

Semantic Web

– Semantic Wikis. Programming

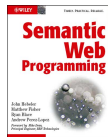
GEIST Research Group
<http://geist.agh.edu.pl>



AGH University of Science and Technology, POLAND

Using slides upon request from:

- JavaOne Online Technical Sessions and Labs:
Semantic Web Programming – by John Hebler
and Matthew Fisher: [http://www.oracle.com/
technetwork/java/index-jsp-156726.html](http://www.oracle.com/technetwork/java/index-jsp-156726.html)



Outline

- 1 Semantic Web Applications: Semantic Wikis
- 2 Semantic Web Programming: Jena
- 3 The End

Outline

Semantic Web

Applications:

Semantic Wikis

Semantic Wikis and
OntologiesOntology
Engineering with
Semantic Wikis

Loki

Semantic Web

Programming: Jena

Building,
Navigating, and
Exporting a
Semantic ModelQuerying the
Semantic ModelSemantic
Reasoning to Unify
Multiple Knowledge
Models

The End

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- Semantic Wikis and Ontologies
- Ontology Engineering with Semantic Wikis
- Loki

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3 The End

Semantic Wikis

Semantic improvement

- Wiki + semantics.
- Transition *content* → *knowledge*.
- Make content **understandable** by machines.
- Knowledge **processing** and conclusion generation.
- **Querying** the wiki for information.

Semantic annotation

''London'' is the capital city of `[[capital of::England]]` and of the `[[capital of::United Kingdom]]`. And it is located in `[[Located in::England]]`. As of `[[year:=2005]]`, the total resident population of London was estimated `[[population:=7,421,328]]`. Greater London covers an area of `[[area:=609 km2]]`. `[[Category:City]]`

page
discussion
edit
history

London

''London'' is the capital city of [England](#) and of the [United Kingdom](#). And it it located in [England](#). As of 2005, the total resident population of London was estimated 7,421,328. Greater London covers an area of [609 km²](#).

[Category: City](#)

Semantic Queries

```




{{#ask: [[Category:City]] [[located in::Germany]]
|?Population
|?Area
|order=DESC
|sort=Area
}}

```

Germany

A fine [European](#) country.

Cities located in Germany:

 City	 Population	 Area
Berlin	3,391,408	891,690,000 m ²
Munich	1,259,677	310,460,000 m ²
Stuttgart	595,452	207,458,047.638 m ²

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Semantic Wikis and Ontologies

- 1 Domain Ontology in a wiki: a **semantic backbone** of the content
- 2 Task Ontology in a wiki: **base for reasoning** and user interface
- 3 Semantic Wiki: **Ontology Development Environment**


→ The above combinations may be mixed

Mapping annotations to OWL DL

The semantics of annotation are mapped to the OWL DL:

- normal pages → individuals,
- properties → OWL properties,
- categories → classes,
- property values → literals or individuals.

Domain Ontologies in Semantic Encyclopaediae



[page](#) | [discussion](#) | [view source](#) | [history](#) | [Log in](#)

Main Page [Like](#) 99 people like this. Be the first of your friends.


Gardenology.org - Plant & Garden Wiki Encyclopedia

Gardenology.org is a complete **plant and garden wiki encyclopedia**. So far we have **19,875 plant entries** and other articles written and edited by gardeners from around the globe, with **15,326 photos**. Check out the help page to see how you can edit any page **right now**.

Plant Categories

<p>Flowers</p> <p>Rose, Hibiscus, Camation, Daylily...</p>	<p>Fruits</p> <p>Apricot, Oranges, Pear, Mulberry, Watermelon...</p>
<p>Houseplants</p> <p>Ferns, Ficus, Jade plant, African Violet...</p>	<p>Vegetables</p> <p>Carrot, Lettuce, Bell pepper, Asparagus...</p>
<p>Trees</p> <p>Pine, Maple, Cedar, Birch, Walnut...</p>	<p>Herbs</p> <p>Oregano, Mint, Parsley, Chives, Basil...</p>
<p>Shrubs</p> <p>Holly, Blueberry, Angel's Trumpet, Fuchsia...</p>	<p>Vines</p> <p>Passionfruit, Grape, Kiwi, Trumpet Vine, Jasmine...</p>
<p>Misc. - Carnivorous, Aquatic, Mosses, Hallucinogenic, Edible seeds, Nuts...</p>	

Featured Plant




Banana passionfruit (*Passiflora tarminiana*)

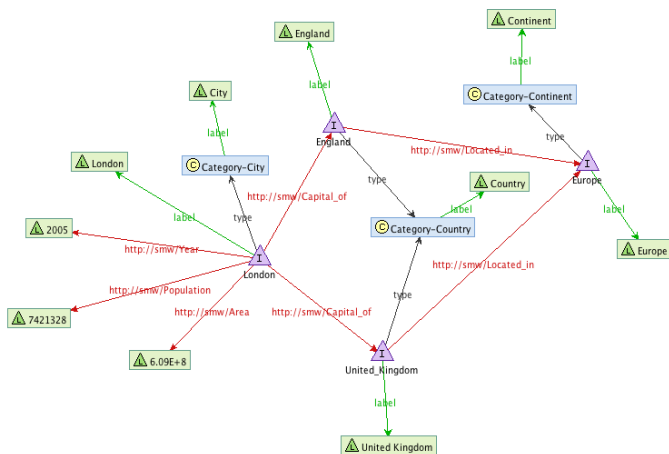
This vine will sprawl over large areas if unchecked, with lots of blooms and decorative fruit. [Click here](#) to learn about this plant.

Help us improve!

How to edit pages on Gardenology.org...



