

# Building Web Applications with Protégé

Csongor Nyulas, Tania Tudorache  
Stanford University

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# Web Applications Are Flourishing

- Everything is going web!
- Software applications as well; especially when:
  - they solve relatively simple tasks,
  - involve access to multiple resources from the web,
  - require easy accessibility, or
  - involve user collaboration
- Web apps are a great way to bring the power of Protégé to the every-day computer user

# Biositemaps

- An NIH Roadmap Initiative for National Centers of Biomedical Computing (NCBCs)
- Goal of the project: To publish, locate, query, compose/combine, and mine **biomedical resources** on the Internet
- Inspired by Google's "sitemap protocol"
- Biositemap = RDF file conforming to the **Biositemap Information Model (IM)** and **Biomedical Resource Ontology (BRO)**

Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ncbcs.org/biositemaps/NCBO\_biositemap.rdf

Google

```
- <rdf:RDF xml:base="http://www.bioontologies.org/biositemaps/NCBO.rdf">
- <owl:Ontology rdf:about="">
  <owl:imports rdf:resource="http://bioontology.org/ontologies/BiomedicalResources.owl"/>
</owl:Ontology>
- <desc:Resource_Description rdf:ID="Protege">
  <desc:platforms rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Platform independent. Java Virtual
  Machine</desc:platforms>
  <desc:organization rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Stanford University</desc:organization>
  <desc:biositemap_author rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Csongor Nyulas</desc:biositemap_author>
  <desc:contact_person_email rdf:datatype="http://www.w3.org
  /2001/XMLSchema#string">tredmond@stanford.edu</desc:contact_person_email>
- <desc:resource_type>
  <BRO:Ontology_Development_and_Management/>
</desc:resource_type>
  <desc:resource_name rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Protégé</desc:resource_name>
  <desc:language rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Java</desc:language>
  <desc:URL rdf:datatype="http://www.w3.org/2001/XMLSchema#string">http://protege.stanford.edu/</desc:URL>
  <desc:keywords rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Ontologies, Protégé</desc:keywords>
- <desc:version_information>
  <desc:Version_Information>
    <desc:version rdf:datatype="http://www.w3.org/2001/XMLSchema#string">3.2.2</desc:version>
    <desc:release_date rdf:datatype="http://www.w3.org/2001/XMLSchema#string">2/6/2007</desc:release_date>
    <desc:development_stage rdf:datatype="http://www.w3.org/2001/XMLSchema#string">3.2.2</desc:development_stage>
  </desc:Version_Information>
</desc:version_information>
  <desc:description rdf:datatype="http://www.w3.org/2001/XMLSchema#string">An ontology authoring tool</desc:description>
  <desc:center rdf:datatype="http://www.w3.org/2001/XMLSchema#string">National Center for Biomedical Ontology</desc:center>
  <desc:contact_person rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Timothy Redmond</desc:contact_person>
  <desc:license rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Mozilla</desc:license>
</desc:Resource_Description>
+ <desc:Resource_Description rdf:ID="Jambalaya"></desc:Resource_Description>
+ <desc:Resource_Description rdf:ID="Phenote"></desc:Resource_Description>
+ <desc:Resource_Description rdf:ID="OBO_Converter"></desc:Resource_Description>
+ <desc:Resource_Description rdf:ID="LexGrid"></desc:Resource_Description>
+ <desc:Resource_Description rdf:ID="OBR"></desc:Resource_Description>
```

Done

# The Biositemap IM and the BRO

BiomedicalResourceOntology\_v2.7 Protégé 3.4 [file:\C:\work\biositemaps\BiomedicalResourceOntology\_v2.7.pprj, OWL / RDF Files]

File Edit Project OWL Reasoning Code Tools Window Collaboration Help

Metadata(BiomedicalResources.owl) OWLClasses Properties Individuals Forms

**SUBCLASS EXPLORER**

For Project: BiomedicalResourceOntology\_v2.7

**Asserted Hierarchy**

- owl:Thing
  - activity:Activity
  - area:Area\_of\_Research
  - BRO:Deprecated\_Resource
  - BRO:Resource
    - BRO:Computational\_Service
    - BRO:Data\_Resource
    - BRO:Facility\_Core
    - BRO:Instrument
    - BRO:Non\_Computational\_Service
    - BRO:Provenance\_and\_Intellectual\_Property
    - BRO:Research\_Supplies
    - BRO:Software
  - desc:Biositemaps\_Information\_Model
    - desc:Resource\_Description
    - desc:Version\_Information
  - desc:Staging\_Area

