Semantics for Cyberinfrastructure: The iPlant Collaborative's Semantic Web Platform

VIRTUAL WORKSHOP

SEMANTICS IN GEOSPATIAL AND OTHER ARCHITECTURES: DESIGN AND IMPLEMENTATION

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The iPlant Collaborative

NSF-funded, multi-institutional, collaborative project
similar in scope to EarthCube.

Mission:

To build a cyberinfrastructure for the nation's plant scientists.

Successfully completed its first five years
and is anticipatory of the next (May 2013)

www.iplantcollaborative.org

All-too-Familiar Challenges

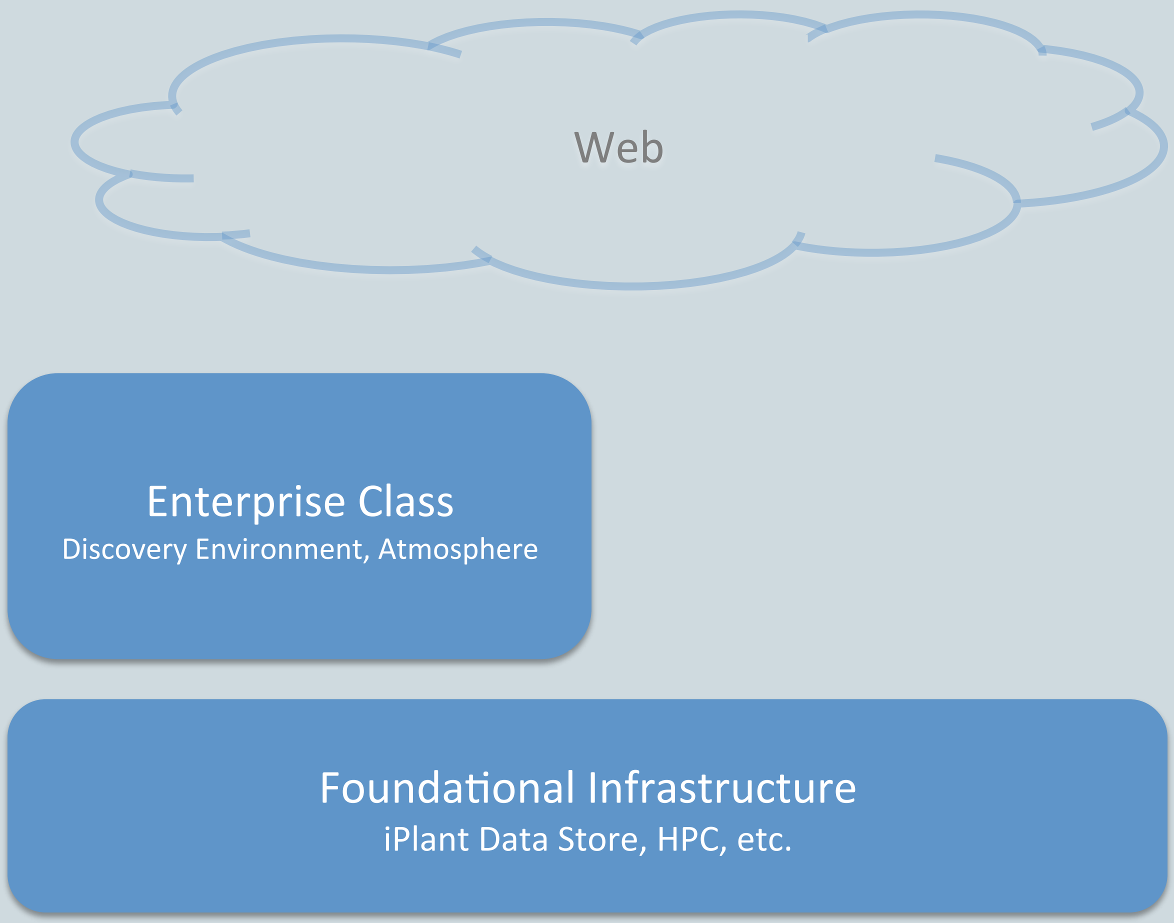
1. Disparate data
2. Varying research agendas
3. Lack—or proliferation—of standards
4. Disruptive technologies (NGS)
5. Rapidly changing science
6. Global externalities
7. Hierarchical, non-linear systems
8. Finite time, money, and resources

A Constrained Solution Space

Perfect solutions either do not exist,
or are not feasibly attainable under the constraints.

Yet even good solutions can be powerfully transformative
(*e.g.*, WWW in 1991)

