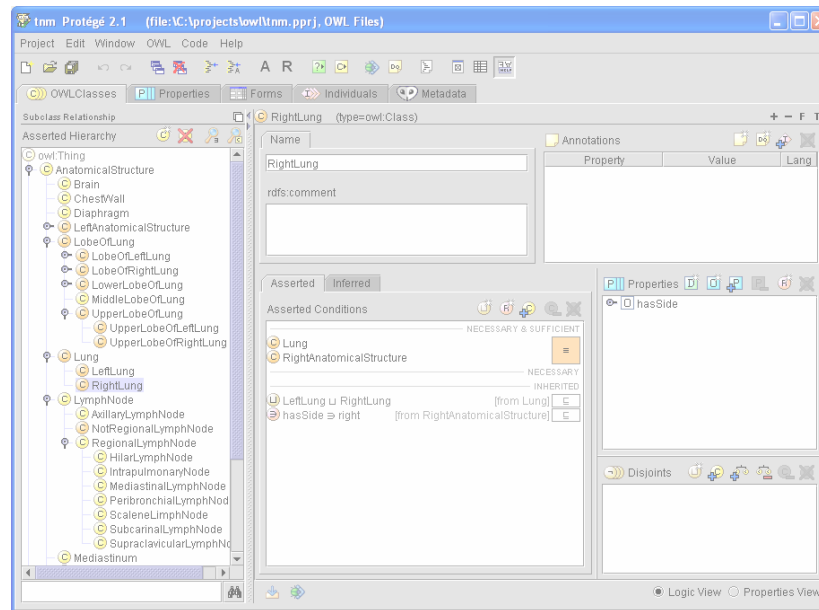


The Protégé OWL Plugin

Holger Knublauch

Stanford University

July 07 2004



Overview

The Semantic Web and OWL

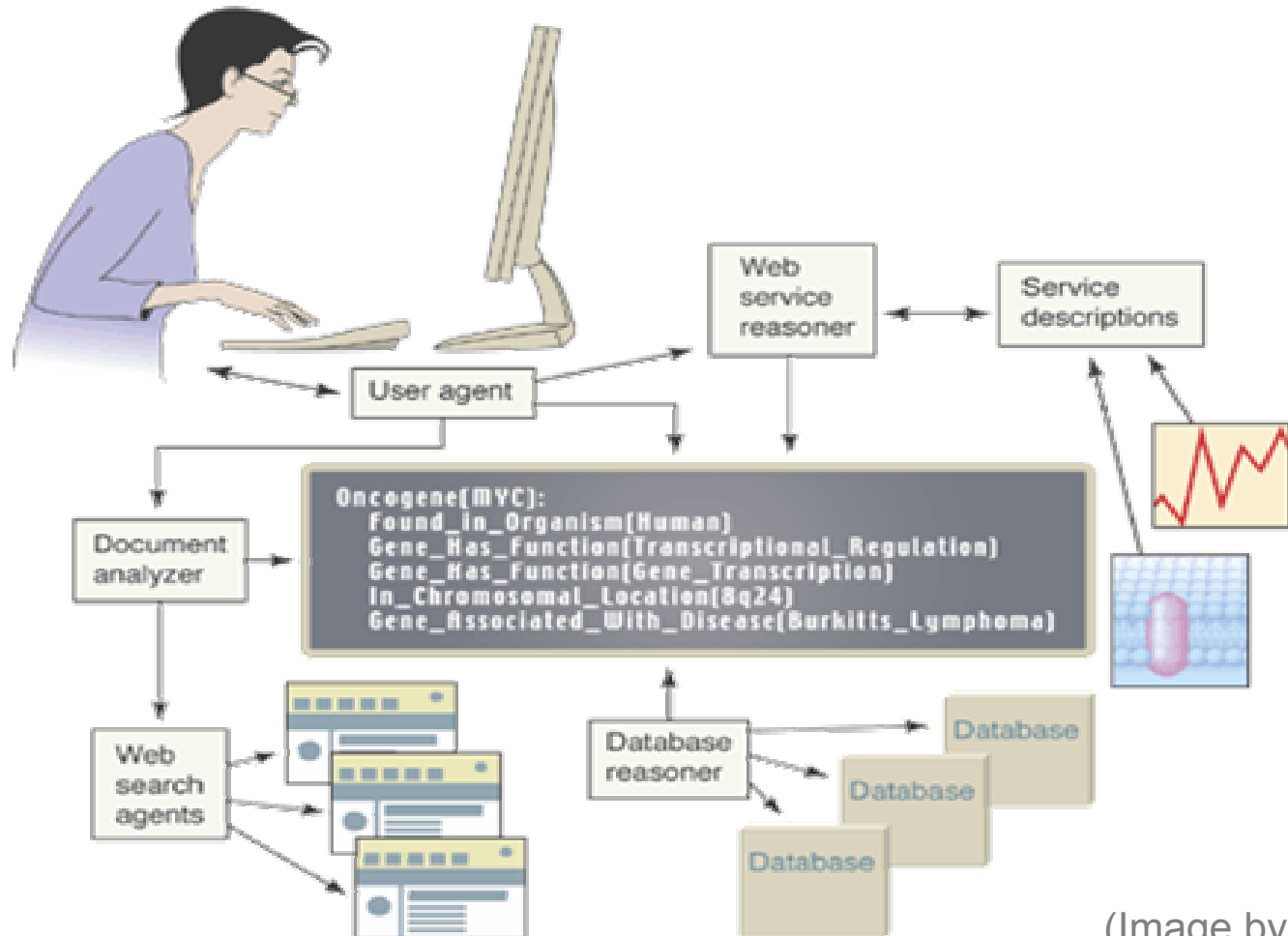
OWL in the Protégé Community

The OWL Plugin

Future Directions

The Semantic Web

Shared ontologies help to exchange data and meaning between web-based services



(Image by Jim Hendler)

