

# Information Accountability or Why DIG is cool

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Tim Berners-Lee  
Decentralized Information Group



# Decentralized Information Group (DIG)

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## ◆ Group members

- Hal Abelson, PI
- Tim Berners-Lee, Director and PI
- Dan Connolly
- Sandro Hawke
- Lalana Kagal, Deputy Director
- Joe Pato (Visiting Scientist from HP)
- Gerry Sussman, PI
- Ralph Swick
- Daniel Weitzner, Director and PI
- K. Krasnow Waterman (Research Affiliate)

## ◆ Students

- 4 PhDs, 2 MEng/SM, 3 Undergrads

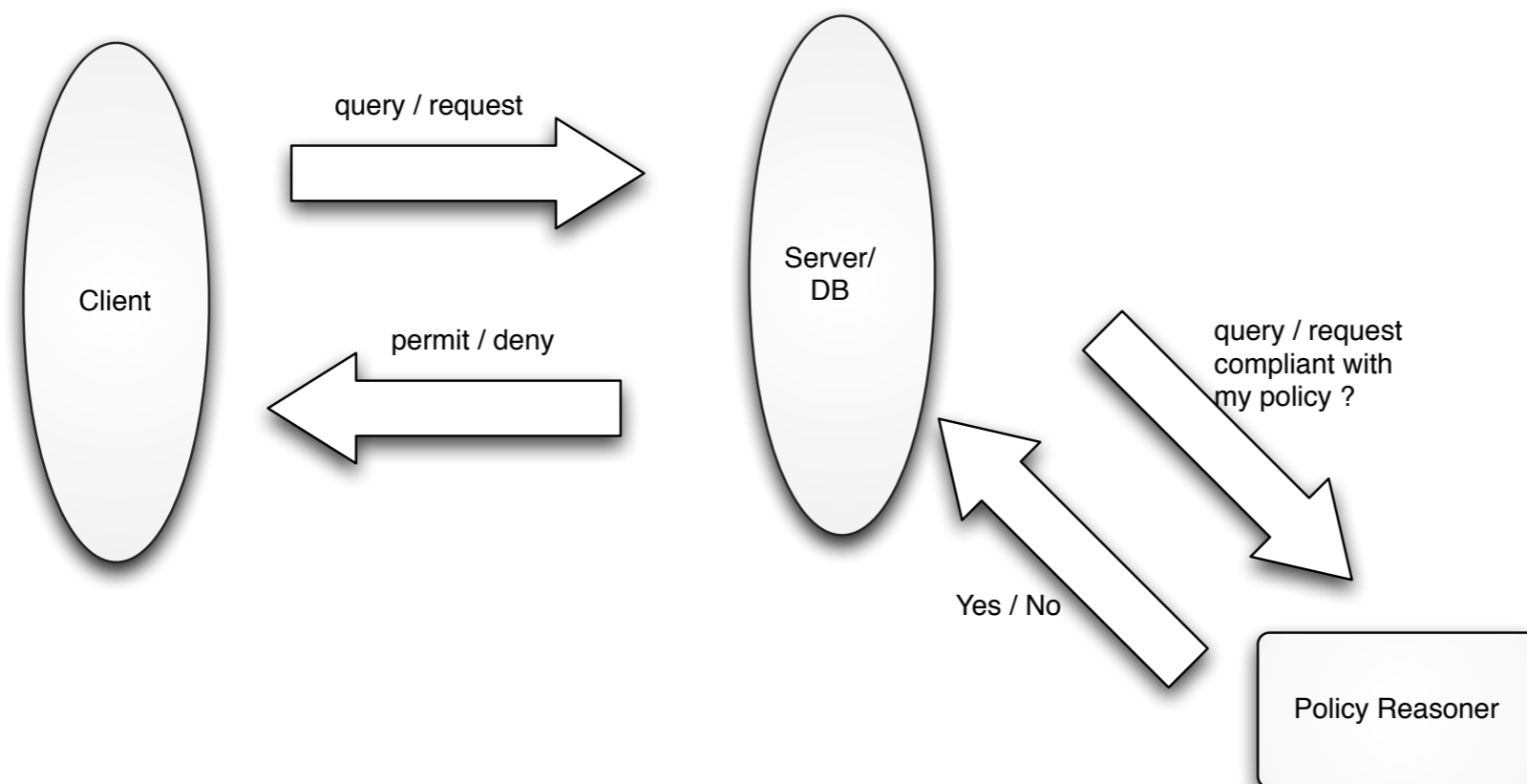
# DIG Research

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- ◆ Tools, technologies and protocols that enable the deployment of decentralized information systems
- ◆ Current areas of focus
  - Policy reasoning and information accountability
  - Semantic Web technologies

# Policy reasoning

- ◆ A policy is a set of norms that define **optimal behavior** of agents in a system
- ◆ What does **policy reasoning** usually entail ?
  - Proving that **requests** made by a client are **compliant with policies**
  - Usually for upfront/a-priori authorization



# Why is policy compliance insufficient ?

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- ◆ In several application contexts, strictly enforced, before-the-fact authorization of every action is insufficient
- ◆ Difficult to prevent information extraction, integration and sharing in decentralized systems such as the Web using authorization
- ◆ Sometimes it is more appropriate to analyze actions after-the-fact and hold policy violators accountable
  - Unexpected circumstances
  - No single action leads to a violation but a combination of actions does
  - User is authorized to access resource/data but misuses it after getting access

# Information Accountability

## ◆ What is Information Accountability

- Determining the purpose for which data was used and inferring whether the use was inappropriate
- Requires augmenting Web information with data about provenance and usage policies, and creating automated means for maintaining that provenance and interpreting policies.