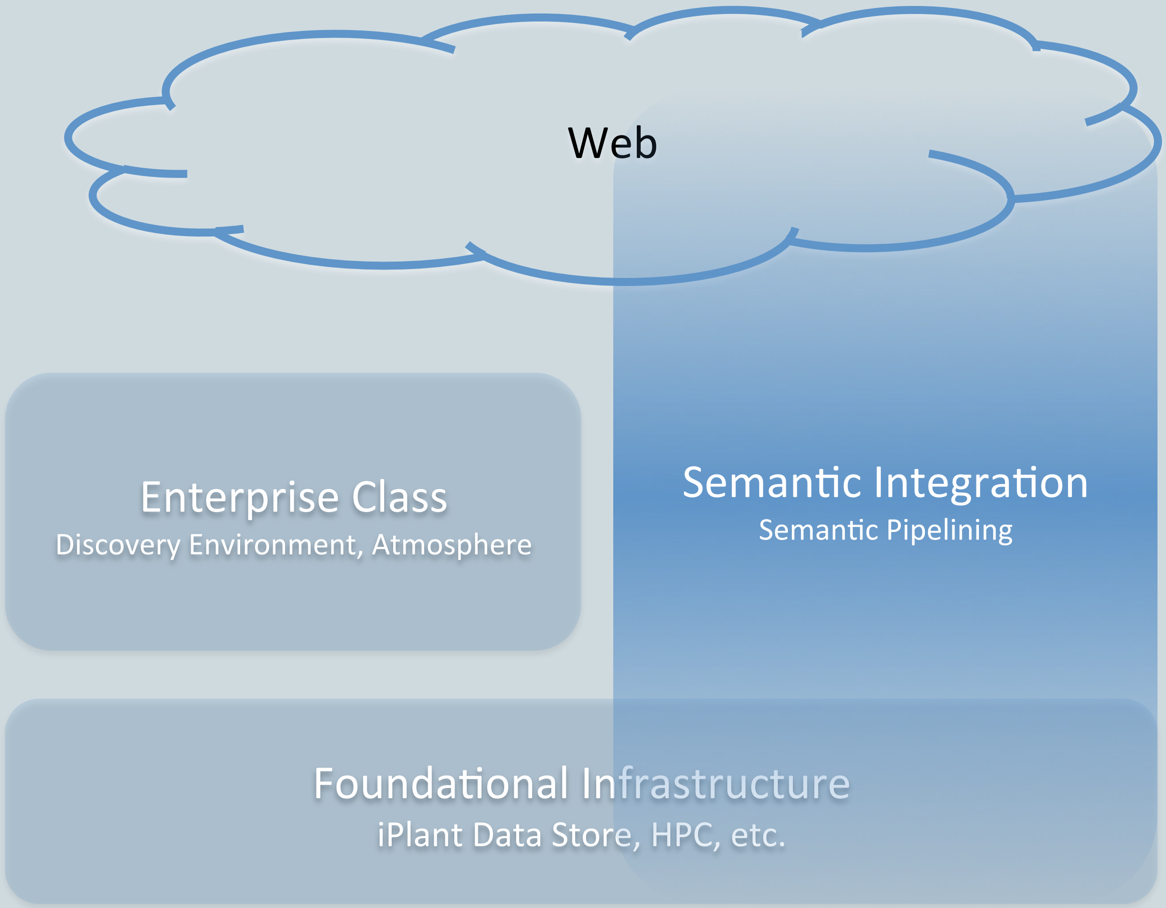
Enterprise and HPC Assets



Enterprise Class
Virtual Workdesk
Cloud, Virtual machines

High Performance Computing
PFLOPS-scale compute power
Petabyte scale storage

Bridging Enterprise, HPC, and Web Assets

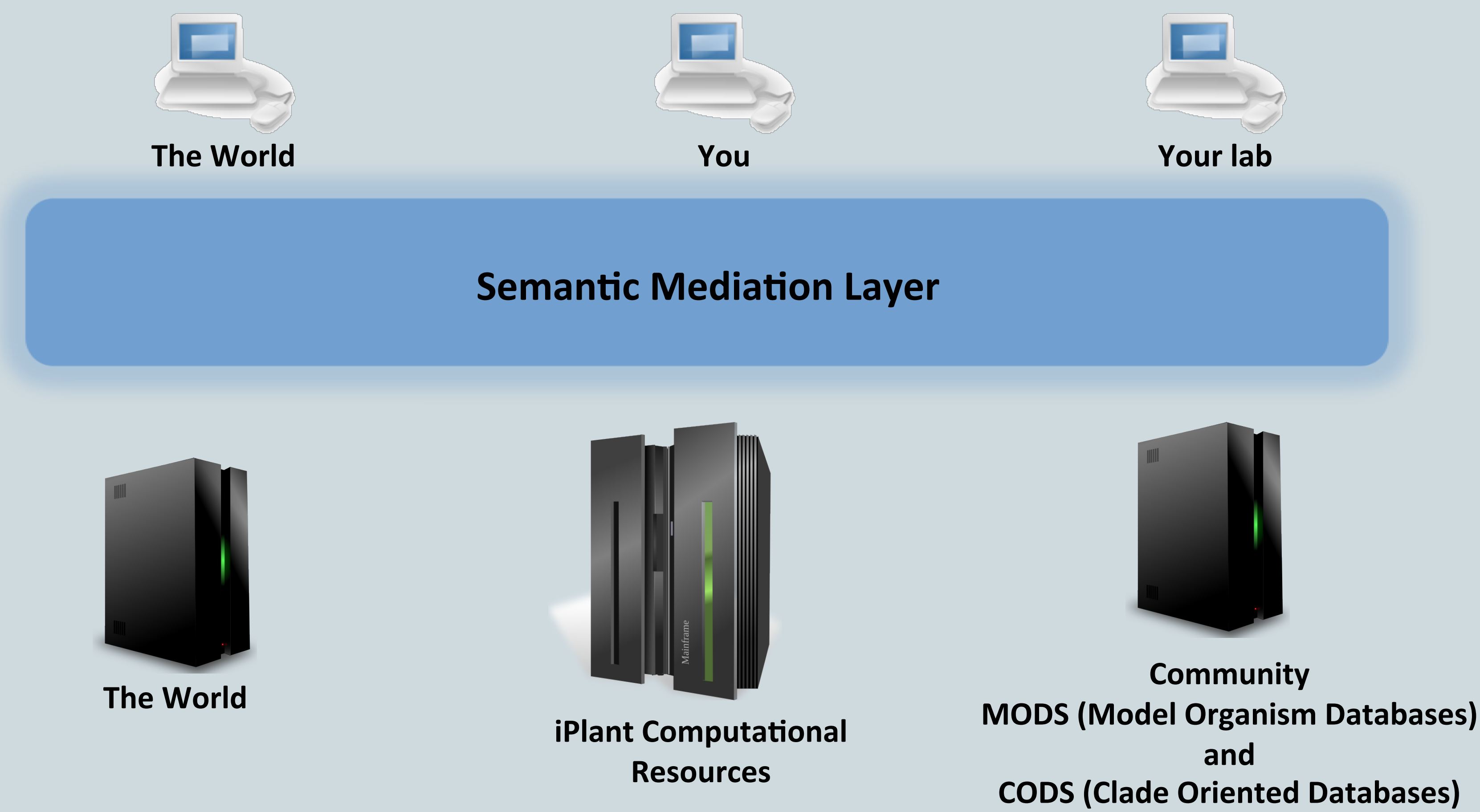


Distributed
Semantic Web Services
Logic-driven semantics

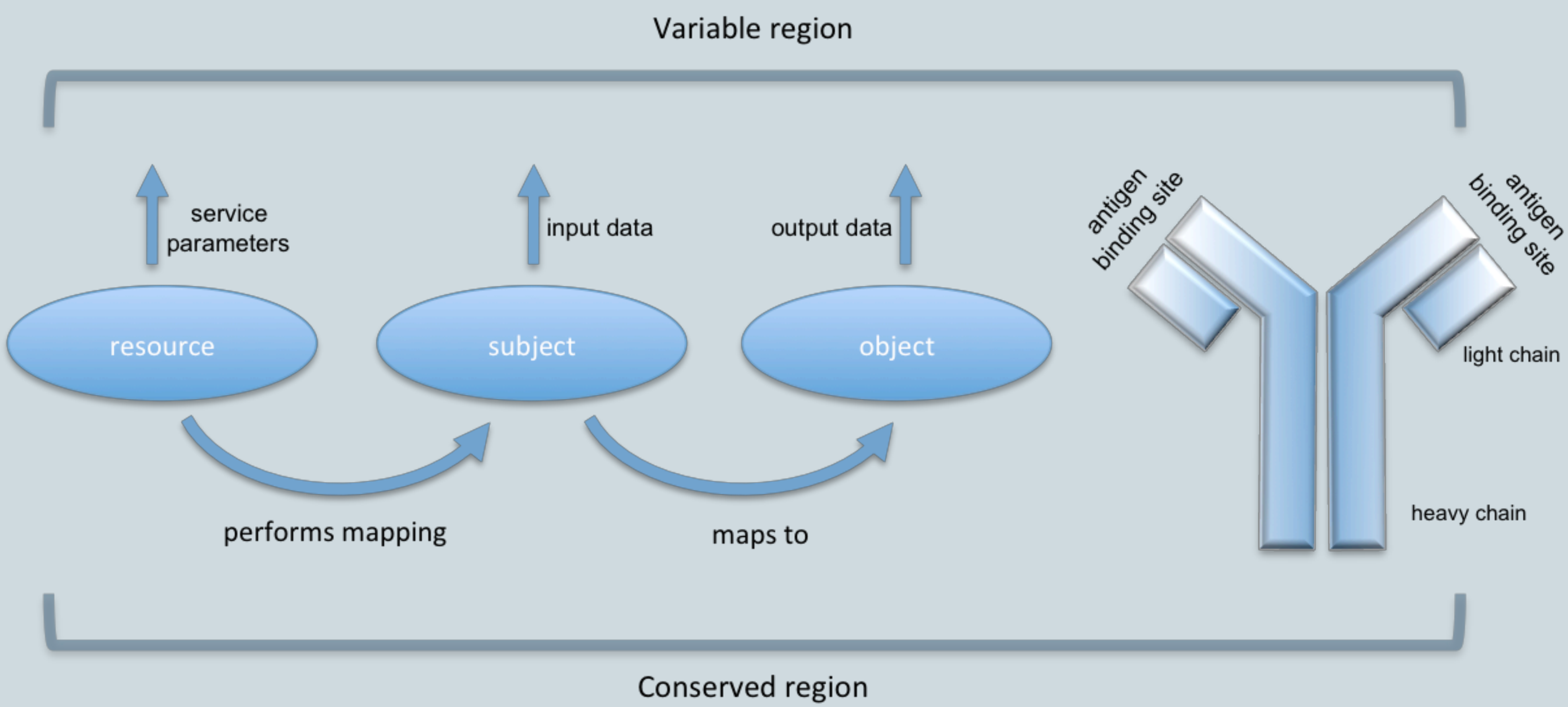
Enterprise Class
Virtual Work desk
Cloud, Virtual machines

High Performance Computing
PFLOPS-scale compute power
Petabyte scale storage

The Actors

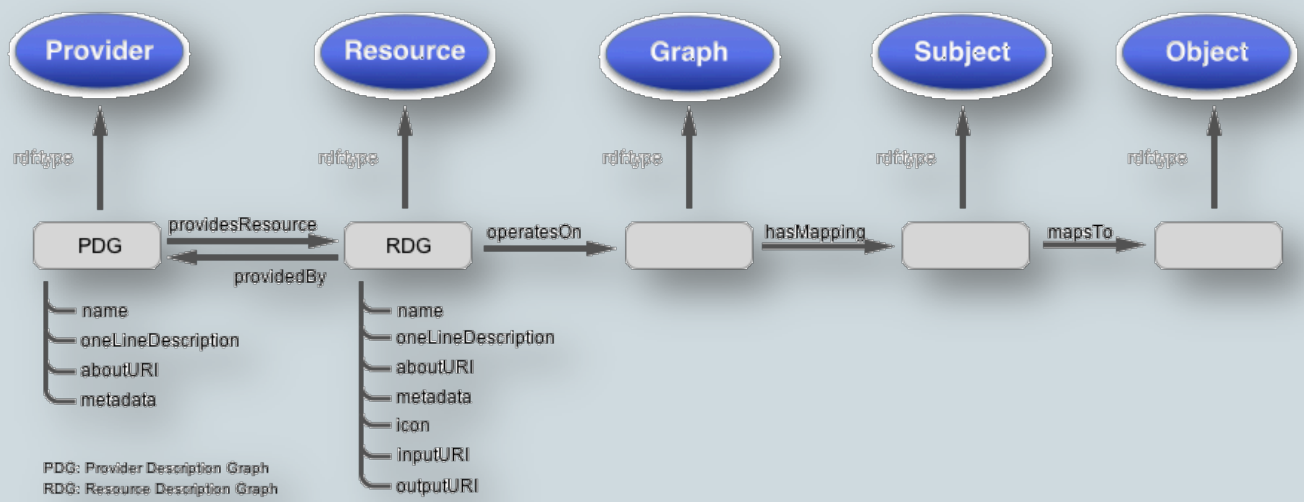

The World
You
Your lab
Semantic Mediation Layer
The World
Mainframe
iPlant Computational Resources
Community
MODS (Model Organism Databases)
and
CODS (Clade Oriented Databases)

