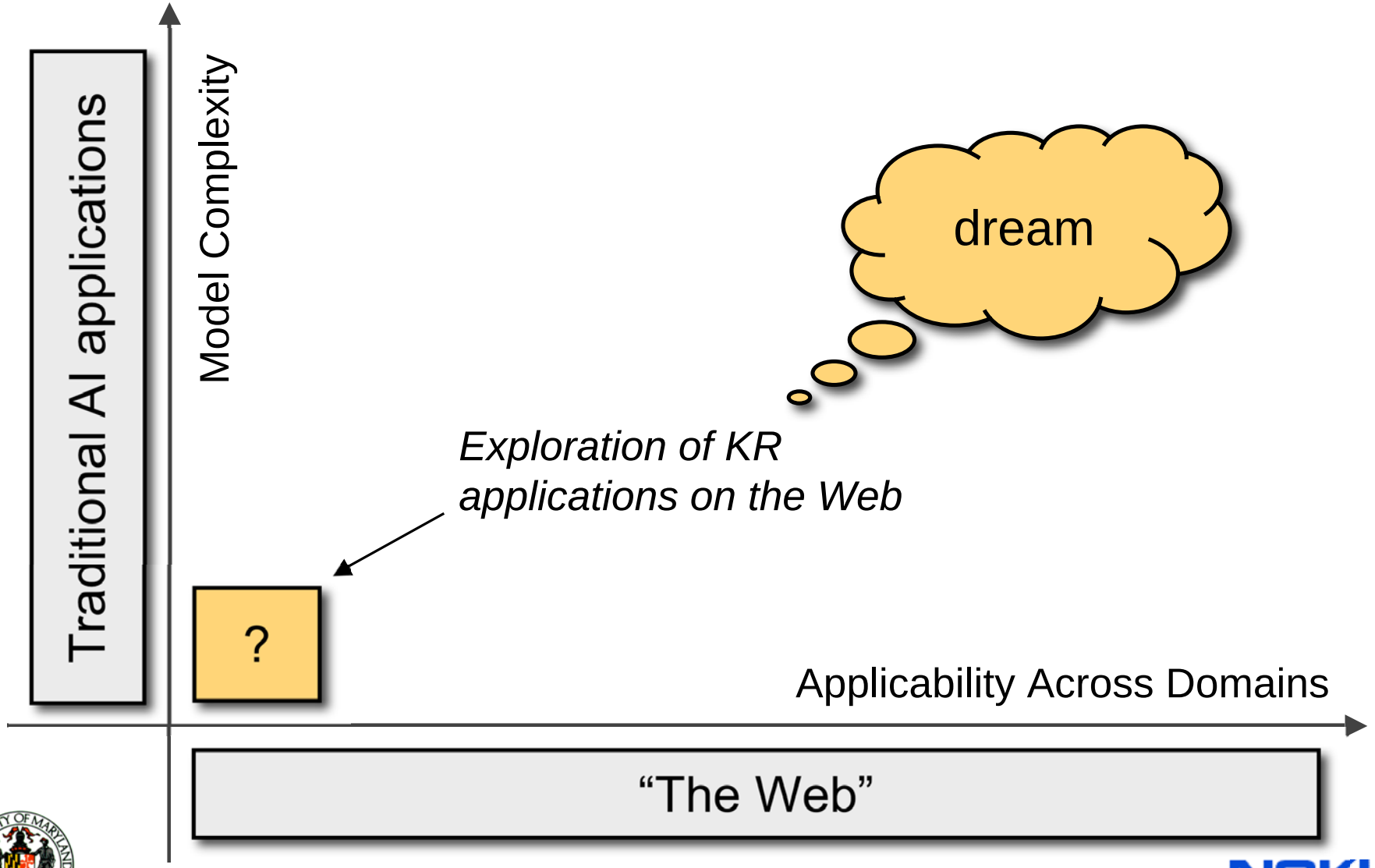
1990's: "Pre-history"



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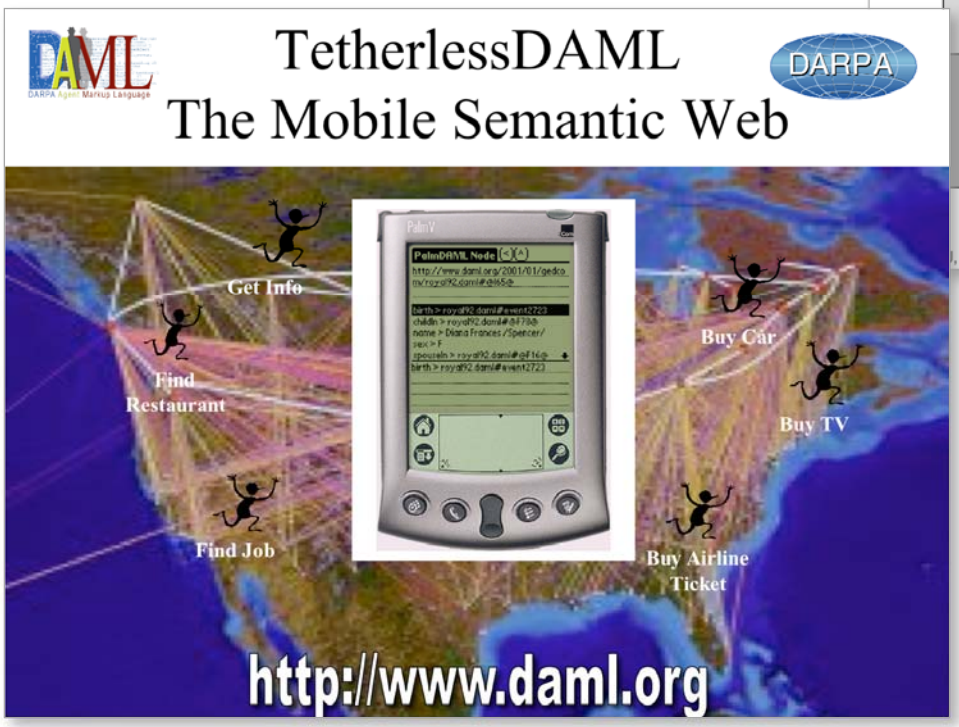
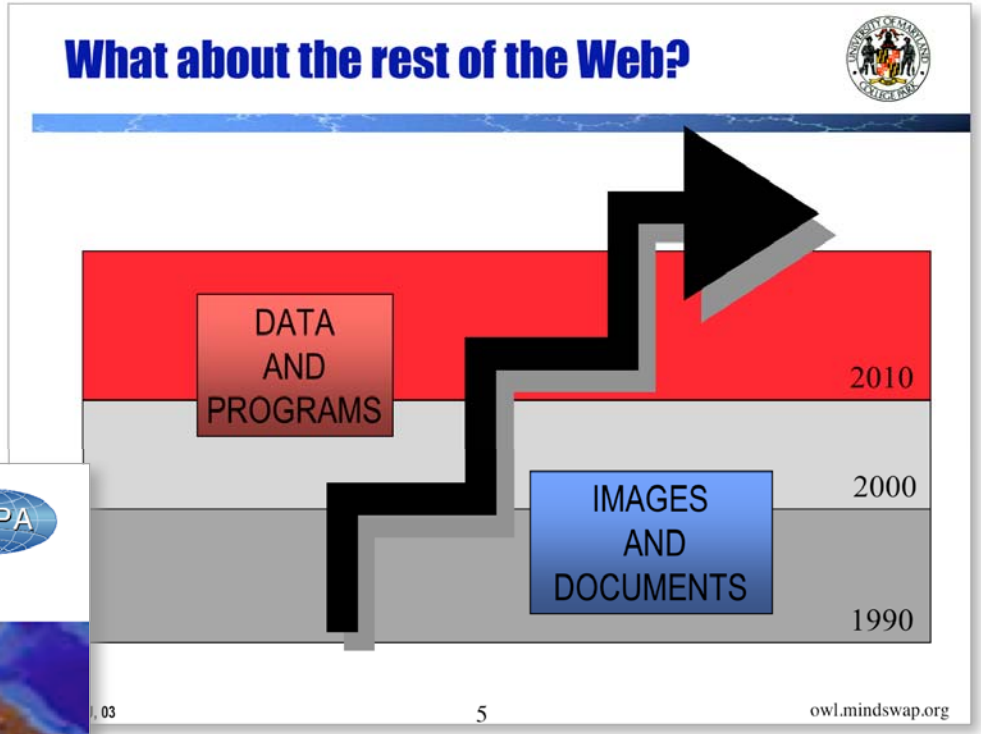
2000-2001: What Did We Believe?