OWL

- Web Ontology Language
- Official W3C Standard since Feb 2004



- A Web Language: Based on RDF(S)
- An Ontology Language: Based on logic

OWL Overview

OWL for data exchange



Classes

- Subclass relationships
- Disjoint classes



Properties

- Characteristics (transitive, inverse)
- Range and Domain



Individuals

- Property values

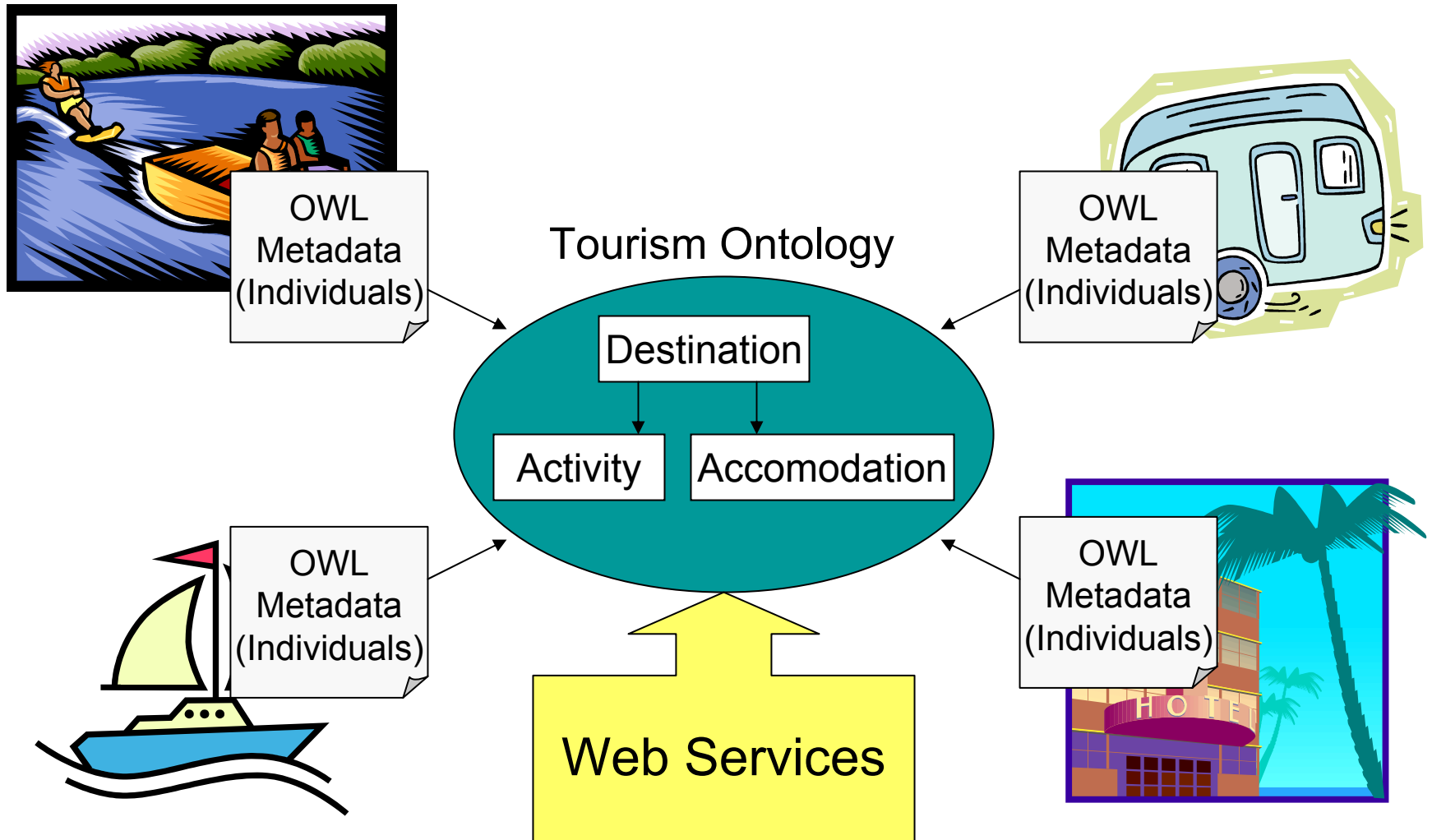


Class Descriptions

- Restrictions
- Logical expressions

OWL for knowledge sharing





Example Semantic Web






Description Logics

- Classes can be defined using logical expressions about their members.

Restrictions

-  allValuesFrom
-  someValuesFrom
-  hasValue
-  minCardinality
-  maxCardinality
-  cardinality