The Antibody Analogy as a Semantic Mediation Layer



Simple Semantic Web Architecture and Protocol

W3C OWL RDF/XML

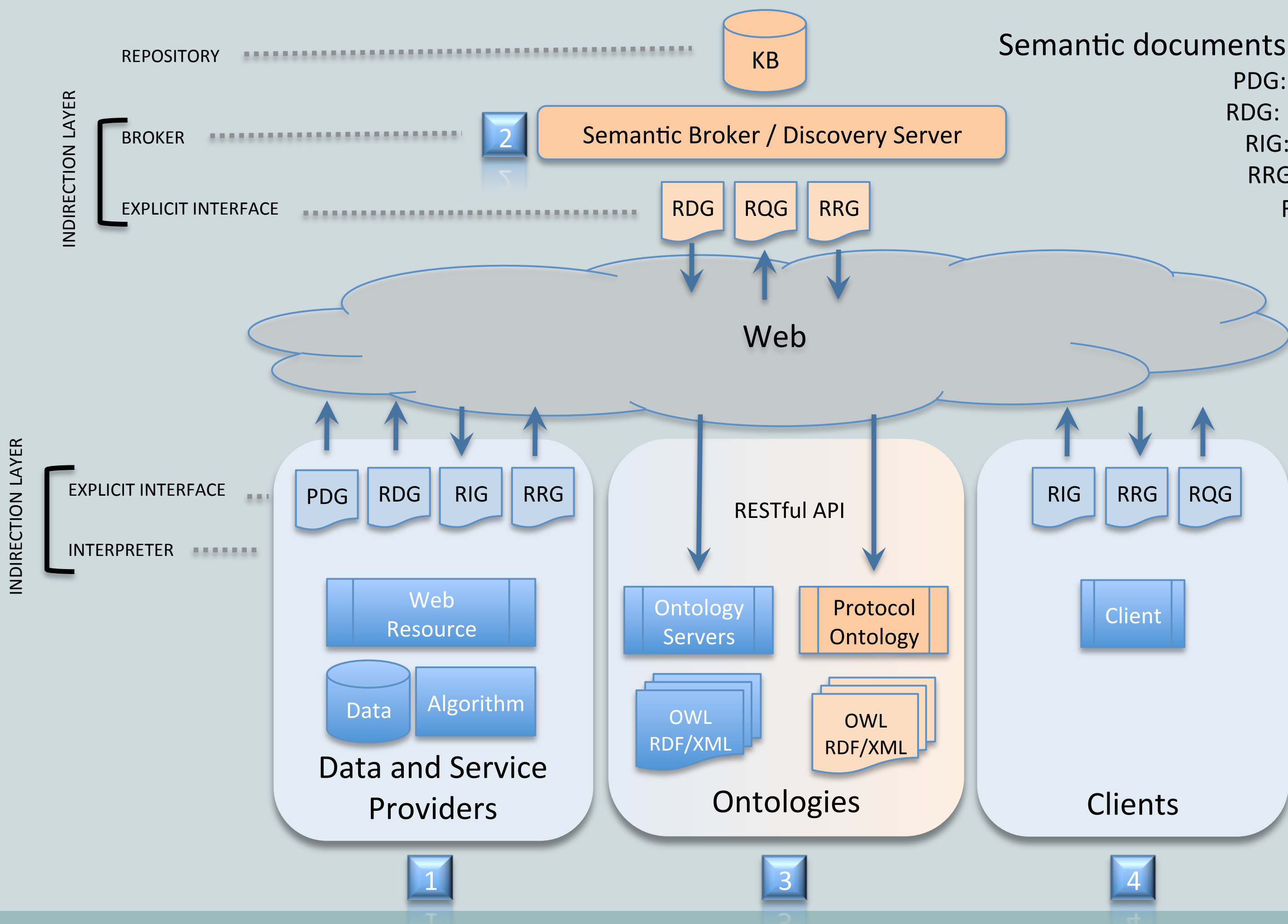


- Establish the framework for web resources to describe themselves and their offerings
- Establish the framework for ontological integration
- Engage first-order, description logic reasoning
- Provide a semantically enabled Discovery Server for service and pipeline coordination

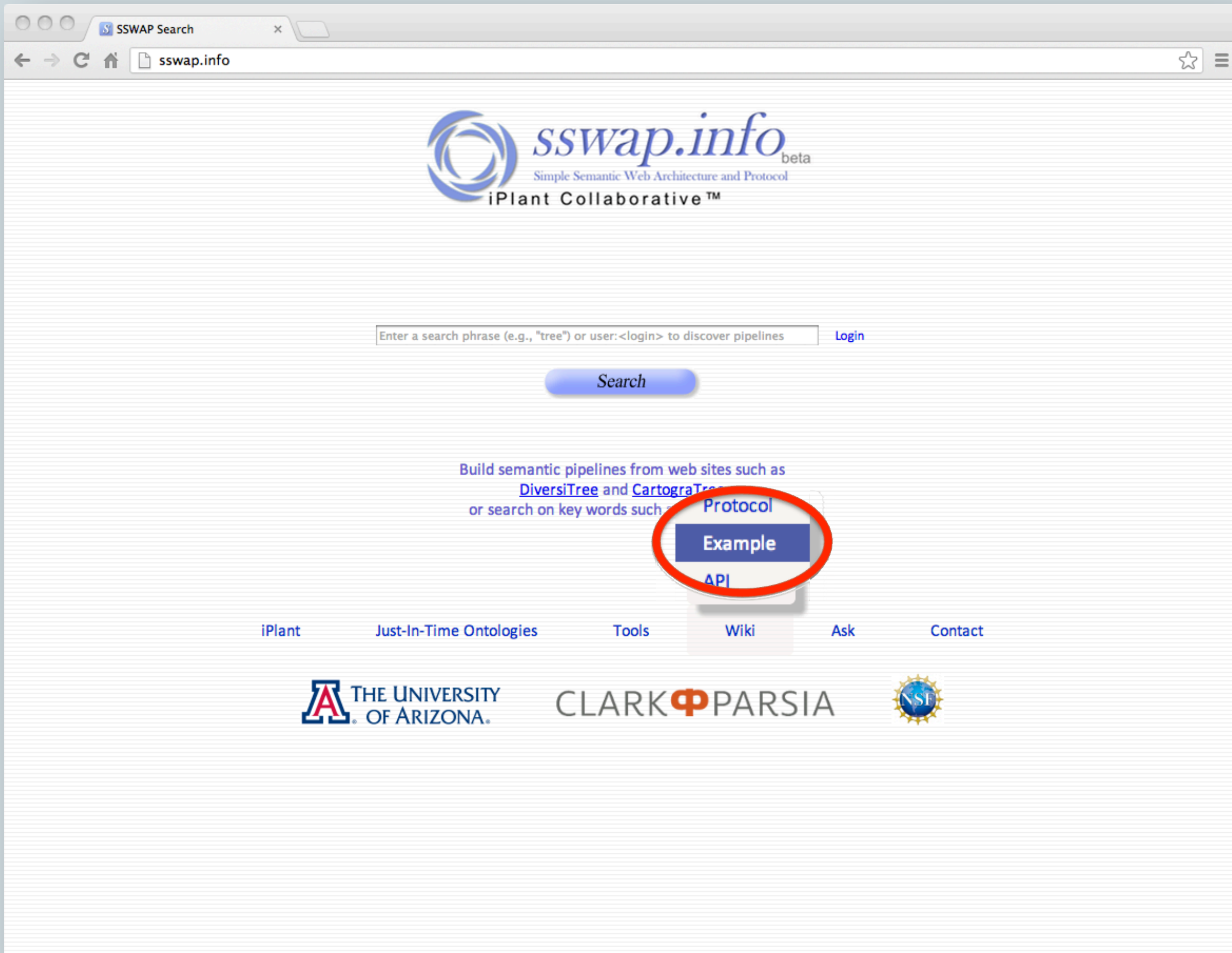
http://sswap.info/protocol

iPlant Semantic Architecture

Semantic documents described in this talk:
PDG: Provider Description Graph
RDG: Resource Description Graph
RIG: Resource Invocation Graph
RRG: Resource Response Graph
RQG: Resource Query Graph