- **Jim: Semantic Web and the advent of pervasive computing (March 2000)**





- **Jim: Roadmap from the "old" Web to the Semantic Web (October 2001)**

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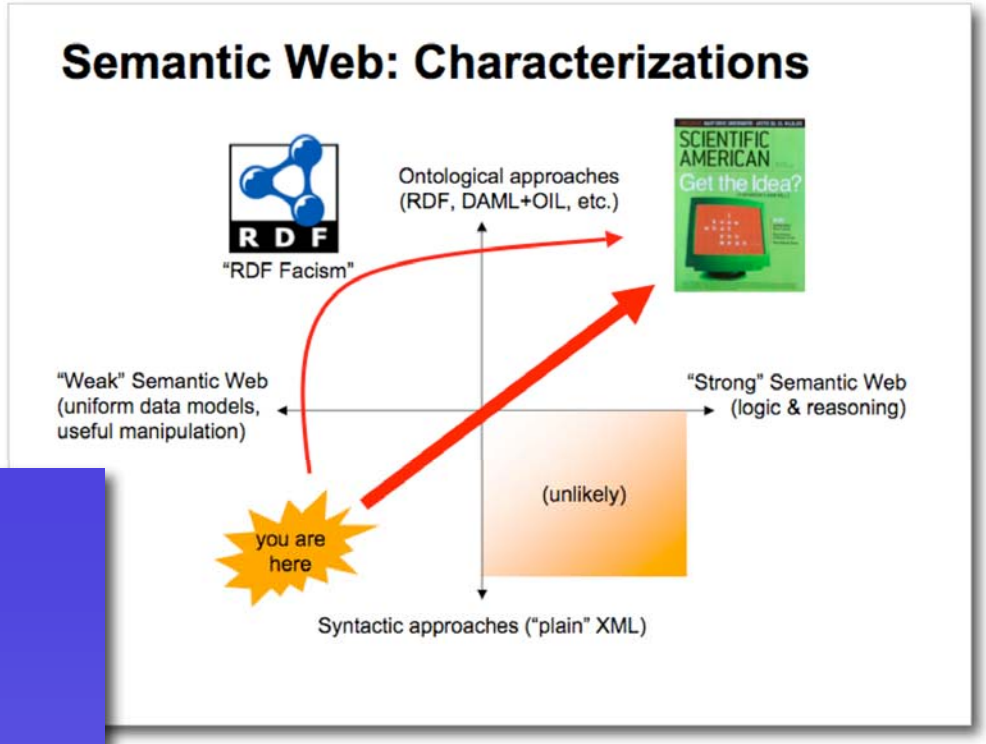

- **Ora: Roadmap from the "old" Web to the Semantic Web (October 2001)**

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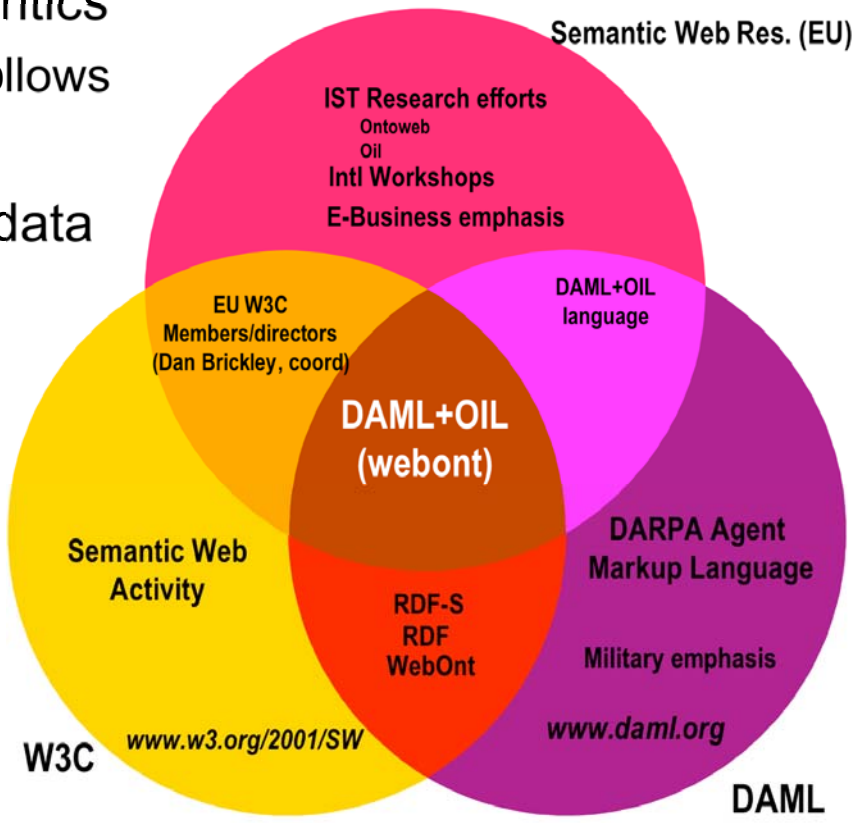
2000-2001: “Early Years”

- **“Dot-Com” optimism still prevails:**
  easy to explore new directions
  - Government meddles with semantics
    - DARPA’s DAML program; EU follows
    - DAML+OIL
  - Web community discovers metadata
    - W3C Metadata Activity
    - RDF

“3-pronged” attack:
- DARPA
- EU IST
- W3C



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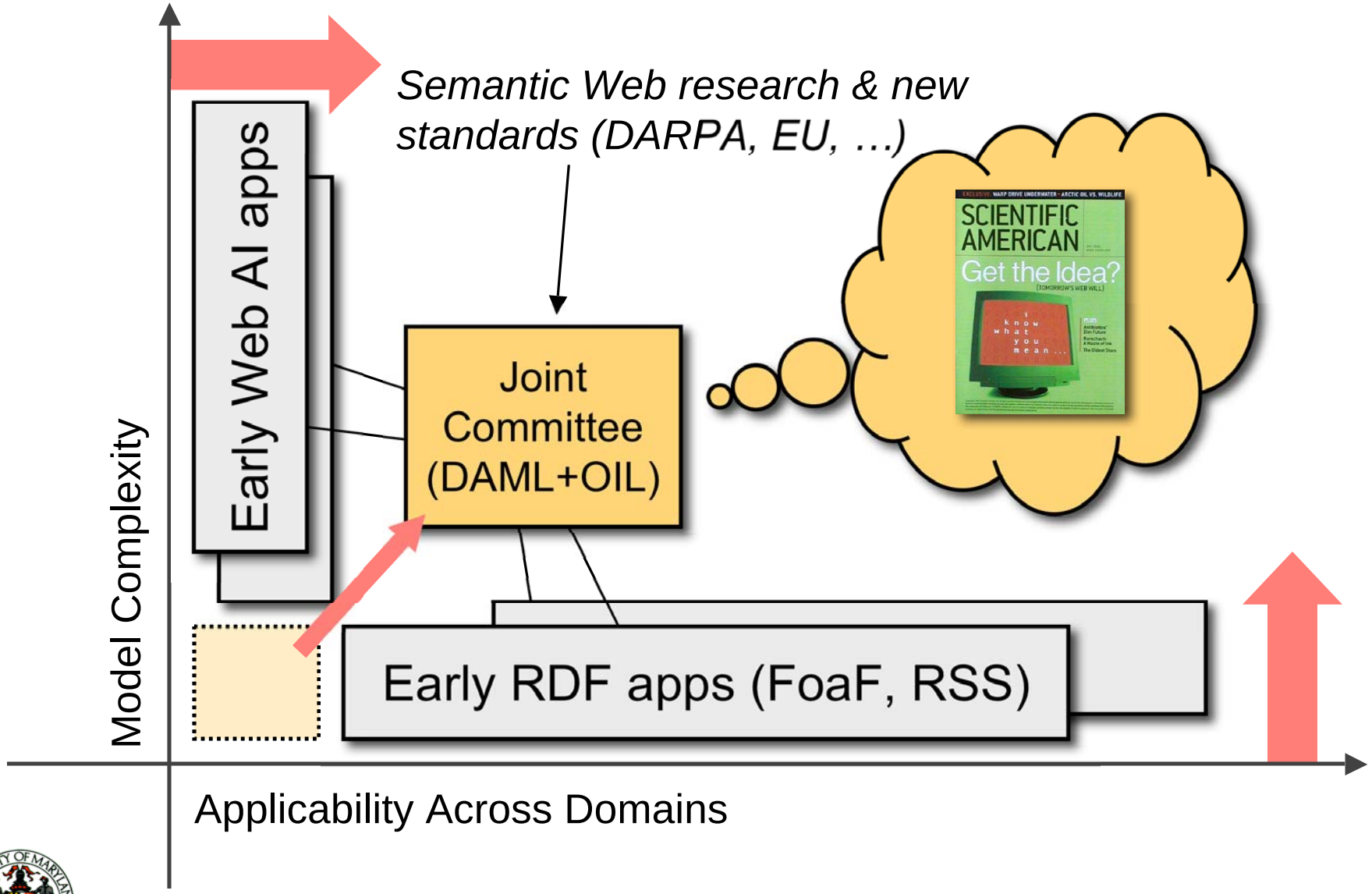
2000-2001: “Early Years”



Original Outline (July 2000)