## ◆ Accountability framework requirements

- expressive policy language and reasoner
- logging and provenance middleware
- justification generation and interface



Image courtesy of Adventure Quest <http://www.battleon.com/>

# AIR Policy Language

- ◆ a machine-understandable policy language
- ◆ **Semantic Web technologies** for shared model of queries and policies
- ◆ Why Semantic Web ?
  - Need to ground terms on common models of data and knowledge so that data can be exchanged and used between different systems with some assurance of its meaning
  - Semantic Web technologies offer several advantages
    - shared model of discourse
    - global unique identifiers
    - open & dynamic
    - interoperability - mapping between concepts and instances possible



Image courtesy of <http://www.cartoonbank.com/>

# AIR Policy Language

- ✦ AIR policies are written in Terse RDF Triple Language (Turtle)
- ✦ Each AIR policy consists of one or more rules
  - `policy = { rule }`
- ✦ A rule is made up of a pattern that when matched causes an action to fired. Optional: variable, description
  - `rule = { pattern, action [ variable description ] }`
- ✦ An action can either be an assertion, which is a set of facts that are added to the knowledge base or a nested rule
  - `action = { [ assert | assertion ] | rule }`

```

:MyFirstPolicy a air:Policy;
  air:rule [
    air:pattern { ... };
    air:assertion { ... };
    air:rule [ ... ]
  ].

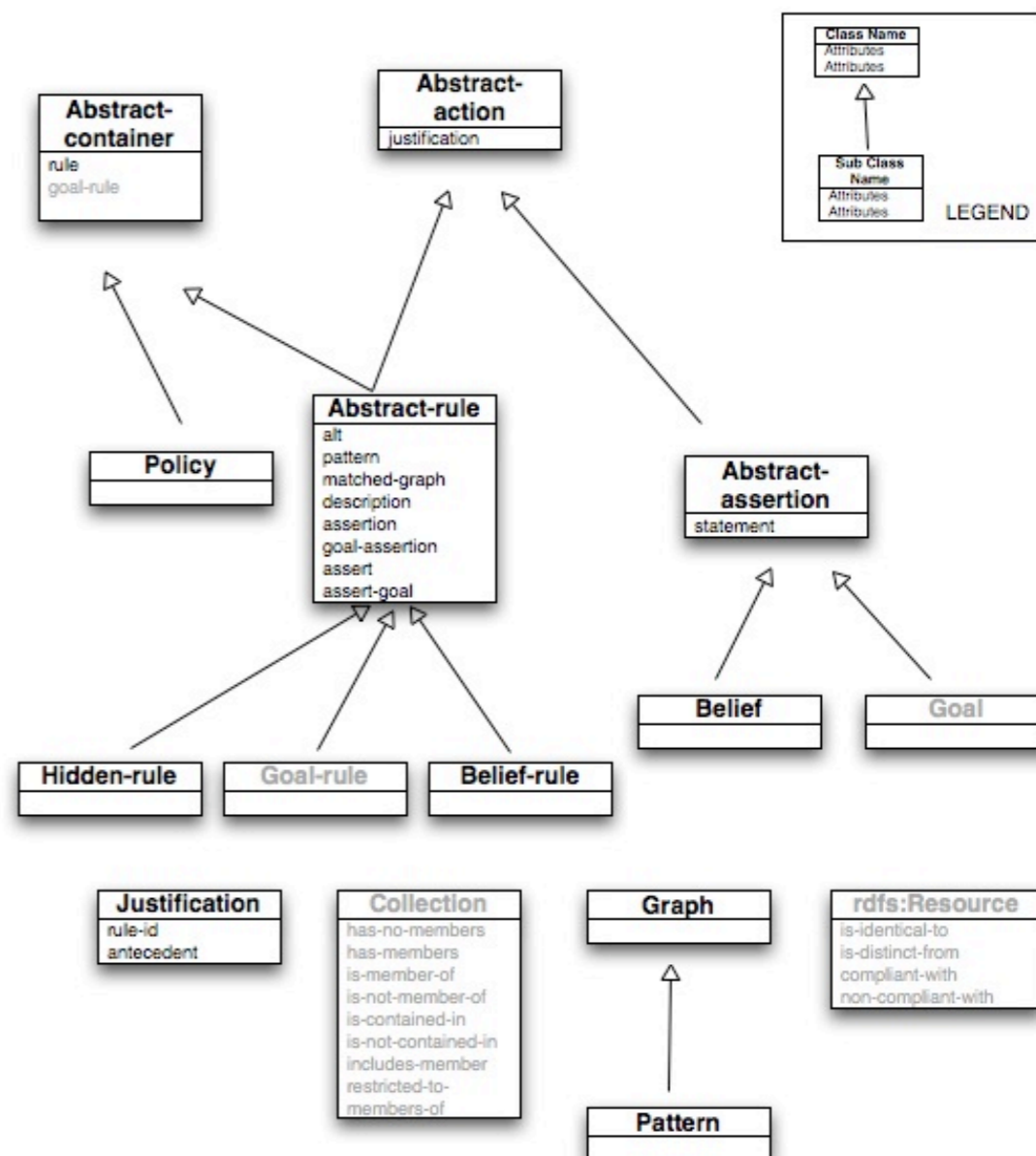
```

- ✦ Third version of AIR to be released in Fall with simpler syntax

```

:MySecondPolicy a air:Policy;
  air:rule [
    air:if { ... };
    air:then { ... };
    air:else { ... }
  ].