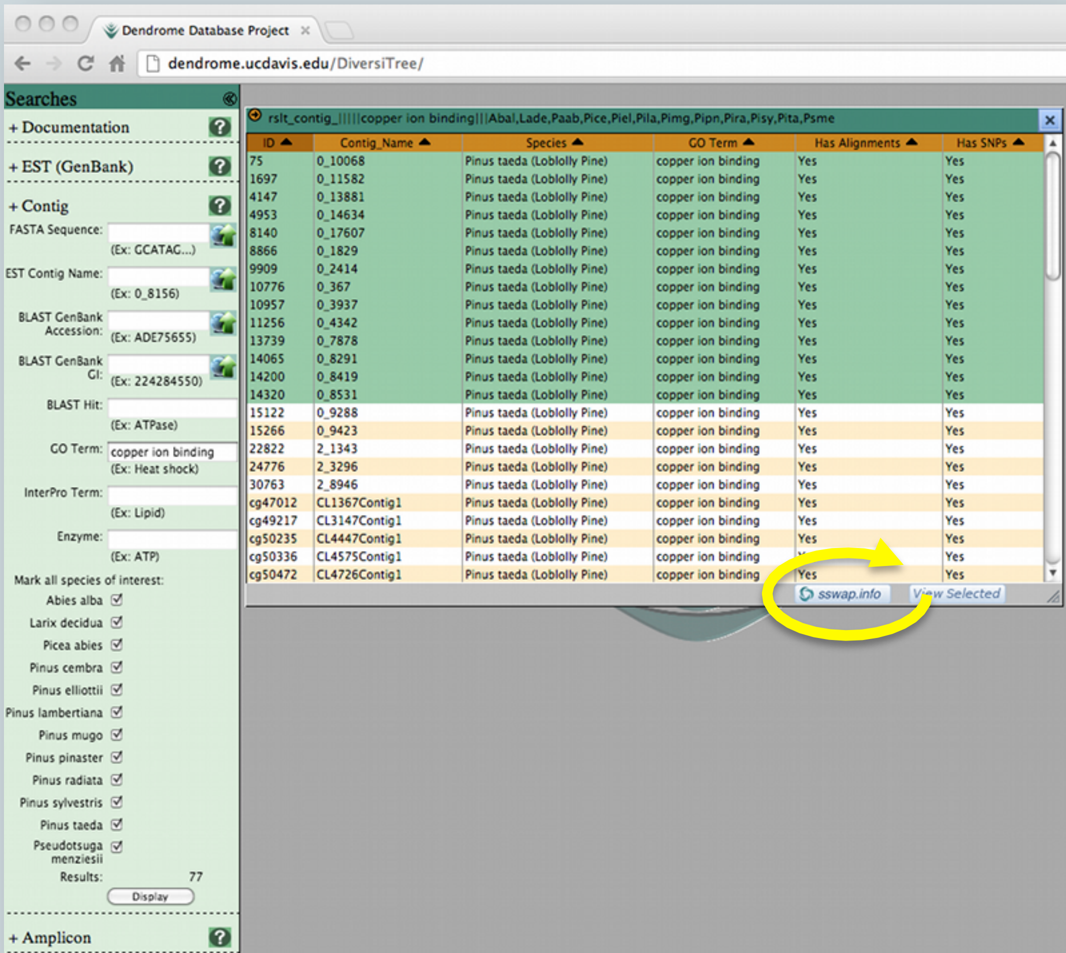


sswap.info/example



Semantic Integration from Third-party Web sites

TreeGenes' DiversiTree



Javascript snippet to launch data for Web Discovery with the press of a button

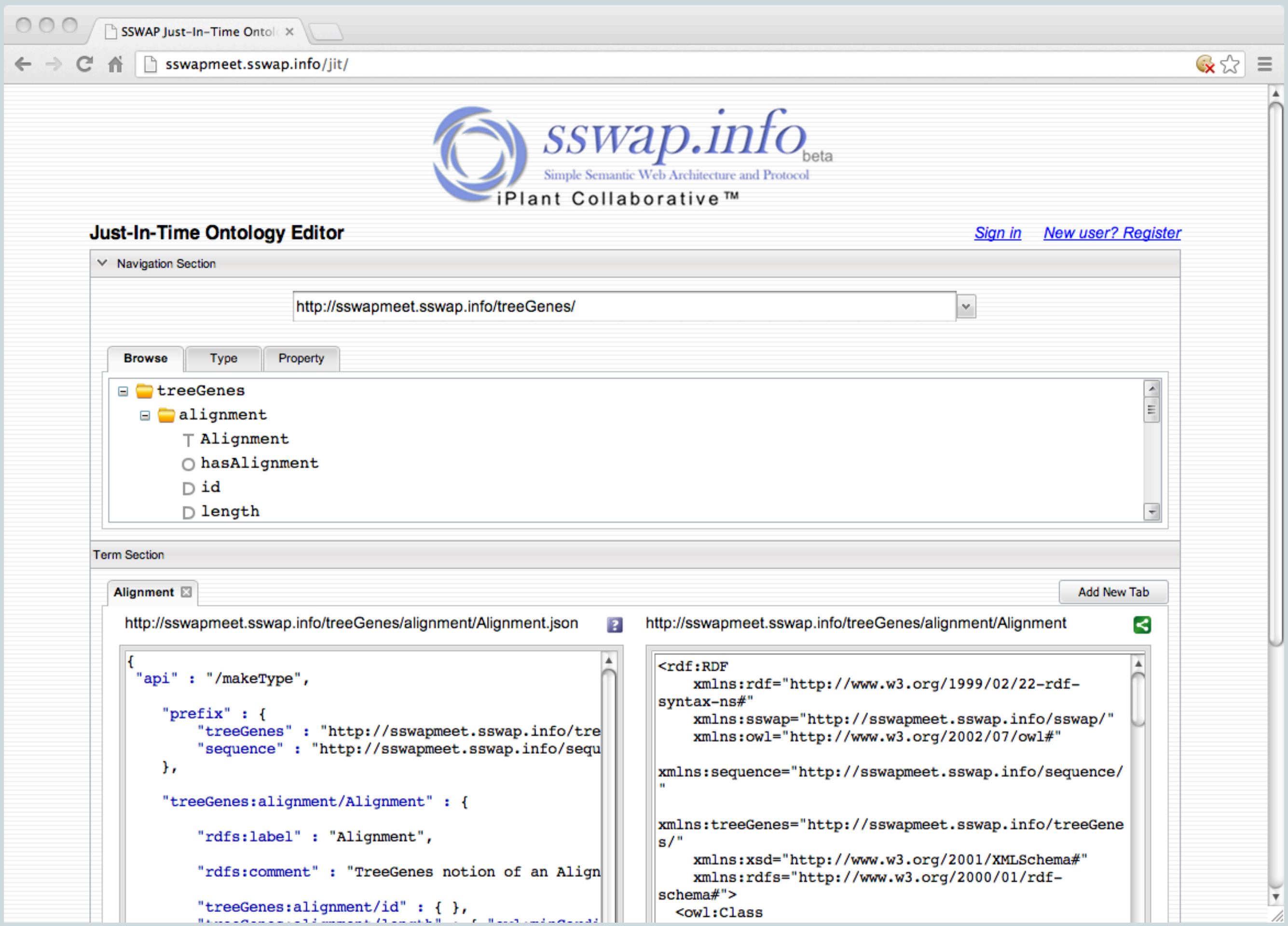
Web Discovery into Semantic Pipelines

Reasoner-assisted Web workflows

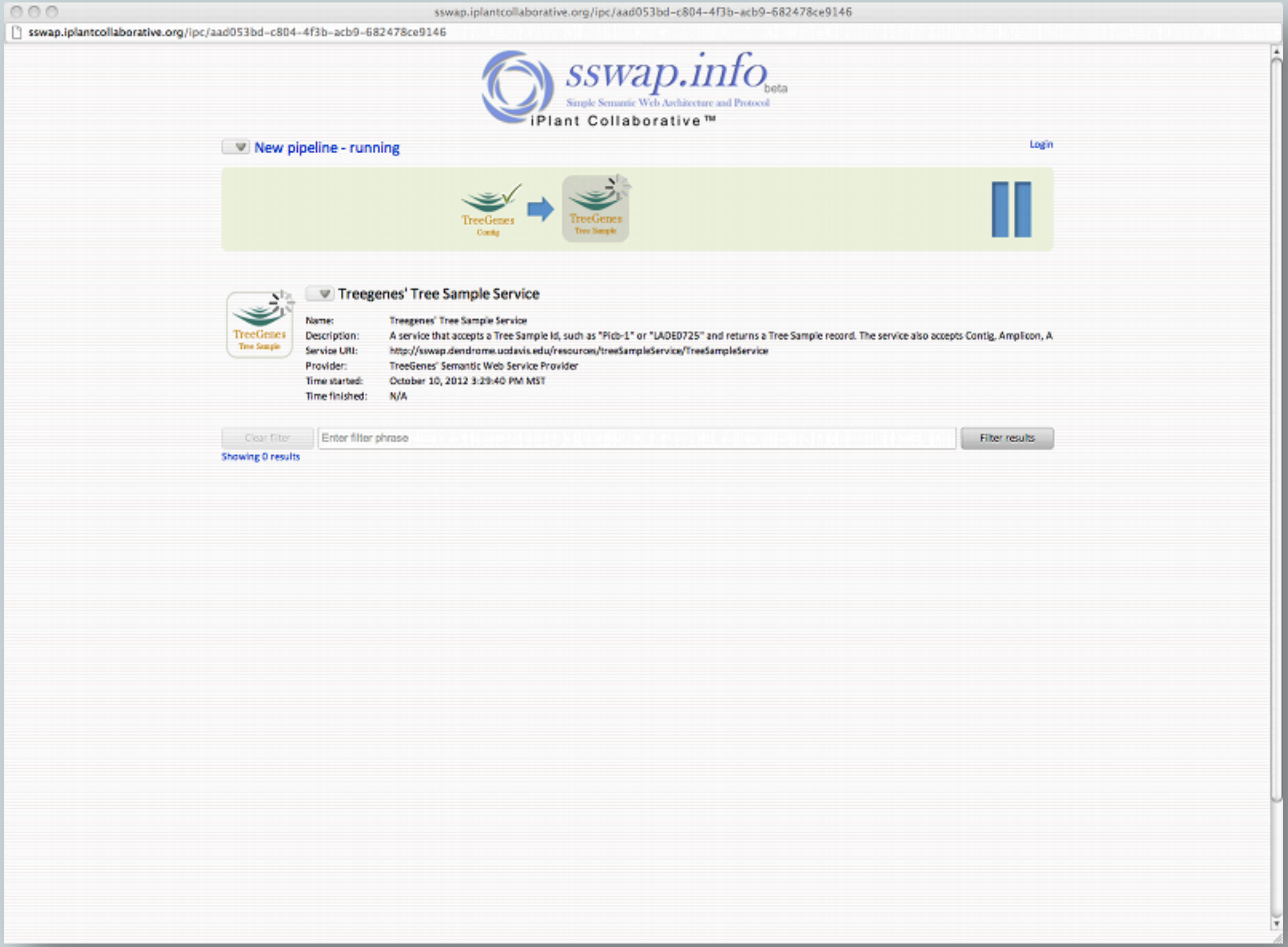
Reasoner uses first-order, description logic to present services and pipelines that can operate on the data at any given step