Logical Expressions

-  unionOf
-  intersectionOf
-  complementOf

Enumerations

{red green blue}

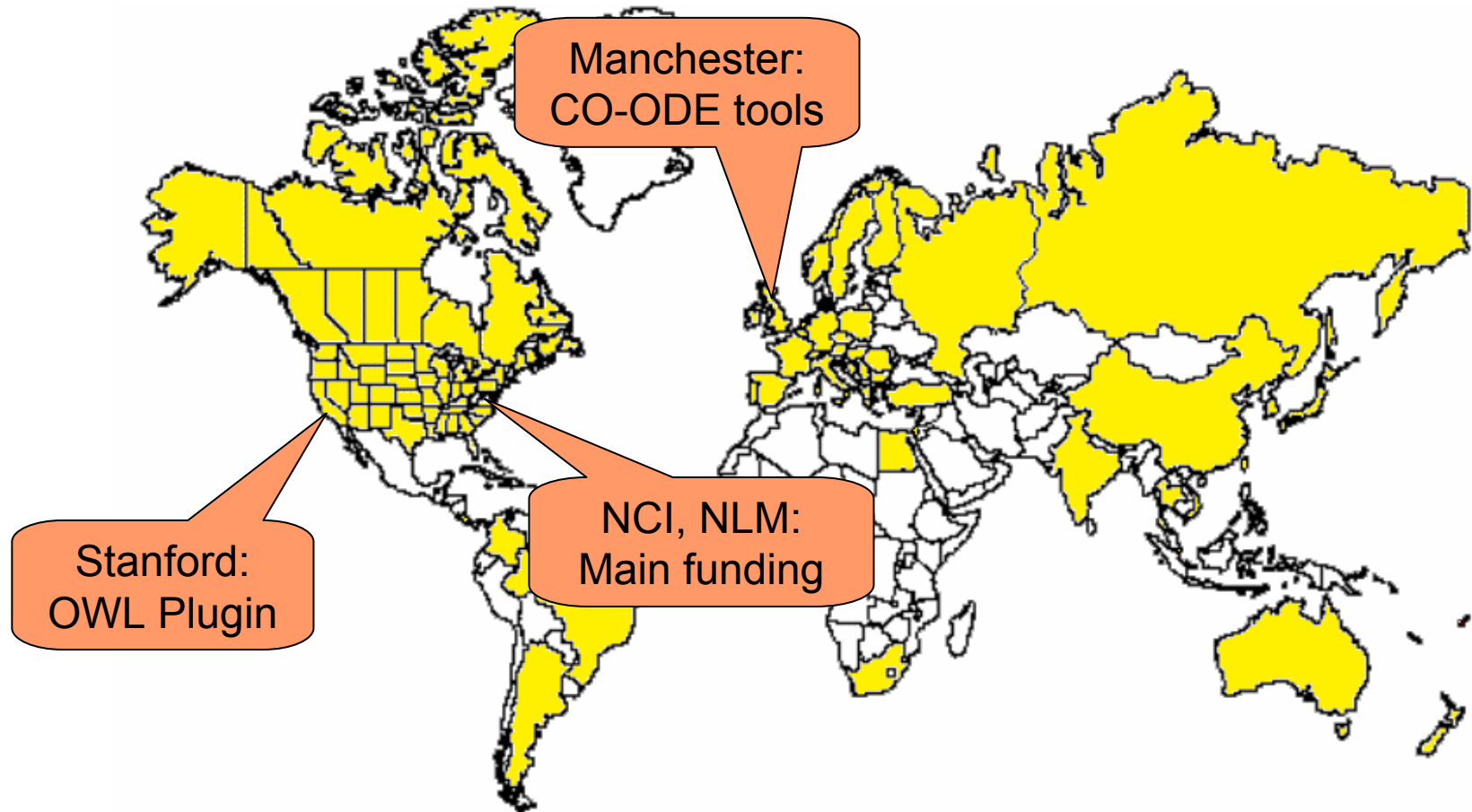
Description Logics Example

- Asserted definitions:
 - “National parks provide hiking trails”
 - “Hiking is a sport”
 - “Those destinations with sporting facilities are backpacker’s destinations”
- Automatically inferred:
 - National parks are backpacker’s destinations

Class Descriptions: Why?

- Make knowledge sharable with machines
- Make explicit intentions and modeling decisions (comparable to test cases)
- Make sure that individuals fulfill conditions
- Tool-supported reasoning
 - Classification of classes and individuals
 - Consistency Checking

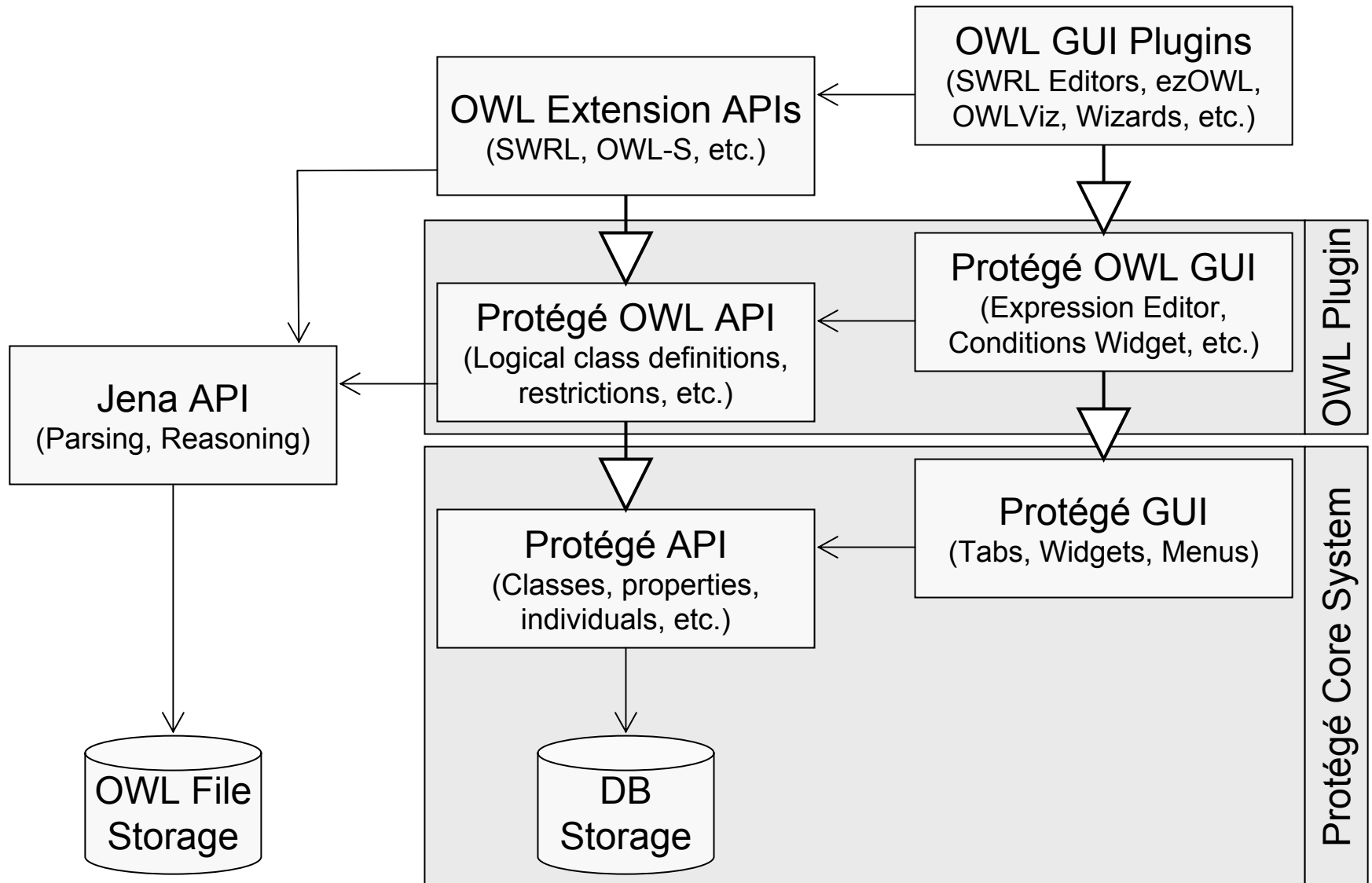
Protégé OWL Community



OWL Plugin

- Large Protégé Plugin (>560 classes)
- Extends base system with
 - OWL language capabilities (metamodel, files)
 - Custom-tailored user interface
 - Access to description logic reasoners
 - Code generators etc
- Many features are native to OWL
- Backwards compatible where possible

OWL Plugin Architecture



Logic View

The screenshot shows the Protégé 2.1.1 interface with the Logic View for the class `BackpackersDestination`. The window title is "travel Protégé 2.1.1 (file:IC:\projects\owl\travel.pprj, OWL Files)".

Subclass Relationship: The left pane shows the "Asserted Hierarchy" for `owl:Thing`. The class `BackpackersDestination` is highlighted under the `Destination` class.

Class Details: The main pane shows the "Name" field as `BackpackersDestination` and the `rdfs:comment` as "A destination that provides budget accomodation and offers sport or adventure activities."

Annotations: A table shows the `rdfs:comment` property with the value "A destination that provide..." and language "en".

