

iPlant Semantic Web Program

SSWAP:

Simple Semantic Web Architecture And Protocol



PLANT AND ANIMAL GENOME CONFERENCE
JANUARY 2012

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The Field



Science is not a spectator sport

From Simple Actions Emerge Complex Systems



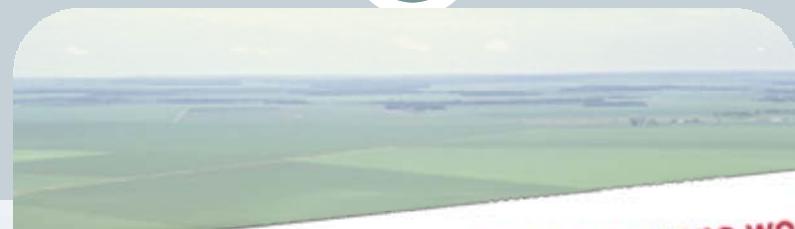
Sugar cane

Rain Forest

http://img.timeinc.net/time/daily/2008/0803/a_wbiofuels_0407.jpg

<http://www.agriculture.com/ag/slideshow/slideshow.jhtml?slideid=/templatedata/ag/slideshow/data/1144946148737.xml&page=2>

Non-Linear Dynamical Systems



Impact of climate change on crops worse than previously thought

The impact of climate change on global crop production is likely to be worse than previously predicted, scientists said in a 2005 Royal Society Discussion Meeting.

The two-day international meeting entitled "Food Crops in a Changing Climate" brought together world-class scientists in the fields of meteorology, climate science and agriculture, to discuss the impacts of a changing climate on the productivity of staple food crops, grown throughout the world.



<http://royalsociety.org/page.asp?tip=1&id=4762>

http://img.timeinc.net/time/daily/2008/0803/a_wbiofuels_0407.jpg

<http://www.agriculture.com/ag/slideshow/slideshow.jhtml?slideid=/templatedata/ag/slideshow/data/1144946148737.xml&page=2>

Non-Linear Dynamical Systems



Impact of climate change on crops worse than previously thought

The impact of climate change on global crop production is likely to be more than previously predicted, according to a new report.

7 BILLION

2011 REPORT LAUNCHES 26 OCTOBER

Seven billion people inhabiting the earth

UN Population Fund 2011

<http://royalsociety.org/page.asp?tip=1&id=4762>

http://img.timeinc.net/time/daily/2008/0803/a_wbiofuels_0407.jpg

<http://www.agriculture.com/ag/slideshow/slideshow.jhtml?slideid=/templatedata/ag/slideshow/data/1144946148737.xml&page=2>

Evidence-based Decision-making



http://blog.lib.umn.edu/ellis271/arch1701/bigstockphoto_Global_Warming_217540%203.jpg



http://www.smartpower.org/blog/wp-content/photos/field_turbines.jpg

Decisions have downstream and unintended consequences; analyses and decisions about our Natural world that utilize a scientific approach bias our odds towards viable solutions.

Evidence-based Decision-making Requires ... Evidence

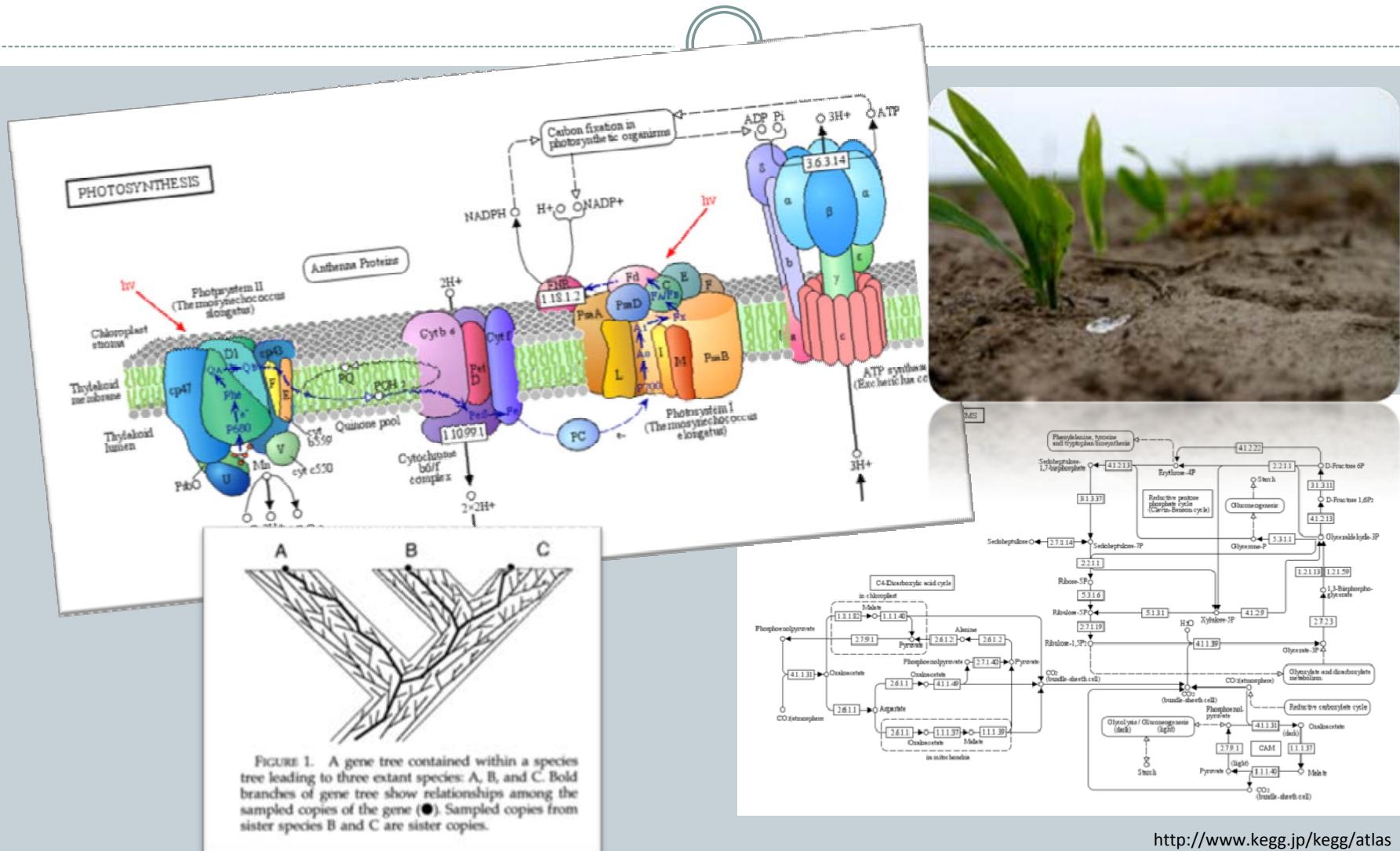


FIGURE 1. A gene tree contained within a species tree leading to three extant species: A, B, and C. Bold branches of gene tree show relationships among the sampled copies of the gene (●). Sampled copies from sister species B and C are sister copies.

Maddison WP 1997 Syst. Biol. 46(3): 523-536

<http://www.kegg.jp/kegg/atlas>

iPlant Integrative, Collaborative, Science



iPToL

Ultra High-Throughput Sequencing
(200+ Gbp/run)

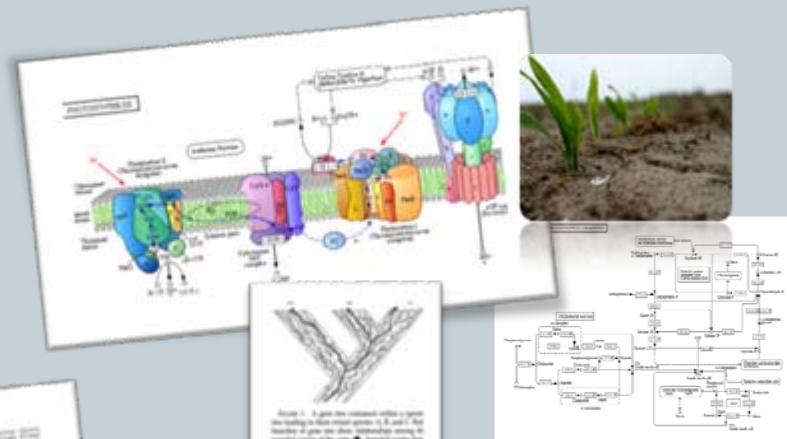
Evolution
(cognitive model)

Association Genetics / QTL
Mapping

Technology
(drivers)

iPG2P

Advances
(scientific and social return)



iPlant Integrative, Collaborative, Science



iPToL

Three reasons:

Scientific: The meaning, refinement, context, and value of scientific ideas and concepts changes with discovery; it changes at a rate faster than the life cycle of many informatic infrastructures

Technical: Much meaning and semantics is implicit, not explicit. Thus it is labor intensive to extract context and merge data and services; scaling is linear, not exponential.

Social: Value and discoveries are generated across disciplines, under different funding models, in different institutions, in different cultures, with different reward structures

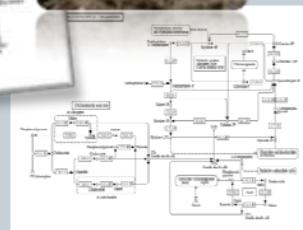
Evolution
(cognitive model)

Technology
(drivers)

Advances
(scientific and social return)

Association Genetics / QTL
Mapping

Ultra High Throughput Sequencing



Data Integration is Hard



Three reasons:

Scientific: The meaning, refinement, context, and value of scientific ideas and concepts changes with discovery; it changes at a rate faster than the life cycle of many informatic infrastructures

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Social: Value and discoveries are generated across disciplines, under different funding models, in different institutions, in different cultures, with different reward structures

Distributed Nature of Modern Science



For today's problems ...

- Effective responses to infectious diseases (including crops)
- Feeding the world
- Bio-fuels research and production
- Many more ...

The relevant data sets and expertise span disciplines, institutions, and countries.

It is, by its nature, distributed, both geographically and cognitively.

The Challenge



Integrate across web sites, across data sets, across scientific models and procedures

This is, of course, hugely challenging and not naively attainable, but significant progress can be made.

Here, I'll show you our approach, starting with the architecture and proceeding into the platform and developer tools.

Our architecture is open; any one from any web site can be part of it and all our code is free and open source.

The Actors



You

The Actors



You



**Community
MODS (Model Organism Databases)
and
CODS (Clade Oriented Databases)**

The Actors



You



iPlant Computational
Resources (*e.g.*, TACC)



Community
**MODS (Model Organism Databases)
and
CODS (Clade Oriented Databases)**