Ontology as a semantic backbone of the content (SMW)



Task Ontology as a base for reasoning and generating User Interface (KnowWE)

(a)

Swimming < Fitness < TWiki

Jump Search English

Questions Solutions Edit Attach Printable Solutions Dialog Options

You are here: [TWiki](#) > [Fitness Web](#) > [Swimming](#) #11 - 25 Jul 2007 - 08:33:56 - JoachimBuessem

Swimming

Swimming as leisure sports

★ **Questionnaire for sports advisor**

Swimming is the most common form of water sports. It is not a very **communicative** or interactive sports, as everyone swims [go to page](#). The duration of a swimming session typically takes about an hour. Swimming is good for **reducing stress** successfully or to train **endurance**. It only should be avoided with **cardio problems**. **What are your Training Goals?**

swimming especially the upper body is trained and calorie consumption is quite effective when done correctly. Swimming is a inexpensive form of sports the admission fee in a indoor swimming pool is typically between 2 and 8 Euros.

History

Drawings from the Stone Age were found in the **old** southwestern part of Egypt. Written references date back up to 2000 B.C. In 1538 Nicolas Wynman, German professor of languages, wrote the first swimming book. Competitive swimming in Europe started around 1800, mostly using breaststroke. The front crawl, then

Established Solutions: (c)

- Cycling [5/4]
- Jogging (occasional) [5/4]
- Jogging (professional) [5/4]
- Swimming (in a club) [5/5]
- Soccer (in a club) [2/4]
- Volleyball (in a club) [2/5]

Expectations

Would social relations be an important aspect?

not important
 important
 unknown

Would having fun be an important aspect?

not important
 important
 unknown

What are the most important muscles you want to train?

upper body
 lower body
 arms
 back
 torso
 buttocks
 unknown

Do you have particular training goals?

endurance
 losing weight
 stress alleviation
 self defense
 rehabilitation
 staying fit
 team coordination
 unknown

What is the expected calorie consumption?

low (<250 cal)
 medium(=432 cal)
 high(>602 cal)
 unknown

Would you prefer a competitive form of sport?

Yes
 No
 unknown

Do you like doing sport in a team?

Yes
 No
 unknown

Answer questions Jump to resultpage remaining questions are unknown

Training Goals

- endurance
- losing weight
- stress alleviation
- self defense
- rehabilitation
- staying fit
- team coordination
- unknown

javascript void(0);

Semantic Wiki as an Ontology Development Environment (Knoodl)

The screenshot displays the Knoodl Semantic Wiki interface. On the left, a class hierarchy is shown under the 'Classes' tab, including 'Accommodation', 'BedAndBreakfast', 'Campground', 'Hotel', 'LuxuryHotel', 'hasRating', 'AccommodationRating', 'Activity', 'BackpackersDestination', 'BudgetAccommodation', 'BudgetHotelDestination', 'Contact', and 'Destination'. The right pane shows the 'Technical Specifications' class overview, which includes sections for 'Overview', 'Ontology Name', 'Comments', 'Version Information', and 'Dependencies'.

Contents

- 1 Technical Specifications
- 1.2 Overview

Technical Specifications

Overview

Ontology Name
http://www.owl-ontologies.com/travel.owl

Comments
An example ontology for tutorial purposes.

Version Information
1.0 by Holger Knublauch (holger@smi.stanford.edu)

Dependencies

Namespaces

owl:	http://www.owl-ontologies.com/travel.owl#
owl2xml:	http://www.w3.org/2002/07/owl#
owl2xml:	http://www.w3.org/2006/12/owl2-xml#
rdf:	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs:	http://www.w3.org/2000/01/rdf-schema#
travel:	http://www.owl-ontologies.com/travel.owl#
xsd:	http://www.w3.org/2001/XMLSchema#

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3 The End

Ontology Engineering


- 1** Ontology Representation
 - natural language, annotations, logical formulas
- 2** Navigating, browsing, viewing the ontology
 - wiki pages, various data formats
- 3** Editing the ontology
 - text, wiki markup, dedicated forms
- 4** Importing/Exporting ontologies
 - OWL, proprietary formats

Representation: ACE Wiki

- Attempto Controlled English language
- mapping sentences to logical formulas (OWL)

The screenshot shows the AceWiki interface for the article 'planet'. The page header includes navigation icons and the user name 'Anonymous'. The article title 'planet' is displayed. Below the title, there is a description from Wikipedia: 'From Wikipedia: A planet, as defined by the International Astronomical Union (IAU), is a celestial body orbiting a star or stell remnant that is massive enough to be rounded by its own gravity, is not massive enough to cause thermonuclear fusion, and has cleared its neighbouring region of planetesimals.' A list of logical statements follows: 'Every planet is a celestial-body.', 'No planet is a star.', 'No planet is a dwarf-planet.', 'No planet is a moon.', 'Every planet orbits a star.', and 'Every planet is a terrestrial planet or is a gas giant.' A context menu is open over the 'Edit...' link, showing options: 'Edit...', 'Delete', 'Add Sentence...', 'Add Comment...', 'Details', and 'Logic'. The 'Logic' option is highlighted. The left sidebar contains navigation links (Main Page, Index, Search, About, Random Article) and action links (New Word..., Export...).

Representation: ACE Wiki

AceWiki  Anonymous

Sentence | Logic

What is a planet?

Paraphrase
What is a planet?

Syntax Boxes
what is a planet ?


Syntax Tree

```

      query
      |
      question
      /  \
    np    vp
   / \  / \
  qpn aux np
   |   |   |
  what is a planet ?
  
```

Navigation:
- Main Page
- Index
- Search
- About
- Random Article

Actions:
- New Word...
- Export...