Asserted Conditions: The "Asserted" tab shows the following conditions:

- `Destination` (NECESSARY & SUFFICIENT)
- `∃ hasAccommodation BudgetAccommodation` (NECESSARY)
- `∃ hasActivity (Sports ⊔ Adventure)` (NECESSARY)

Properties: The right pane shows the "Properties" section with the following restrictions:

- `hasAccommodation` (multiple Accomodation) with restriction `⊖ BudgetAccommodation`
- `hasActivity` (multiple Activity) with restriction `⊖ Sports ⊔ Adventure`
- `hasPart` (multiple Destination)

Disjoints: The "Disjoints" section shows a restriction on `RetireeDestination`.

View Mode: The bottom right corner indicates the current view is "Logic View".

Prose Generation

Asserted Inferred

Asserted Conditions

NECESSARY & SUFFICIENT

- Destination
- \neg FamilyDestination

NECESSARY

Is not a family destination

Asserted Conditions

NECESSARY & SUFFICIENT

- Destination
- \exists hasAccommodation BudgetAccommodation
- \exists hasActivity (Sports, Adventure)

NECESSARY

Has a budget accomodation as its accomodation

Properties View

The screenshot shows the Protégé 2.1.1 interface with the following components:

- Title Bar:** travel Protégé 2.1.1 (file:IC:\projects\owl\travel.pprj, OWL Files)
- Menu Bar:** Project Edit Window OWL Code Help
- Toolbar:** Standard Protégé icons for file operations and editing.
- Navigation Tabs:** OWLClasses, Properties (selected), Forms, Individuals, Metadata.
- Subclass Relationship:** Destination (type=owl:Class)
- Asserted Hierarchy:**
 - owl:Thing
 - Accommodation
 - BedAndBreakfast
 - BudgetAccommodation
 - Campground
 - Hotel
 - AccommodationRating
 - Activity
 - Adventure
 - Relaxation
 - Sightseeing
 - Sports
 - Contact
 - Destination** (selected)
 - BackpackersDestination
 - Beach
 - BudgetHotelDestination
 - FamilyDestination
 - QuietDestination
 - RetireeDestination
 - RuralArea
 - Farmland
 - NationalPark
 - UrbanArea
 - City
 - Capital
 - Town

- Name:** Destination
- Annotations:** rdfs:comment
- Properties:**
- hasAccommodation (multiple Accommodation)
- hasActivity (multiple Activity)
- hasPart (multiple Destination)
- Superclasses:** owl:Thing
- Disjoints:** (empty)
- View Mode:** Properties View (selected)

Classification

travel-new Protégé 2.1.1 (file:IC:\projects\owl\travel-new.pprj, OWL Files)

Project Edit Window OWL Code Help

OWLClasses Properties Forms Individuals Metadata

Subclass Relationship

Asserted Hierarchy

- Campground
 - Hotel
 - LuxuryHotel
- AccommodationRating
- Activity
 - Adventure
 - Relaxation
 - Sightseeing
 - Sports
- Contact
- Destination
 - BackpackersDestination
 - NationalPark
 - FamilyDestination
 - QuietDestination
 - RetireeDestination
 - Capital
 - RuralArea
 - Farmland
 - NationalPark
 - UrbanArea
 - City
 - Capital
 - Town
 - BackpackersDestination
 - FamilyDestination
 - QuietDestination

Inferred Hierarchy

- BedAndBreakfast
- BudgetAccommodation
 - Campground
- Hotel
- AccommodationRating
- Activity
- Contact
- Destination
 - BackpackersDestination
 - NationalPark
 - FamilyDestination
 - QuietDestination
 - RetireeDestination
 - Capital
 - RuralArea
 - Farmland
 - NationalPark
 - UrbanArea
 - City
 - Capital
 - Town

NationalPark (type=owl:Class)

Name: NationalPark

Annotations: rdfs:comment

Asserted Inferred

Asserted Conditions

- NECESSARY & SUFFICIENT
- NECESSARY
- RuralArea
- ∃ hasAccommodation Campground
- ∃ hasActivity Hiking

Logic View Properties View

Class	Changed superclasses
Campground	Moved from Accommodation to BudgetAccommodation
Capital	Added RetireeDestination
NationalPark	Added BackpackersDestination

Classification Results

Consistency Checking

The screenshot shows the Protégé 2.1.1 interface with the 'LuxuryCampground' class selected. The 'Subclass Relationship' pane on the left shows a hierarchy where 'LuxuryCampground' is a subclass of 'Campground', which is a subclass of 'Accommodation'. The 'Asserted Conditions' pane shows that 'LuxuryCampground' inherits the 'hasRating' property from 'Campground', which is necessary and sufficient for 'ThreeStarRating' and 'OneStarRating'. The 'Properties' pane shows that 'hasRating' is a property of 'Accommodation' with values 'ThreeStarRating' and 'OneStarRating'. The 'Classification Results' pane at the bottom shows the following table:

Class	Changed superclasses
Campground	Moved from Accommodation to BudgetAccommodation
Capital	Added RetireeDestination
LuxuryCampground	Inconsistent
NationalPark	Added BackpackersDestination
Safari	Inconsistent

TODO Lists

The screenshot shows the Protégé 2.1.1 interface. The main window displays the 'Animal' class (type=owl:Class) with its name and an annotation 'owl:versionInfo' with the value 'TODO: Add languages'. The 'Subclass Relationship' panel shows a hierarchy starting from 'owl:Thing' and including 'Animal', 'Marsupials', 'Parent', 'Person', 'Student', 'GraduateStudent', and 'MaleStudentWith3Daugh'. The 'Properties' panel lists 'hasChildren' (multiple Animal), 'hasGender' (single Gender), and 'hasHabitat' (multiple Habitat). The 'Test Results' panel at the bottom shows a table with two rows: 'Marsupials' with the test result 'TODO: Add more marsupials' and 'Animal' with the test result 'TODO: Add languages'.

koala-fail Protégé 2.1.1 (file:C:\projects\owl\koala-fail.pprj, OWL Files)

Project Edit Window OWL Code Help

OWLClasses Properties Forms Individuals Metadata

Subclass Relationship

Animal (type=owl:Class)

Annotations

Property	Value	Lang
owl:versionInfo	TODO: Add languages	

Properties

- hasChildren (multiple Animal)
- hasGender (single Gender)
- hasHabitat (multiple Habitat)

Test Results

Type	Source	Test Result
Marsupials		TODO: Add more marsupials
Animal		TODO: Add languages

Ontology Tests

The screenshot shows the Protégé 2.1.1 interface with the 'hasBrother' property selected. The 'Test Results' panel at the bottom displays the following table:

Type	Source	Test Result
✗	hasBrother	Symmetric properties must have equal ranges and domains.
⚠	hasChildren ↔ isChildOf	The inverse of a transitive property should be also transitive.
⚠	IllegalParent	Constraint violation at hasGender: A value is required
⚠	IllegalParent	Constraint violation at hasHabitat: A value is required
⚠	MetaCls	Metaclasses are not allowed in OWL DL.
⚠	hasChildren = 3	Cardinality restrictions on transitive properties (or inverse or super properties of them) are not allowed in O...
⚠	hasChildren ≥ 1	Cardinality restrictions on transitive properties (or inverse or super properties of them) are not allowed in O...
⚠	hasChildren ↔ isChildOf	Transitive properties (or inverse or super properties of them) cannot be functional in OWL DL.