Scientific American Article notes

[Joint starting place:]

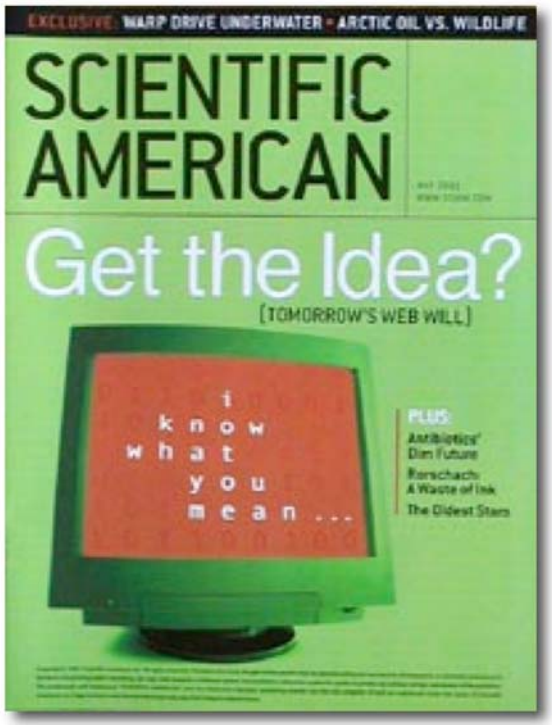
I. Semantic Web Vision (TBL)

II. What are the enablers? (in sequence)
Screen Scraping (Ora and TBL)
Data on Web (Ora and TBL)
Zip code link between Data Bases (TBL)
Ontology Independence (JAH)

Effect of Scale (TBL)

"Then, a miracle occurs"

III. What can you do with it? (not necessarily in sequence)
Self-describing documents (JAH)
Logic to encode… (TBL)
Services and Advertising (Ora)
Devices (Ora)
Digital Signatures, Authentication, and Trust (TBL)



(historical note: last draft to printers - March 9, 2001)

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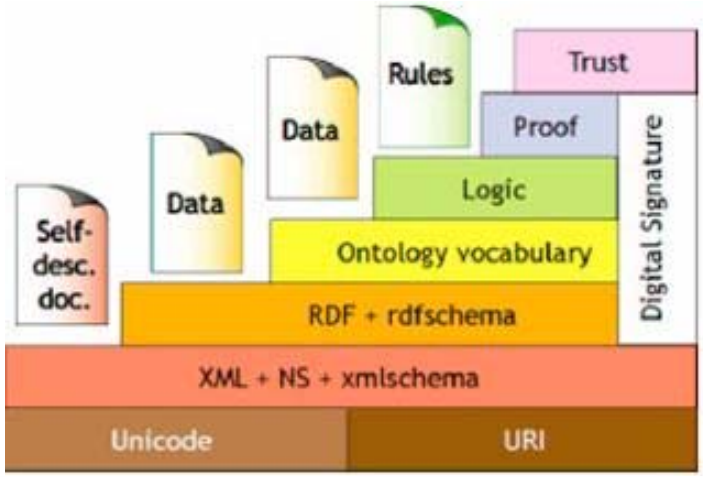
2001



Funded Research

WG activity

Recommendation

Semantic Web Today

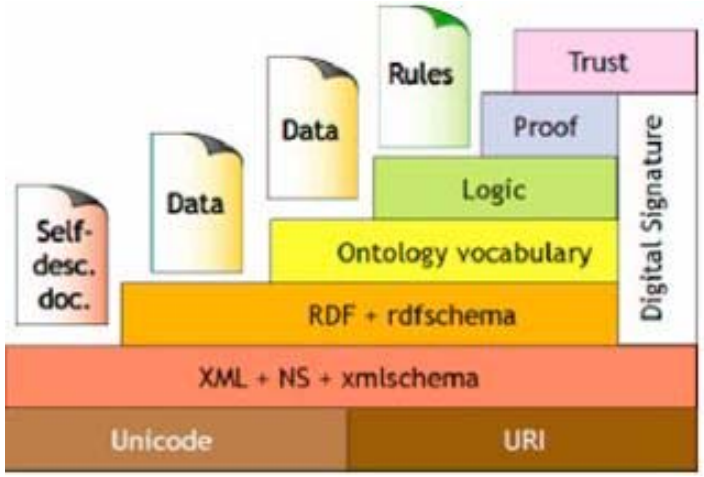
- The Semantic Web of 2002 resembles the early days of the World Wide Web
  - Development funded primarily by Govt, but emerging corporate interest
  - A lot of excitement, but confusion as to business case
  - Open source tools and "geeks in control"
  - Standards starting to stabilize to point where they permit deployment
  - Developer tools, libraries, languages

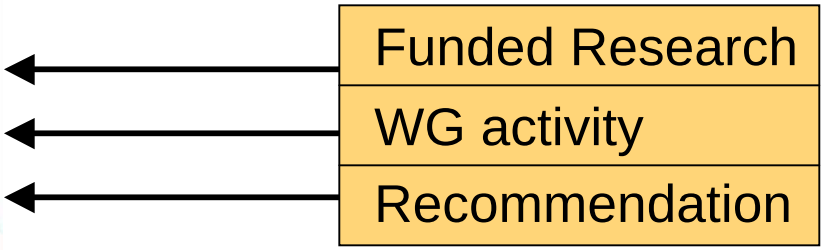
10

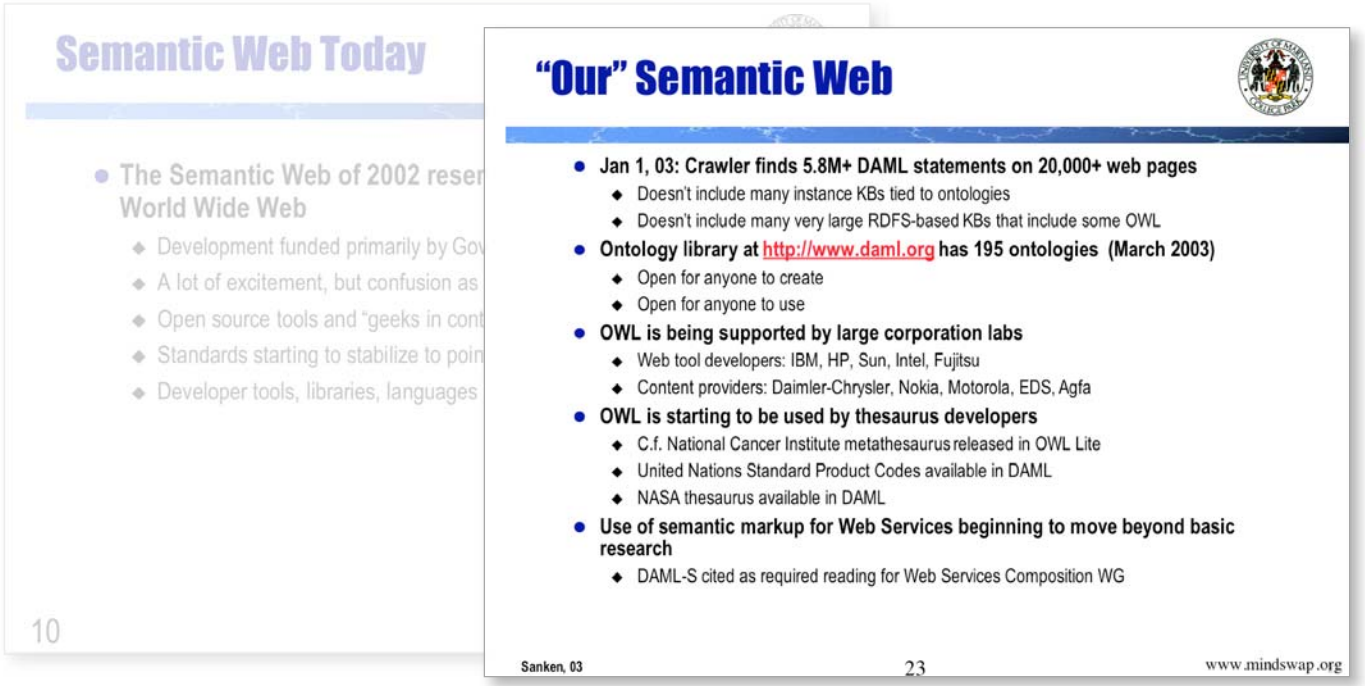
MIND

- **Research, experimentation, early demonstrations**
- **Reminiscent of the early days of the Web**