AceWiki  Anonymous

Sentence | Logic

What is a planet? - Logic

Logical representation

```

[]
QUESTION
[A,B,C]
query(A,what)-1/1
object(B,planet,countable,na,eq,1)-1/4
predicate(C,be,A,B)-1/2
  
```

OWL

```

Ontology(
  http://attempo.ifi.uzh.ch/acewiki/geo
  SubClassOf(
    Class(:planet)
    Class(owl:Thing)
  )
)
  
```

Navigation:
- Main Page
- Index
- Search
- About
- Random Article

Actions:
- New Word...
- Export...

Representation: KnowWE

■ Knowledge Formalization Continuum (KFC)

```

----+ Swimming

----++ Swimming as leisure sports

<ref-kb id="GuidedDialog..simple">Questionnaire for sports advisor</ref-kb>

  %IMG{ src="%ATTACHURLPATH%/752px-FrontCrawlSwimming.JPG"
  alt="752px-FrontCrawlSwimming.JPG" width='200' height='160'}%

Swimming is the most common form of [water sports <=> explains:: Medium = in
water]. It is good for [successfully reducing stress or to train endurance
<=> explains:: Training Goals = endurance OR reducing stress].
It only should be avoided when [cardio problems <=> isContradictedBy::
Physical restrictions = cardio problems] are present. Further, Swimming is
quite inexpensive [explains:: Running costs = low].

<Kopic id="SwimmingRules">
  <Rules-section>
    IF (Training Goals = reducing stress) OR (Training Goals = endurance)
    THEN Swimming = SUGGESTED

    IF Medical restrictions = allergy
    THEN Swimming = EXCLUDED
  </Rules-section>
</Kopic>

```


Semantic relations

Rules

Kopic tag Rules tag Config tag AttributeTable tag SetCoveringList Tag Dialog link

Browsing ontology: SMW


[page](#) [discussion](#) [edit](#) [history](#) [delete](#) [move](#) [protect](#) [watch](#) [refresh](#)



Gardenology
.org

Solanum muricatum

Like 3 people like this.

Solanum muricatum	Pepino Dulce, Pepino, Melon Shrub, Pear Melon	
	<p>Habit: herbaceous</p> <p>Height: ↓ 1 m</p> <p>Width: ↔ 0.9 m</p> <p>Lifespan: ∞ perennial</p> <p>Origin: → temperate Andes</p>	<p>Exposure: ☀ sun</p> <p>Water: ● moist, moderate</p> <p>Features: ✓ edible, fruit</p> <p>USDA Zones: 9 to 12</p> <p>Sunset Zones: 17, 24, 25, 27</p> <p>Flower features: ● blue, purple, white</p>
Solanaceae > Solanum muricatum		

Growth Habit: Pepino dulce is a small, unarmed, herbaceous plant or bush with a woody base and fibrous roots. Growth is erect or ascending to about 3 feet high and several feet across. It is similar in these respects to a small tomato vine, and like the tomato may need staking or other support.


Foliage: The bright green leaves are sparsely covered with very small hairs. In appearance the pepino dulce is much like a potato plant, but the leaves may take many forms—simple and entire, lobed, or divided into leaflets.

Flowers: The small flowers are blue, violet-purple or white marked with purple, and are similar in form to unopened potato flowers. The pepino dulce is deemed to be parthenocarpic but a much heavier crop results from self-pollination or cross-pollination. The plants will not set fruit until the night temperatures are above 65° F.

Fruit: The fruit also show considerable diversity in size and shape. In the areas of its origin there are small oblong types with many seeds, while others are pear or heart-shaped with few or many seeds. Still others are round, slightly larger than a baseball and completely seedless. The colors also vary—completely purple, solid green or green with purple stripes, or cream colored with or without purple stripes. The fruit of cultivars grown in this country are usually round to egg-shaped, about 2 to 4 inches long, with some growing up to 6 inches. The skin is typically yellow or purplish green, often with numerous darker streaks or stripes. The flesh is greenish to white and yellowish-orange. Better quality fruit is moderately sweet, refreshing and juicy with a taste and aroma similar to a combination of cantaloupe and honeydew melon. In

search

SHARE [f](#) [t](#) [e](#) [m](#)

Ads by Google 

[Plastic Garden Mesh](#)

Plastic netting for garden fencing plant protection & tree guard mesh

[www.broddingtond.co...](#)

[Savanni Seeds Store](#)

Super Strains From

Browsing ontology: OntoWiki

The screenshot displays the OntoWiki web interface for the Beer Ontology. The browser address bar shows the URL: `http://demo.ontowiki.net/model/info/?m=http%3A%2F%2Fwww.dayf.de%2F2004%2Fow%2Fbeer.owl`. The page title is "OntoWiki — Model info".

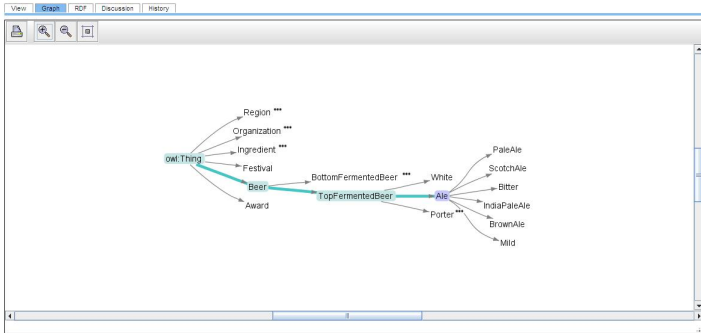
The interface is divided into several sections:

- OntoWiki**: Includes a search bar for resources and a navigation menu with "View", "User", "Extras", and "Help".
- Knowledge Bases**: Lists various ontologies, with "Beer Ontology, OWL Lite" selected.
- Navigation: Classes**: A sidebar menu for navigating through classes like "ns0:Region", "ns0:Organization", etc.
- Model info**: The main content area, titled "Beer Ontology, OWL Lite". It contains a description: "An ontology that models types of beer and brewers/brands. http://purl.org/net/ontology/beer.owl". It also includes a "Comments, Descriptions and Notes" section with a detailed paragraph about the ontology's history and purpose.
- Actions**: A section for "view all resources".
- Properties**: A table listing properties such as "tags.taggedWithTag", "rdf:type", "rdfs:label", and "owl:versionInfo".
- Latest Discussions**: A list of recent comments or discussions, including one from "sysconf:shellcode on Hallo!".
- Bookmarklet**: A section with a link to "Use this Bookmarklet to add content to this Knowledge Base." and a "Save to OntoWiki with RDFauthor" button.
- Latest Changes**: A list of recent changes to the ontology, such as "Hallo! by Anonymous" and "Beer Ontology, OWL Lite by sysconf:chacha".
- Login**: A section at the bottom with buttons for "Local", "OpenID", and "FOAF+SSL".

Viewing ontology: Different Views

Beer

Community Tutorial vocabulary Beer



Search: OntoWiki (Admin)

User View Extras Help

Search Text

Search All Knowledge Bases

Submit

Knowledge Bases

- OntoWiki System Ontology
- OntoWiki System Configuration
- Class Test Schema
- Conference Model

Languages (Tagged Literals)

de en none

swrc:AcademicStaff

Edit View

Instances Map Calendar History Edit

different views

Instances of swrc:AcademicStaff

swrc:AcademicStaff swrc:phone foaf:depiction

- Jens Lehmann
swrc:AcademicStaff, Person, swrc:PHDStudent
+49 341 9732260
- Muhammad Abulham Aslam
swrc:AcademicStaff, Person, swrc:PHDStudent

Editing: Wiki Markup

''London'' is the capital city of
 [[capital of::England]] and of the
 [[capital of::United Kingdom]]. And
 it is located in [[Located in::England]].

[[Category:City]]

The screenshot shows a web interface for editing a wiki page. At the top, there are four tabs: 'page' (selected), 'discussion', 'edit', and 'history'. Below the tabs, the page title 'London' is displayed. The main content area contains the rendered text: ''London'' is the capital city of [England](#) and of the [United Kingdom](#). And it it located in [England](#). As of 2005, the total resident population of London was estimated 7,421,328. Greater London covers an area of [609 km²](#). Below the text, there is a box containing the text 'Category: City'.

Editing: Forms

The screenshot displays the Semantic Web editor interface. On the left, there are three vertical panels: 'OntoWiki (Sebastian Tramp)' with a search bar, 'Knowledge Bases' with a list of sources, and 'Navigation' with a search bar and a list of categories. The main area is titled 'Properties of AS - Management activities' and shows a table of properties:

content	AS - Management activities will ensure that LOD2 runs smoothly in a coherent and cohesive fashion and that all contractual obligations are met.
previous	http://lod2.eu/a4
wp	http://lod2.eu/wp12
rdfs:type	http://lod2.eu/ActivityCluster
rdfs:label	AS - Management activities
skos:broader	http://lod2.eu/ActivityClusters

Below the table are several utility panels: 'Tagging' (No tags yet), 'Similar Instances' (listing ActivityCluster instances), 'Rating' (Current Rating and Rate the Resource), and 'Instances linking here' (listing next1).

Editing: Dedicated Editors

The screenshot shows a web-based editor for an ontology. On the left is a tree view of the ontology's structure, including classes like `AccommodationRating`, `BudgetAccommodation`, `BudgetHotelDestination`, and `Contact`. The right side features two main panels:

Namespaces

Prefix	URI
<input checked="" type="checkbox"/> owl	http://www.owl-ontologies.com/travel.owl#
<input checked="" type="checkbox"/> owl	http://www.w3.org/2002/07/owl#
<input checked="" type="checkbox"/> owl2xml	http://www.w3.org/2006/12/owl2-xml#
<input checked="" type="checkbox"/> rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
<input checked="" type="checkbox"/> rdfs	http://www.w3.org/2000/01/rdf-schema#
<input checked="" type="checkbox"/> travel	http://www.owl-ontologies.com/travel.owl#
<input checked="" type="checkbox"/> xsd	http://www.w3.org/2001/XMLSchema#

Save all changes to this page

Ontology Metadata

Ontology Name	<input checked="" type="checkbox"/> http://www.owl-ontologies.com/travel.owl
Comments	<input checked="" type="checkbox"/> An example ontology for tutorial purposes
Label	
Defined by	
Version Information	<input checked="" type="checkbox"/> 1.0 by Holger Knublauch (holger@ami.stanford.edu)
See also	

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2 Semantic Web Programming: Jena

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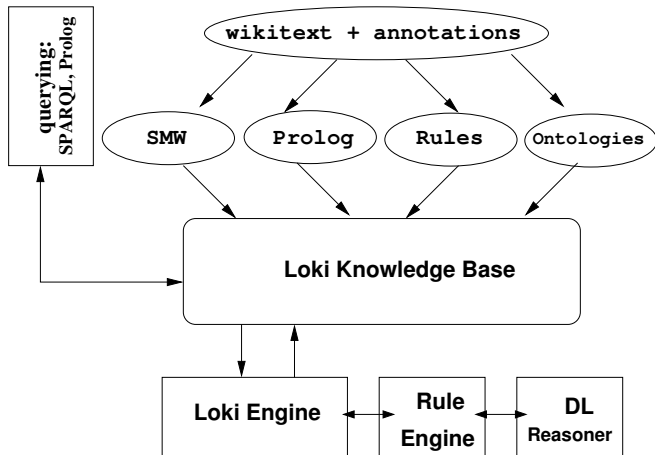
3 The End