Individuals

heli-bunjee Protégé 2.1.1 (file:\C:\projects\owl\heli-bunjee.pprj, OWL Files)

Project Edit Window OWL Code Help

OWLClasses Properties Forms Individuals Metadata

Classes

- owl:Thing
 - travel:Accommodation
 - travel:AccommodationRating (3)
 - travel:Activity
 - travel:Adventure
 - travel:Relaxation
 - travel:Sightseeing
 - travel:Sports
 - travel:Contact (1)
 - travel:Destination
 - travel:BackpackersDestination
 - travel:Beach (2)
 - travel:BudgetHotelDestination
 - travel:FamilyDestination
 - travel:QuietDestination
 - travel:RetireeDestination
 - travel:RuralArea (2)
 - travel:UrbanArea

Display Slot

S:NAME

Direct Instances

- MSBInc

MSBInc (type=travel:Contact)

Name SameAs DifferentFrom

MSBInc

rdfs:comment

Annotations

Property	Value
----------	-------

Travel:hasCity

Sydney

Travel:hasEMail

Travel:hasStreet

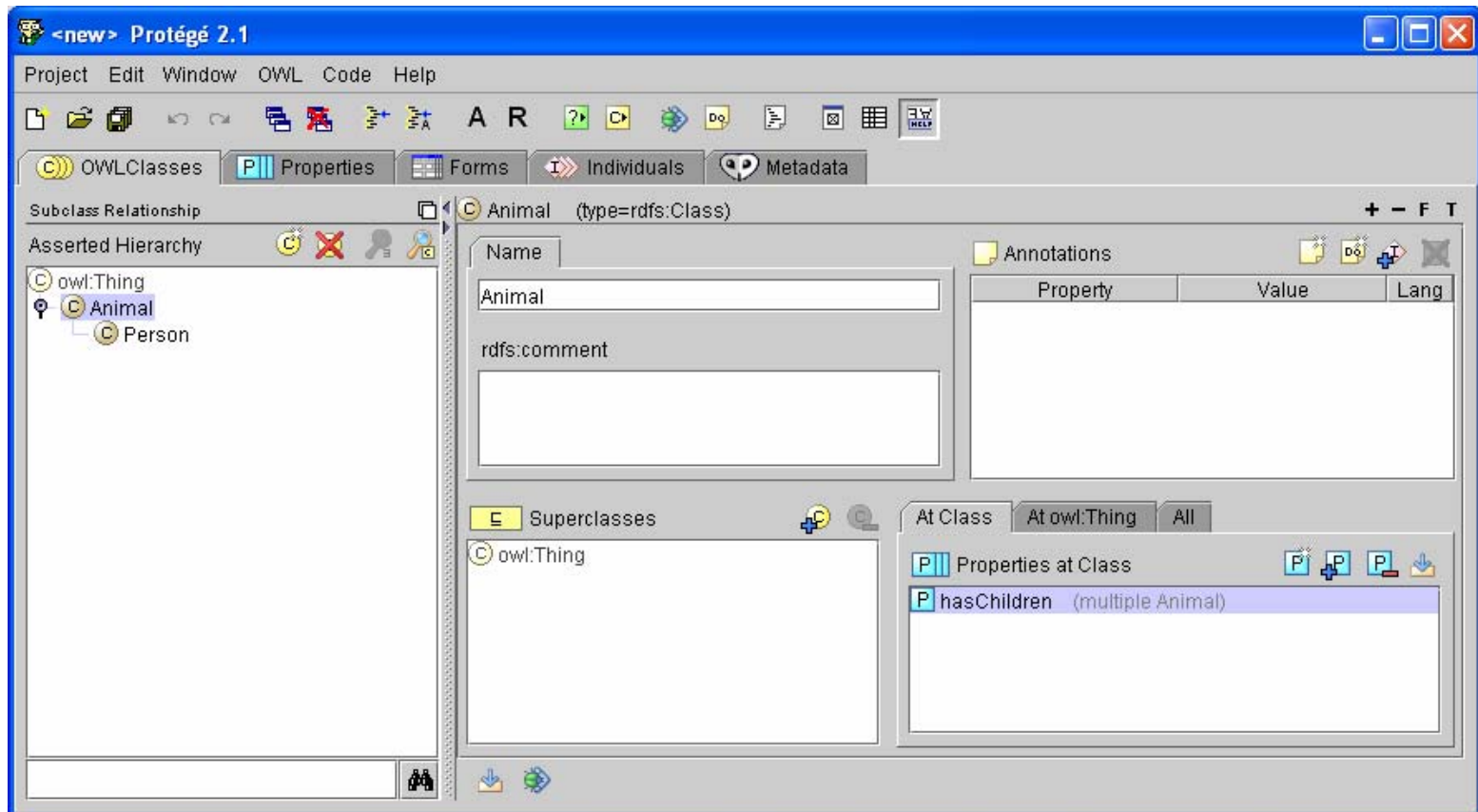
Queen Victoria St

Travel:hasZipCode

1240

RDF(S) Editing

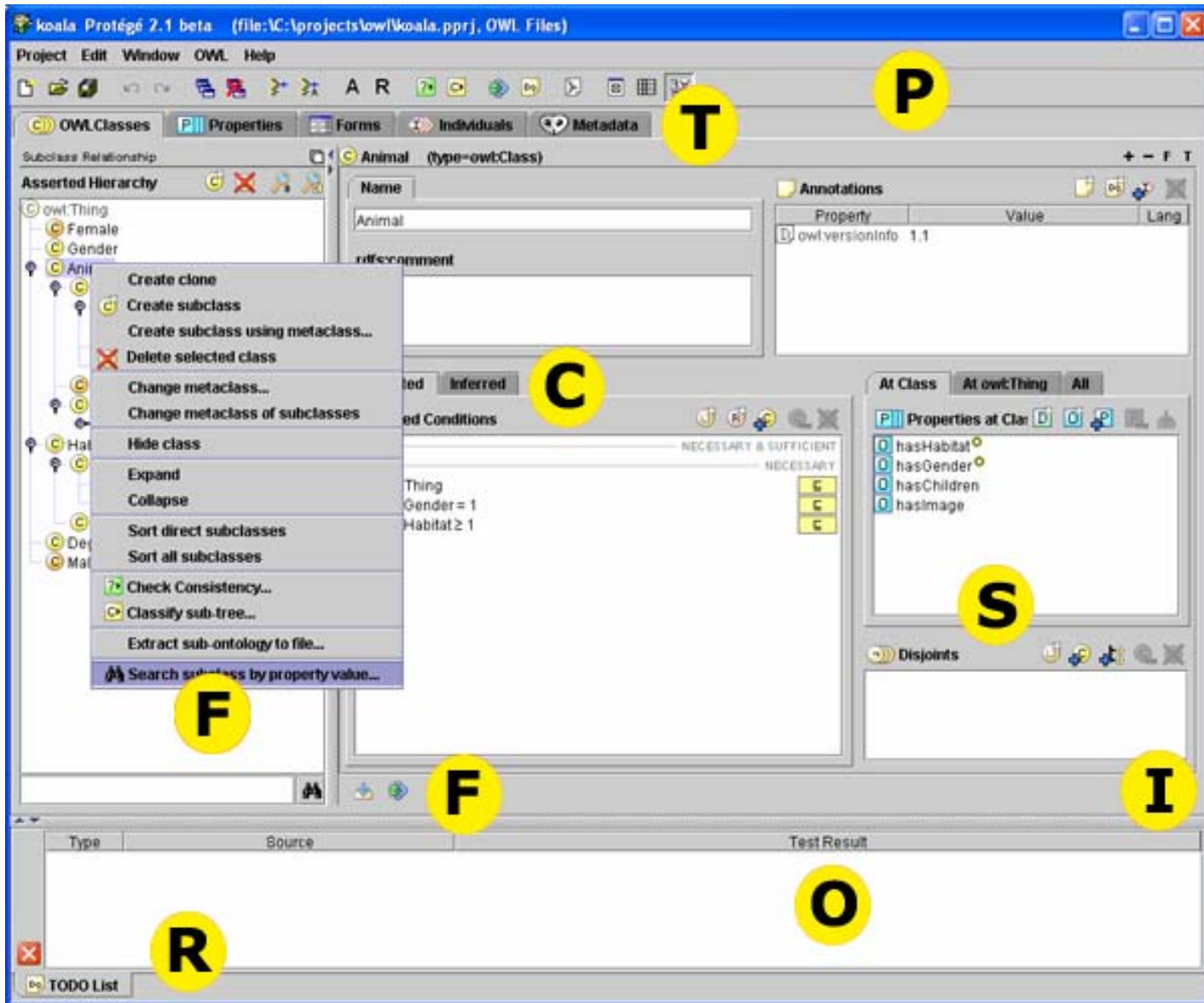
- OWL extends RDF, OWL Plugin can edit RDF
- Select Language Profile RDF(S)



Code Generators

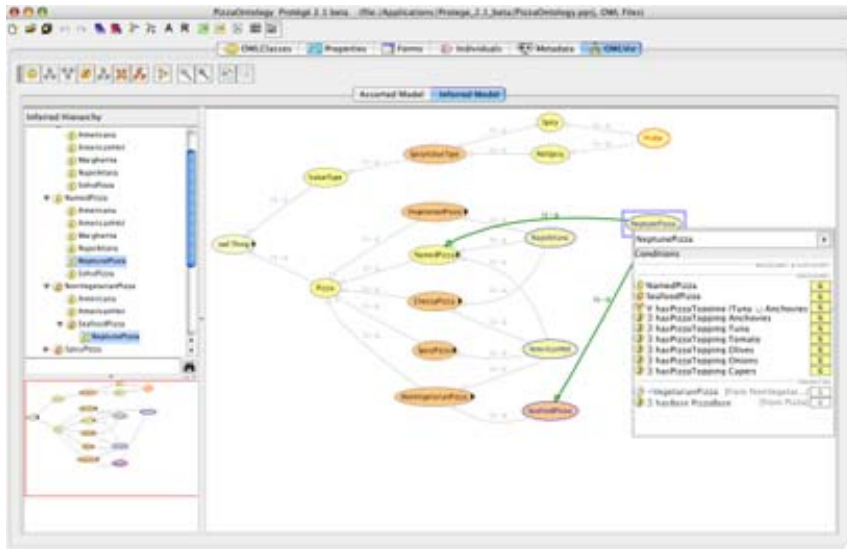
- Create Java classes to easier access OWL ontologies
 - Jena Schema generator
 - Kazuki interfaces
- Better integration into other software development activities

Extending the OWL Plugin

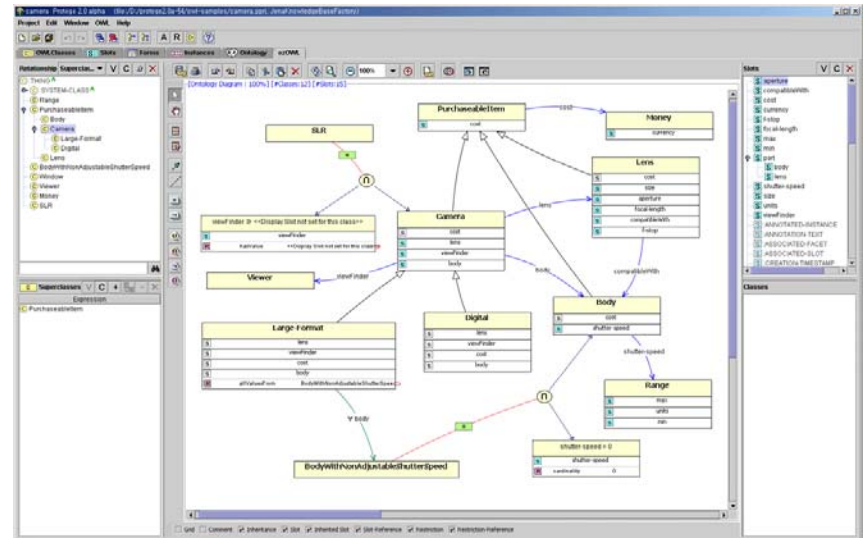


Other OWL Plugins

OWLViz (Manchester)



ezOWL (Korea)



OWLWizards (Manchester)