The Actors



The World



You



Your lab



The World

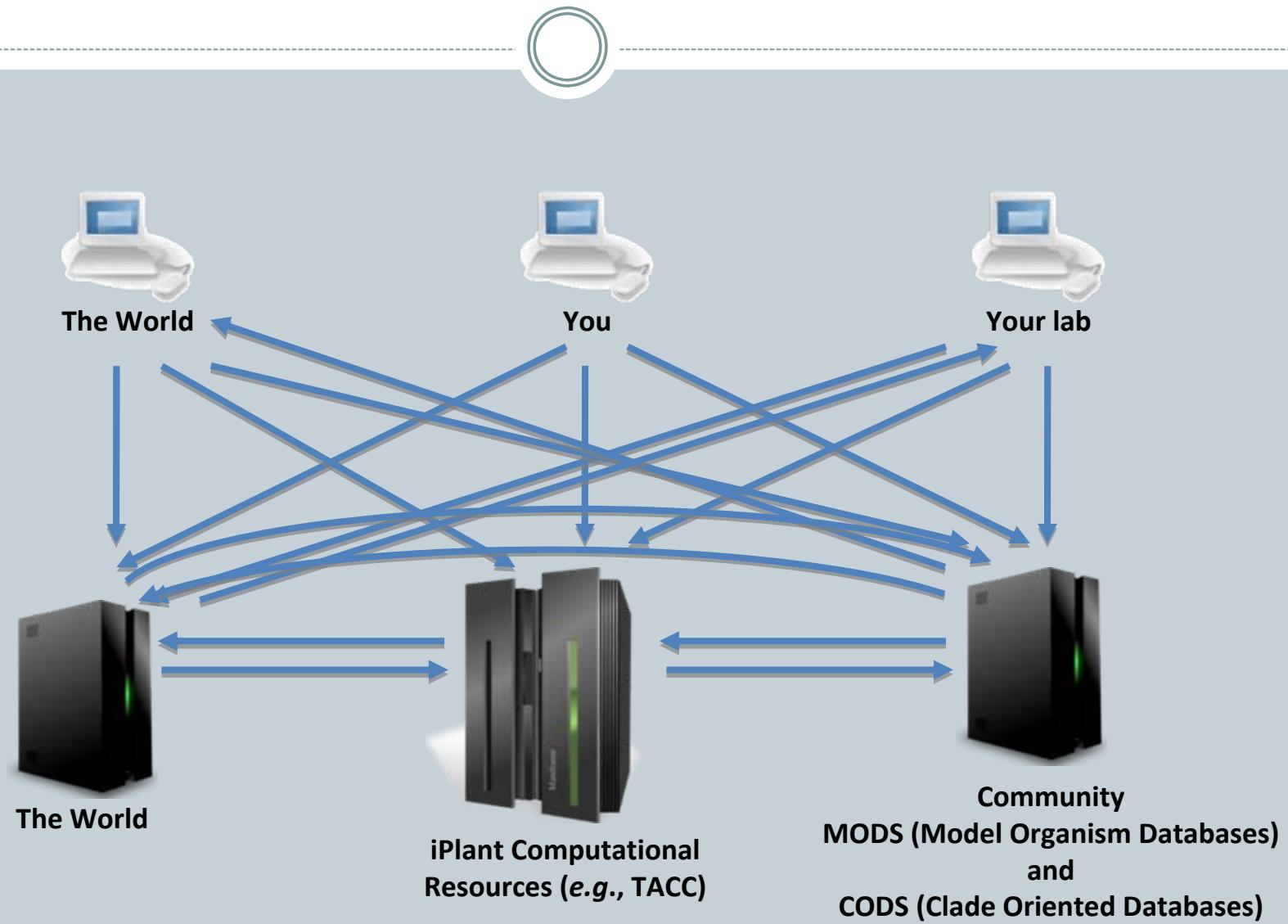


**iPlant Computational
Resources (e.g., TACC)**



**Community
MODS (Model Organism Databases)
and
CODS (Clade Oriented Databases)**

The Actors



The Actors



The World



You



Your lab

Open Semantic Mediation Layer



The World

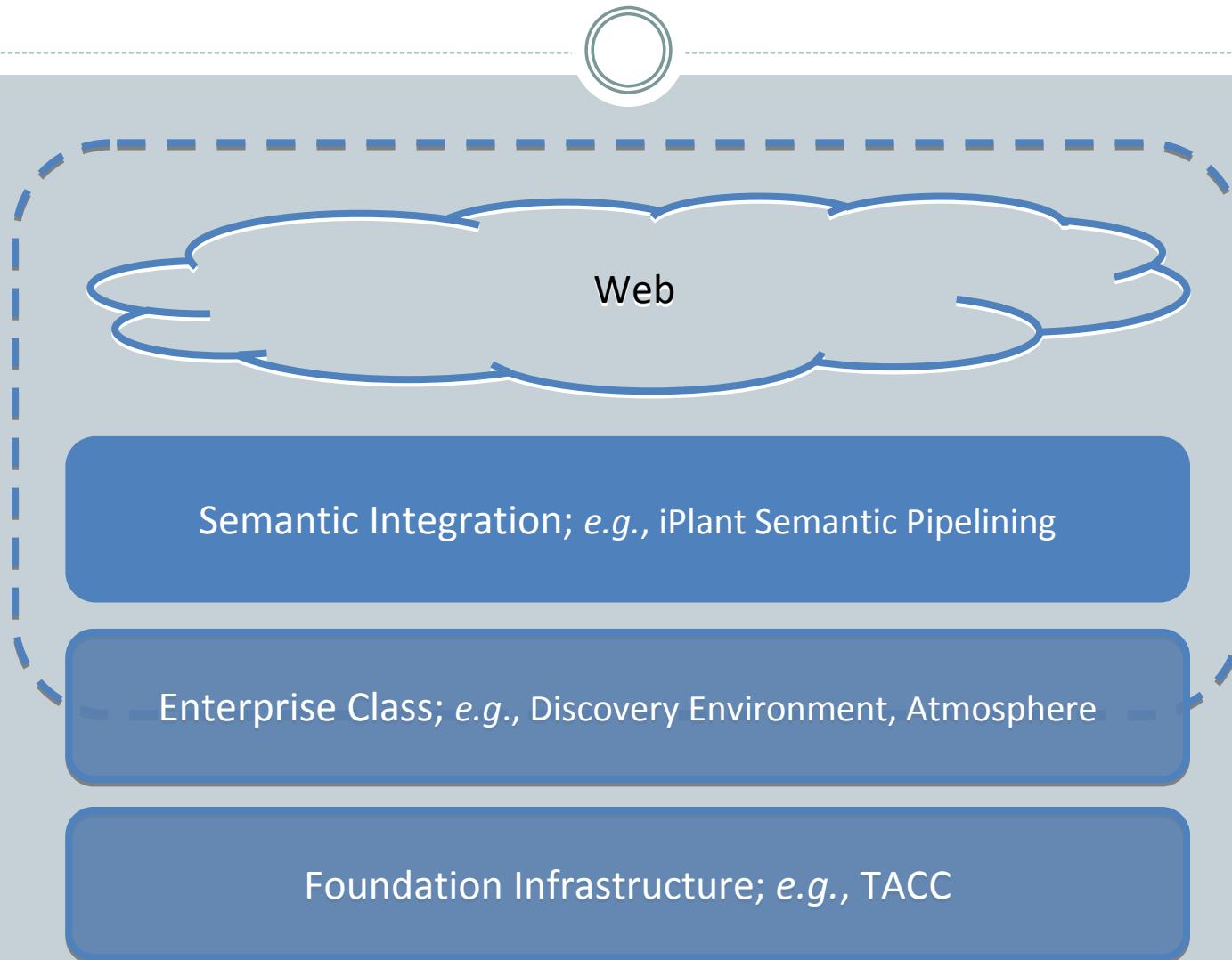


iPlant Computational
Resources (e.g., TACC)

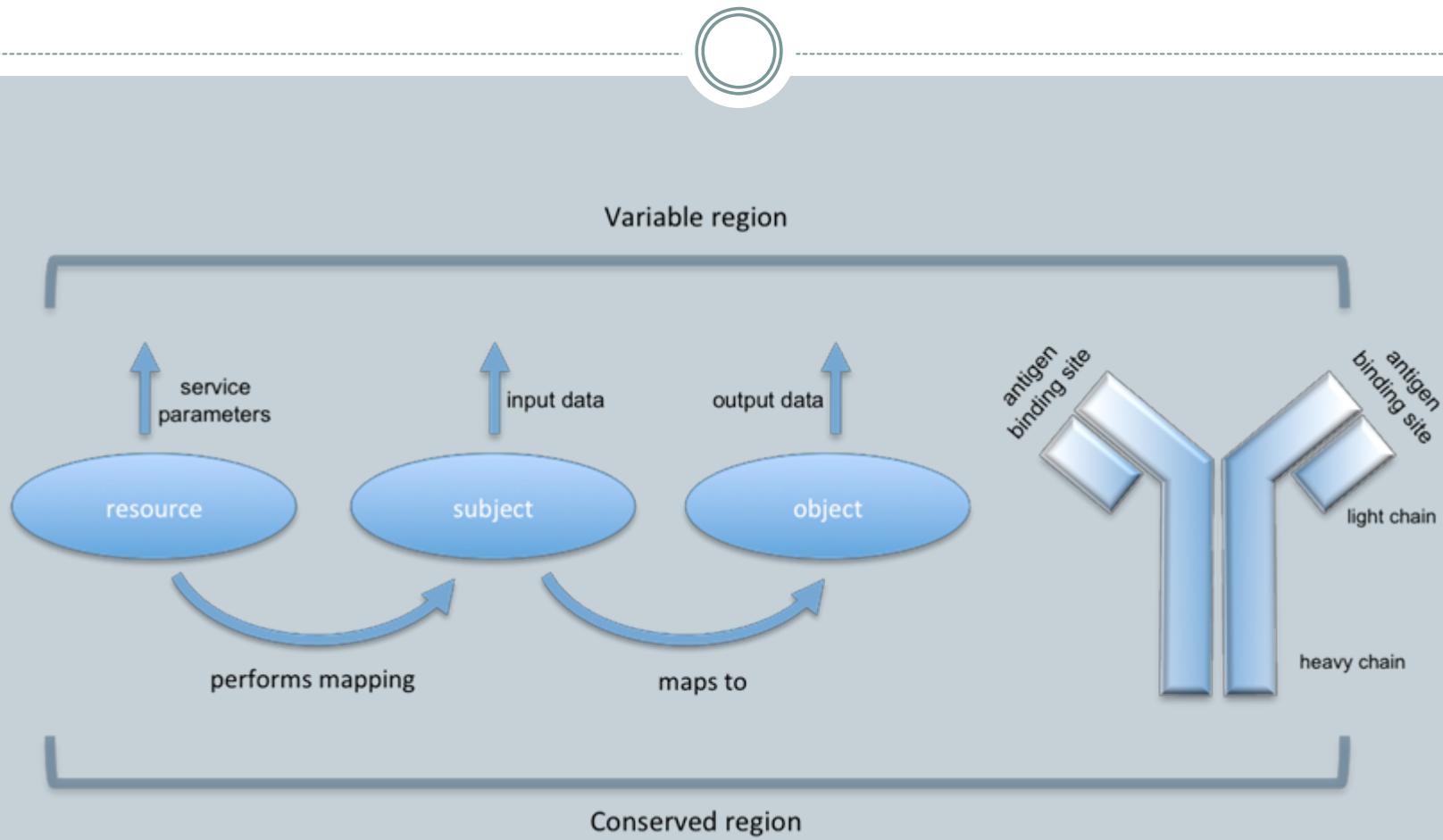


Community
MODS (Model Organism Databases)
and
CODS (Clade Oriented Databases)

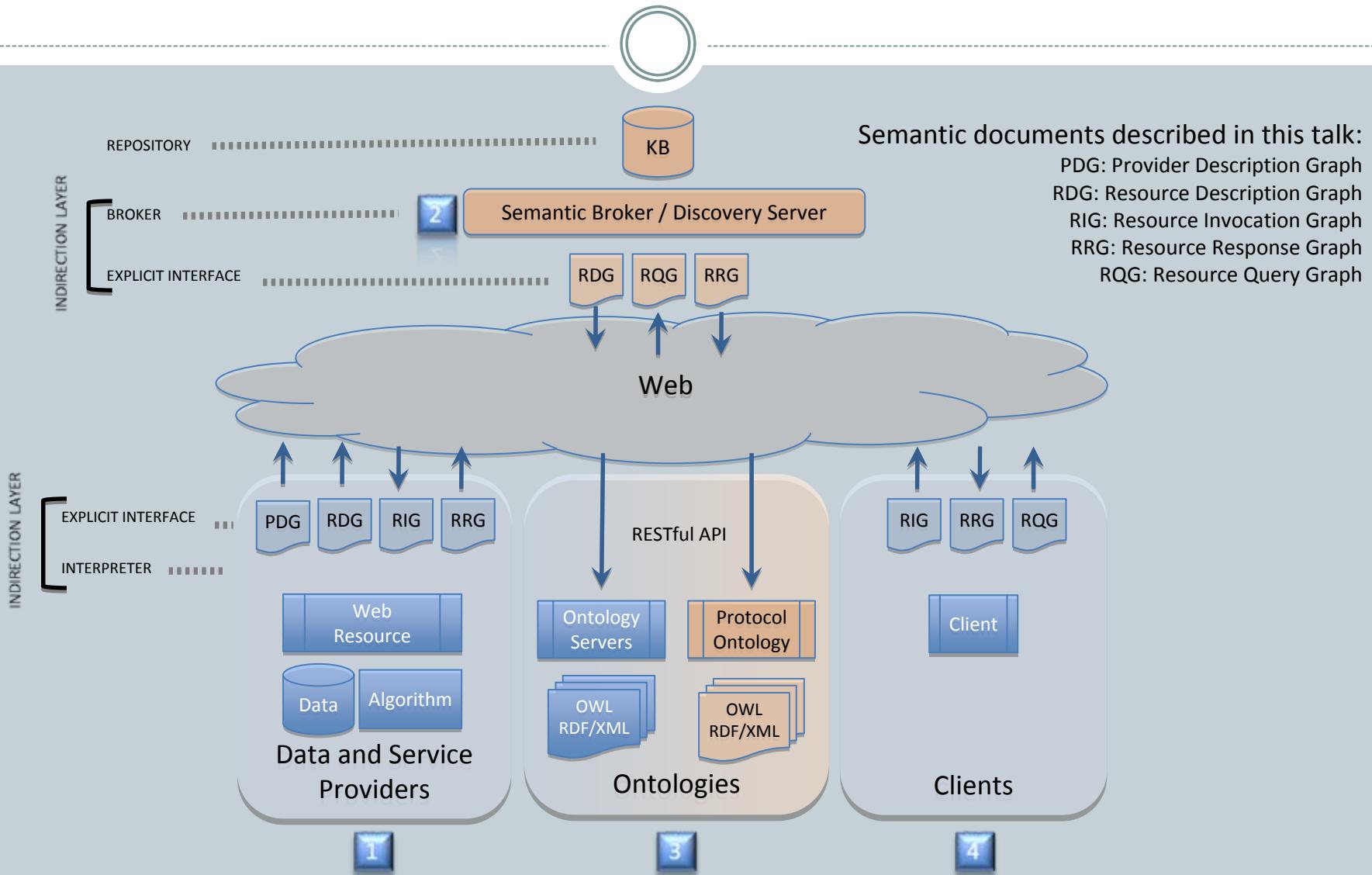
Bridging HPC, Enterprise, and Web assets with a single iPlant cyberinfrastructure