Loki – logic in a wiki

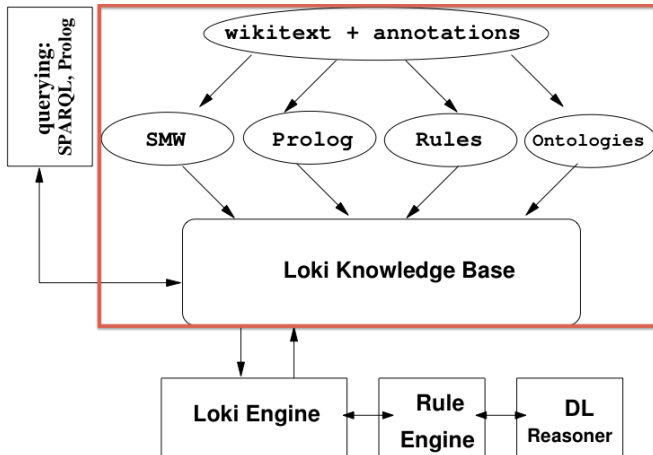
- Semantic Wiki with strong logical representation
- semantic annotations, semantic queries
- **support for rule representation and reasoning**
- See <http://loki.ia.agh.edu.pl>



Loki Architecture



Loki Architecture



Semantic annotations

Book details:

book ← category

Title: The Call of Cthulhu

Author: h_p_lovecraft ← relation

Publisher: iap

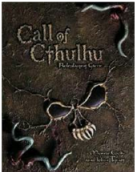
Date: 2009 ← attribute

Language: english

Genre: horror

Pages: 52

Keywords: evenings



Recommendation:

Books by this author:

- at_the_mountains_of_madness
- the_call_of_cthulhu

Books in this genre:

- at_the_mountains_of_madness
- desperation
- insomnia
- it

Annotations:

- categories
- relations
- attributes

Special pages:

- sub-categories
- sub-properties

Semantic queries

Rules

Editing the content

===== Book details: =====

[[category:book]]

```

**Title**: [[title:=The Call of Cthulhu]]
**Author**: [[author::bookstore:author:h_p_lovecraft]]
**Publisher**: [[publisher::bookstore:publisher:iap]]
**Date**: [[date:=2009]]
**Language**: [[language:=english]]
**Genre**: [[genre::bookstore:genre:horror]]
**Pages**: 52
**Keywords**: [[keyword:=evenings]]
  
```

Semantic data export

Author: [betty_crocker](#)

Publisher: [wiley_publishing](#)

Date: 2006

Language: english

Genre: [handbook](#)

Pages: 352

Keywords: christmas, cooking



Recommendation:

Books by this author:

[betty_crocker_christmas_cookbook](#)

Books in this genre:

[betty_crocker_christmas_cookbook](#)

[logical_foundations_for_rule_based_systems](#)

[the_christmas_table](#)

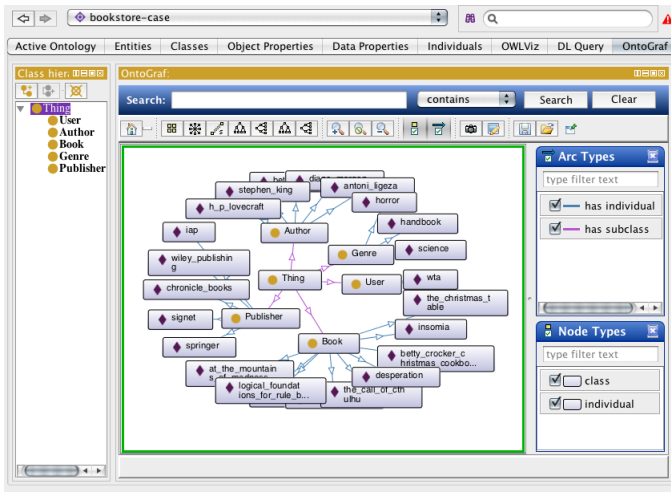
Books by this publisher:

[betty_crocker_christmas_cookbook](#)

Export to RDF/XML

Export to RDF

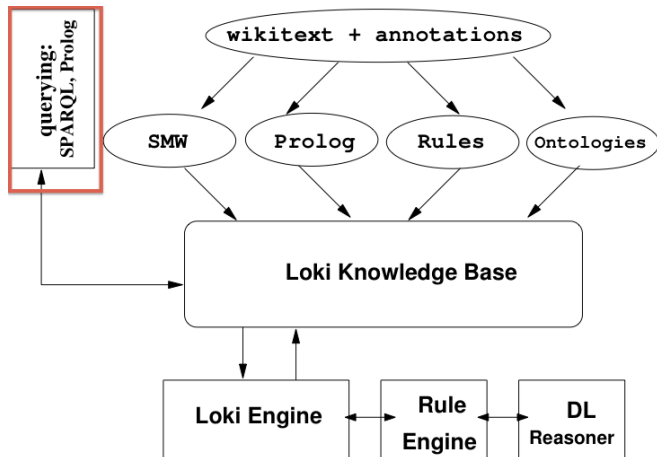
Background ontology of the wiki content



- Semantic Web Applications: Semantic Wikis and Ontologies
- Ontology Engineering with Semantic Wikis
- Loki

- Semantic Web Programming: Jena Building, Navigating, and Exporting a Semantic Model
- Querying the Semantic Model
- Semantic Reasoning to Unify Multiple Knowledge Models