Properties Matrix

click here for more help

Steps
 Choose Classes
 Choose Properties
 Set Properties
 Finish

Class	hasBase	hasPizzaTopping	hasSpiciness
AmericanHot		<input type="radio"/> JalapenoPepper <input type="radio"/> Tomato <input type="radio"/> Pepperoni <input type="radio"/> Mozzarella	NotSpicy
Americana		<input type="radio"/> Mozzarella <input type="radio"/> Pepperoni <input type="radio"/> Tomato	Spicy
Margherita	<input checked="" type="radio"/> ThinAndCrispyBase	<input type="radio"/> Tomato <input type="radio"/> Mozzarella	
Napoletana		<input type="radio"/> Tomato <input type="radio"/> Olives <input type="radio"/> Mozzarella <input type="radio"/> Olives <input type="radio"/> Capers <input type="radio"/> Tomato	NotSpicy
NeptunePizza		<input checked="" type="radio"/> PizzaBase <input type="radio"/> DeepPan <input type="radio"/> ThinAndCrispyBase	
SohoPizza			

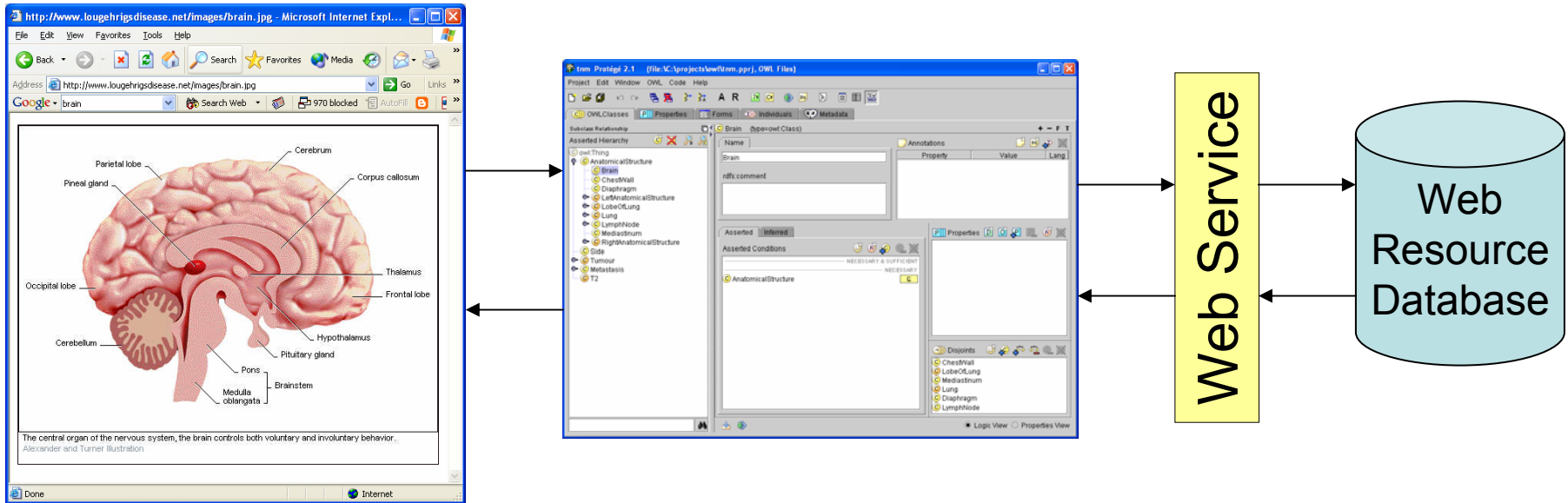
Finish Cancel

Under Development:

- OWL-S
- SWRL
- Semantic Debugging
- Joseki (Jena Database)

Integrating Web Services

- Arbitrary extensions can benefit from the Protégé infrastructure as a platform



OWL Benefits

- OWL is the W3C ontology standard
- Interoperable with RDF and XML
- Growing community and tool support
- OWL has formal semantics and built-in reasoning support
- Semantics support maintenance of large ontologies / knowledge models