2003

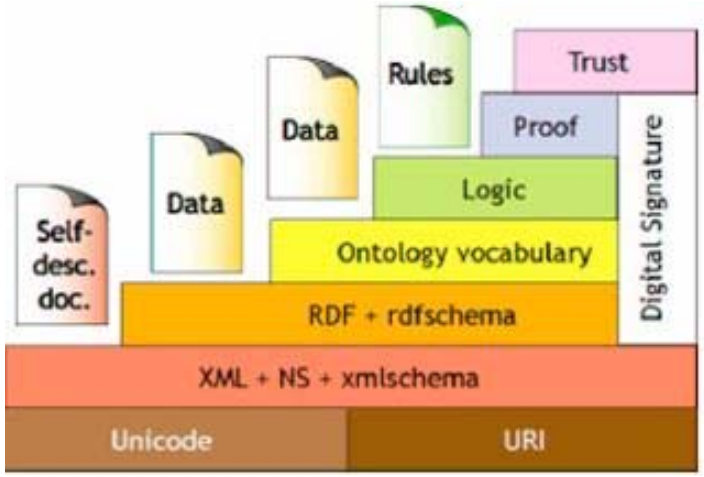


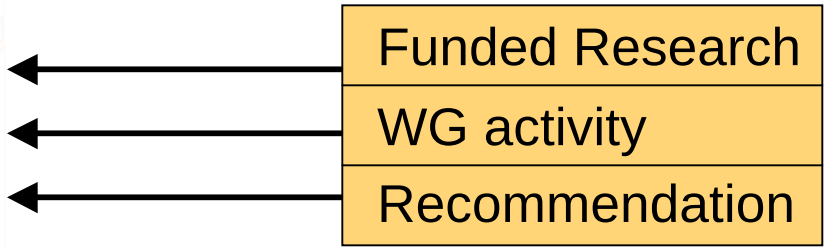




- **Early government adoption**
- **Emerging corporate interest**

2005





- **Commercial tools**
- **Lots of open source software**
- **Scalability**

Now

- Companies getting into the act
  - IBM SNObase ontology management system
  - Oracle to support RDF in Oracle 10.2
  - Open source (Kowari) scalable triple store
    - Supports RDFS
    - OWL support coming
  - HP Labs open-source Jena API
- Many open source tools becoming available for experimentation/academic use
  - Kowari, RDFLib, 3Store…
  - Jena, Sesame…
  - Protégé, SWOOP, Onto(xxx)..
- Building corporate demonstrators becoming cheap and easy

SemTechConf 3/05

MINDSWAP

2006: You Are Here!

Significant Corporate Activity

- **Semantic (Web) technology companies starting & growing**
  - Cerebra, Siderean, SandPiper, SiberLogic, Ontology Works, Intellidimension, Intellisophic, TopQuadrant, Data Grid, …
- **Bigger players buying in**
  - Adobe, Cisco, HP, IBM, Nokia, Oracle, Sun, Vodaphone… announcements/use in 2005
  - integrator and contractor uptake: Northrop Grumman buys TKS, Lockheed-Martin uses SiberLogic in FCS, SAIC teams with ClarkParsia, …
  - tools being announced: AllegroGraph, TopBraid, …
- **Government projects in and across agencies**
  - US, EU, Japan, Korea, China, …
- **Life sciences/pharma an increasingly important market**
  - Health Care and Life Sciences Interest Group at W3C
- **Many open source tools available**
  - Kowari, RDFLib, Jena, Sesame, Protégé, SWOOP, Onto(xxx), Wilbur, …

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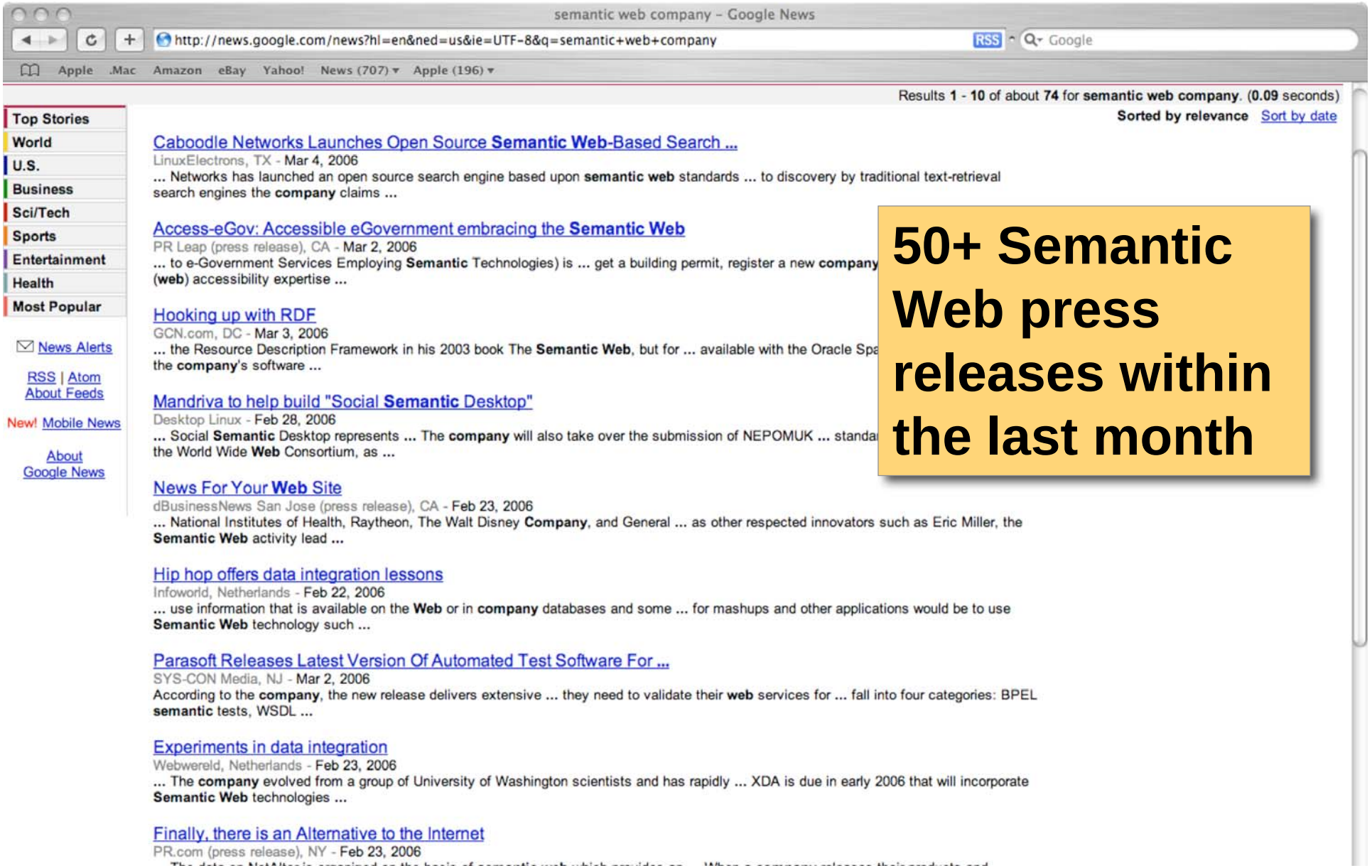
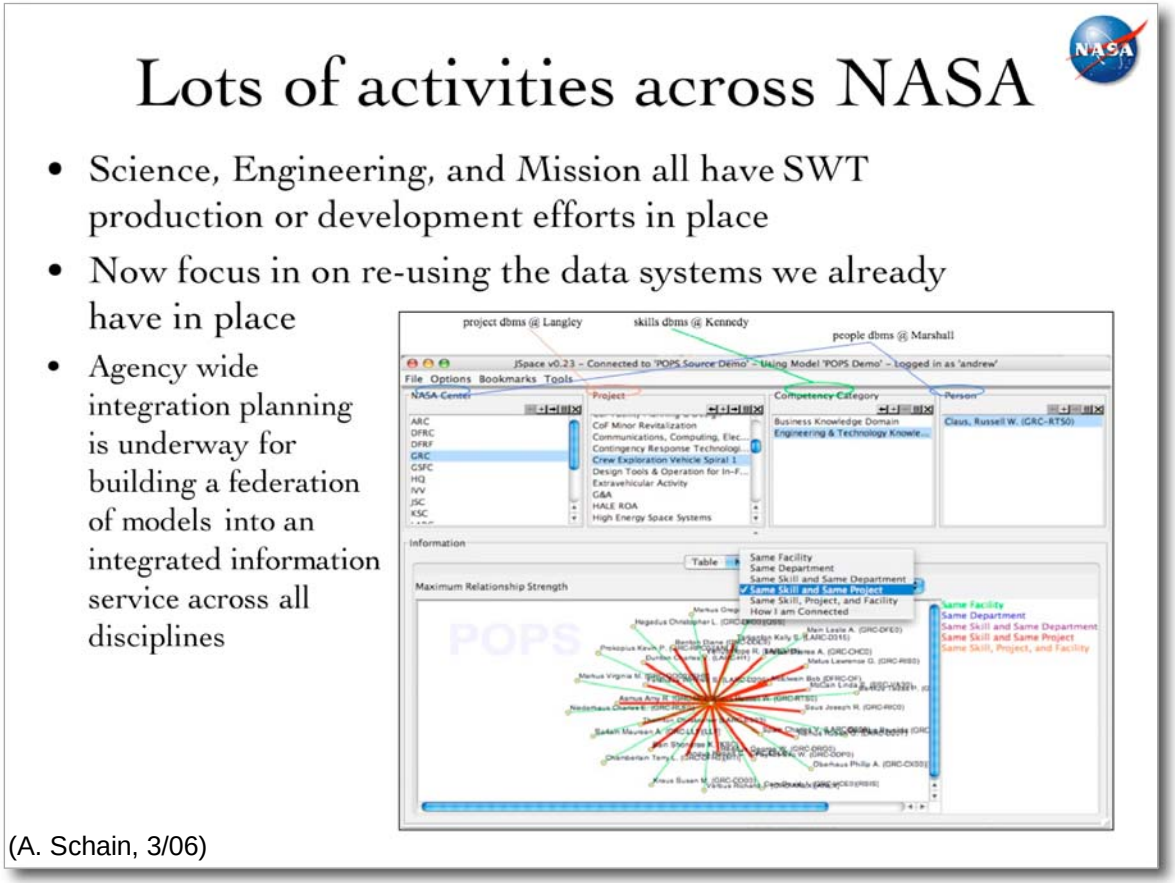
Significant Corporate Activity