Loki Architecture



Querying the Knowledge

==== Recommendation: =====

```
**Books by this author**: {{#ask: [[category:book]]
    [[author::bookstore:author:h_p_lovecraft]] }}
```

```
**Books in this genre**: {{#ask: [[category:book]]
    [[genre::bookstore:genre:horror]] }}
```

```
**Books by this publisher**: {{#ask: [[category:book]]
    [[publisher::bookstore:publisher:iap]] }}
```

Recommendation:

Books by this author:

[at_the_mountains_of_madness](#)

[the_call_of_cthulhu](#)

Logical representation

- 1 Mapping annotations to Prolog predicates:

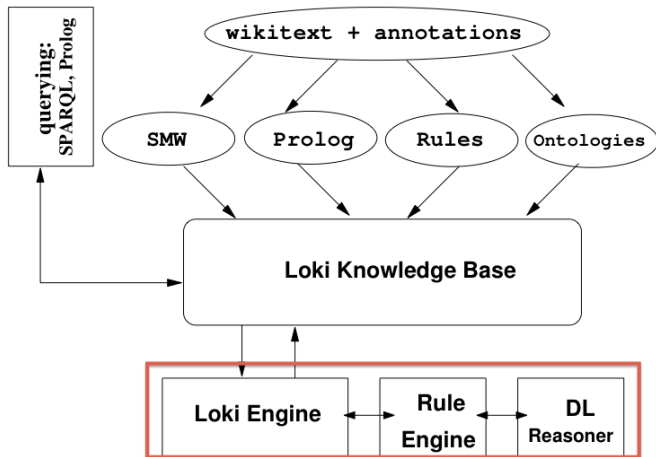
```
wiki_category('bookstore:book:the_call_of_cthulhu',
             'book').
wiki_attribute('bookstore:book:the_call_of_cthulhu',
              'title', 'The Call of Cthulhu').
wiki_relation('bookstore:book:the_call_of_cthulhu',
              'author', ':bookstore:author:h_p_lovecraft').
```

- 2 Arbitrary rule/goal formulation:

```
custom_recommendations(X) :-
    wiki_attribute(X, 'keyword', 'christmas').

goal="custom_recommendations(X),write(X),nl,fail"
scope="*>
```

Loki Architecture



HeaRT in the Wiki

- HeKatE Run Time rule engine
- Inferene modes
 - Data-Driven Inference
 - Goal-Driven Inference
 - Token-Driven Inference
- HMR – HeKatE Markup Language

Modularized Rule Base

⚡ (?) recently_read	⚡ (->) {recently_read_filter}
= The call of Cthulhu	:= At the mountains of madness
in Desperation	:= {Insomnia,It}
in The Christmas Table	:= Betty Crocker Christmas Cookbook

Table id: tab_7 - recently_read

⚡ (?) age	⚡(?) fav_genres	⚡ (->) {age_filter}
< 18	= horror	:= young_horror
< 18	= poetry	:= young_poetry
in [18,100]	= horror	:= adult_horror
in [18,100]	= handbook	:= adult_handbooks
< 18	= any	:= {young_poetry,young_horror,all_science}
in [18,100]	= poetry	:= adult_poetry
in any	in science	:= all_science

Table id: tab_2 - age_filter

⚡ (?) {age_filter}	⚡(?) {recently_read_filter}	⚡(?) {known_languages}	⚡ (->) {recommended_books}
sim {adult_poetry,horror}	in any	supset english	:= The Raven and Other Poems
in all_science	in any	sim {polish,english}	:= Logical Foundations for RBS
in any	= It	supset english	:= It
= handbooks	in any	= any	:= The Christmas Table
in {young_horror,adult_horror}	in any	= any	:= The call of Cthulhu

Table id: tab_6 - recommend_books

Embedding HMR in Wiki

Draft autosaved on 2011/02/25 03:09

```

===== User details =====
[[category:user]]

**Name:** [[hasName=Weronika T. Adrian]]
<pl>xstat wta: [name, 'Weronika T. Adrian'].</pl>

**Age:** [[hasAge=26]]
<pl>xstat wta: [age, 26].</pl>

**Recently read:** [[[[hasRecentlyRead::bookstore:book:the_call_of_cthulhu]]]]
<pl>xstat wta: [recently_read,the_call_of_cthulhu].</pl>

**Knows languages:** [[knowsLanguage=english]], [[knowsLanguage=polish]],
[[knowsLanguage=german]], [[knowsLanguage=spanish]], [[knowsLanguage=hebrew]]
<pl>xstat wta: [knows_language, [english, polish, german, spanish, hebrew]].</pl>

**Favourite genres:** [[hasFavouriteGenre=science]]
<pl>xstat wta: [favourite_genre, science].</pl>

**Favourite authors:** [[hasFavouriteAuthor::bookstore:author:witold_gombrowicz]],
[[hasFavouriteAuthor::bookstore:author:h_p_lovecraft]]
<pl>xstat wta: [favourite_author, [witold_gombrowicz, h_p_lovecraft]].</pl>

===== Recommendations: =====
<pl scope="user|book"
goal="gox(wta,[recommend_books], gdi),
print_results"
>
</pl>

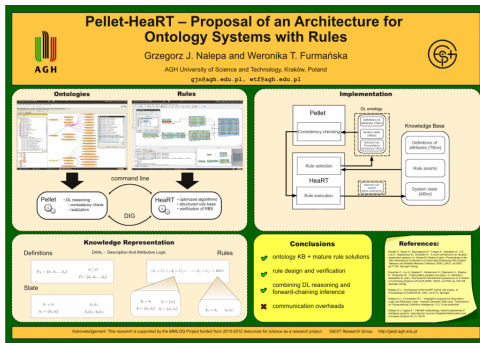
```