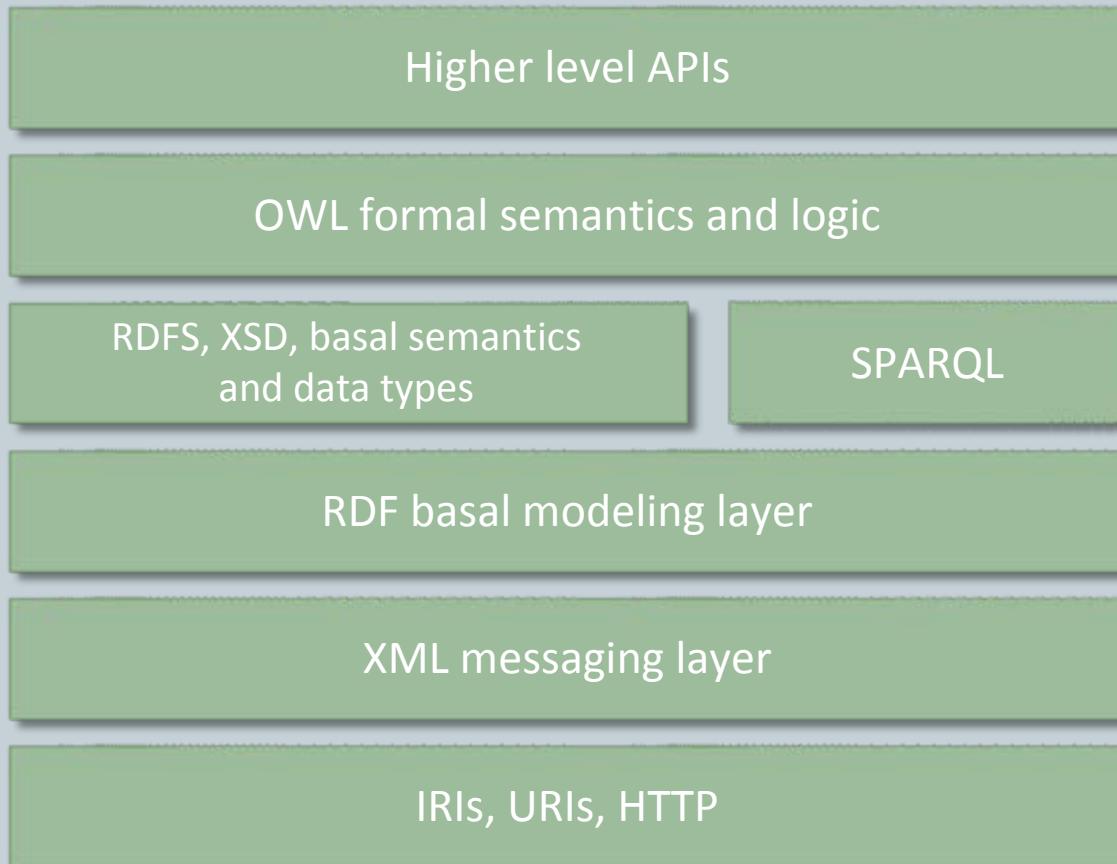
The Antibody Analogy as the Mediation Layer



iPlant Semantic Architecture

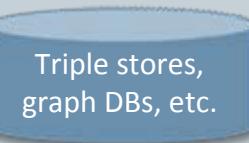
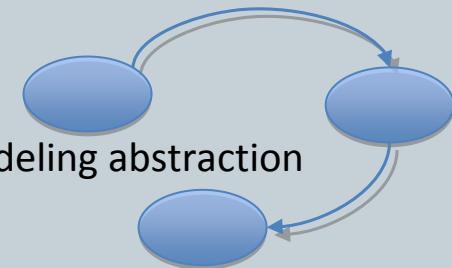


The Technology Stack



Domain model

Programmatic control



Universal namespace and web protocols

Requirements



Common syntax: W3C RDF/XML

Computable semantic: W3C OWL DL, with graceful fail-over to OWL Full and RDFS semantics

Shared semantic: Ontologies; yours and those of others

Protocol: SSWAP: Simple Semantic Web Architecture and Protocol

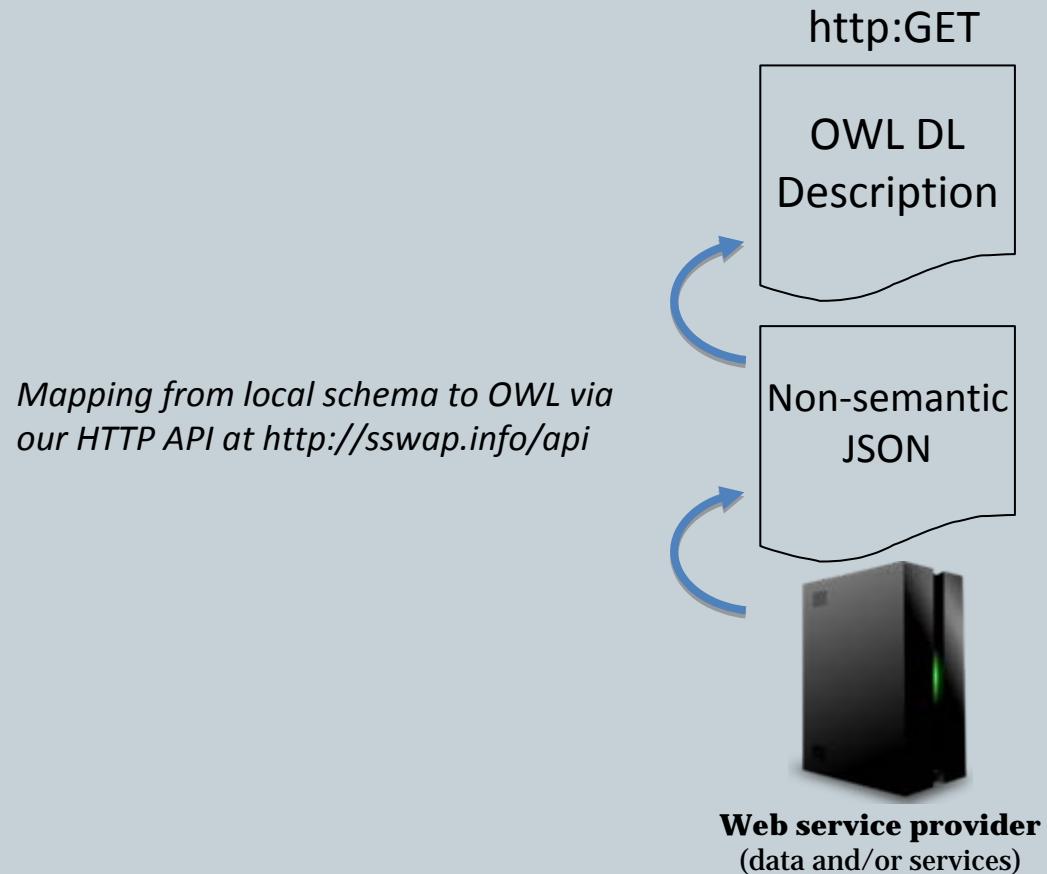
Platform: put it all together; iPlant Semantic Web Program

Architecture

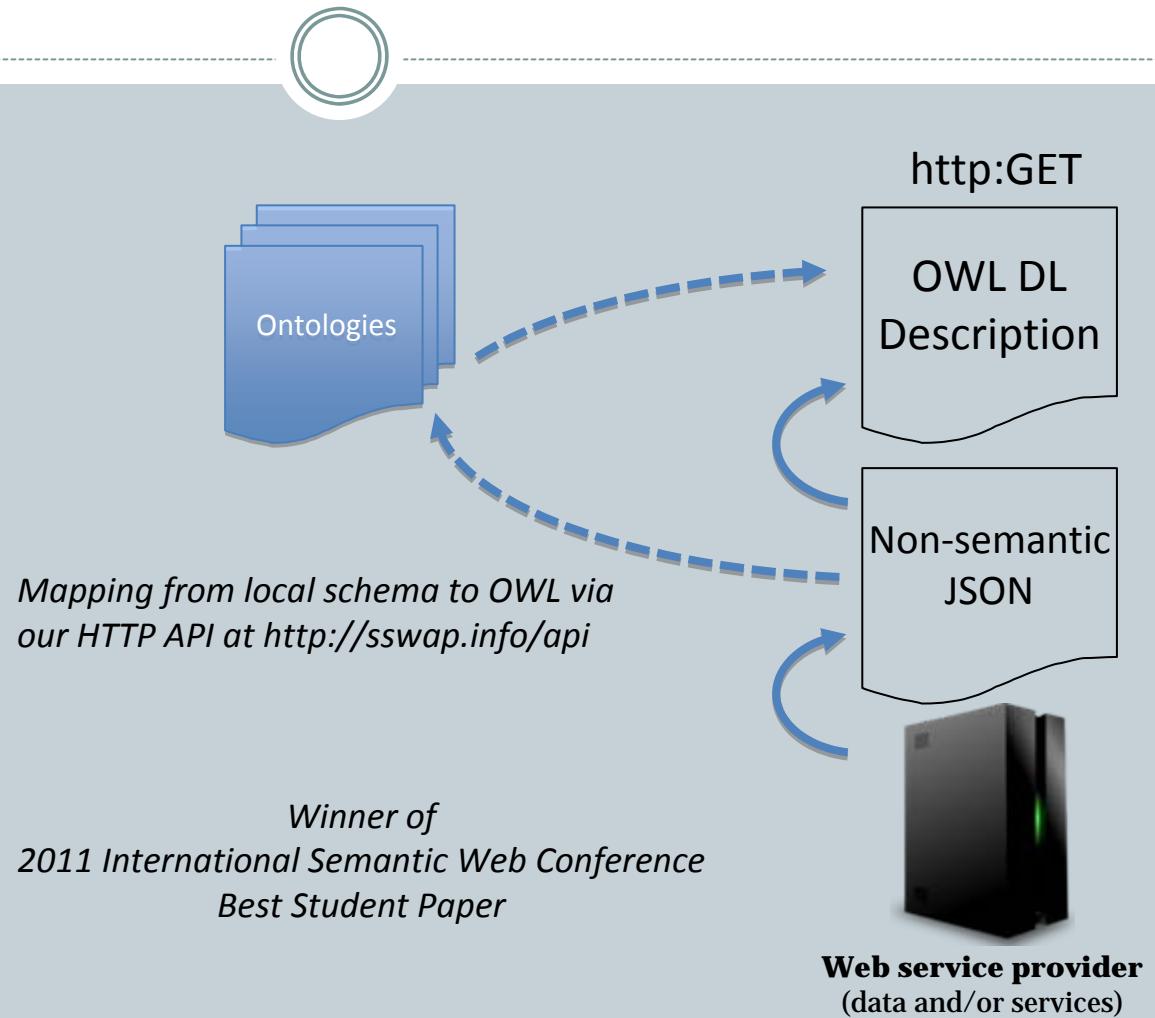


Web service provider
(data and/or services)

Architecture: Protocol



Architecture: Protocol



HTTP API: sswap.info/api

The screenshot shows a web browser window with the URL sswap.info/api/makeRDG. The page title is "SSWAP HTTP API". The content area contains the following sections:

- NAME**: `/makeRDG` — make an RDG (Resource Description Graph)
- SYNOPSIS**:
e.g., `curl -d @<jsnFile> http://sswap.info/api/makeRDG`
- DESCRIPTION**:
`/makeRDG` is the basename of a URL for a RESTful web service that converts JSON (Javascript Object Notation) into a SSWAP OWL RDF/XML Resource Description Graph (RDG). Input is sent to the URL via a HTTP POST, for example by a program such as curl or wget. A HTTP GET on `/makeRDG` (for example, as initiated by visiting the URL with a browser) returns this manual page. Content negotiation may be used to return a machine parseable JSON schema if the requested response MIME type is `application/json`.
A Resource Description Graph (RDG) is a human-readable, machine-parsable description of a semantic web service using the SSWAP Protocol. The use of OWL allows an RDG to describe a service in terms that are amenable to a computable logic. The RDG is hosted at the URL of the service such that a HTTP GET on the service URL (with no query string parameters) returns the RDG, while an HTTP POST (with an RIG [Resource Invocation Graph] as the body of the POST; see `/makeRIG`) or an HTTP GET with a query string invokes the service. RDGs are OWL DL RDF/XML documents that follow the SSWAP Protocol and are used to describe a service.
RDGs allow automated semantic matching, as possible, between service invocation vocabularies and semantics (as used by a client) and service description vocabularies and semantics as used by the service. They set the template for the service's invocation (via a Resource Invocation Graph; see `/makeRIG`), its return data (as a Resource Response Graph; see `/makeRRG`) and semantic discovery via query graphs (a Resource Query Graph; see `/makeRQG`).
Third-party web servers may host their own `/makeRDG` (see **AVAILABILITY**). `/makeRDG` is hosted as a public service at <http://sswap.info/api/makeRDG>.
- Examples**: Examples of RDGs are numerous; search on anything at <http://sswap.info>, then click on the RDF icon next to any service on the results page to view its RDF/XML RDG; or view the canonical graph at sswap.info/examples/resources/canonical/canonicalResource.
- Quick Start**: Here, we use the program curl to POST the in-line JSON content to the public `/makeRDG` service:

W3C Web Ontology Language OWL



OWL 2 Web Ontology Language Document Overview

Web www.w3.org/TR/owl2-overview/ Search with Google

W3C

OWL 2 Web Ontology Language Document Overview

W3C Recommendation 27 October 2009

This version: <http://www.w3.org/TR/2009/REC-owl2-overview-20091027/>

Latest version (series 2): <http://www.w3.org/TR/owl2-overview/>

Latest Recommendation: <http://www.w3.org/TR/owl-overview>

Previous version: <http://www.w3.org/TR/2009/PR-owl2-overview-20090922/> (color-coded diff)

Editors: W3C OWL Working Group (see [Acknowledgements](#))

Please refer to the [errata](#) for this document, which may include some normative corrections.

This document is also available in these non-normative formats: [PDF version](#).

See also [translations](#).

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Abstract

The OWL 2 Web Ontology Language, informally OWL 2, is an ontology language for the Semantic Web with formally defined meaning. OWL 2 ontologies provide classes, properties, individuals, and data values and are stored as Semantic Web documents. OWL 2 ontologies can be used along with information written in RDF, and OWL 2 ontologies themselves are primarily exchanged as RDF documents.

This document serves as an introduction to OWL 2 and the various other OWL 2 documents. It describes the syntaxes for OWL 2, the different kinds of semantics, the available profiles (sub-languages), and the relationship between OWL 1 and OWL 2.

Status of this Document

Formal Logic



There are many logic systems. We concentrate on one called
First-order, description logic

First-order — We make statements and inferences about things, their relations to other things, and sets of things. We do not talk about properties of properties, or classes of classes.