```





# AIR Reasoner

- ◆ Production-rule system in python
- ◆ Uses dependency tracking to generate **justifications** for compliant and non-compliant queries

<pre> @prefix : &lt;http://dig.csail.mit.edu/data#&gt; . @prefix foaf: &lt;http://xmlns.com/foaf/0.1/&gt; . @prefix air: &lt;http://dig.csail.mit.edu/TAMI/2007/amord/air#&gt; . @prefix tms: &lt;http://dig.csail.mit.edu/TAMI/2007/amord/tms#&gt; . @prefix yosi: &lt;http://dig.csail.mit.edu/People/yosi#&gt; .  :DAP_1 tms:justification tms:premise .  :DAP_3 tms:description (   :Req2   " is a request made by a requester with openid, "   &lt;http://auth.mit.edu/syosi&gt;   ", for DIG resource "   &lt;http://dig.csail.mit.edu/proposals/nsf.tex/&gt; );   tms:justification [     tms:antecedent-expr [       a tms:And-justification;       tms:sub-expr :DAP_1,       { :DIG :owns         &lt;http://dig.csail.mit.edu/proposals/nsf.tex/&gt; .         :Req2 a air:Request;         air:resource         &lt;http://dig.csail.mit.edu/proposals/nsf.tex/&gt;       };       foaf:openid &lt;http://auth.mit.edu/syosi&gt; .     }];     tms:rule-name :DAP_1 ] .  :Req2 air:compliant-with :DIGPolicy . </pre>	<pre> {   :Req2 air:compliant-with :DIGPolicy . } tms:description (   "The requester with openid, " &lt;http://auth.mit.edu/syosi&gt;   ", is known to a DIG member, "   &lt;http://dig.csail.mit.edu/People/RRS&gt; );   tms:justification [     tms:antecedent-expr [       a tms:And-justification;       tms:sub-expr :DAP_3,       { &lt;http://dig.csail.mit.edu/People/RRS&gt; air:in         :MemberList;         foaf:knows yosi:YES .         yosi:YES foaf:openid &lt;http://auth.mit.edu/syosi&gt; .       }];     tms:rule-name :DAP_3 ] .  {   &lt;http://dig.csail.mit.edu/People/RRS&gt; air:in   :MemberList;   foaf:knows yosi:YES .   yosi:YES foaf:openid &lt;http://auth.mit.edu/syosi&gt; .   :DIG :owns &lt;http://dig.csail.mit.edu/proposals/nsf.tex/&gt; .   :Req2 a air:Request;   air:resource &lt;http://dig.csail.mit.edu/proposals/nsf.tex/&gt;;   foaf:openid &lt;http://auth.mit.edu/syosi&gt; . } tms:justification tms:premise . </pre>
1	2

Part of justification generated by reasoner

# Justification User Interface

- ◆ AIR reasoner generates **proofs** of compliance and non-compliance
- ◆ Proofs are not easy to understand
- ◆ Graphical justification interface that provides an explorable structured natural language explanation for policy compliance and non-compliance
- ◆ Part of Tabulator, a Semantic Web browser
- ◆ Available as a Firefox extension

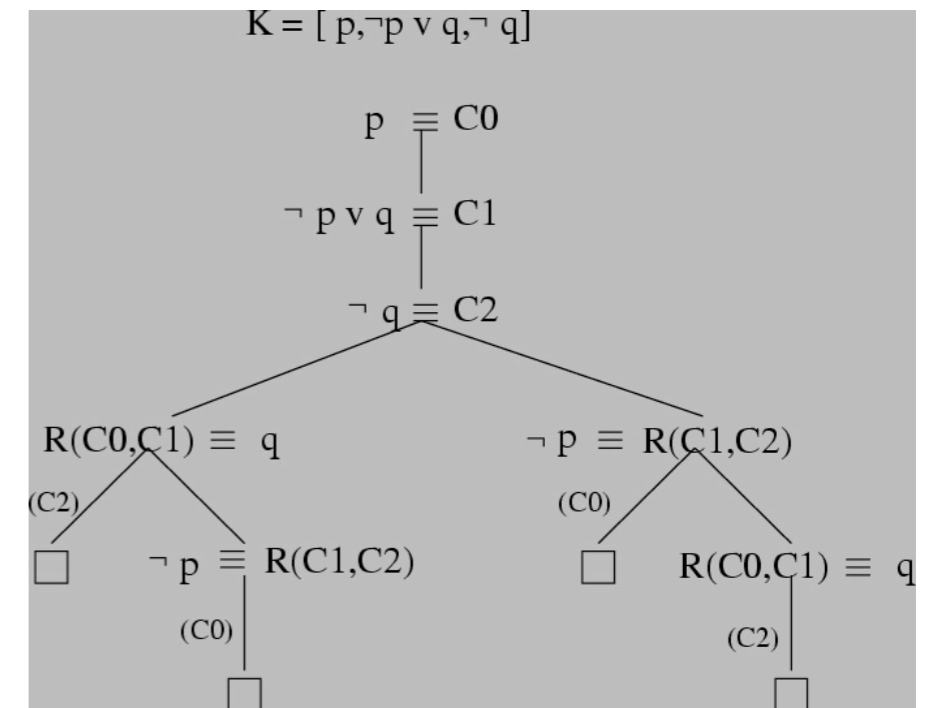









Image courtesy <http://clip.dia.fi.upm.es/~logalg/slides/>

# Justification User Interface

[http://mr-burns.w3.org/cgi-bin/server\\_cgi.py?logFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3&rulesFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3](http://mr-burns.w3.org/cgi-bin/server_cgi.py?logFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3&rulesFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3)

[▼ http://mr-burns.w3.org/cgi-bin/server\\_cgi.py?logFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3&rulesFile=http://dig.csail.mit.edu/TAMI/2007/s9/variation1/log.n3](#)

[/demo-policy.n3](#)








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The reason `Bettyrejectsbobsreq` is non compliant with MA Disability Discrimination Policy is because:

**Bobsrequest** is denied based on health information contained in `xphone record 2892`. Under the MA Disability Discrimination Law it is illegal to use health information to deny a service request.