Annotations:

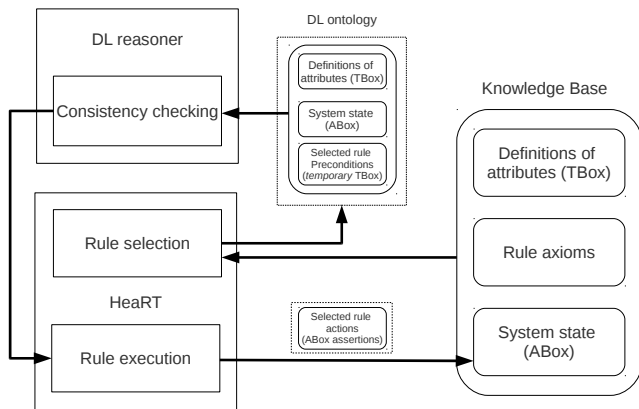
- state definitions (pointing to `<pl>xstat wta: [age, 26].</pl>`, `<pl>xstat wta: [recently_read,the_call_of_cthulhu].</pl>`, and `<pl>xstat wta: [knows_language, [english, polish, german, spanish, hebrew]].</pl>`)
- HearT Invocation (pointing to `<pl scope="user|book" goal="gox(wta,[recommend_books], gdi), print_results">`)

Hybrid Reasoning: Ontologies and Rules

- DL descriptions in rule atoms
- conditions checked by a DL reasoner (Pellet)
- rule selection by HearT



Hybrid Reasoning: Pellet-HeaRT



Loki: Summary

Loki Features

- Semantic Wiki with strong logical representation
- Supports semantic annotations (SMW)
- Supports rule representation and reasoning (Prolog predicates)
- Embedded HeaRT engine
 - custom inference
 - modularized rule bases
 - hybrid reasoning with Pellet-HeaRT



Outline

Semantic Web
Applications:
Semantic Wikis
Semantic Wikis and
Ontologies
Ontology
Engineering with
Semantic Wikis
Loki

Semantic Web
Programming: Jena
Building,
Navigating, and
Exporting a
Semantic Model
Querying the
Semantic Model
Semantic
Reasoning to Unify
Multiple Knowledge
Models

The End

Other applications

- Semantic Web browsers, e.g., Tabulator
- SW Search Engines
- Linked Data Mashups
- Knowledge Management for Enterprises (e.g., TopBraid Composer, semafora)
- More work on: querying Linked Data, reasoning in Linked Data (not much logic required), efficient ontology languages and their applications...

Further reading...

- readwrite.com/2010/12/29/top_10_semantic_web_products_of_2010
- www.slideshare.net/mtgreaves/tutorial-semantic-wikis-and-applications
- readwrite.com/2007/09/20/the_top-down_semantic_web
- ...

What can we do with the Semantic Web?

- What can we do with data?
- What for?
- Use case scenarios?
- What we would *like* to do?

Outline

1 Semantic Web Applications: Semantic Wikis

- Semantic Wikis and Ontologies
- Ontology Engineering with Semantic Wikis
- Loki

2 Semantic Web Programming: Jena

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- Querying the Semantic Model
- Semantic Reasoning to Unify Multiple Knowledge Models

3 The End

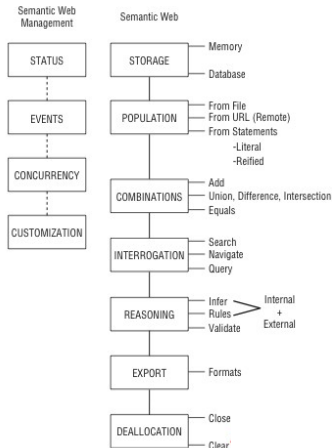
JavaOne



Jena Semantic Web Framework



- > Consistent Programming Environment for Triples (e.g. The Semantic Web)
- > Features...
 - Open Source
 - Java
 - Popular, Growing
 - Flexible, Extendable



Outline

Semantic Web

Applications:

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Ontology

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Semantic Web

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The End



Establishing the Semantic Jena “Model”

- > Central *Class* for the Semantic Web
 - Decoupled from storage mechanisms
 - Decoupled from reasoning, etc
 - Tune-able Reasoning Level
- > Examples

```
Model yourModel = ModelFactory.createDefaultModel()
```

```
Model yourOWLModel = ModelFactory.createOntologyModel()
```

```
Model yourFileBackedModel =  
  ModelFactory.createFileModelMaker()
```

```
Model yourDBBackedModel = ModelFactory.createRDBMaker()
```





Populating the Jena “Model” object

```
yourModel.read(String URL, String default
  base, String format)
```

```
// format: "RDF/XML", "N-TRIPLE", "TURTLE" (or "TTL") and "N3"
// base: "http://mylocation.com/"
```

```
yourModel.read(InputStream inputFile,
  String default base, String format)
```

> Others

- add(Model anotherModel)
- add(Statement statement)
- intersection(Model anotherModel)
- union(Model anotherModel)
- difference (Model anotherModel)





Navigating the Jena Model



> Graph Orbit

```
1) Resource me = model.getResource();
2) StmtIterator iter = me.listProperties();
3) iter.nextStatement().getPredicate()
   (.getObject);
```

> Simple Selections

```
1) SimpleSelector yourSelector =
   new SimpleSelector(Resource matchSubject,
   Resource matchPredicate,
   Resource matchObject ); // null is wild
2) StmtIterator yourList =
   yourModel.listStatements
   (yourSelector);
```





Exporting your Model

- > `yourModel.write(FileOutputStream yourFile, String format)`
 - Format is "RDF/XML", "N-TRIPLE", "TURTLE" (or "TTL") and "N3"



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Graduating from Navigating to Querying

- > Navigating is not optimal method for information retrieval
- > Lacks
 - Scalability
 - Focus
 - Resource Conservation
- > Jena supports queries with ARQ
 - SPARQL Query Engine
 - <http://jena.sourceforge.net/ARQ/>





ARQ – We start with just a string...