Just-In-Time Ontology Hosting

sswap.info/jit

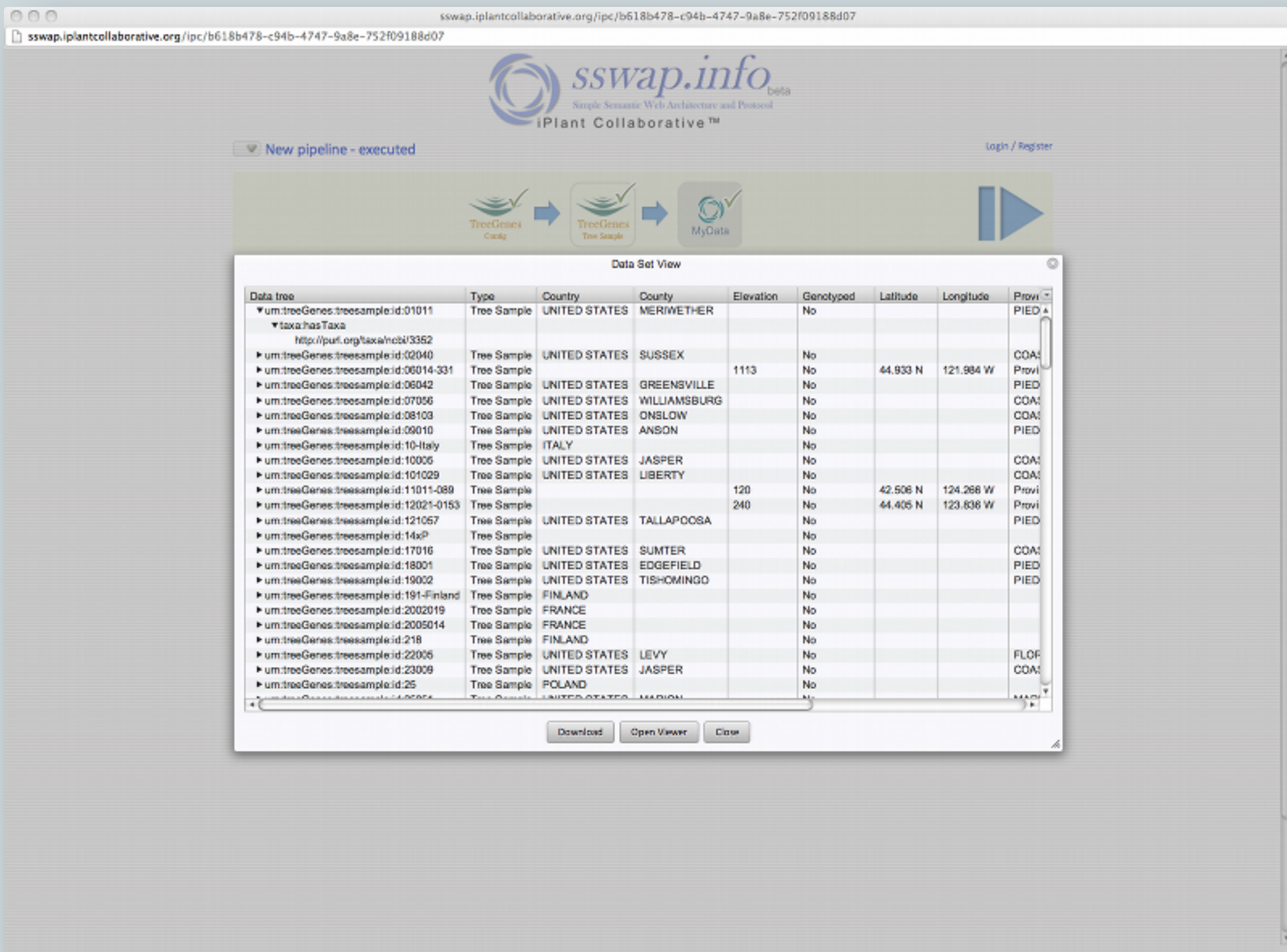


RESTful Pipeline Execution



Data Tree View

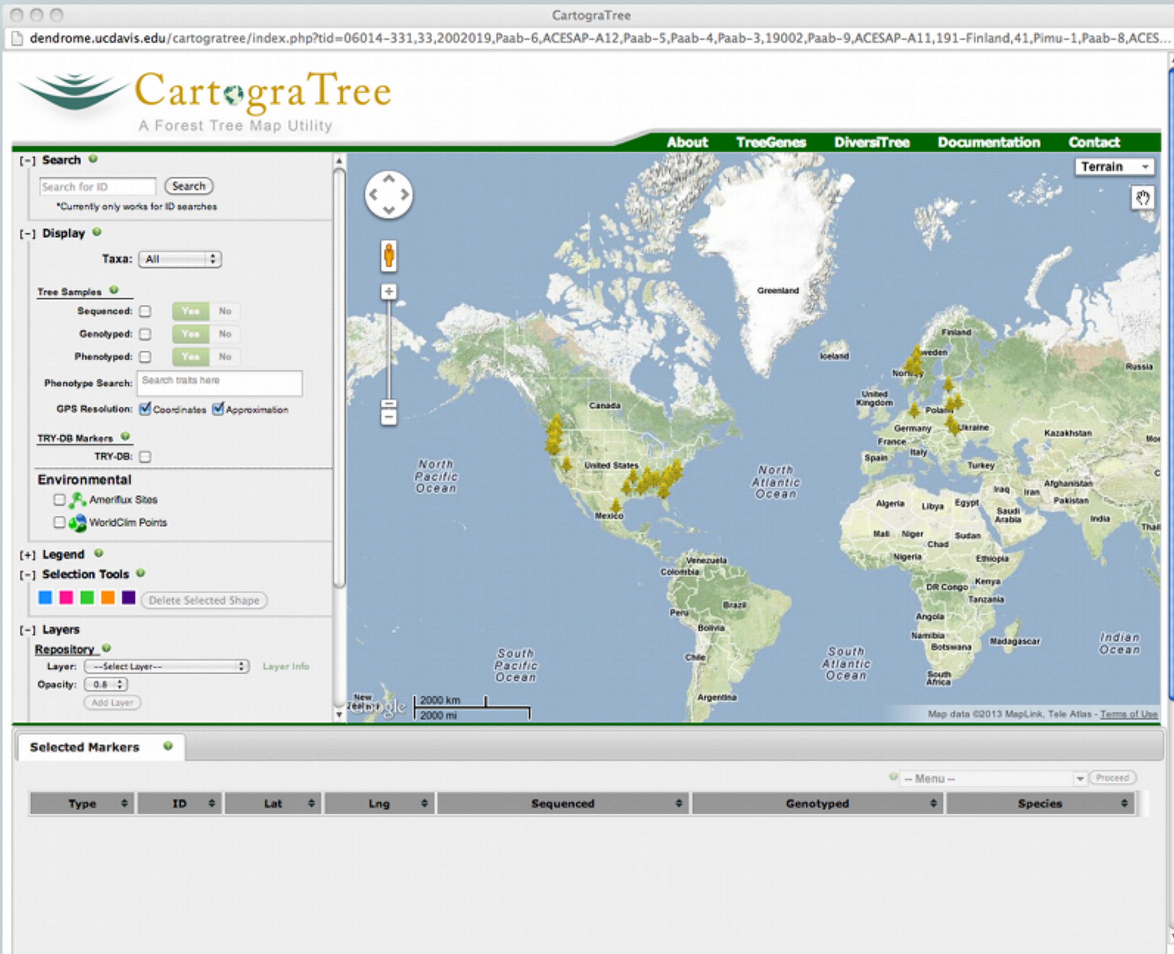
“Ontologized” data and metadata



SSWAP enables on-the-fly Data Tree views