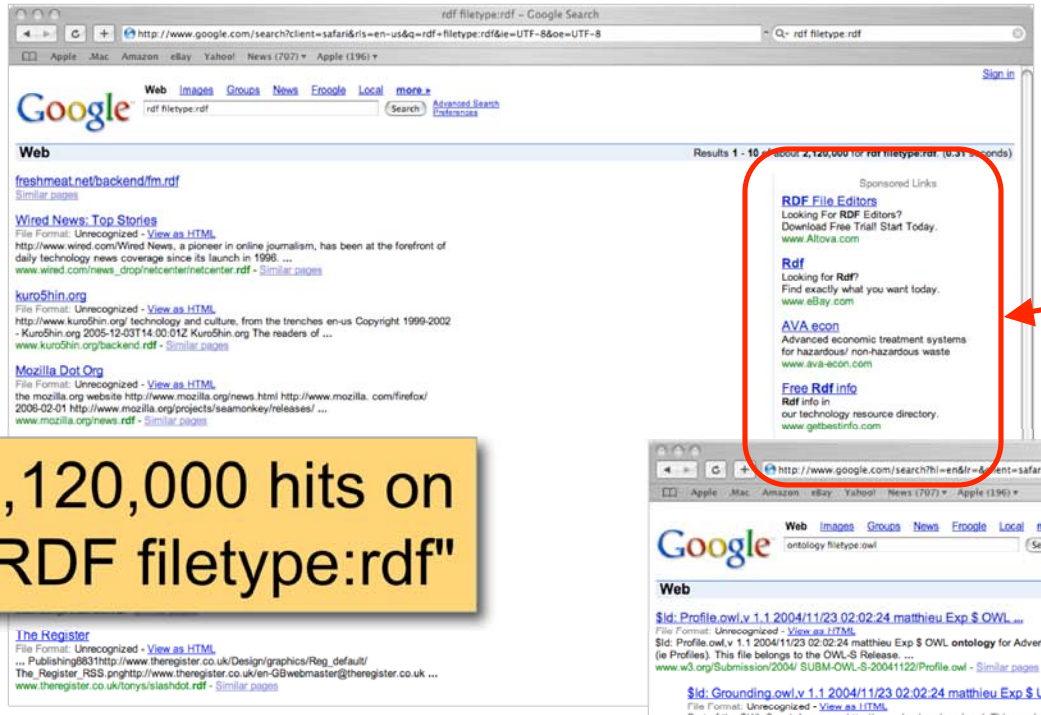


Significant Government Activity

- **Agencies moving beyond the "talk" phase**
  - primarily prototyping, but first acquisitions starting
- **Example:**
  - NASA is developing an enterprise data strategy around using existing data via Semantic Web integration

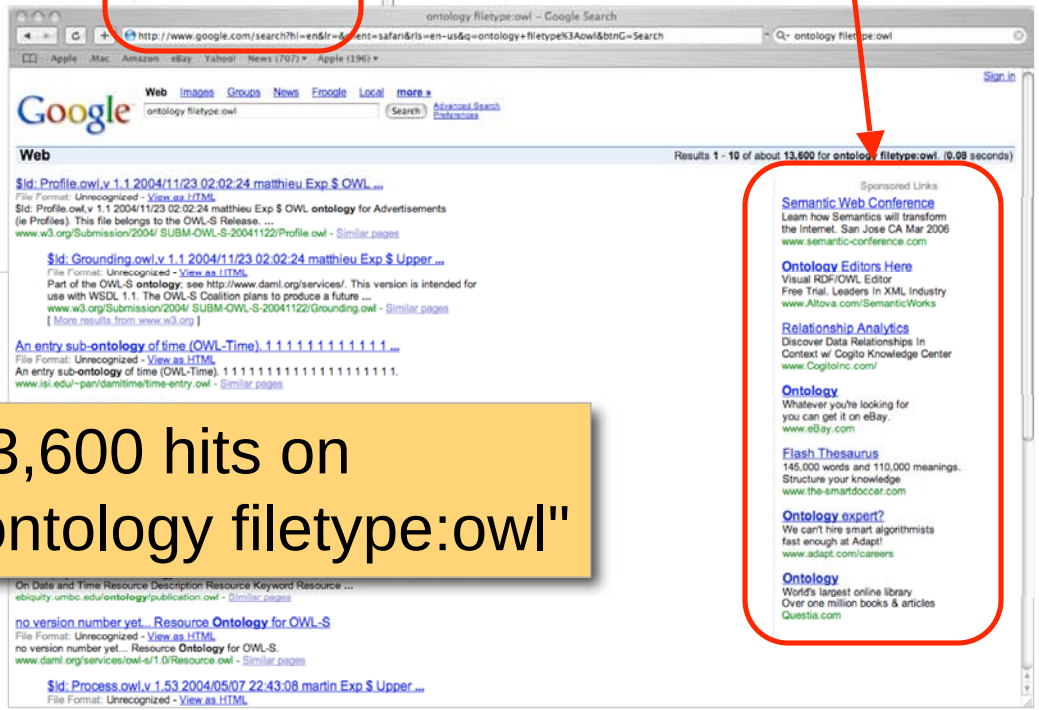


There's a Lot Out There!



2,120,000 hits on "RDF filetype:rdf"

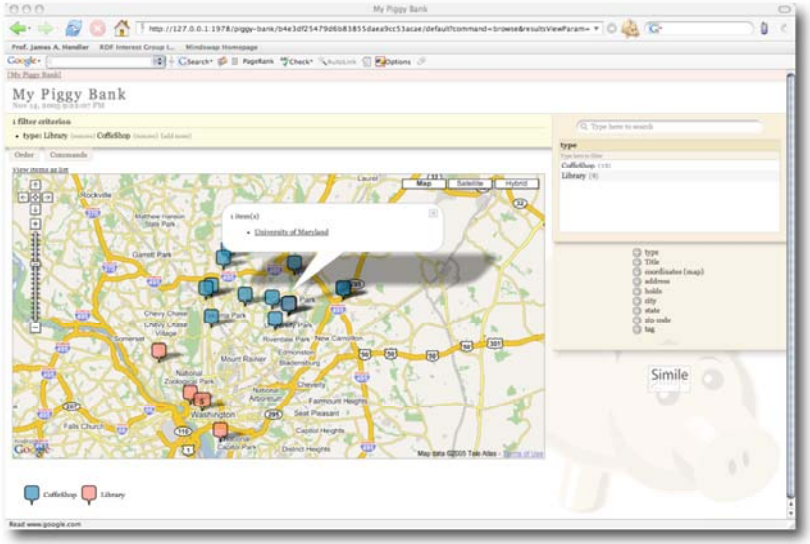
Paid ads



13,600 hits on "ontology filetype:owl"

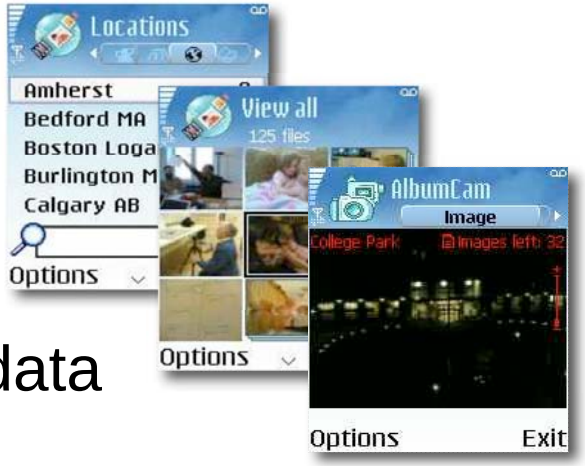
(March, 2006)