Description logic — We describe things:

Individuals: “things”

Properties: relations between things

Classes: sets of things—all things that share common properties

A Foundational Comfort Zone that Pays Dividends



Formal logics has advantages (and disadvantages):

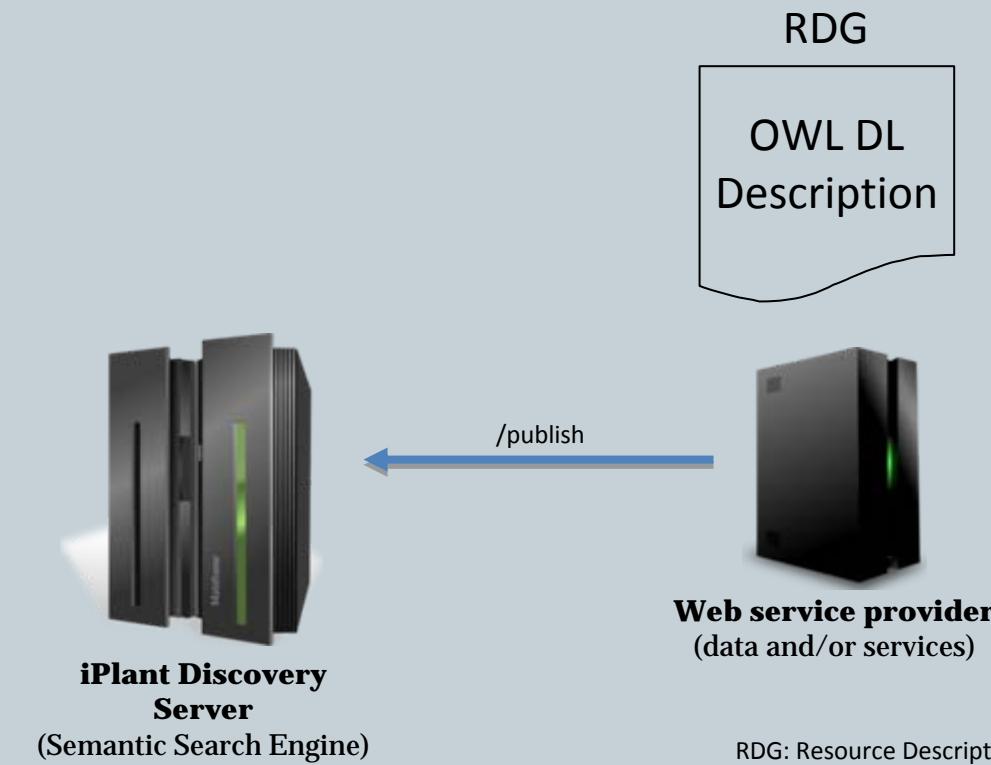
Pros:

- We ground ourselves in a *discipline*. There is a formal computer science and logics study of the system (e.g., complexity, decidability, etc). Compare this to the arbitrary semantics inferred from the *ad hoc* syntax of conventional protocols.
- We gain a formal semantics; e.g., `rdfs:subClassOf` has an explicit and clear definition; the formal subClass concept is implemented in a technology, rather than a technology creating a semantic that has no formal model.
- We gain important guarantees and checks into *validity* (only “truths” can be derived), *soundness*, *completeness* (all “truths” can be derived), *consistency* (lack of contradictions), and *decidability* (determination in finite time with finite resources).

Cons:

- Logics can be unintuitive; this can require retraining and new expertise
- DL's have a complexity of NExpTime-Complete $O(2^{p(n)})$ —this is “harder” than NP-complete

Architecture: Publication



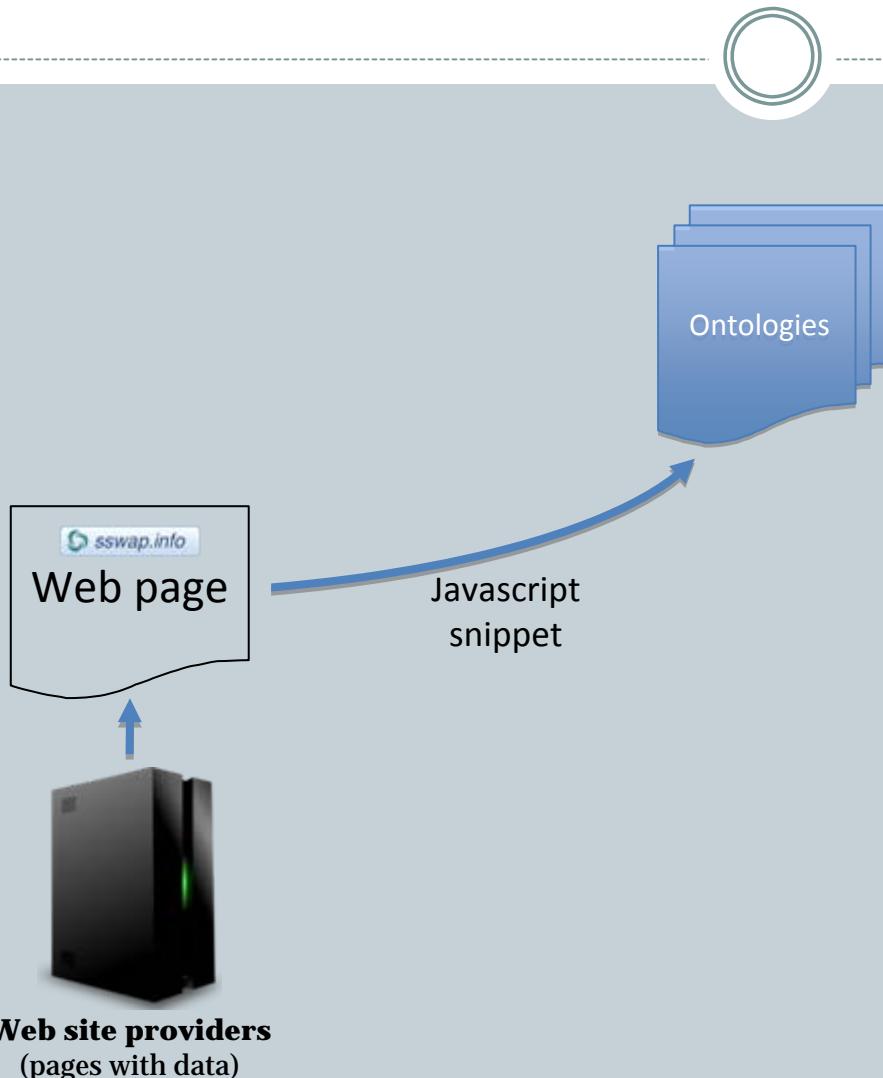
RDG: Resource Description Graph

Behind the Scenes

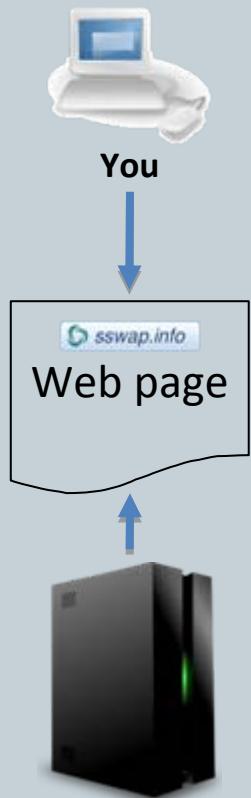


- Read the file as valid RDF/XML OWL SSWAP;
- Retrieve relevant terms;
- Disambiguate and validate the graph;
- Determine on OWL species for reasoning guarantees;
- Generate inferred truths (Pellet: <http://clarkparsia.com/pellet>)
- Evaluate consistency: do any statements imply a logical impossibility?
- Fully classify: make an explicit, complete subsumption hierarchy;
- Fully realize: assign each and every individual to its most direct class

Architecture: Web site annotation



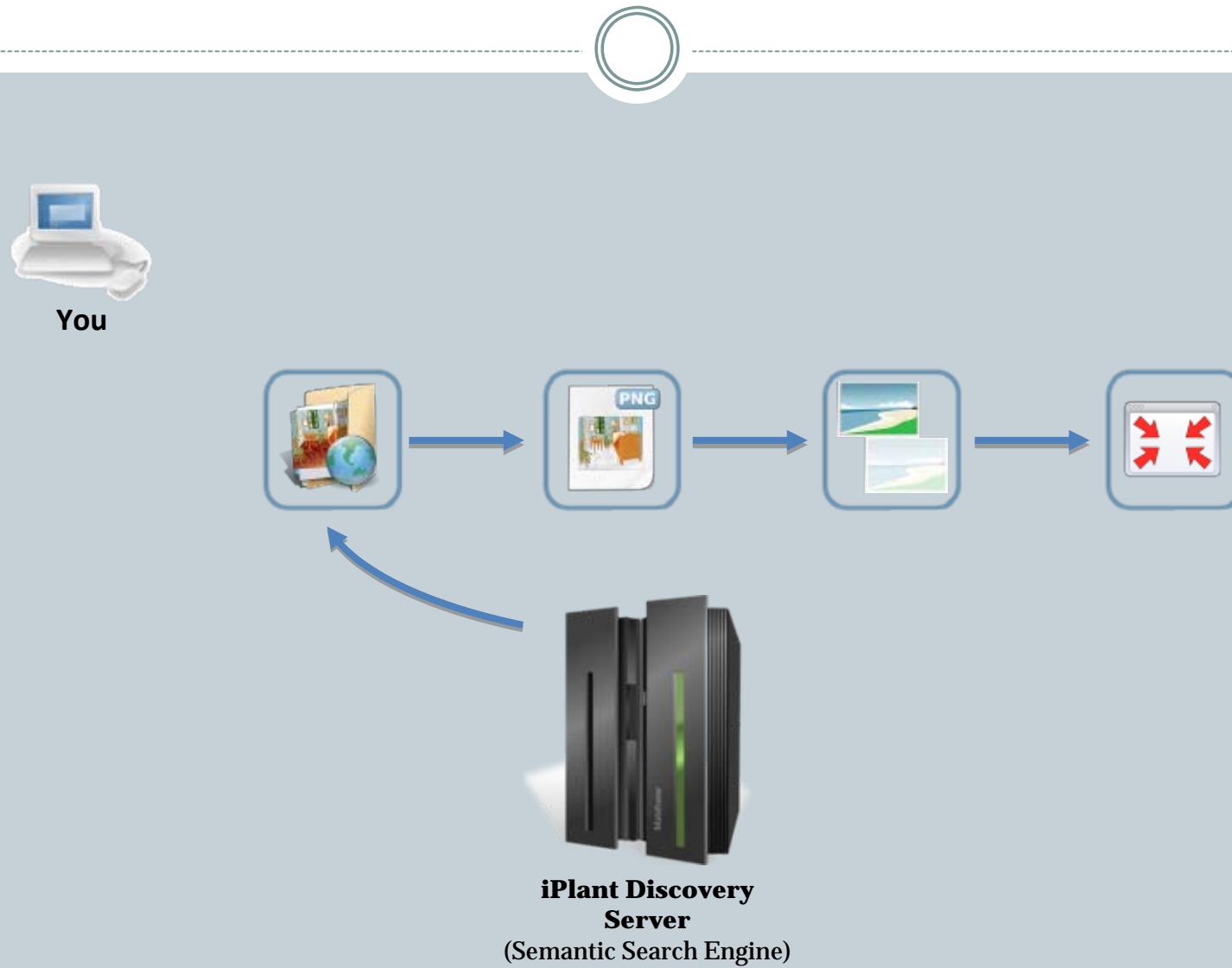
Architecture: Discovery from web sites



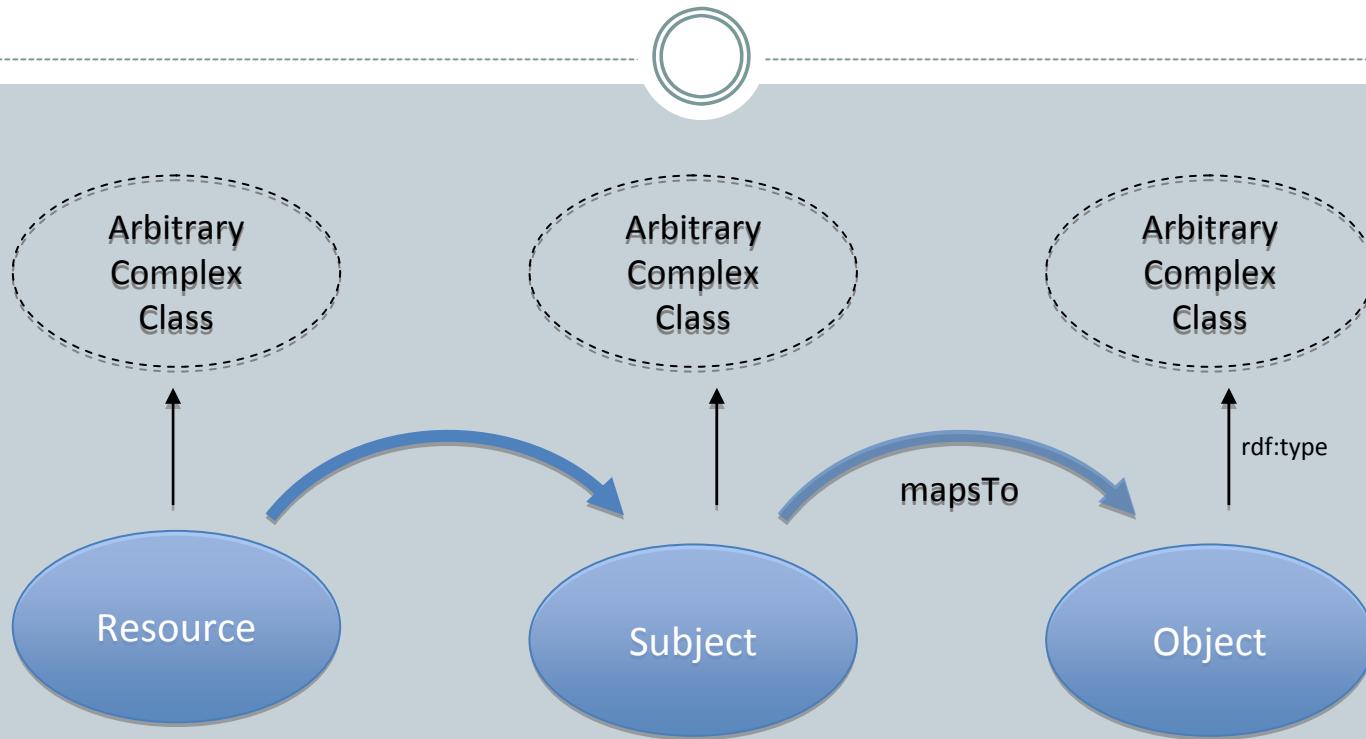
Architecture: Discovery from web sites



Architecture: Discovery from web sites



On-demand Transaction-time Reasoning for Resolving Semantic Querying



Query: RQG (Resource Query Graph)