The requester, Bob Same, resides in MA and is covered by the MA Disability Discrimination Law

Bob Same's request, `Bobsrequest`, was refused because of `xphone record 2892`

Premises:

<code>Bettyrejectsbobsreq</code>	reason	<code>xphone record 2892</code>
	receiver	<code>customer351</code>
	reply to	<code>Bobsrequest</code>
	type	<code>Refuse Request</code>
<code>customer351</code>	name	<code>Bob Same</code>

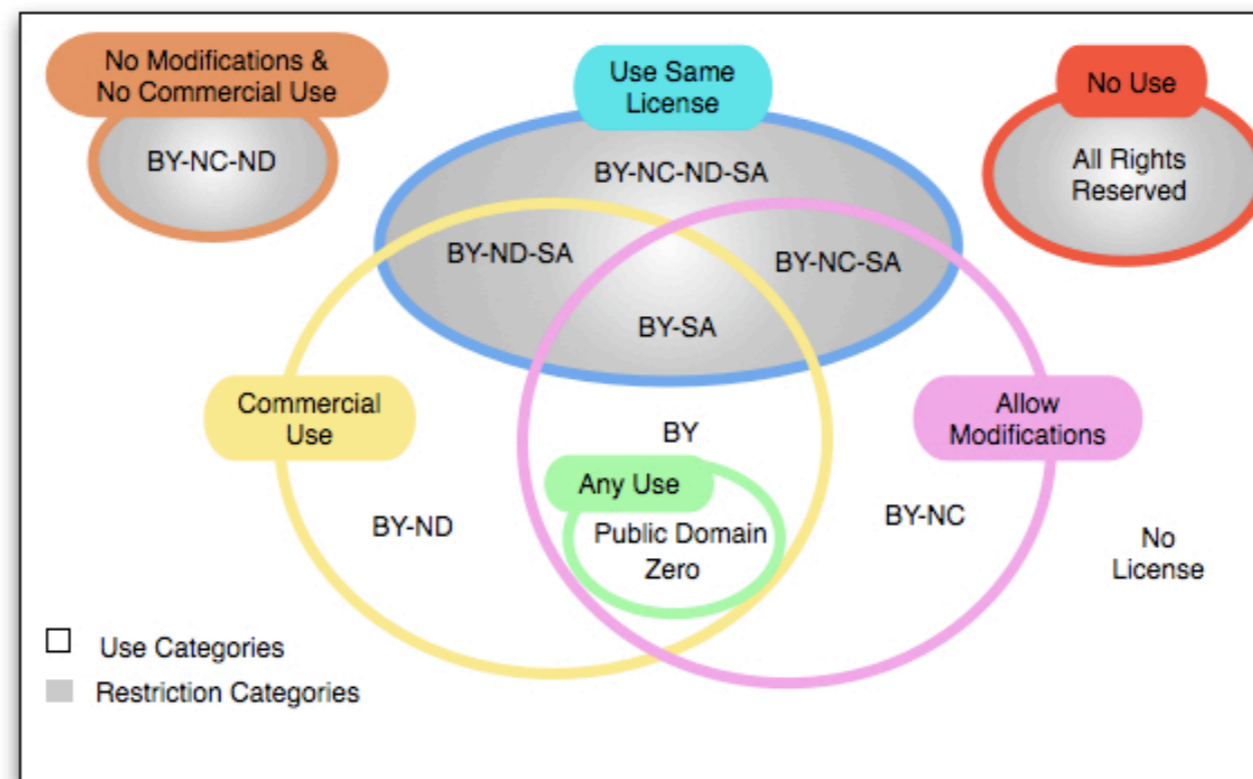
# Accountability Projects at DIG

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- ◆ License validator & Semantic Clipboard
  - leveraging Creative Commons licenses to support appropriate content reuse
- ◆ Policy-aware mash-ups
  - providing policy-awareness in SW mashups
- ◆ Social Web Privacy or Respect My Privacy
  - adding and viewing privacy preferences in social networks
- ◆ Fusion Center project
  - modeling Privacy Act and Massachusetts General Law
- ◆ Secure SPARQL federation
  - managing security constraints while integrating data from diverse sources

# License Validator and Semantic Clipboard

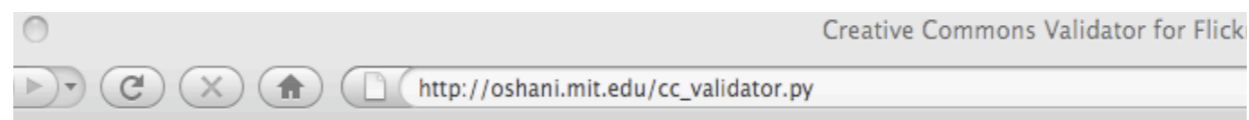
- ◆ Exploits **Creative Commons** license metadata associated with online media to prevent support correct re-use of content
- ◆ License validation: Checks for license violations on existing pages
- ◆ Semantic Clipboard: Supports selecting of appropriately licensed images and license metadata for easy content re-use



# License Validator Screenshot



Website to





## Creative Commons License Validator for Flickr Images

URI:

Results for the site <http://oshanis.blogspot.com/>.

Found 1 license violations for the following images.