Semantic Integration into Third-party Web sites

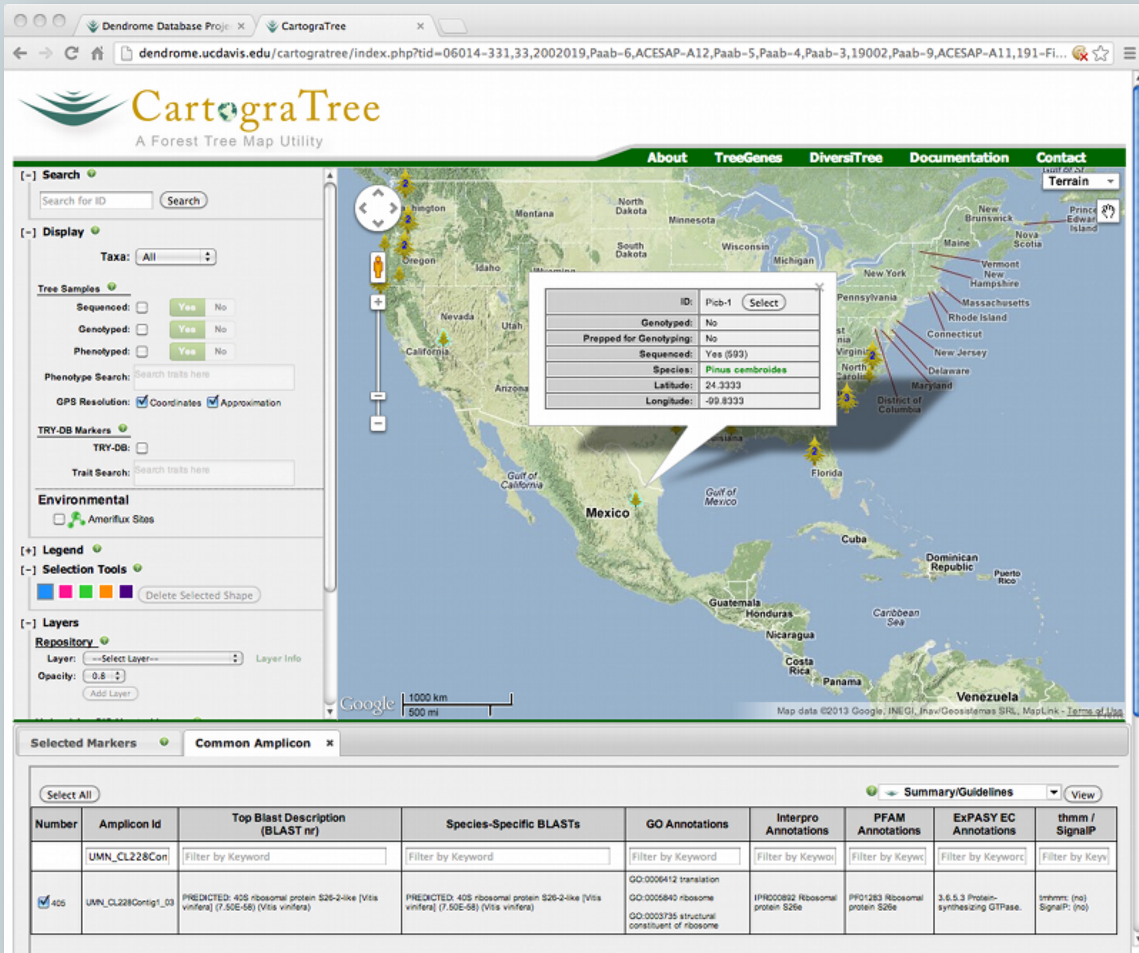
TreeGenes' CartograTree



Third-party web sites can engage as renderers on result sets ...

CartograTree

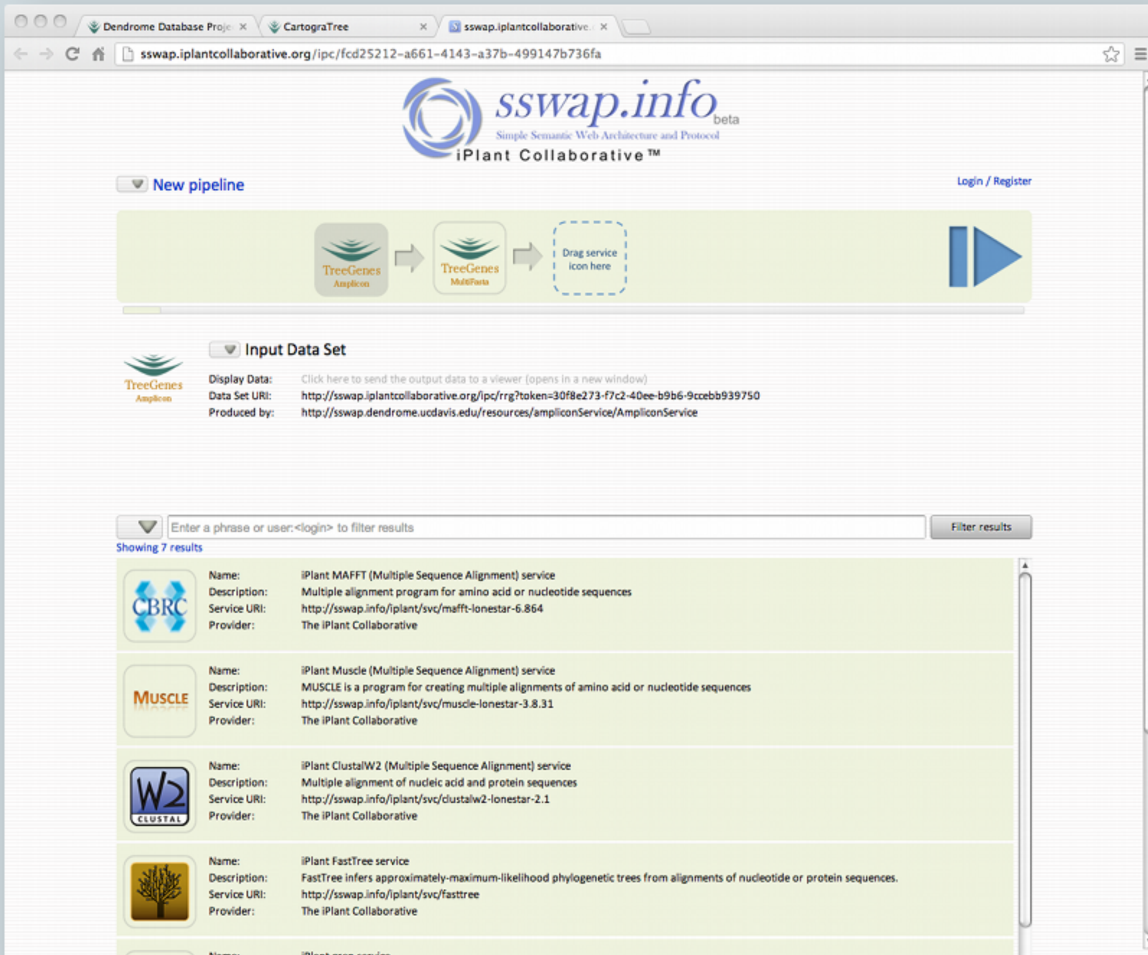
Custom user interface data selection and analysis