subclass

super class

subclass

Data store: RDGs (Resource Description Graphs)

iPlant Semantic Pipeline

Discovery from any web site



The screenshot shows a web browser window titled "Taxonomic Name Resolution Service". The URL in the address bar is "http://iplantcollaborative.org/ttns/TNRSdemo.html". The page has a dark green header with the title "Taxonomic Name Resolution Service". Below the header, there are logos for iPlant Collaborative, BIEN, and Missouri Botanical Garden. A horizontal line of logos includes The University of Arizona, CSHL, and Yale. Below these, a navigation menu lists: Home, About, Instructions, API/Source Code, Sources, Contributors, Future, TNRS Application. The main content area has tabs for "Enter List", "Upload and Submit List", and "Retrieve Results". The "Enter List" tab is active, showing a text input field with the entries "zea mays" and "acacia". Below the input field are "Clear" and "Submit List" buttons. To the right of this is a "Welcome" section with instructions for using TNRS. It mentions that TNRS allows validation and correction of plant names against an authoritative database. It also notes that users can upload a text file with up to 5000 names. A link to "Click here for support" is provided. At the bottom of the "Enter List" section is a "swapp.info" button. The "Retrieve Results" tab is shown below, displaying a table of results. The table has columns for "Name Submitted" (zea mays, acacia), "Name Matched" (Zea mays L., Acacia Mili.), "Overall Score" (1.00, 1.00), "Status" (Accepted, Accepted), and "Accepted Name" (Acacia Mili. (+1 more)). There are "Details" links for each row. At the bottom of the results table, it says "Displaying 1 - 2 of 2".

Name Submitted	Name Matched	Overall Score	Status	Accepted Name	Details
zea mays	Zea mays L.	1.00	Accepted		Details
acacia	Acacia Mili. (+1 more)	1.00	Accepted	Acacia Mili.	Details

Mock page for proof-of-principle only

iPlant Semantic Pipeline

Automatically presents semantic results

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org) website. The URL in the address bar is <http://sswap.iplantcollaborative.org/>. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

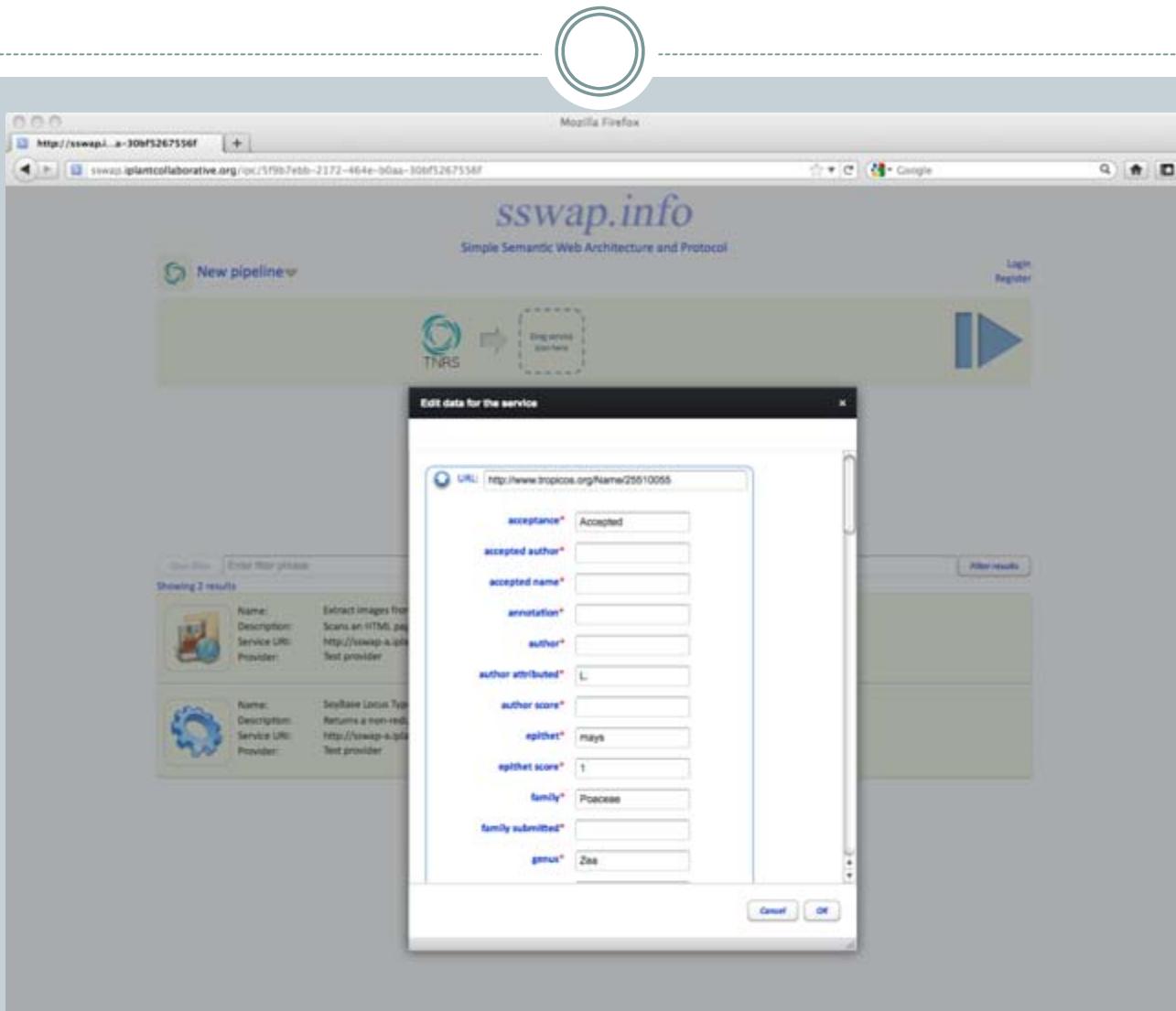
The interface includes a "New pipeline" button, a "TNRS" icon, a "Drag service here" placeholder, and a large blue play button icon.

Below this, there is a search bar with "Showing 2 results" and a "Filter results" button. Two service entries are listed:

- Name:** Extract images from page
Description: Scans an HTML page and extracts all images from it.
Service URI: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
Provider: Test provider
- Name:** Soybase Locus Type Service
Description: Returns a non-redundant list of all soybean genetic map loci contained in Soybase.
Service URI: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/SoybaseLocusTypeService>
Provider: Test provider

iPlant Semantic Pipeline

Generic and automatic input browser



iPlant Semantic Pipeline

Drag-n-drop (DnD) in the browser pipeline building

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org/) website. The URL in the address bar is `http://sswap.iplantcollaborative.org/`. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol". On the left, there is a "New pipeline" button. In the center, there is a "TNRS" icon followed by a dashed box containing the text "Drag service here". To the right of the dashed box is a large blue play button icon. On the far right, there are "Login" and "Register" links. Below these elements, there is a search bar with "Enter filter phrase" placeholder text and a "Filter results" button. Underneath the search bar, it says "Showing 2 results". There are two service cards listed:

Name:	Description:	Service URI:	Provider:
	Extract images from page Scans an HTML page and extracts all images from it.	http://sswap.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage	Test provider
	Soybase Locus Type Service Returns a non-redundant list of all soybean genetic map loci contained in Soybase.	http://sswap.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/SoybaseLocusTypeService	Test provider

iPlant Semantic Pipeline

Automatic semantic match-making on DnD drop

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org/) website. The URL in the address bar is <http://sswap.iplantcollaborative.org/>. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area features a "New pipeline" button and a "Service Details" section for a service named "TNRS". The TNRS service has the following details:

- Name: Extract images from page
- Description: Scans an HTML page and extracts all images from it
- Service URL: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
- Provider: Test provider
- Time started: N/A
- Time finished: N/A

Below this, there is a "Service Catalog" section titled "Showing 2 results" with two listed services:

- Converter to PNG**: Converts an image to a format supported by Java ImageIO.
- Soybase Locus Type Service**: Returns a non-redundant list of all soybean genetic map loci contained in Soybase.

At the bottom of the page, there is a footer with the text "www.iplantcollaborative.org".

iPlant Semantic Pipeline

Real-time reasoning on pipeline sanity



Mozilla Firefox

http://sswap.i...a-30bf5267556f

sswap.iplantcollaborative.org:8080/iplc/5f9b7ebd-2172-464e-b0aa-30bf5267556f

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline

Login Register

TNRS

Extract images from page

Name: Extract images from page
Description: Scans an HTML page and extracts all images from it
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage
Provider: Test provider
Time started: N/A
Time finished: N/A

Clear filter Enter filter phrase Filter results

Showing 5 results

	Name: Image conversion to grayscale Description: Given images in PNG format, converts them into a grayscale version Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale Provider: Test provider
	Name: Dim image Description: Given images in PNG format, it dims them by the specified factor Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim Provider: Test provider
	Name: Converter to PNG Description: Given an image in a format supported by Java ImageIO, it converts it into PNG Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG Provider: Test provider
	Name: Scale image Description: Given Images in PNG format, scales them to the desired size Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale Provider: Test provider
	Name: SoylBase Locus Type Service Description: Returns a non-redundant list of all soybean genetic map loci contained in SoylBase.

iPlant Semantic Pipeline

DnD positioning for constrained service matching

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org/) website. The URL in the address bar is `http://sswap.iplantcollaborative.org/`. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area features a "New pipeline" button and a "Service Details" section. The "Service Details" section displays the following information for a service named "Extract images from page":

- Name: Extract images from page
- Description: Scans an HTML page and extracts all images from it
- Service URL: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
- Provider: Test provider
- Time started: N/A
- Time finished: N/A

Below this, there is a search bar with the placeholder "Enter filter phrase" and a "Filter results" button. A message indicates "Showing 1 results".

The bottom of the page contains a footer with the text "www.iplantcollaborative.org".

iPlant Semantic Pipeline

DnD pipeline editing with ...



Mozilla Firefox

http://sswap.i...a-30bf5267556f sswap.iplantcollaborative.org/ ipc/5f9b7ebb-2172-464e-b0aa-30bf5267556f

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline ▾

Login Register

TNRS → Extract images from page → PNG → Drag service icon here

Service Details

Name: Extract images from page
Description: Scans an HTML page and extracts all images from it
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage
Provider: Test provider
Time started: N/A
Time finished: N/A

Clear filter Enter filter phrase Filter results

Showing 5 results

	Name: Image conversion to grayscale Description: Given images in PNG format, converts them into a grayscale version Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale Provider: Test provider
	Name: Dims image Description: Given images in PNG format, it dims them by the specified factor Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim Provider: Test provider
	Name: Converter to PNG Description: Given an image in a format supported by Java ImageIO, it converts it into PNG Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG Provider: Test provider
	Name: Scale image Description: Given Images in PNG format, scales them to the desired size Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale Provider: Test provider
	Name: SoyBase Locus Type Service Description: Returns a non-redundant list of all soybean genetic map loci contained in SoyBase.

iPlant Semantic Pipeline

... automatic enforcement of semantic sanity

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org/) website. The URL in the address bar is `http://sswap.iplantcollaborative.org/`. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area features a "New pipeline" button and a visual pipeline editor. The pipeline consists of four stages connected by arrows: 1. TNRS (represented by a green circular icon), 2. Extract images from page (represented by a folder icon with a camera and globe), 3. Dim image (represented by a blue square icon with a camera and globe), and 4. Scale image (represented by a red square icon with a camera and globe). A placeholder box labeled "Drag service icon here" is available for adding more steps. A large blue play button icon is positioned to the right of the pipeline.

Below the pipeline editor, there is a section titled "Service Details" for the first stage:

	Name: Extract images from page Description: Scans an HTML page and extracts all images from it Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage Provider: Test provider Time started: N/A Time finished: N/A
--	---

At the bottom of the page, a yellow warning box states: "Service cannot be removed. The upstream and downstream services of the removed service are not compatible". It lists five services that cannot be removed due to compatibility issues:

	Name: Grayscale Description: Converts an image to grayscale Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale Provider: Test provider
	Name: Dim image Description: Given images in PNG format, it dims them by the specified factor Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim Provider: Test provider
	Name: ConvertToPNG Description: Given an image in a format supported by Java ImageIO, it converts it into PNG Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG Provider: Test provider
	Name: Scale image Description: Given Images in PNG format, scales them to the desired size Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale Provider: Test provider
	Name: SoyBase Locus Type Service Description: Returns a non-redundant list of all soybean genetic map loci contained in SoyBase.

iPlant Semantic Pipeline

Save (and load) data from your iPlant account with ...