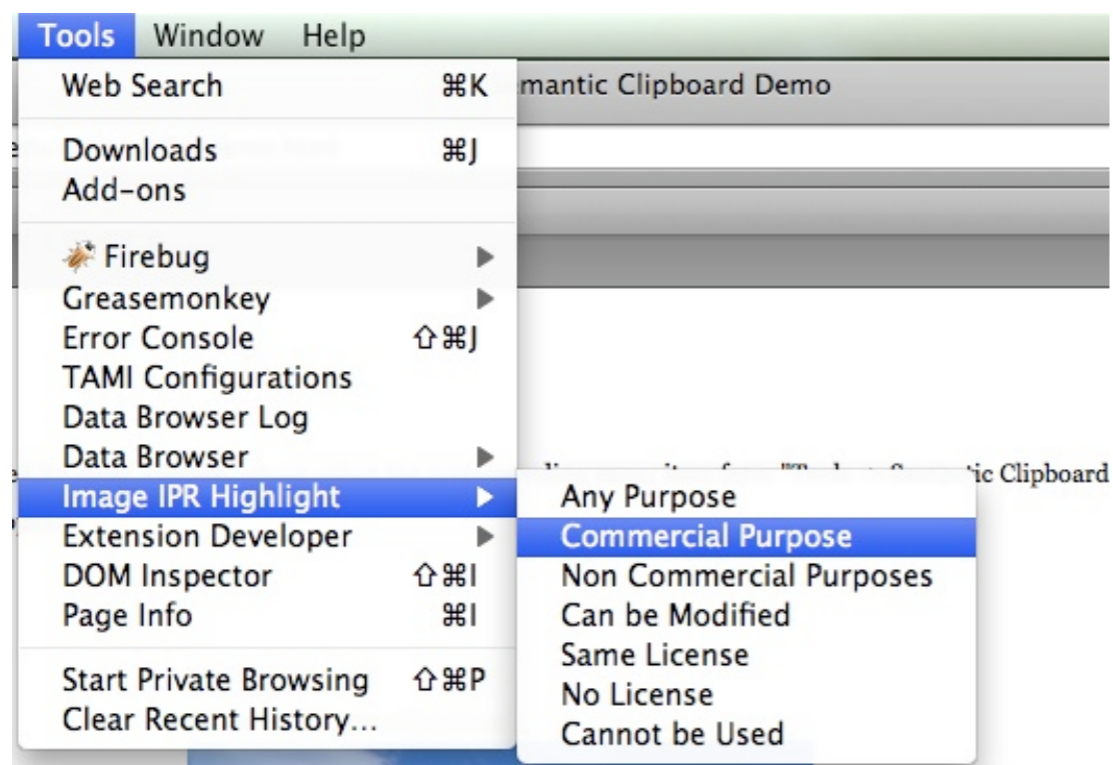
By [steren.giannini](#)  
Has License  

Validator

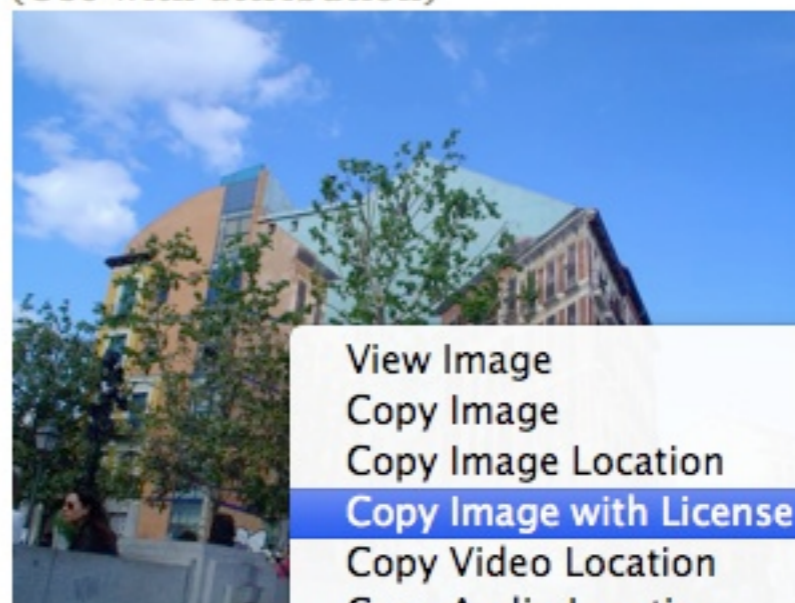
***License Violations Validator***



# Semantic Clipboard Screenshot



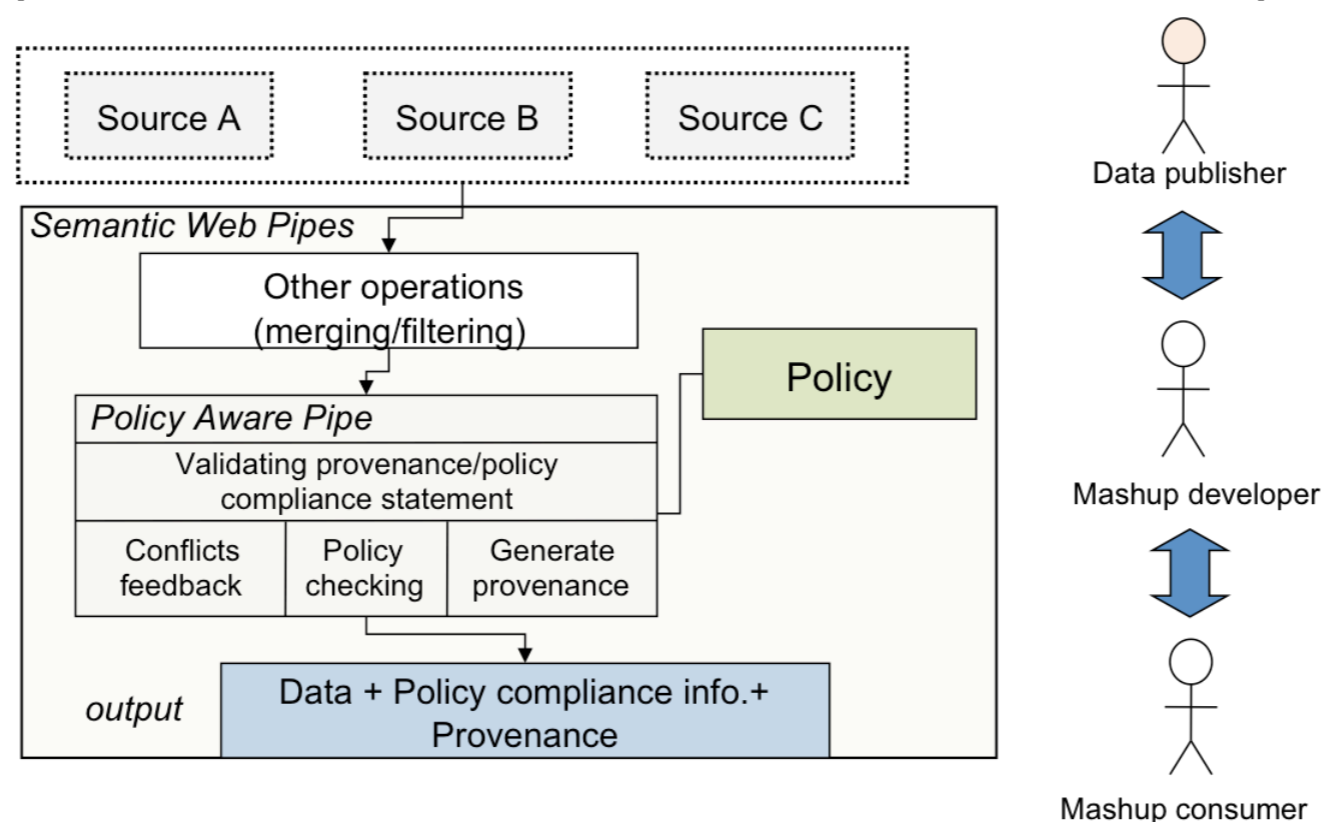
CC-BY  
(Use with attribution)



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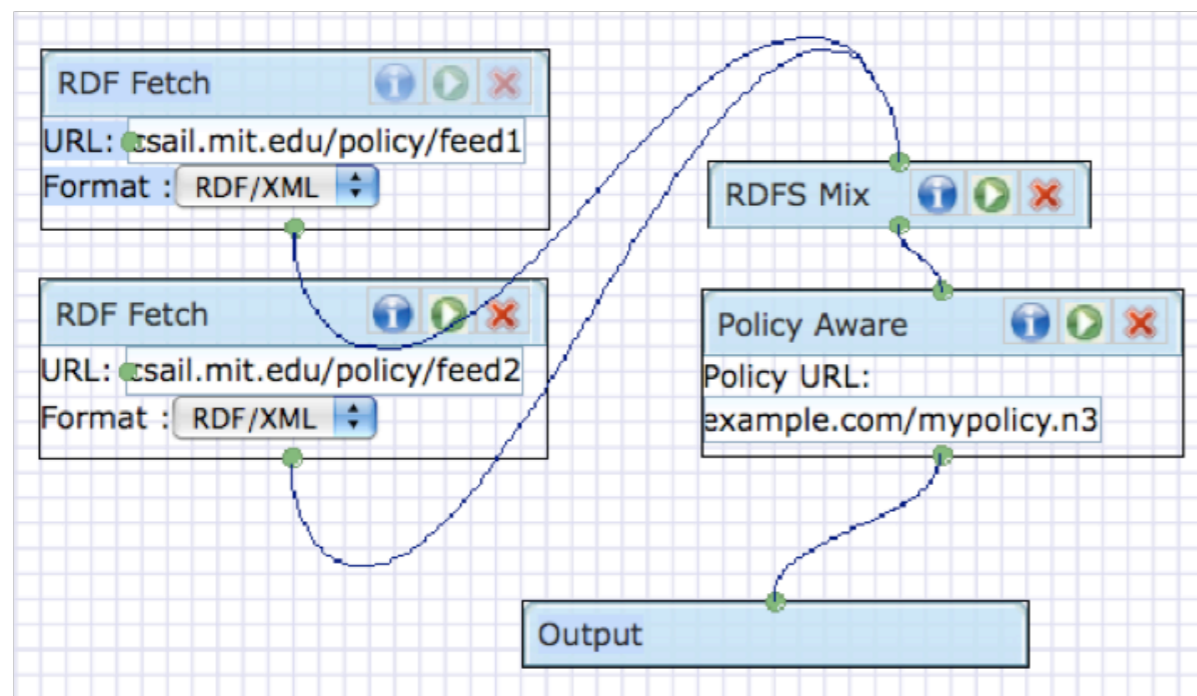
# Policy-Aware Mashup

- ◆ Provides a **policy-aware operator** for SW Mashups
- ◆ Adds usage restrictions statements and service descriptions to web services and sparql endpoints
- ◆ Operator validates mashup by verifying usage policy of sources
- ◆ Adds policy compliant/non-compliant statement to mashup log, which is used by mashup consumers to establish trust in mashup