... enabling directed user experiences back into Web Discovery

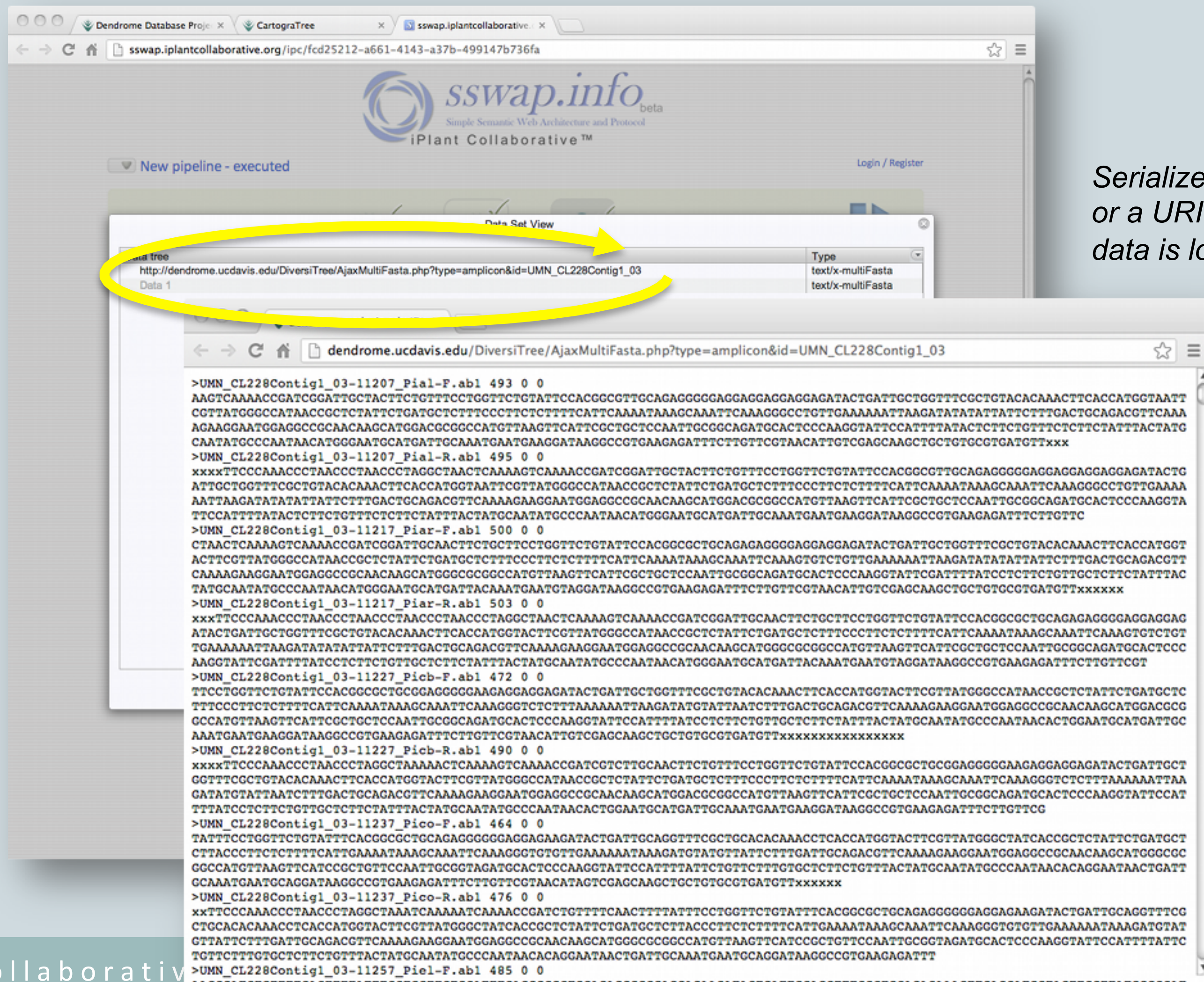
Semantic Integration from Third-party Web sites

Data slicing and contextual augmentation



Direct and Indirect Data Referencing

URI dereferencing of arbitrarily large data sets



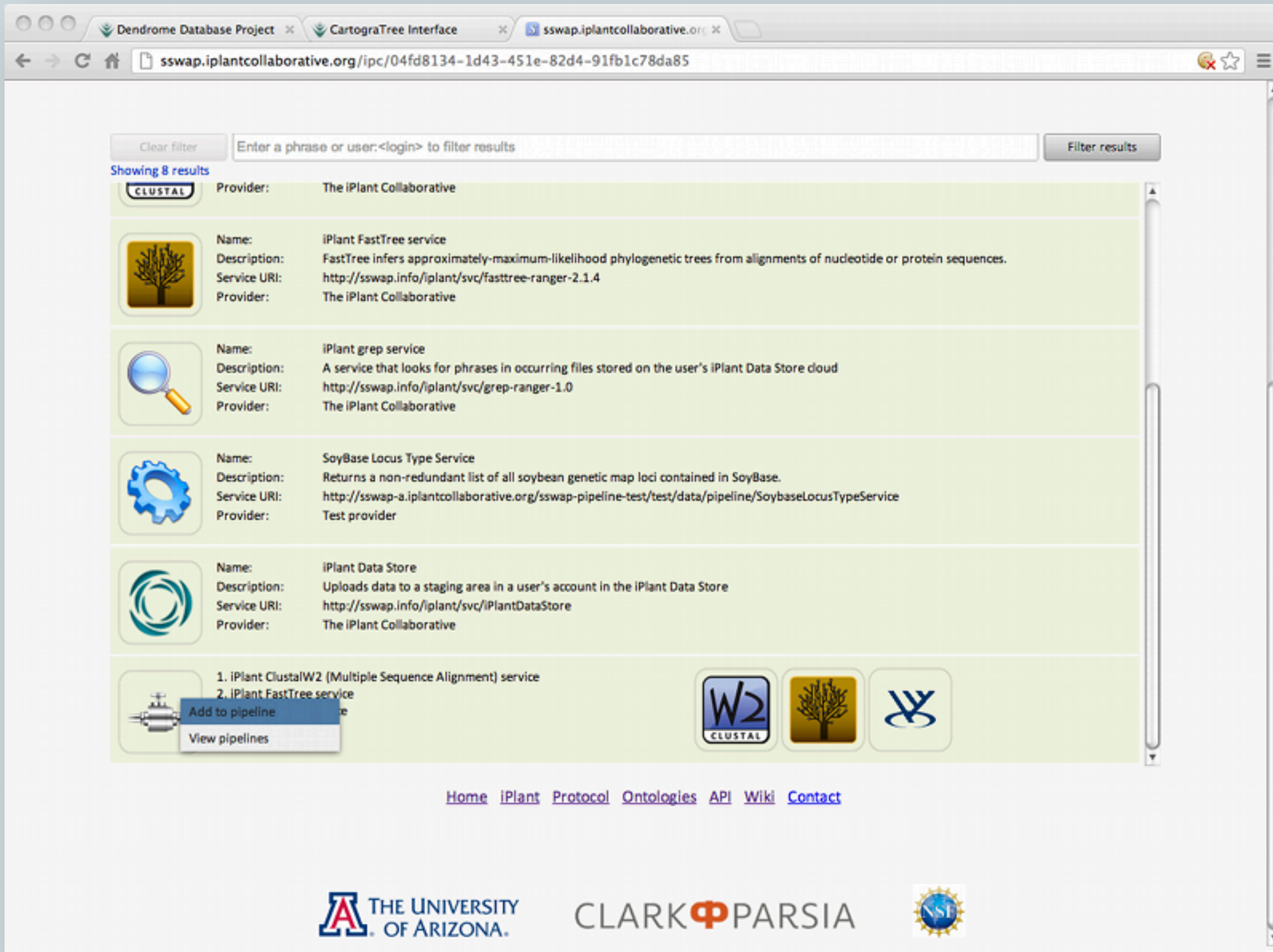
Serialize the data itself, or a URI to where the data is located