Semantic WEB

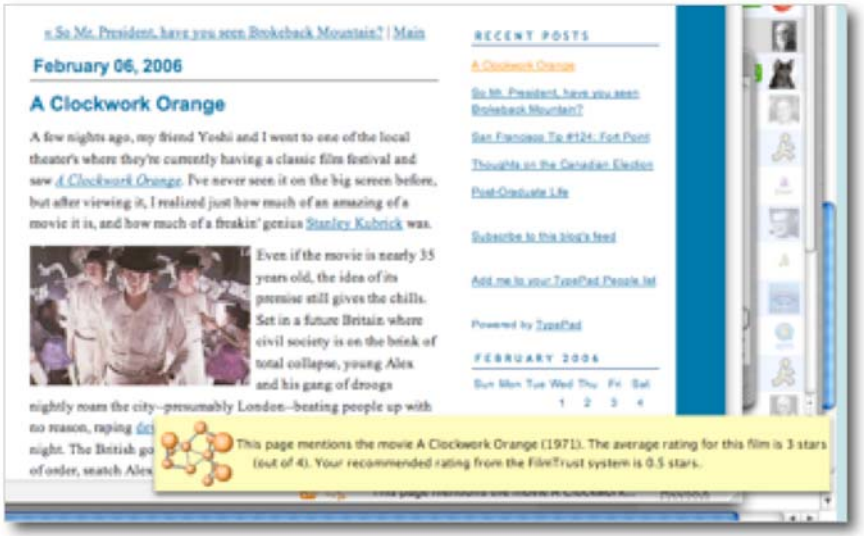


Data harvesting & visualization

Rich metadata



A little **Semantics** goes a long way



Web-based social networks

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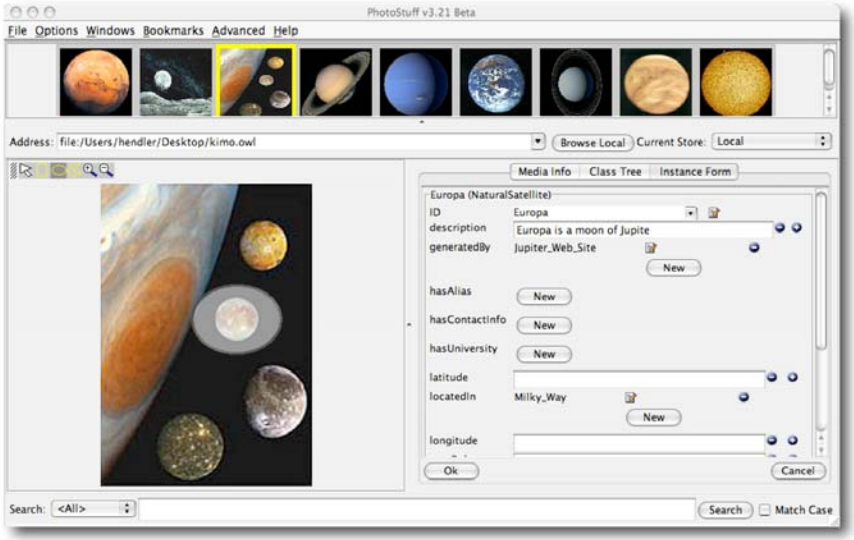
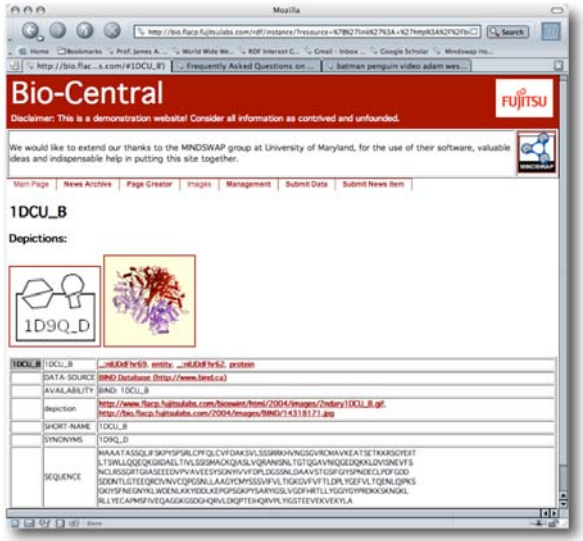
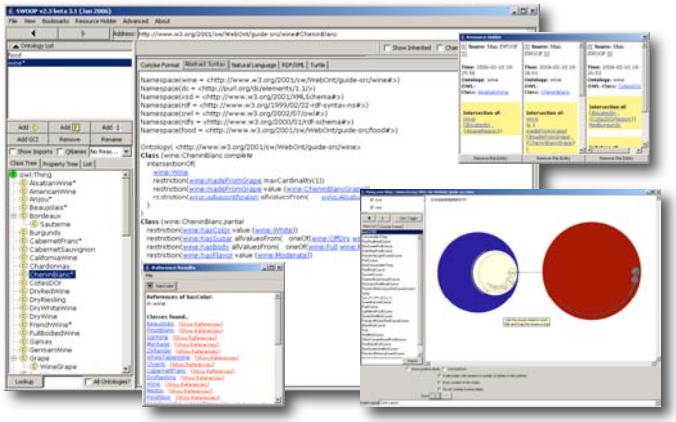
SEMANTIC Web



Digital asset management



Scientific portals



Tools for developers

A little **Web**
goes a long way

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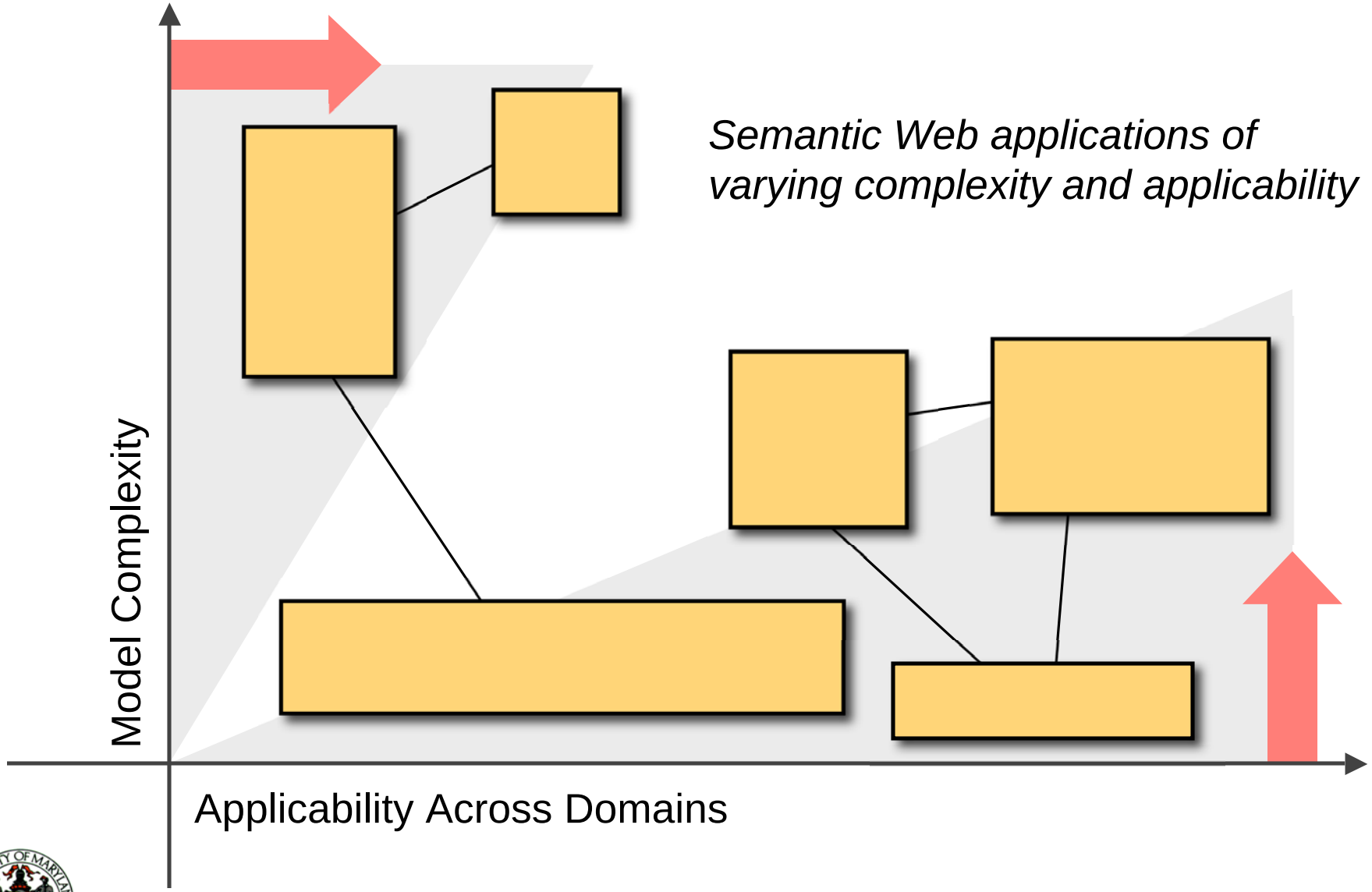
2006: The Gap Is Closing