- > Create a SPARQL query string
- > Create a Query object from the query string
 - `Query q = QueryFactory.create(queryString);`
- > Create a QueryExecution object from Query object
 - `QueryExecution qexec = QueryExecutionFactory.create(q, _socialModel);`
- > Fire off any one of four SPARQL queries



```
qexec.execSelect();
```



Four Query Options

> **SELECT**

- Most popular
- Much like a SQL
SELECT Statement

> **CONSTRUCT**

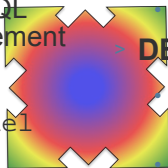
- Returns a Model
object
- Ontological
Mediation

> **ASK**

- Boolean return value
- “Pre-query”

> **DESCRIBE**

- Returns a Model
object
- SPARQL endpoint
decides content!





SELECT Query Basics

```
# comment
SELECT ?subject, ?object
WHERE {
  ?subject http://example.org/somePredicate ?object
}
```

Query results variables in SELECT clause

WHERE clause

```
# George Washington's Namesakes
SELECT ?location
WHERE {
  ?person <http://www.w3.org/2000/01/rdf-schema#label>
    "George Washington"@en.
  ?location <http://dbpedia.org/property/namedFor>
    ?person
}
```

Period-delimited statements

Triple statement

Recommendation has many good examples:
<http://www.w3.org/TR/rdf-sparql-query/>



ARQ Bonuses

- > Built in support for Visitor Pattern
 - QueryVisitor Interface
- > Support for RDQL, ARQ
 - same name but home-grown query language
- > Support for SPARUL
 - Ability to update data (vs. SPARQL's read only)
 - Experimental
 - UpdateRequest has its own `exec()` call



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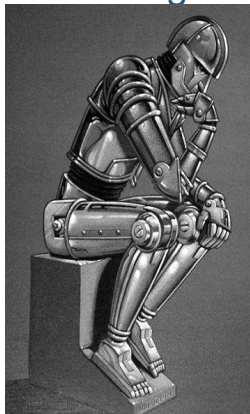
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Reasoning Backdrop



- > Infers what is logical per the provided statements
 - Inheritance
 - Class Assignment
 - Equivalence
- > *Amplifies* Statements
 - Good gets Better
 - Bad gets Worse (even stupid)
- > Rules enable Flexible Inference



Key OWL Reasoning Constructs

- > Direct Classes and Property Equivalence
 - owl:equivalentClass and owl:equivalentProperty,
 - rdfs:subClassOf and rdfs:subPropertyOf
- > Instance Equivalence
 - owl:sameAs
- > Constraint Class Declaration
 - owl:Restriction
- > Special Properties
 - owl:SymmetricProperty, owl:FunctionalProperty, owl:InverseFunctionalProperty
- > Domain and Ranges
 - owl:allValuesFrom, owl:someValuesFrom, owl:hasValue





Alignment Reasoning

> Unify Different Ontologies

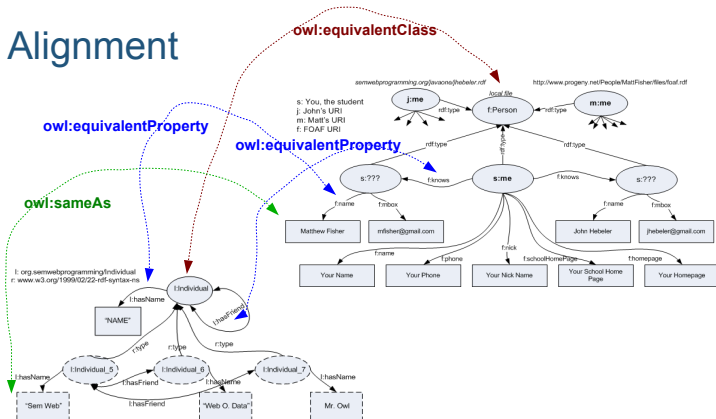
- Seamless navigation and queries across diverse ontological representation (and reasoning)
- Logic outlines the alignment, reasoner does the heavy lifting
- Automatic alignment active R&D area

> Examples

- `ont1:Individual owl:equivalentClass ont2:Person`
- `ont1:friendOf rdfs:subClass ont2:knows`



Alignment





Setting up a Reasoner in Jena

1) Add "Logic" Statements to Jena Model (*add anytime*)

- `model.createResource()` for Subject and Object
- `model.createObjectProperty()` or Direct static OWL (*OWL.sameAs*)
- `model.add(sub, pred, obj)`

2) Acquire a Reasoner

- Reasoner reasoner =
`ReasonerRegistry.getOWLReasoner () // Jena`
- Reasoner reasoner =
`PelletReasonerFactory.theInstance().create(); // Pellet`

3) Bind the Reasoner to the Model

- `model = ModelFactory.createInferModel(reasoner, model);`
- > Activation immediate via *forward* or *backward* chaining



Further Reading

- Jena Tutorials: <http://kill.devc.at/node/84>,
<http://www.devx.com/semantic/Article/34968>, <http://www.ibm.com/developerworks/xml/library/j-jena/>
- Protégé Tutorials:
<http://protege.stanford.edu/doc/users.html>
- Pellet Reasoner: <http://clarkparsia.com/pellet>

Questions

Any questions?

Thank you

Thank you for your attention!

<http://geist.agh.edu.pl>
GEIST Research Group



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