The screenshot shows a Mozilla Firefox browser window displaying the sswap.info website. The URL in the address bar is <http://sswap.iplantcollaborative.org:30bf5267556f>. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area shows a pipeline editor with a sequence of four boxes: "TRRS", "Image", "Image", and "Soybase GenBank". Below this is a "Service Details" section for the first service, "Extract images from page".

A modal dialog box titled "Log into your iPlant account" is displayed in the center of the screen. It contains fields for "User name" and "Password", along with "Forgot password?", "Cancel", and "Login" buttons.

The pipeline editor shows several other services listed below the first one:

- Name: Extract images from page
Description: Scans an HTML page and extracts all images from it.
Service URL: <http://sswap-iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
Provider: Test provider
- Name: Image conversion to grayscale
Description: Given images in PNG format, converts them to grayscale.
Service URL: <http://sswap-iplantcollaborative.org:sswap-pipeline-test/test/data/pipeline/dim>
Provider: Test provider
- Name: Dims image
Description: Given images in PNG format, it dims them by the specified factor.
Service URL: <http://sswap-iplantcollaborative.org:sswap-pipeline-test/test/data/pipeline/dim>
Provider: Test provider
- Name: Converter to PNG
Description: Given an image in a format supported by Java ImageIO, it converts it into PNG.
Service URL: <http://sswap-iplantcollaborative.org:sswap-pipeline-test/test/data/pipeline/convertToPNG>
Provider: Test provider
- Name: Scale image
Description: Given images in PNG format, scales them to the desired size.
Service URL: <http://sswap-iplantcollaborative.org:sswap-pipeline-test/test/data/pipeline/scale>
Provider: Test provider
- Name: SoyBase Lotus Type Service
Description: Returns a non-redundant list of all soybean genetic map loci contained in SoyBase.

iPlant Semantic Pipeline

... interactive file chooser

The screenshot shows a Mozilla Firefox browser window displaying the sswap.iplantcollaborative.org website. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol". A "Logout" link is visible in the top right corner.

The main content area shows a "Service Details" section for a service named "Extract image" provided by "Test provider". Below this, a list of services is shown, including "Image converter", "Data Image", "Converter to PDF", and "Scale image".

A modal dialog titled "Dataset selection" is open in the center. It displays a table of files and folders under the heading "Folder: /opensesame". The table has columns for "FILE NAME", "FORMAT", and "LAST MODIFIED". The data is as follows:

FILE NAME	FORMAT	LAST MODIFIED
analyses	folder	2011-08-31 09:45:00
archive	folder	2011-10-20 00:00:00
images	folder	2012-01-13 01:00:00
RNASeq	folder	2011-10-12 12:00:00
SemanticData	folder	2011-09-26 03:00:00
Tree View	folder	2011-10-13 07:00:00
iPlantCollaborative.owl	raw	2011-09-26 04:00:00
iplant_grayscale.rdf	raw	2011-09-27 04:00:00
MyNewOutput.owl	raw	2011-10-19 10:00:00
My_Pipeline-2012-01-11-18-05-14.owl	raw	2012-01-11 03:00:00
myResults.owl	raw	2011-10-14 09:00:00
newdata	raw	2012-01-15 09:00:00
New_pipeline-2011-10-05-09-13-49.owl	raw	2011-10-05 09:00:00
New_pipeline-2011-10-19-09-39-25.owl	raw	2011-10-19 09:00:00

At the bottom of the dialog, there is a "File Name:" input field and two buttons: "Cancel" and "OK".

iPlant Semantic Pipeline

'Play' enabled when data conditions are met

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.a.iplantcollaborative.org/) website. The URL in the address bar is `http://sswap.a.iplantcollaborative.org/`. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area features a "New pipeline" button and a "Logout" link. Below this is a visual pipeline editor with icons for TNRS, Extract images from page, MyData, and a placeholder for "Drag service icon here". A large blue play button is on the right.

A "Service Details" section is shown, listing a single service:

	Name: Extract images from page
	Description: Scans an HTML page and extracts all images from it
	Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage
	Provider: Test provider
	Time started: N/A
	Time finished: N/A

Below this, a search bar with "Showing 5 results" and a "Filter results" button is visible. A list of five services is displayed:

	Name: Image conversion to grayscale
	Description: Given images in PNG format, converts them into a grayscale version
	Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale
	Provider: Test provider
	Name: Dim image
	Description: Given images in PNG format, it dims them by the specified factor
	Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim
	Provider: Test provider
	Name: Converter to PNG
	Description: Given an image in a format supported by Java ImageIO, it converts it into PNG
	Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG
	Provider: Test provider
	Name: Scale image
	Description: Given Images in PNG format, scales them to the desired size
	Service URI: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale
	Provider: Test provider
	Name: SoylBase Locus Type Service
	Description: Returns a non-redundant list of all soybean genetic map loci contained in SoylBase.

iPlant Semantic Pipeline

'Pause' between independent web services



Mozilla Firefox

http://sswap.i...-30bf5267556f

sswap.iplantcollaborative.org/isp/5fb7ebd-2172-464e-b0aa-30bf5267556f

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline - running

Logout

Logged as dgennar

TNRS → Extract images from page → MyData

Service Details

Name: Extract images from page
Description: Scans an HTML page and extracts all images from it
Service URL: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
Provider: Test provider
Time started: January 16, 2012 2:10:32 PM MST
Time finished: January 16, 2012 2:10:49 PM MST

Clear filter Enter filter phrase Filter results

Showing 2 results

	Name: Extract images from page Description: Scans an HTML page and extracts all images from it Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage Provider: Test provider
	Name: Soybase Locus Type Service Description: Returns a non-redundant list of all soybean genetic map loci contained in Soybase. Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/SoybaseLocusTypeService Provider: Test provider

iPlant Semantic Pipeline

100% idempotent and RESTful via JSON API to a separate, underlying pipeline manager



```
5f9b7ebb-2172-464e-b0aa-30bf5267556f.json
Last Saved: 1/16/12 2:13:55 PM
File Path : ~/Downloads/5f9b7ebb-2172-464e-b0aa-30bf5267556f.json
( no symbol selected )

{
  "id": "5f9b7ebb-2172-464e-b0aa-30bf5267556f",
  "timeFinished": 1326748325988,
  "status": "EXECUTED",
  "timeStarted": 1326748232342,
  "name": "New pipeline",
  "owner": "owner",
  "elements": [
    {
      "timeFinished": 1326748243249,
      "input": {
        "label": "",
        "type": "http://www.w3.org/2002/07/owl#Thing"
      },
      "status": "EXECUTED",
      "timeStarted": 1326748232485,
      "serviceURL": "http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage",
      "type": "service"
    },
    {
      "timeFinished": 1326748325988,
      "input": {
        "label": "",
        "type": "http://www.w3.org/2002/07/owl#Thing"
      },
      "status": "EXECUTED",
      "timeStarted": 1326748294830,
      "serviceURL": "http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG",
      "type": "service"
    }
  ],
  "outputData": "iplant:/username/outputdata",
  "inputData": "http://sswap.iplantcollaborative.org/ipc/rrg?token=4cdf020f-8e8f-4c2f-a722-4924cf884b9f",
  "timeout": 600000,
  "private": "false"
}
```

iPlant Semantic Pipeline

Copy, share, name, and manipulate pipelines



Mozilla Firefox

http://sswap.a.iplantcollaborative.org:5191b7ebd-2172-464e-b0aa-30bf1267556f.json

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline - executed

Logout
Logged as dgennar

New
Copy
Share
Rename
Reset
Clear

Extract images from page
Scans an HTML page and extracts all images from it
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage
Provider: Test provider
Time started: January 16, 2012 2:10:32 PM MST
Time finished: January 16, 2012 2:10:43 PM MST

Service Details

Showing 5 results

Name: Image conversion to grayscale
Description: Given images in PNG format, converts them into a grayscale version
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale
Provider: Test provider

Name: Dim image
Description: Given images in PNG format, it dims them by the specified factor
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim
Provider: Test provider

Name: Converter to PNG
Description: Given an image in a format supported by Java ImageIO, it converts it into PNG
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG
Provider: Test provider

Name: Scale image
Description: Given Images in PNG format, scales them to the desired size
Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale
Provider: Test provider

Name: SoylBase Locus Type Service
Description: Returns a non-redundant list of all soybean genetic map loci contained in SoylBase.

iPlant Semantic Pipeline

Generic data viewer



Mozilla Firefox

http://sswap.i...-a-30bf5267556f

sswap.iplantcollaborative.org:8080/...-2172-464e-b0aa-30bf5267556f.json

Google

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline - executed

Logout

Logged as dymond

TNRS → [Service] → [Service] → Drag service here → MyData

View data from the service

Service Details

Name: Extract images from an HTML page
Description: Scans an HTML page for images.
Service URL: http://sswap-a.iplantcollaborative.org/...
Provider: Test provider
Time started: January 16, 2012
Time finished: January 16, 2012

Show more | Enter filter phrase

Showing 5 results

Name	Description	Service URL	Provider
Image conversion	Given images in PDF format and converts them to other formats.	http://sswap-a.iplantcollaborative.org/.../sswap-pipe[...]	Test provider
Dens Image	Given images in PDF format and converts them to other formats.	http://sswap-a.iplantcollaborative.org/.../sswap-pipe[...]	Test provider
Converter to PNG	Given an Image in PDF format and converts it to a PNG file.	http://sswap-a.iplantcollaborative.org/.../sswap-pipe-test/test/data/pipeline/convertToPNG	Test provider
Scale image	Given Images in PNG format, scales them to the desired size.	http://sswap-a.iplantcollaborative.org/.../sswap-pipe-test/test/data/pipeline/scale	Test provider

URL: http://sswap-a.iplantcollaborative.org/.../sswap-pipe[...]

Show optional properties

URL:

Show optional properties

URL:

Show optional properties

URL: http://sswap-a.iplantcollaborative.org/.../sswap-pipe[...]

OK

Filter results

iPlant Semantic Pipeline

Generic, automatic semantic support for required and optional service parameters

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.a.iplantcollaborative.org/) website. The URL in the address bar is <http://sswap.a.iplantcollaborative.org/5f9b7ebd-2172-464e-b0aa-30bf1267556f.json>. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main content area features a "New pipeline - executed" message and a visual pipeline editor. The pipeline consists of several steps: TNRS, Extract images from page, Convert to grayscale, Dim image, Converter to PNG, Scale image, and MyData. The "Extract images from page" step is highlighted with a green checkmark icon. A dashed box surrounds the "Scale image" and "MyData" steps, with a placeholder text "Drag service icon here".

Below the pipeline editor, there is a "Service Details" section for the "Extract images from page" step. It includes:

Name:	Extract images from page
Description:	Scans an HTML page and extracts all images from it
Service URI:	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage
Provider:	Test provider
Time started:	January 16, 2012 2:10:32 PM MST
Time finished:	January 16, 2012 2:10:43 PM MST

At the bottom of the page, there is a table titled "Showing 5 results" listing five services:

Name:	Description:	Service URI:	Provider:
Image conversion to grayscale	Given images in PNG format, converts them into a grayscale version	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale	Test provider
Dim image	Given images in PNG format, it dims them by the specified factor	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim	Test provider
Converter to PNG	Given an image in a format supported by Java ImageIO, it converts it into PNG	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG	Test provider
Scale image	Given Images in PNG format, scales them to the desired size	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale	Test provider
SoyBase Locus Type Service	Returns a non-redundant list of all soybean genetic map loci contained in SoyBase.		

iPlant Semantic Pipeline

Generic, automatic semantic support for required and optional service parameters

The screenshot shows a Mozilla Firefox browser window displaying the [sswap.info](http://sswap.iplantcollaborative.org/) website. The URL in the address bar is `http://sswap.iplantcollaborative.org/`. The page title is "sswap.info" and the subtitle is "Simple Semantic Web Architecture and Protocol".

The main interface features a pipeline editor at the top, showing a sequence of service icons: TNRS, Scale image, Given images in PDF, and a third service icon. Below the pipeline is a "Service Details" section for a service named "Image conversion". This section includes fields for Name, Description, Service URL, Provider, Time started, and Time finished. A "Edit parameters for the service" dialog box is open over the service details, showing the URL `http://sswap-iplantcollaborative.org/sswap-pipe[...]` and an "Output dimension*" configuration with Height and Width set to 400.

The bottom part of the interface shows a list of available services, each with a thumbnail, name, description, service URL, and provider information. Some services listed include "Image conversion", "Data Image", "Converter to PNG", "Scale image", and "SoyBase Lotus Type Service".

iPlant Semantic Pipeline

Automatic data tagging on uploads from the desktop or web



Mozilla Firefox

http://sswap.i...a-30bf5267556f

sswap.iplantcollaborative.org:8080/5fb7febd-2172-464e-b0aa-30bf5267556f.json

sswap.info

Simple Semantic Web Architecture and Protocol

New pipeline

Logout

Logged as dgennar

Service Details

Name: Scale image
Description: Given images in PNG format, scales them to the desired size
Service URL: http://sswap...
Provider: Test provider
Time started: N/A
Time finished: N/A

Load a Resource Response Graph (RRG)

Resource Response Graphs (RRGs) are the results of previous service runs.
They can be used as input for new runs.

Create an RRG for me; I will enter the data
 Load an RRG from my iPlant account
 Upload an RRG from my desktop
 Specify a URL to an RRG hosted on the web

Cancel OK

Showing 5 results

	Name: Image convert	Description: Given images in JAI format, it dims them by the specimen factor	Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim	Provider: Test provider
	Name: Converter to PNG	Description: Given an image in a format supported by Java ImageIO, it converts it into PNG	Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG	Provider: Test provider
	Name: Scale image	Description: Given Images in PNG format, scales them to the desired size	Service URL: http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale	Provider: Test provider
	Name: SoylBase Locus Type Service	Description: Returns a non-redundant list of all soybean genetic map loci contained in SoylBase.		