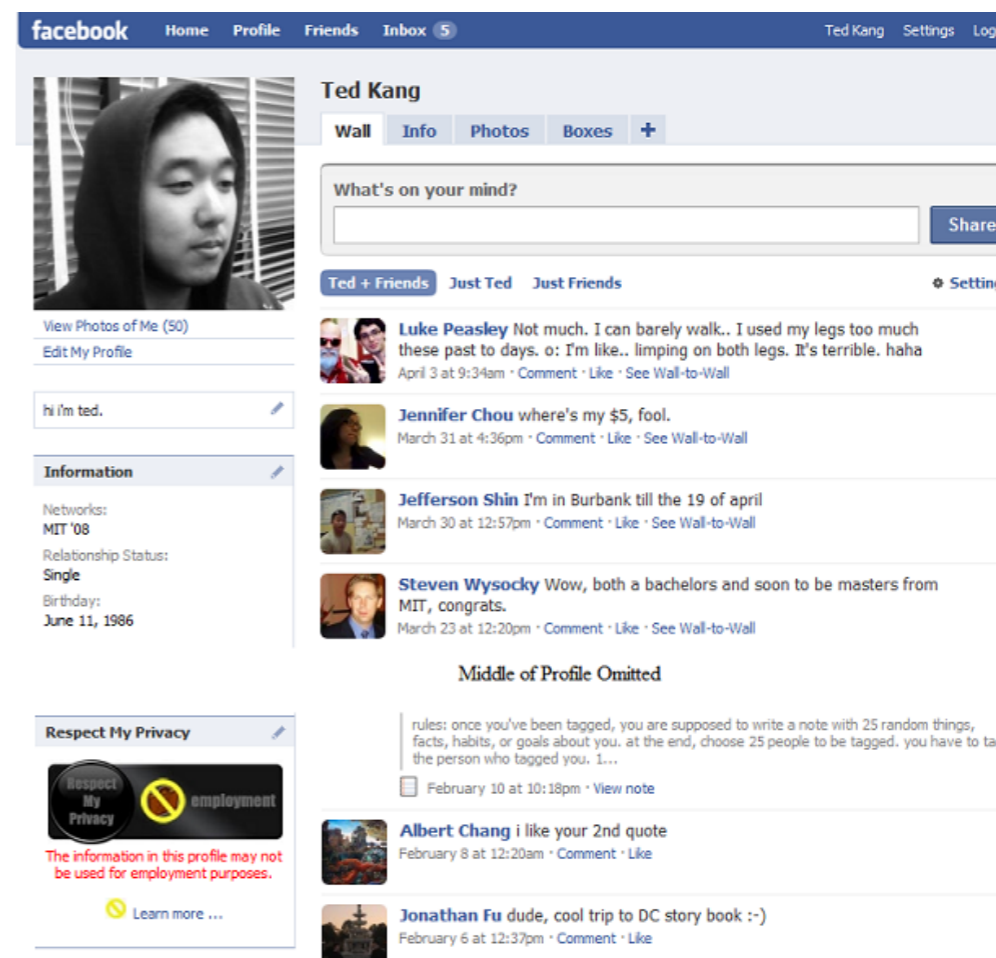
# Policy-Aware Mashup Screenshot



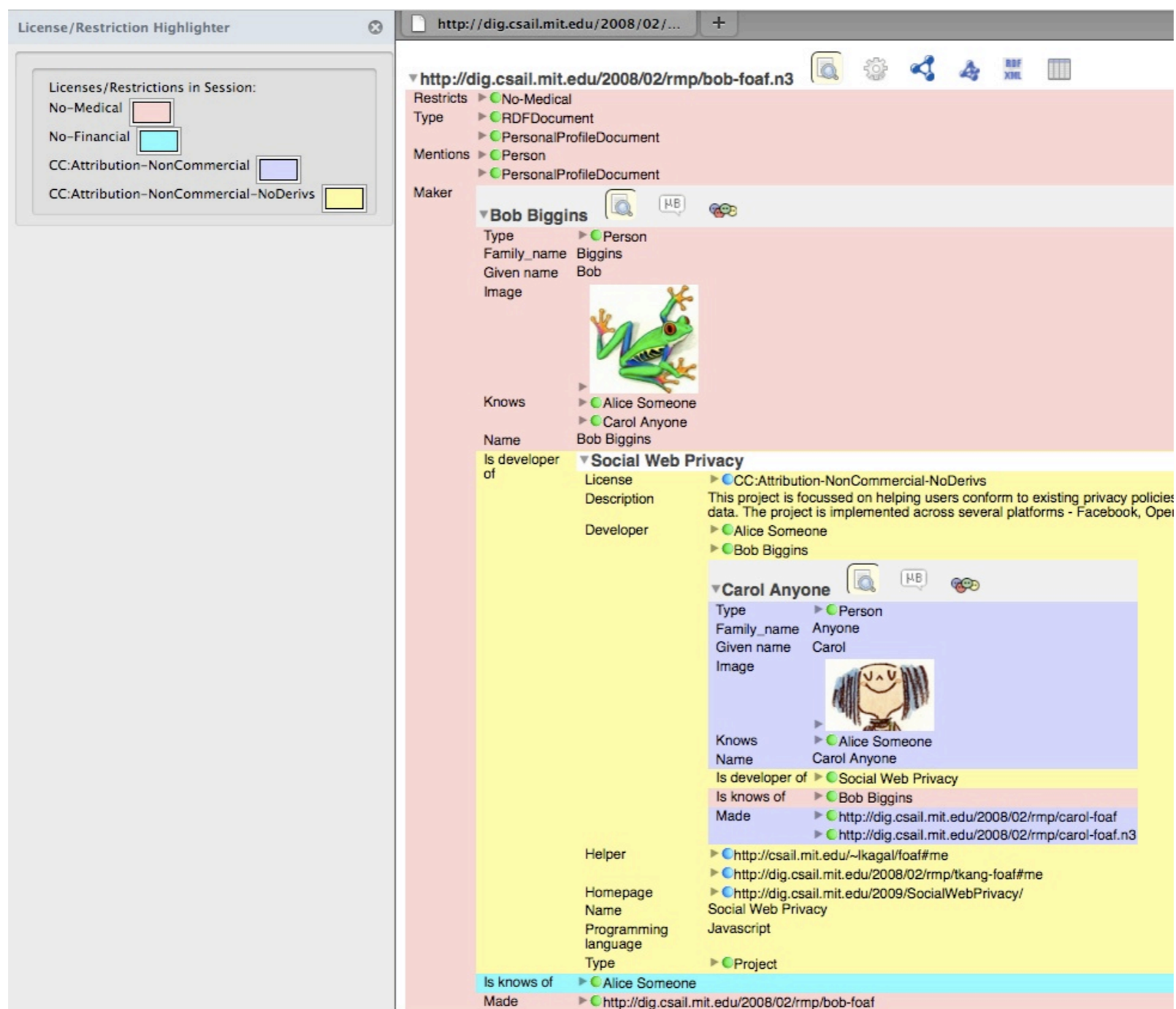
log	type	timestamp	message
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_660	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Alert]Profile of http://foolme.csail.mit.edu/wsprofileB#profile is conflicted with policy :http://foolme.csail.mit.edu/policy/policyA#wspolicy"
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_661	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Alert]Rejecting profile with author:http://www.w3.org/People/djweitzner/foaf#DJW"
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_662	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Error]Some merged web service is conflicted with the policy of channel:http://meerkat.oreillynet.com/?_fl=rss1.0"
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_679	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Alert]Profile of http://foolme.csail.mit.edu/wsprofileA#profile is conflicted with policy:http://foolme.csail.mit.edu/policy/policyB#wspolicy"
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_682	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Alert]Rejecting profile with subject:news"
http://foolme.csail.mit.edu/policy/log/log2009-07-13#00-00-32_684	"POLICY"	"2009-07-13T00:00:32-04:00"	"[Error]Some merged web service is conflicted with the policy of channel:http://johnson.freenet.net/?_fl=rss1.0"