High Performance Computing

Services engage like any other Web services

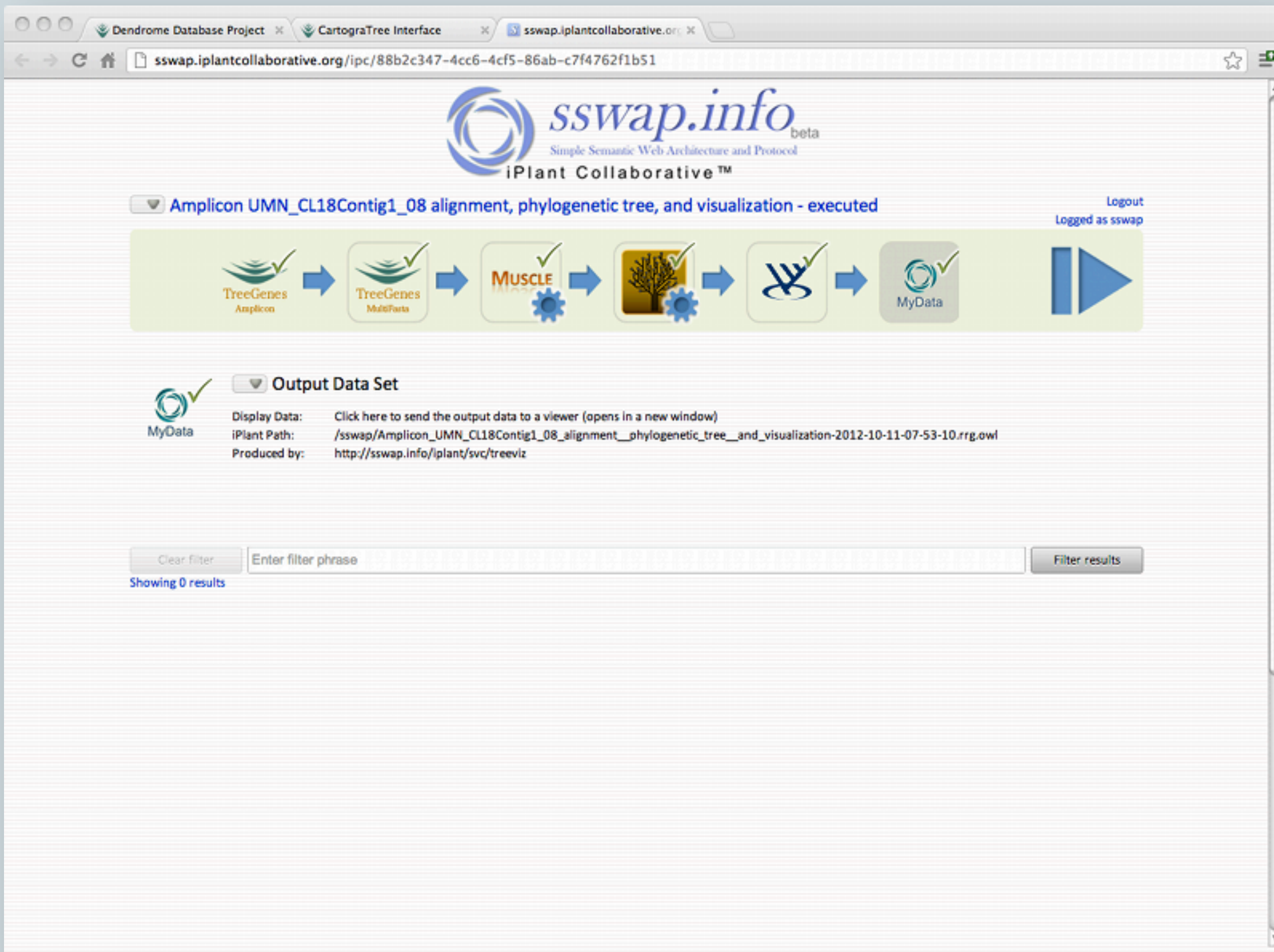
Publishing Pipelines

Private data, shared service parameterization



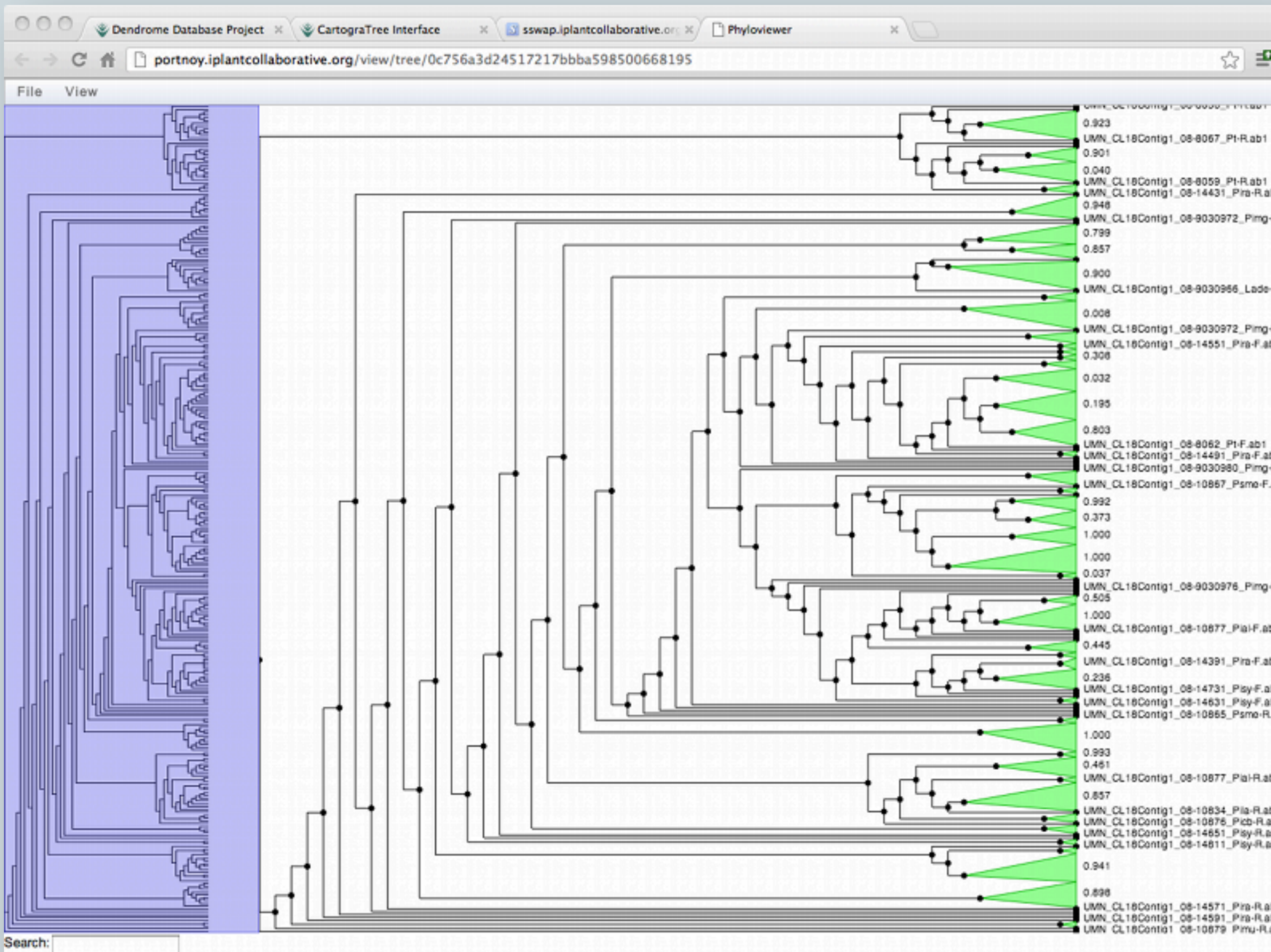
Phylogenetics

Pipeline runs are persisted in OWL and can start new pipelines



TreeViz

Multi-state, multi-institution, web/HPC run



Quick Vitals

- 185,000 lines of code
- 100+ libraries
- Open source and freely available
- Three 48 GB RAM servers
- More info: sswap.info/wiki

Acknowledgements

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- iPlant Collaborative
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