Semantic Web applications of varying complexity and applicability

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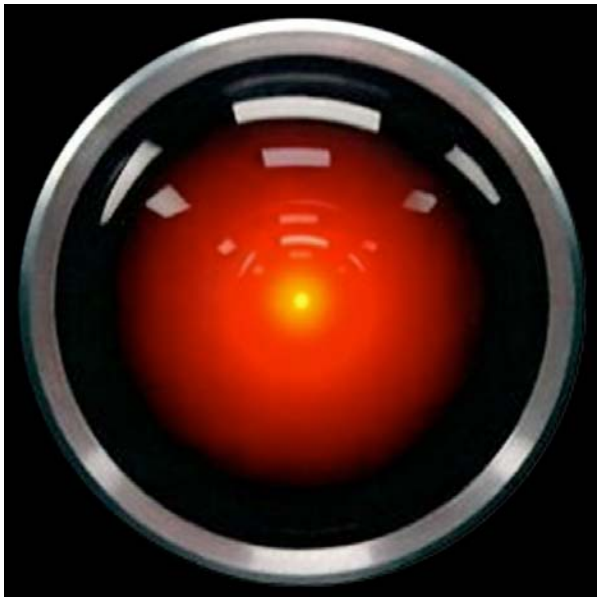
SEMANTIC Web Lessons

- **What we learned from AI…**
  - embedded AI succeeded, stand-alone did not
  - tools are hard to sell
  - reasoners are a *means*, not an end
  - knowledge engineering bottleneck
- **…applied in the Web context**
  - futureproofing
    - URIs are important
  - good standards evolve
    - languages (RDFS, OWL, RIF, …)
    - content!



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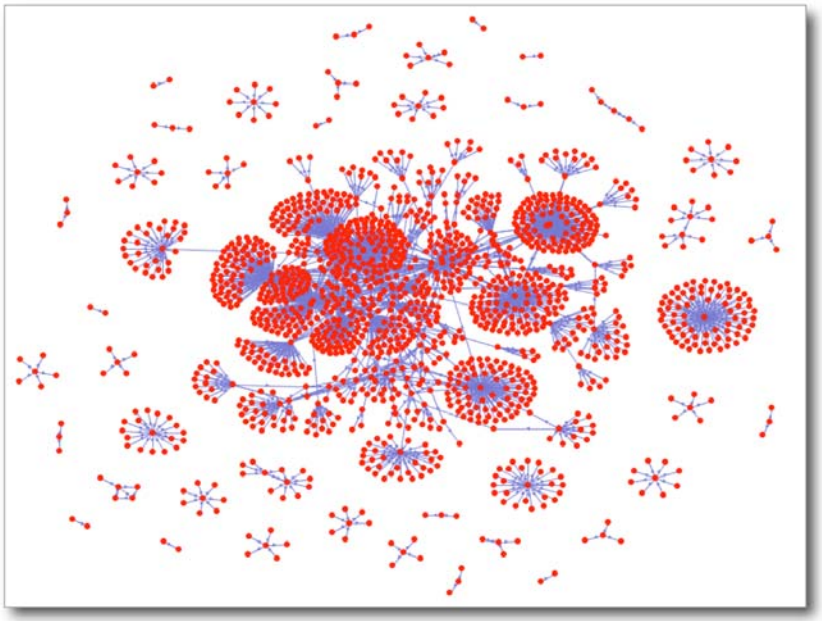
Semantic WEB Lessons

- **Web needed high value sites**
  - personal (homepages, pets)
  - public (hobbyists, govt)
- **As these linked up, new functionality emerged**
  - Yahoo, Alta Vista, …
- **New business models followed…**
  - “give it away” (Netscape)
  - marketplace (Amazon)
  - advertising (Yahoo, Google)
- **Semantic Web?**
  - **SHARE; GIVE IT AWAY!**



- **What do we need?**
  - Open Source Tools
  - Open Source Datasets
  - Open Source Harvesters

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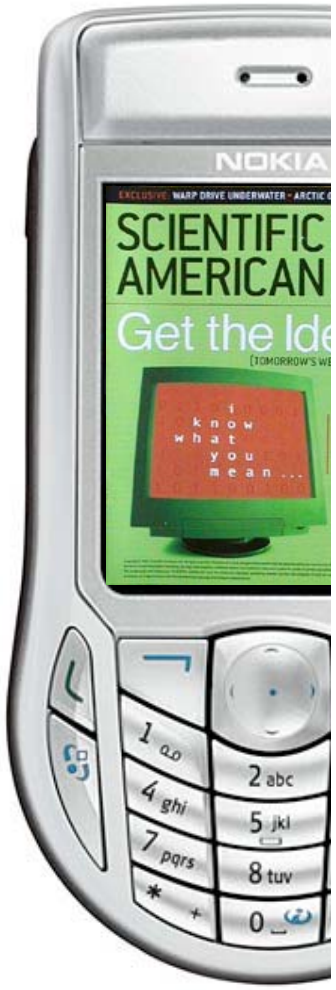
Where Are the Agents?

- **“Brave New Applications”**
  - operate autonomously in “unanticipated” situations
  - exhibit robustness in the face of
    - changing, inconsistent and unexpected data
    - variations in reliability, trust
  - capable of serendipitous behavior, opportunism
- **Move from the “tool use” of personal computing to systems that *work on our behalf***
- **(Semantic) Web services as “plumbing” for agents**
  - emerging as we speak…



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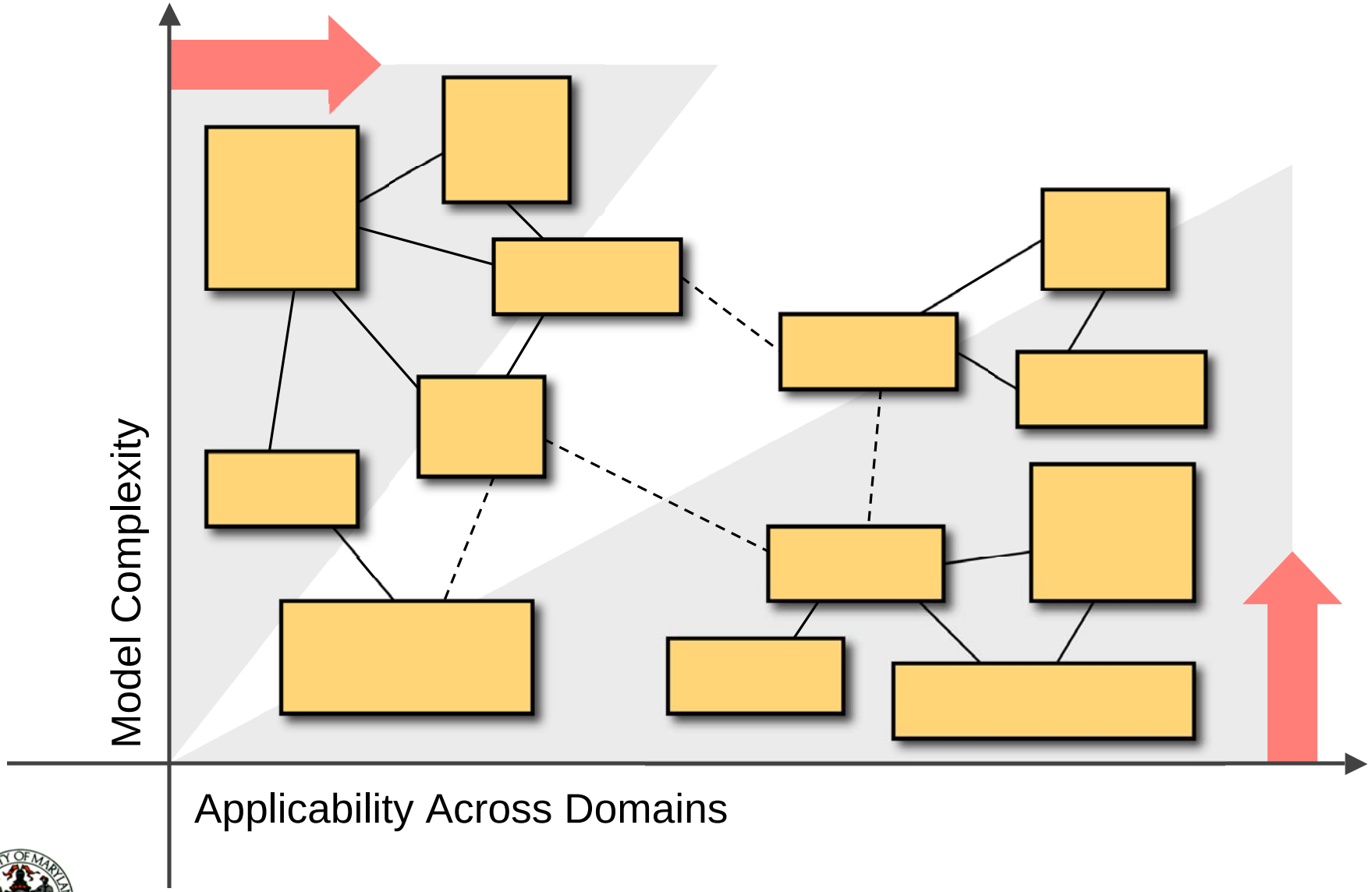
Linking Is Power!