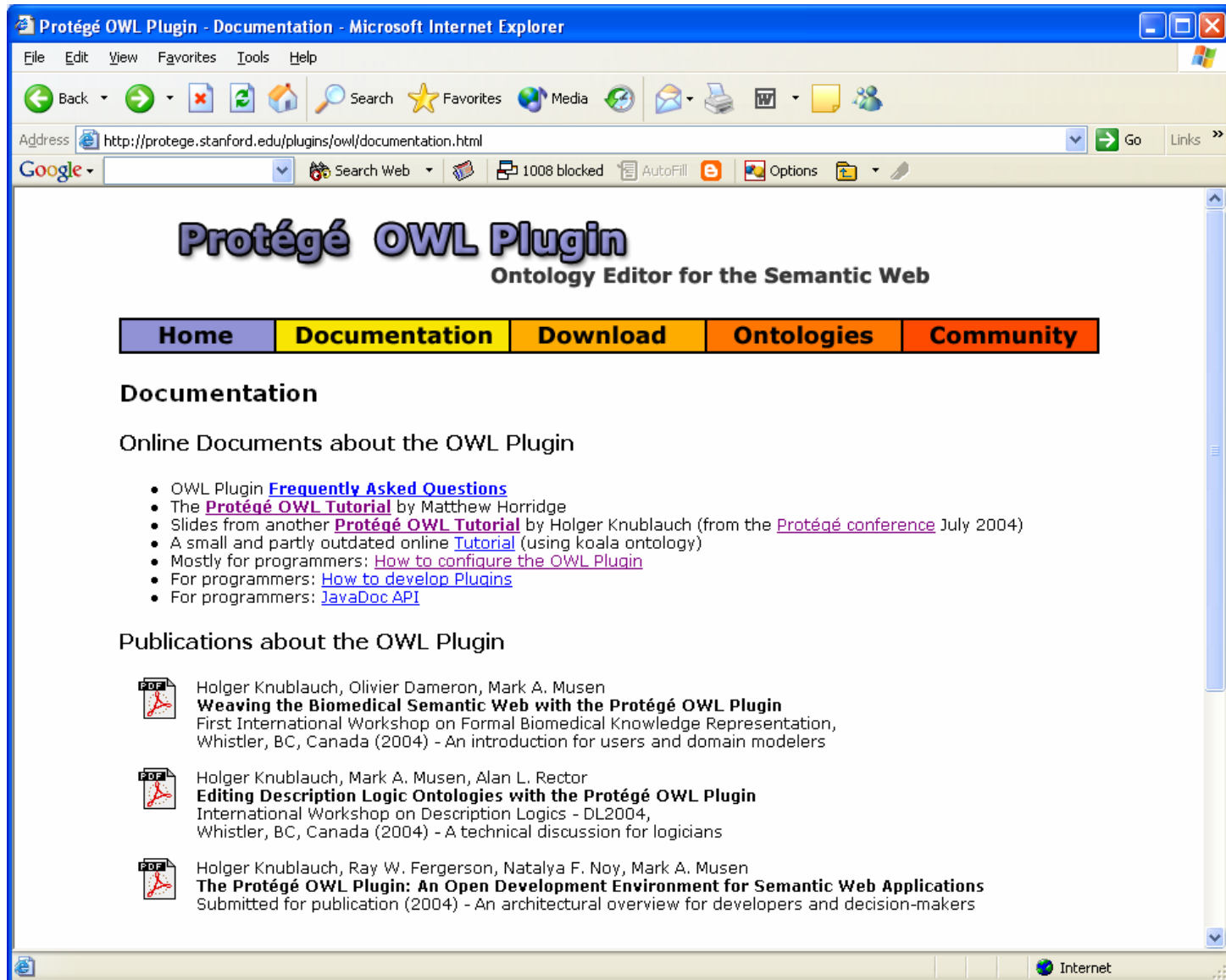
Protégé OWL Benefits

- A de facto standard tool in the OWL world
- Growing number of plugins / adaptations
- Custom-tailored Open-Source API
- Online support
- Robust platform
- Compatibility with Jena
- Scalable (Database backend)

OWL Risks

- Steep learning curve
 - Difficult syntax
 - Difficult semantics (→ OWL Tutorial)
- Semantic Web hype /
Lack of real-world example applications
- Chicken-and-egg problem of Semantic Web

Getting Started



The screenshot shows a Microsoft Internet Explorer browser window with the title "Protégé OWL Plugin - Documentation - Microsoft Internet Explorer". The address bar contains the URL "http://protege.stanford.edu/plugins/owl/documentation.html". The page content includes a navigation menu with buttons for "Home", "Documentation", "Download", "Ontologies", and "Community". The "Documentation" section is active, showing a list of online documents and publications about the OWL Plugin.

Protégé OWL Plugin
Ontology Editor for the Semantic Web


[Home](#) [Documentation](#) [Download](#) [Ontologies](#) [Community](#)


Documentation


Online Documents about the OWL Plugin

- OWL Plugin [Frequently Asked Questions](#)
- The [Protégé OWL Tutorial](#) by Matthew Horridge
- Slides from another [Protégé OWL Tutorial](#) by Holger Knublauch (from the [Protégé conference](#) July 2004)
- A small and partly outdated online [Tutorial](#) (using koala ontology)
- Mostly for programmers: [How to configure the OWL Plugin](#)
- For programmers: [How to develop Plugins](#)
- For programmers: [JavaDoc API](#)

Publications about the OWL Plugin

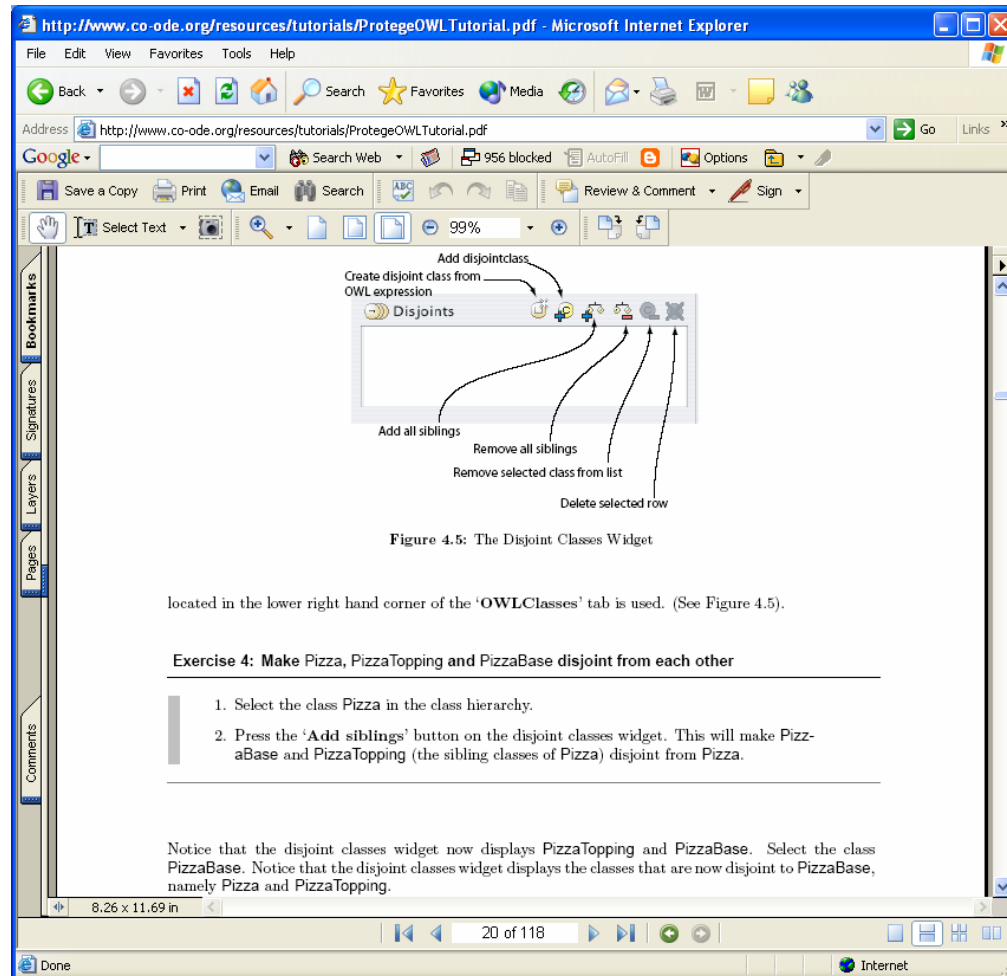
 Holger Knublauch, Olivier Dameron, Mark A. Musen
Weaving the Biomedical Semantic Web with the Protégé OWL Plugin
First International Workshop on Formal Biomedical Knowledge Representation, Whistler, BC, Canada (2004) - An introduction for users and domain modelers

 Holger Knublauch, Mark A. Musen, Alan L. Rector
Editing Description Logic Ontologies with the Protégé OWL Plugin
International Workshop on Description Logics - DL2004, Whistler, BC, Canada (2004) - A technical discussion for logicians

 Holger Knublauch, Ray W. Fergerson, Natalya F. Noy, Mark A. Musen
The Protégé OWL Plugin: An Open Development Environment for Semantic Web Applications
Submitted for publication (2004) - An architectural overview for developers and decision-makers

OWL Tutorial (Manchester)

<http://www.co-ode.org/resources/>



Outlook

- OWL will remain a focus at Stanford
 - Simpler user interface
 - Better Workflow/Versioning support
 - Optimized access to reasoners (RACER)
 - Numeric range restrictions
 - Access to UML/Model Driven Architecture
- More plugins will be available
- Collaborations?