# Privacy/License Highlighter

- ◆ Social networks are plagued with privacy issues
- ◆ Instead of focusing on enforcing privacy policies through restricted access, we help users conform to existing policies by making them **aware of the usage restrictions** associated with the data
- ◆ This functionality is supported across three platforms: Facebook, OpenSocial, and the Tabulator Semantic Web browser
- ◆ These applications enable users to **specify** privacy preferences for their data and also **display privacy-annotated data** prominently enabling other users to easily recognize and conform to these preferences



# Privacy/License Highlighter in Tabulator

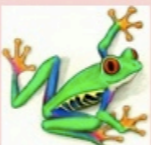
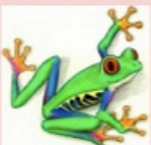




**License/Restriction Highlighter**

Licenses/Restrictions in Session:

- No-Medical
- No-Financial
- CC:Attribution-NonCommercial
- CC:Attribution-NonCommercial-NoDerivs

**http://dig.csail.mit.edu/2008/02/rmp/bob-foaf.n3**

- Restricts ▶ No-Medical
- Type ▶ RDFDocument
- ▶ PersonalProfileDocument
- Mentions ▶ Person
- ▶ PersonalProfileDocument
- Maker
- Bob Biggins** 
  - Type ▶ Person
  - Family\_name Biggins
  - Given name Bob
  - Image 
  - Knows ▶ Alice Someone
  - ▶ Carol Anyone
  - Name Bob Biggins
  - Is developer of ▶ **Social Web Privacy**
    - License ▶ CC:Attribution-NonCommercial-NoDerivs
    - Description This project is focussed on helping users conform to existing privacy policies data. The project is implemented across several platforms - Facebook, Open
    - Developer ▶ Alice Someone
    - ▶ Bob Biggins
  - Carol Anyone** 
    - Type ▶ Person
    - Family\_name Anyone
    - Given name Carol
    - Image 
    - Knows ▶ Alice Someone
    - Name Carol Anyone
    - Is developer of ▶ Social Web Privacy
    - Is knows of ▶ Bob Biggins
    - Made ▶ http://dig.csail.mit.edu/2008/02/rmp/carol-foaf
    - ▶ http://dig.csail.mit.edu/2008/02/rmp/carol-foaf.n3
  - Helper ▶ http://csail.mit.edu/~lkagal/foaf#me
  - ▶ http://dig.csail.mit.edu/2008/02/rmp/tkang-foaf#me
  - ▶ http://dig.csail.mit.edu/2009/SocialWebPrivacy/
  - Homepage Name Social Web Privacy
  - Programming language Javascript
  - Type ▶ Project
- Is knows of ▶ Alice Someone
- Made ▶ http://dig.csail.mit.edu/2008/02/rmp/bob-foaf

# References

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- ◆ DIG, <http://dig.csail.mit.edu>
- ◆ Tabulator extension, <http://dig.csail.mit.edu/2007/tab/>
- ◆ Information Accountability, <http://dspace.mit.edu/bitstream/handle/1721.1/37600/MIT-CSAIL-TR-2007-034.pdf?sequence=2>
- ◆ Paper on AIR, <http://dig.csail.mit.edu/2008/Papers/IEEEPolicy>