Status



- Everything shown today is public; try it at <http://sswap.iplantcollaborative.org>
- But as of today, only a minimal set of “test” image conversion services
- Our 2012 work: add community services
- Currently working with the UC Davis Tree Biology group on a suite of services
- Parallel work on semantic phylogenetic pipeline services
- For your services, contact me at sswap @ iplantcollaborative . org

iPlant Semantic Pipeline

Discovery from any web site



The screenshot shows a web browser window titled "Taxonomic Name Resolution Service". The URL in the address bar is www.iplantcollaborative.org/ttns/TNRSdemo.html. The page header features the iPlant Collaborative logo, the BIEN logo, and the Missouri Botanical Garden logo. Below the header, there are logos for The University of Arizona, CSHL (Cold Spring Harbor Laboratory), and Yale. A navigation menu includes links for Home, About, Instructions, API/Source Code, Sources, Contributors, Future, TNRS Application, Enter List, Upload and Submit List, and Retrieve Results.

The main content area has three tabs: "Enter List" (selected), "Upload and Submit List", and "Retrieve Results". The "Enter List" tab contains a text input field with the entries "zea mays" and "acacia". Below the input field are "Clear" and "Submit List" buttons. To the right of the input field is a "Welcome" section with instructions for using TNRS. It states that TNRS allows users to validate and correct a list of plant names against an authoritative database of published scientific names and authorities. It also mentions that users can upload a text file with up to 5000 names. A link to "Click here for support" is provided.

The "Download results" tab is visible at the bottom left. The "Entered names result" table displays the following data:

Name Submitted	Name Matched	Overall Score	Status	Accepted Name	Details
zea mays	Zea mays L.	1.00	Accepted		Details
acacia	Acacia Mill. (+1 more)	1.00	Accepted		Details

Pagination controls at the bottom indicate "Page 1 of 1". A note at the bottom right says "Displaying 1 - 2 of 2".

Mock page for proof-of-principle only

HTTP API



- Generate SSWAP RDF/XML OWL by sending JSON to sswap.info/api
- No programming necessary
- Self-documenting API at sswap.info/api
- Wiki at sswap.info/wiki
- Web service providers use it to create their RDGs
 - Example at sswap.info/api/makeRDG
- Web site providers use it to test their RRGs
 - Example at sswap.info/api/makeRRG
 - Get started at [Discovering Semantic Web Services](#) wiki page

RDG: Resource Description Graph
RRG: Resource Response Graph

HTTP API: /makeRRG

The screenshot shows a web browser window with the URL <http://sswap.info/api/makeRRG> in the address bar. The page content is as follows:

SSWAP HTTP API NAME /makeRRG — make an RRG (Resource Response Graph) **SYNOPSIS** e.g., curl -d @...
Home /makePDG /makeRDG /makeType
 /makeRIG /makeProperty JSON Syntax
 /makeRRG /makeRQG Protocol
 /makeRQG

SSWAP HTTP API

NAME
/makeRRG — make an RRG (Resource Response Graph)

SYNOPSIS
e.g., curl -d @<jsonFile> http://sswap.info/api/makeRRG

DESCRIPTION
/makeRRG is the basename of a URL for a RESTful web service that converts JSON (Javascript Object Notation) into a SSWAP OWL RDF/XML Resource Response Graph (RRG). Input is sent to the URL via a HTTP POST, for example by a <FORM> element in a web page, or by programs such as curl or wget. A HTTP GET on /makeRRG (for example, as initiated by visiting the URL with a browser) returns this manual page. Content negotiation may be used to return a machine parseable JSON schema if the requested response MIME type is application/json.
A Resource Response Graph (RRG) is a human-readable, machine-parsable description of the output data (the result) of a semantic web service using the SSWAP Protocol. The use of OWL allows an RRG to describe its mapping of input data to output data in terms that are amenable to a computable logic. An RRG for a given service is similar to its invoking RIG (Resource Invocation Graph; see /makeRIG. RIGs are OWL DL RDF/XML documents that follow the SSWAP Protocol and are used to invoke a service). RRGs are essentially RIGs with the necessary output data added to the graph.
Best practices on RRG generation follow the guidelines of "Do no harm", "Ignore what you don't

Done

HTTP API: /makeRRG



/makeRRG

Quick Start

Here, we use the program curl to POST the in-line JSON content to the public /makeRRG service:

```
curl -d '{
  "prefix" : {
    "taxaLookup" : "http://sswap.info/examples/resources/
taxonomyLookupService/",
    "ncbiTaxa" : "http://sswapmeet.sswap.info/NCBITaxonomyRecord/",
    "ncbi" : "http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/"
  },
  "taxaLookup:taxonLookupService" : { },
  "mapping" : { _:subject" : "ncbi:wwwtax.cgi?lvl=0&id=3880" },
  "definitions" : {
    _:subject" : {
      "ncbiTaxa:commonName" : "barrel medic"
    },
    "ncbi:wwwtax.cgi?lvl=0&id=3880" : {
      "rdf:type" : "ncbiTaxa:TaxonomyRecord",
      "ncbiTaxa:taxonID" : "3880",
      "ncbiTaxa:recordURL" : "http://www.ncbi.nlm.nih.gov/Taxonomy/
Browser/wwwtax.cgi?lvl=0&id=3880",
      "ncbiTaxa:scientificName" : "Medicago truncatula",
      "ncbiTaxa:commonName" : "barrel medic"
    }
  }
}
' http://sswap.info/api/makeRRG
```

(For Windows CMD.exe users, see USAGE NOTES below). The <ResourceURI> is taxaLookup:taxonLookupService. Note that the RRG maps the input (_:subject) based on its properties (ncbiTaxa:commonName = "barrel medic") to a URL on the web (ncbi:wwwtax.cgi?lvl=0&id=3880) and then marks up that web resource by typing it (ncbiTaxa:TaxonomyRecord) and adding properties. Using URLs as graph nodes in both input and output statements is a way to pass references to data without embedding the data itself as RDF/XML. Developers implementing a service can use the Software Development Kit to aid in handling the response of the service.

iPlant Semantic Web Wiki: sswap.info/wiki

The screenshot shows a web browser window with the following details:

- Title Bar:** Discovering Semantic Web Services - Semantic Web Program - iPlant Collaborative Wiki
- Header:** Dashboard - Semantic Web Program - Home - Discovering Semantic Web Services
- Search:** A search bar with placeholder text "This box searches only this space. The box at the upper right searches the entire iPlant wiki." and a "Search" button.
- Left Sidebar:** A navigation menu with items: Get Started, The Basics, Discovering Semantic Web Services (which is the current page), Hosting Semantic Web Services, and Semantic Pipeline RESTful API.
- Content Area:**
 - Section Header:** iPlant Collaborative™ Wiki Discovering Semantic Web Services
 - Text:** Added by Darian Gessner, last edited by Darian Gessner on Jan 10, 2012 (view change)
 - Text:** I am a web master. I want my users to simply press a button and be taken directly to semantic Discovery.
 - Section Header:** Steps:
 - Step 1:** Include this snippet of Javascript in the <HEAD> of any web page that will launch Discovery.

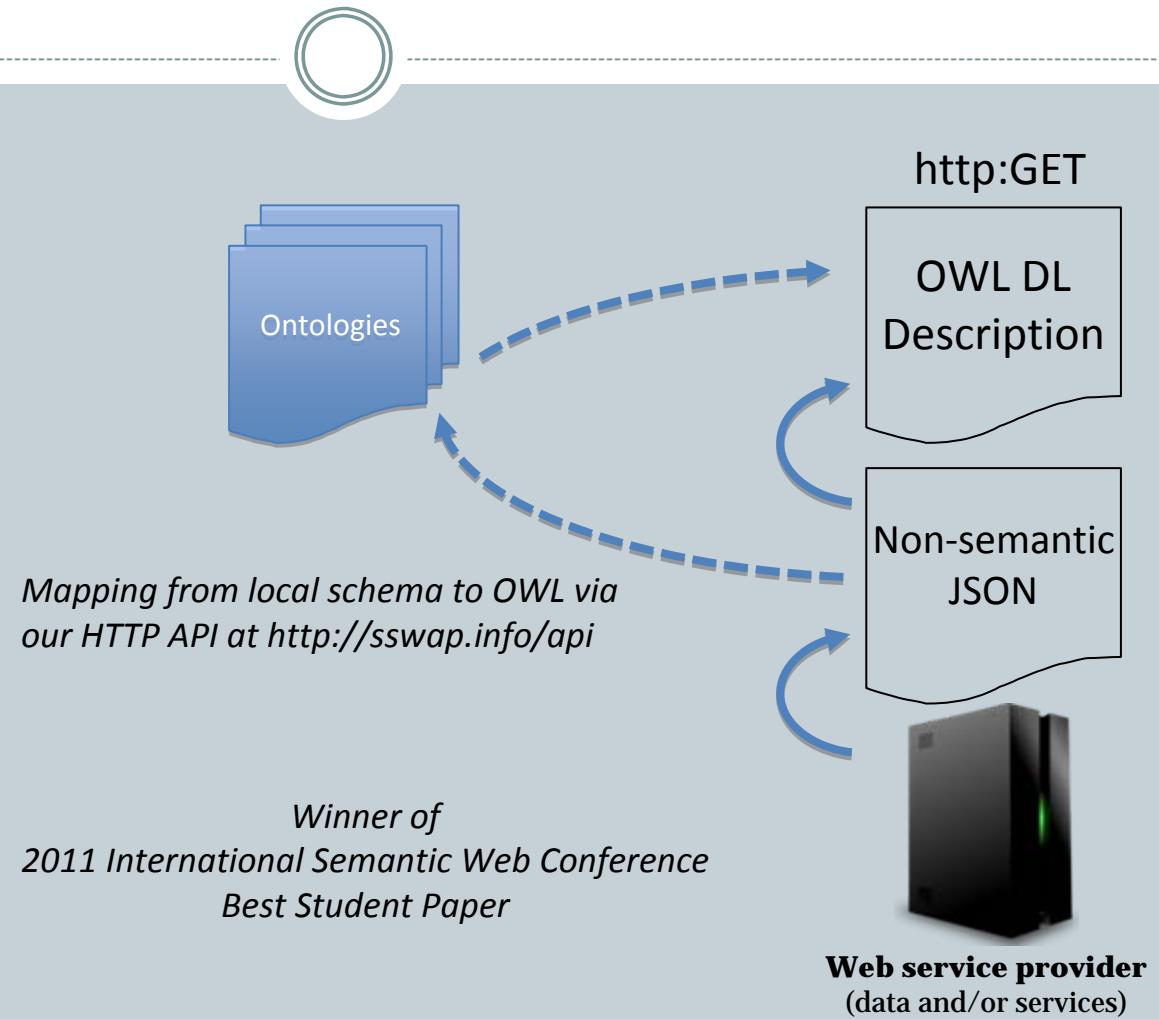
```
<head>
<script src="http://ajax.googleapis.com/ajax/libs/jquery/1.6.2/jquery.min.js" type="text/javascript"></script>
<script src="http://sswap.info/sswap.js" type="text/javascript"></script>
</head>
```
 - Step 2:** Place this <div> (or) in the <BODY> of the web page where you want the Discovery button to appear.

```
<body>
<div id="pipelineButton"></div>
</body>
```
 - Step 3:** Include this <script> in the <BODY> of the web page; set the variable jsonRNG in Step 4.

```
script type="text/javascript">
var jsonRNG = { ... };
SSWAP.discover(jsonRNG, "#pipelineButton");
</script>
```
 - Step 4:** Set the variable jsonRNG to a JSON description of the data following the SSWAP protocol and API at <http://sswap.info/api>. See especially /makeRNG. An example is below:

```
var jsonRNG = {
  "api": "/makeRNG",
  "prefix": {
    "treelevel": "http://sswap.dendrome.ucdavis.edu/ontolog/sswap/ontologies/",
    "label": "http://sswapmet.sswap.info/label",
    "gen": "http://sswapmet.sswap.info/gen",
    "obo": "http://sswapmet.sswap.info/obo",
    "ncbitaxa": "http://sswapmet.sswap.info/NCBITaxonomyRecord/",
    "taxa": "http://sswapmet.sswap.info/taxa/"
  },
  "http://sswap.info/examples/resources/canonical/canonicalResource": {}
};
```
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Architecture: Protocol



HTTP API: /makeRDG

The screenshot shows a web browser window with the URL sswap.info/api/makeRDG. The page title is "SSWAP HTTP API". The content is a detailed API documentation for the `/makeRDG` endpoint.

NAME
`/makeRDG` — make an RDG (Resource Description Graph)

SYNOPSIS
e.g., `curl -d @<jsnFile> http://sswap.info/api/makeRDG`

DESCRIPTION
`/makeRDG` is the basename of a URL for a RESTful web service that converts JSON (Javascript Object Notation) into a SSWAP OWL RDF/XML Resource Description Graph (RDG). Input is sent to the URL via a HTTP POST, for example by a program such as curl or wget. A HTTP GET on `/makeRDG` (for example, as initiated by visiting the URL with a browser) returns this manual page. Content negotiation may be used to return a machine parseable JSON schema if the requested response MIME type is `application/json`.

A Resource Description Graph (RDG) is a human-readable, machine-parsable description of a semantic web service using the SSWAP Protocol. The use of OWL allows an RDG to describe a service in terms that are amenable to a computable logic. The RDG is hosted at the URL of the service such that a HTTP GET on the service URL (with no query string parameters) returns the RDG, while an HTTP POST (with an RIG [Resource Invocation Graph] as the body of the POST; see `/makeRIG`) or an HTTP GET with a query string invokes the service. RDGs are OWL DL RDF/XML documents that follow the SSWAP Protocol and are used to describe a service.