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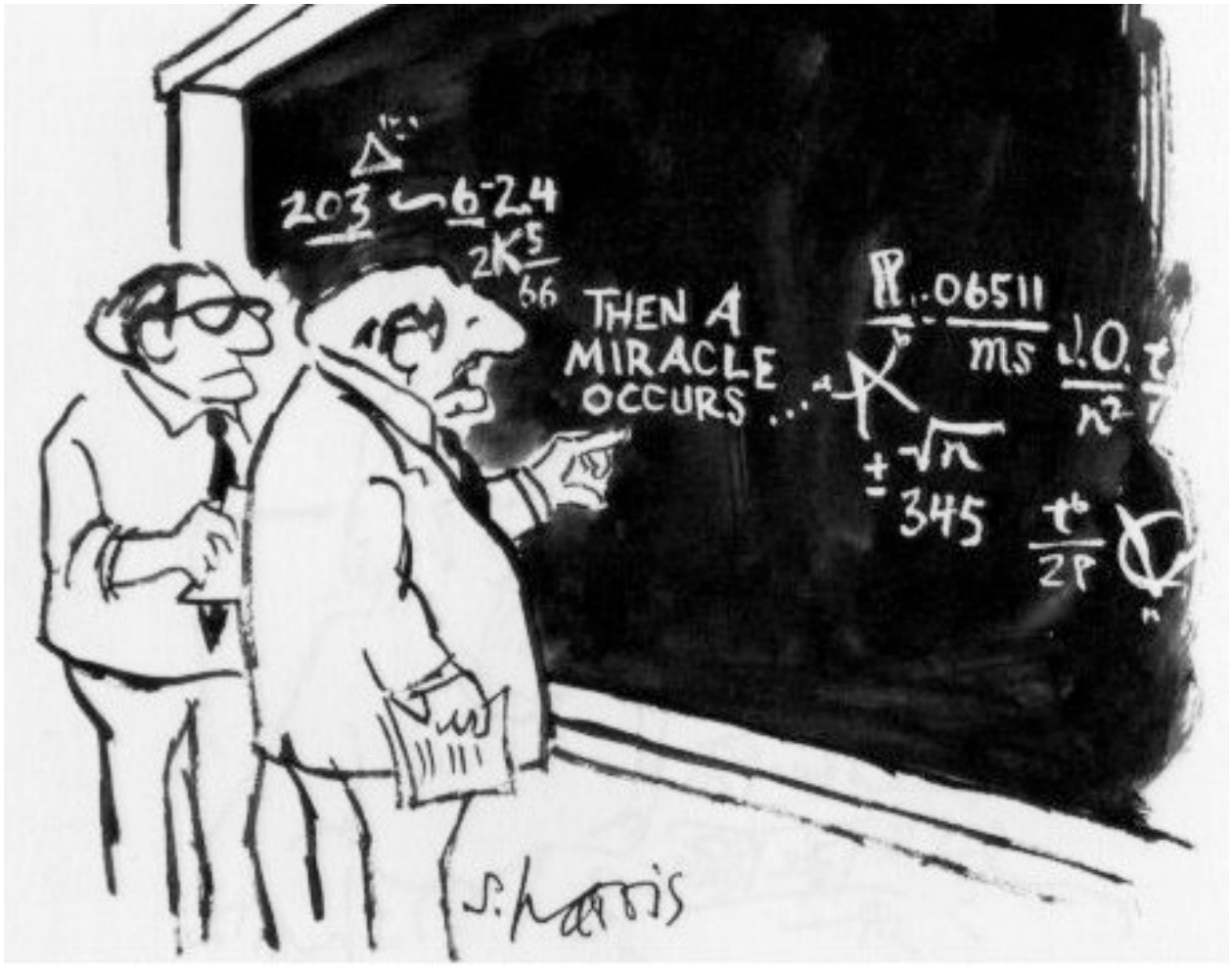
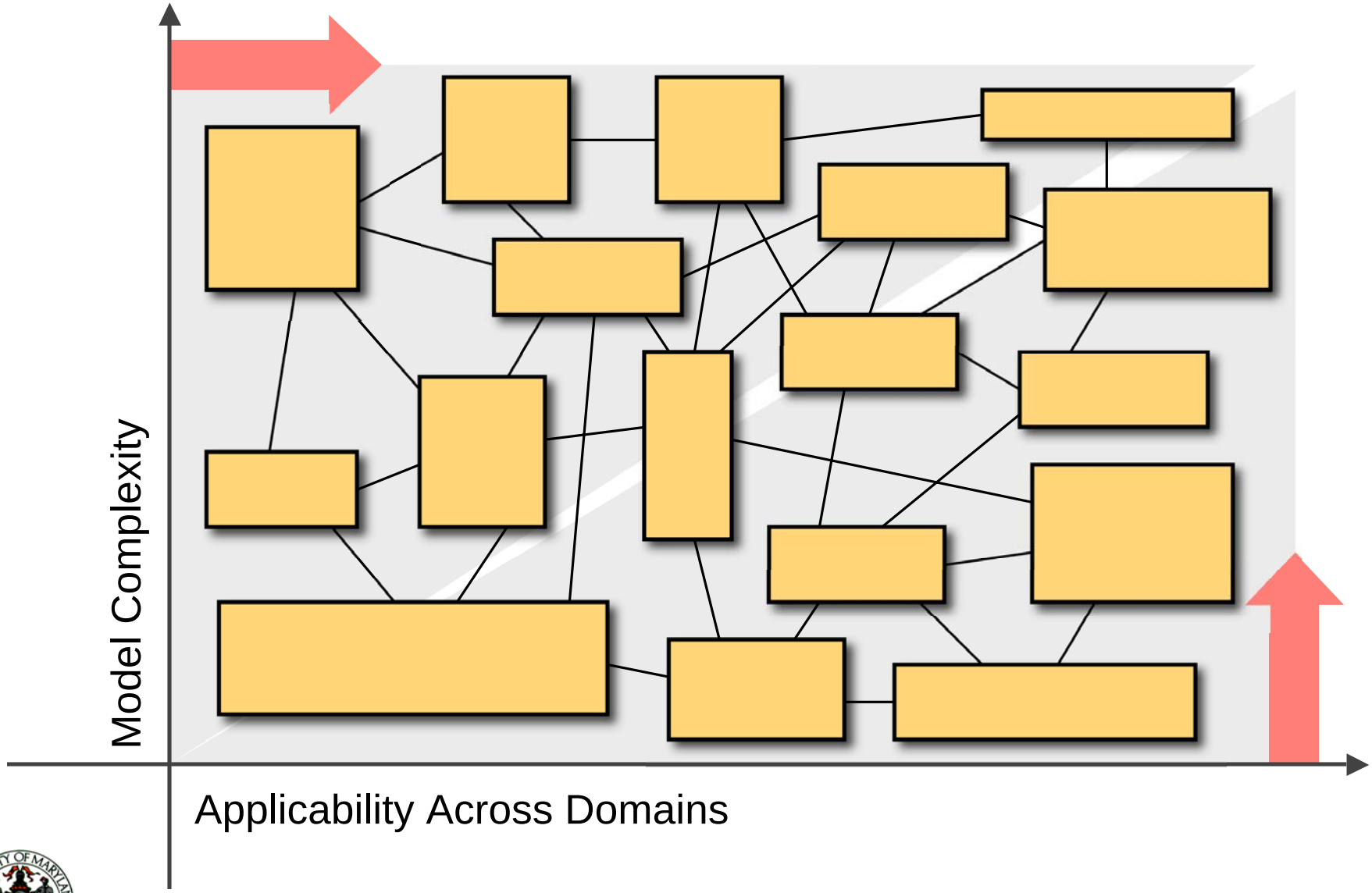
Then a Miracle Occurs…



"I think you should be more explicit here in step two."

from *What's so Funny about Science?* by Sidney Harris (1977)

Looking Further Out



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Summary

- **Most things we predicted have happened**
  - (or are happening at the moment…)
- **Some things happened faster than we anticipated**
  - triple store scaling
  - reasoner performance *actually matters*
  - ontologies are there (but very little linking)
- **Some things are yet to materialize (but we are hopeful)**
  - public information sources (as RDF, OWL, …)
  - digital convergence, pervasive computing just emerging
  - little progress on agents

Now go out there and make some money off this…!

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Any Questions?

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