RDGs allow automated semantic matching, as possible, between service invocation vocabularies and semantics (as used by a client) and service description vocabularies and semantics as used by the service. They set the template for the service's invocation (via a Resource Invocation Graph; see `/makeRIG`), its return data (as a Resource Response Graph; see `/makeRRG`) and semantic discovery via query graphs (a Resource Query Graph; see `/makeRQG`).

Third-party web servers may host their own `/makeRDG` (see **AVAILABILITY**). `/makeRDG` is hosted as a public service at <http://sswap.info/api/makeRDG>.

Examples of RDGs are numerous: search on anything at <http://sswap.info>, then click on the RDF icon next to any service on the results page to view its RDF/XML RDG; or view the canonical graph at sswap.info/examples/resources/canonical/canonicalResource.

Quick Start
Here, we use the program curl to POST the in-line JSON content to the public `/makeRDG` service:

HTTP API: /makeRDG



On many operating systems you can also in-line content such as in the **Quick Start** example above and the example below:

```
curl -d '
{
    "api" : "/makeRDG",

    "prefix" : {
        "gramene" : "http://sswap.gramene.org/vpin/",
        "grql1"   : "http://sswap.gramene.org/vpin/ontologies/qt1/",
        "qt1"     : "http://sswapmeet.sswap.info/qt1/"
    },

    "gramene:qt1-by-linkage-group" : {

        "sswap:label" : "Gramene QTLs for Linkage Group Retrieval",
        "sswap:oneLineDescription" : "Given an input linkage group this service returns a list of QTL accessions and published name",
        "sswap:providedBy" : "gramene:resourceProvider",

        "sswap:aboutURI" : "http://www.gramene.org/qt1",
        "sswap:metadata" : "gramene:qt1-by-linkage-group-metadata.txt",
        "sswap:inputURI" : "gramene:invoke-qt1-by-linkage-group.jsp"
    }

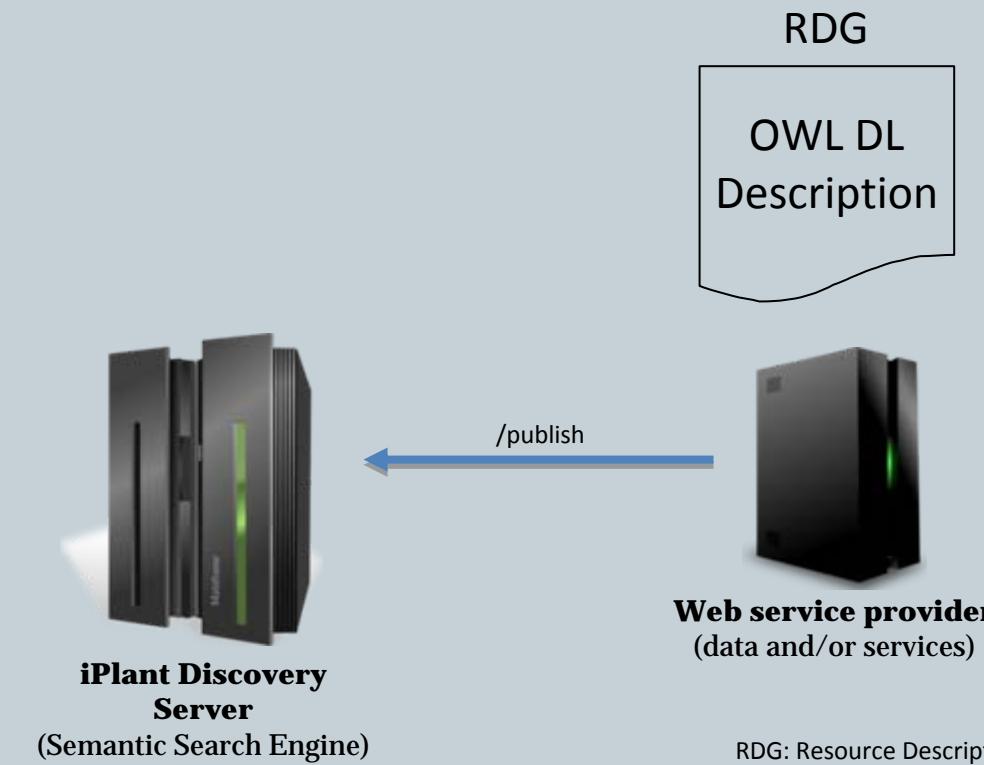
    "mapping" : { "_:subject" : "_:object" },

    "definitions" : {
        "_:subject" : { "rdf:type" : "grql1:Qt1ByLinkageGroupRequest" },
        "_:object"  : { "rdf:type" : "qt1:QTL" }
    }
}
' http://sswap.info/api
```

The contents between and including the opening and closing curly braces { } are exemplary of the contents of `myJSONInputfile`. When in-lining content, note the use of opening and closing single quotes (') around the braces { }; this protects the contents from interpretation by the shell in many operating systems. The mapping of subject to object, and their subsequent typing in the definitions section follows the protocol at <http://sswap.info/protocol>. SSWAP uses a highly distributed model of data re-use, thus while it is possible to embed definitions within the text of an RDG, a stronger model is to place those definitions at web-accessible URIs, such as is done with `grql1:Qt1ByLinkageGroupRequest` and `qt1:QTL`. `/makeRDG` will deference these URIs as part of determining constraints and constructing the graph.

If a `definitions` directive solely sets a single `rdf:type` and those types are hosted on the web and available when the API is called to create the RDG (as above), then the directive may be skipped by simply stating the types in the `mapping`, e.g.:

Architecture: Publication



Java API



- Run your own transaction-time reasoning servlet by using our SDK
- SDK (Software Development Kit) at sswap.info/sdk
- Javadocs at sswap.info/docs/API/Java-API
- Extend the single class `info.sswap.api.servlet.AbstractSSWAPServlet` by overriding the single method `handleRequest()` to perform your service specifics
- Examples available at
- Get started at [Hosting Semantic Web Services](#) wiki page

RDG: Resource Description Graph
RRG: Resource Response Graph

info.sswap.api.servlet.AbstractSSWAPServlet.handleRequest()

The screenshot shows a Java API documentation page for the class `AbstractSSWAPServlet`. The page is titled "AbstractSSWAPServlet" and includes a navigation bar with links for Overview, Package, Class, Use, Tree, Deprecated, Index, and Help. Below the navigation bar, there are links for PREV CLASS, NEXT CLASS, SUMMARY, NESTED, FIELD, CONSTR, and METHOD. There are also links for FRAMES, NO FRAMES, DETAIL, FIELD, CONSTR, and METHOD.

Class AbstractSSWAPServlet

Inheritance:

```
java.lang.Object
  ↳ javax.servlet.GenericServlet
    ↳ javax.servlet.http.HttpServlet
      ↳ Info.sswap.api.servlet.AbstractSSWAPServlet
```

All Implemented Interfaces:

```
java.io.Serializable, javax.servlet.Servlet, javax.servlet.ServletConfig
```

Direct Known Subclasses:

```
Info.sswap.ontologies.exec.impl.ExecImpl, LegacyServiceWrapperService
```

public abstract class AbstractSSWAPServlet
extends javax.servlet.http.HttpServlet

Handles HTTP GETs and POSTs to a SSWAP service point. This is the main entry point to SSWAP Semantic Web Services. This class is a bridge between handling a HTTP request and the SSWAP Java API that allows on-demand, transaction-time reasoning to satisfy the request.

To use, extend this abstract class and override the `handleRequest` method. When an Resource Invocation Graph (RIG) is sent to the servlet, `handleRequest` will allow action on the RIG to create a Resource Response Graph (RRG) to be returned back to the client. The RIG supports a `translate` method to allow semantic mapping of the RIG into the vocabulary and concepts of the service's Resource Description Graph (RDG).

Upon return from `handleRequest`, this class generates an RRG which is serialized back to the client.

The servlet responds to HTTP GETs and POSTs in the following manner:

- GET with no query string returns the RDG;
- GET with a query string initiates auto-invocation whereby the servlet creates an RIG from the GET query string and the service's RDG. The service is then self-invoked. During GET query string parsing, query string terms are semantically matched to terms on the SSWAPResource or SSWAPSubjects of the RDG. An RIG is generated and the service is invoked as if it was POSTed the RIG.
- POST should contain a RIG as the body of the POST. Upon receipt, the service is invoked. Exercise care if POSTing from a HTML <form> element so as to not prepend the POST body with a parameter name. If necessary, use Javascript to POST the contents directly or POST to a handler servlet that extracts the RIG content and POSTs only it to the service. URLs within the RIG may be URL encoded (if needed), but the RIG itself should be plain RDF/XML.

GET query string parameters (e.g., `http://.../MyService?property=valu&prefix.property=value2`) are converted into service parameters according to the following rules:

- `property=valu`; `property` is prefixed with the default namespace of the RDG and mapped to a fully qualified URI (ontology term)

iPlant Semantic Web Wiki: sswap.info/wiki

The screenshot shows a web browser window displaying the iPlant Collaborative Wiki page for "Hosting Semantic Web Services". The URL is pods.iplantcollaborative.org/wiki/display/SemanticWeb/Hosting+Semantic+Web+Services. The page title is "iPlant Collaborative™ Wiki Hosting Semantic Web Services".

Powerful: I want to offer legacy services, or write new services, as semantic web services. I am willing to use Java.

Steps:

1. Download the SDK (Software Development Kit) from <http://sswap.info/sdk>
Example code is available at [SourceForge](#)
2. Create a Java project and link in all the library files in the SDK's /lib directory
 - Eclipse is an excellent integrated development environment (IDE) for developing your code
 - Set up your project as a Dynamic Web Project, available as part of the Java EE version or as part of the Web, XML, and Java EE Development software extension to the basic Eclipse Java
3. Extend the class `info.sswap.api.servlet.AbstractSSWAPServlet.java` by overriding the single method `handleRequest()`.
 - All your custom code is connected in via `handleRequest()`
 - Bridge between the semantic world and your world using the SSWAP Java API included as a .jar in /lib
 - Javadocs at <http://sswap.info/docs/API/Java-API>
 - For more info, see [AbstractSSWAPServlet](#)
4. Describe your service with an RDG (Resource Description Graph)
 - Your RDG is a web document that describes your service to the world; your servlet executes the service it describes
 - The URL of the RDG is linked to your servlet via your servlet container's web.xml file
 - Use the HTTP API [/makeRDG](#) to convert a simple JSON description into an RDF/XML OWL RDG.
 - Use the other HTTP API methods to make [types](#) and [properties](#) to describe your data; see [HTTP API](#)
5. Compile your project into a .war (Web Archive) file and host on your web server

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Semantic Translation



RDG: TaxonomyRecord

Medicago truncatula

TaxonomyRecord

RIG:MySpeciesRecord

RRG:MySpeciesRecord

TaxonomyRecord

rdfs:subClassOf

MySpeciesRecord



Providers
(Data and/or Services)



Clients



On-demand Semantic Translation Enables “future-proof” Extensibility



RDG: accessionID = 5

accessionID = 3

RIG:myAccessionID = 3

RRG:myAccessionID = 3



Providers
(Data and/or Services)

accessionID
rdfs:subPropertyOf
myAccessionID



Clients

Workshop



Two-day developer workshop in June 2012 in Santa Fe, NM

Details will be posted at www.iplantcollaborative.org

Semantic Web Program at iPlant



Academics

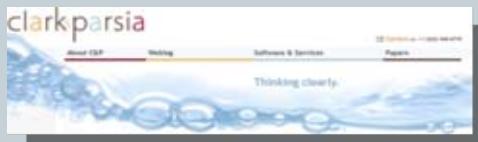
HOMER EUCLID CHAUCER EINSTEIN DU BOIS VIRGIL
AUGUSTINE ARISTOTLE WASHINGTON WOOLF PLATO
TOCQUEVILLE AUSTEN NEWTON CERVANTES DARWIN
MOZART GALILEO TOLSTOY DESCARTES FREUD [MORE]

St. John's College, Santa Fe, NM
Two work-study students

Infrastructure



Industry



Clark and Parsia LLC
(Washington D.C.)
expert semantic web firm

Grand Challenges

Meetings



- Plant & Animal Genome 2012
- International Semantic Web Conference
- June 2012 Semantic Web Workshop

Research



Acknowledgements



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- NSF grants #0943879 and #EF-0735191

iPlant Semantic Pipeline

The screenshot shows the iPlant Semantic Pipeline interface running in Mozilla Firefox. The title bar indicates the URL is <http://sswap.a.iplantcollaborative.org/>. The main header says "sswap.info Simple Semantic Web Architecture and Protocol". A navigation bar at the top includes "New pipeline" (with a green checkmark icon), "Logout" (logged in as dgennar), and a "Drag service icon here" placeholder.

Service Details

Extract images from page

- Name: Extract images from page
- Description: Scans an HTML page and extracts all images from it
- Service URI: <http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/extractImagesFromPage>
- Provider: Test provider
- Time started: January 16, 2012 2:10:32 PM MST
- Time finished: January 16, 2012 2:10:43 PM MST

Showing 5 results

	Name: Image conversion to grayscale	Description: Given images in PNG format, converts them into a grayscale version	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/grayscale
	Name: Dim image	Description: Given images in PNG format, it dims them by the specified factor	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/dim
	Name: Converter to PNG	Description: Given an image in a format supported by Java ImageIO, it converts it into PNG	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/convertToPNG
	Name: Scale image	Description: Given Images in PNG format, scales them to the desired size	http://sswap-a.iplantcollaborative.org/sswap-pipeline-test/test/data/pipeline/scale
	Name: SoylBase Locus Type Service	Description: Returns a non-redundant list of all soybean genetic map loci contained in SoylBase.	