**CLASS EDITOR for desc:Resource\_Description (instance of owl:Class)**

For Class: [http://bioontology.org/ontologies/biositemap.owl#Resource\\_Description](http://bioontology.org/ontologies/biositemap.owl#Resource_Description) ☐ Inferred View

Property	Value
desc:data_output	(multiple BRO:Data_Resource)
desc:description	(multiple string)
desc:documentation_available	(single string)
desc:keywords	(multiple string)
desc:language	(multiple string)
desc:license	(multiple string)
desc:organization	(multiple string)
desc:platforms	(multiple string)
desc:related_activities	(multiple activity:Activity)
desc:related_areas_of_research	(multiple area:Area_of_Research)
desc:related_resource	(multiple desc:Resource_Description)
desc:resource_name	(multiple string)
desc:resource_sharable	(single string)
desc:resource_type	(multiple BRO:Resource)
desc:technical_support	(multiple string)
desc:URL	(multiple string)

**Superclasses**

- desc:Biositemaps\_Information\_Model

Logic View Properties View

# Biositemap Editor



BIO SITEMAPS EDITOR



## Resource Descriptions

Name ▲

BioPortal

Jambalaya

LexGrid

OBA

OBO\_Converter

OBO\_Edit

OBR

Phenote

PROMPT

Protege

## Resource Properties

**Resource Name:**

BioPortal

Organization:

Stanford University

Center or Institute:

National Center for Biomedical Ontology

Research Program:

Description:

A Web portal to a virtual library of ontologies and ontology tools

Resource Type:

[-] BRO (1 Item)

BRO:Ontology\_Development\_and\_Management

Add new

Change selected

Remove selection(s)

Related Areas Of Research:

Add new

Change selected

Remove selection(s)

Related Activities:

Add new

Change selected

Remove selection(s)

URL:

<http://www.bioontology.org/>

Keywords:

Web portal, ontologies

Contact Person:

Trish Whetzel



This biositemap was not saved yet

Cancel

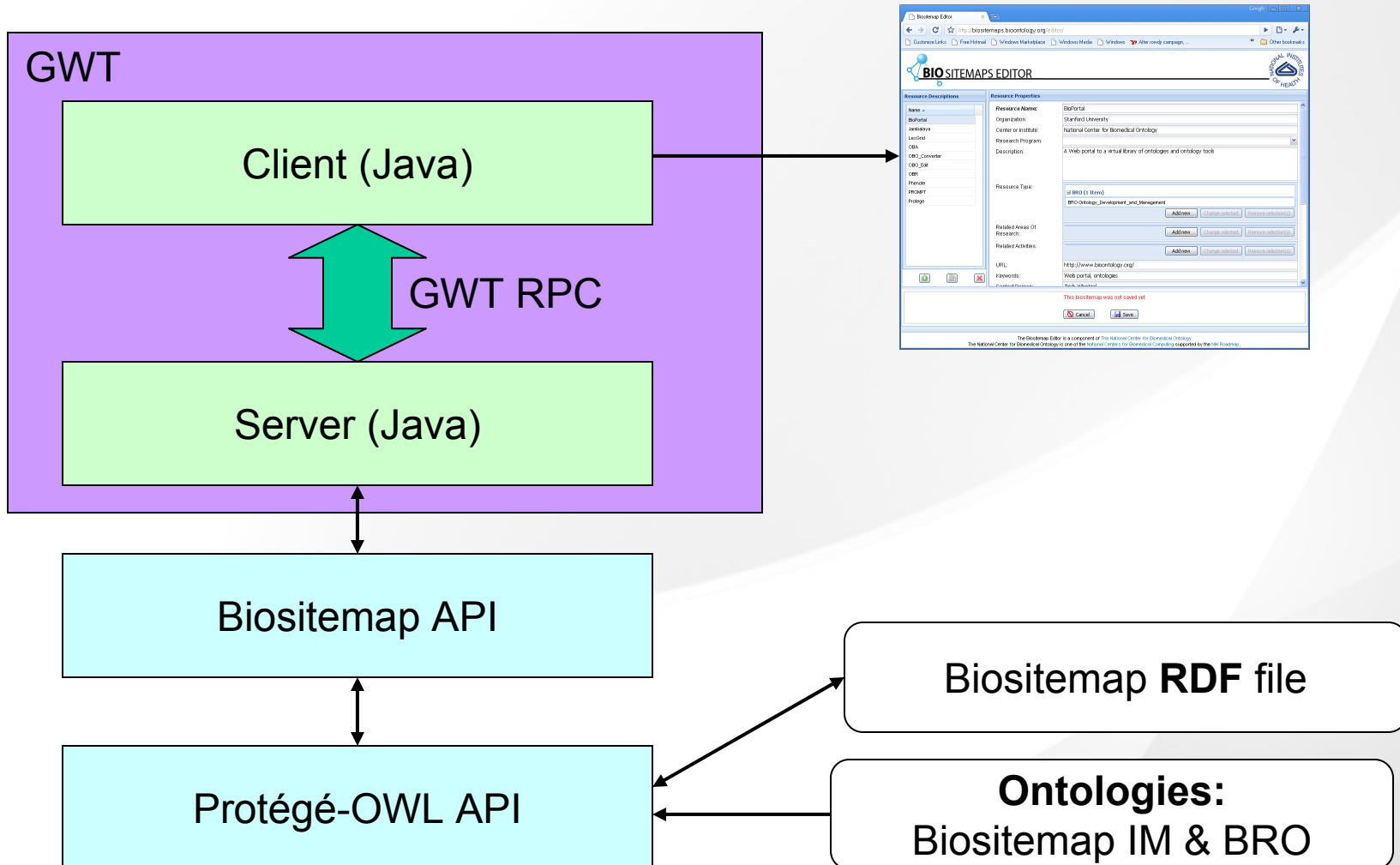
Save

# The Google Web Toolkit (GWT)

- <http://code.google.com/webtoolkit/>
- Write AJAX front-end in Java that GWT compiles into optimized, cross-browser compatible JavaScript
  - The changes made in the Java files can be seen immediately in the web browser, without recompiling.
  - Developers can step through live AJAX code with the Java debugger.
  - GWT compiles and deploys strongly optimized, cross-browser JavaScript.
  - In addition to supporting an open ended set of transfer protocols, GWT also offers a simple, but efficient and sophisticated client-server communication with GWT RPC.
  - Supports efficient application localization, and optimized JavaScript script downloads based on user profile.
  - UI component can be easily reused across projects.
  - Allows the usage of other JavaScript libraries and native JavaScript code.
  - Easily supports the browser back button and history.
  - Works with the Java development tool of choice, incl. testing with JUnit.



# System Architecture: Overview





# Client-Server Communication

- Data Structures (encoded in package `org.bioontology.biositemaps.editor.client.rpc.data`) for:
  - File handling (`FileHandlingData`)
  - Property-values pair (`BiositemapPropertyValuesData`)
  - Resource description (`BiositemapElementData`)
  - Class hierarchy (`BROClassHierarchyData`)
  - Field layout (`FieldLayoutData`)
  - Form layout (`FormLayoutData`)
  - A full form configuration (`FormConfigurationData`)

# Client-Server Communication

## - continuation -

- Define Service interfaces to be implemented on the server side, and ...

```
@RemoteServiceRelativePath("biositemap-service")
public interface BiositemapService extends RemoteService {
    public FileHandlingData createBioSitemap(FileHandlingData data) throws BiositemapFormsException;
    public FileHandlingData openBioSitemap(FileHandlingData data) throws BiositemapFormsException;
    public FileHandlingData saveBioSitemap(FileHandlingData data) throws BiositemapFormsException;
    public FileHandlingData closeBioSitemap(int clientId) throws BiositemapFormsException;

    public FileHandlingData ping(FileHandlingData data) throws BiositemapFormsException;

    public FormConfigurationData getFormConfiguration(String layoutConf, boolean isEditable) throws BiositemapFormsException;

    public BROClassHierarchyData getBROClassHierarchy(String layoutConf, String className) throws BiositemapFormsException;

    public BiositemapElementData[] getAllTopLevelElements(int clientId) throws BiositemapFormsException;
    public BiositemapElementData[] getElementsOfType(int clientId, String className) throws BiositemapFormsException;

    public BiositemapElementData createAnonymousElementOfType(int clientId, String className) throws BiositemapFormsException;
    public BiositemapElementData renameElementOfType(int clientId, String className, String oldName, String newName) throws BiositemapFormsException;
    public BiositemapElementData updateElementOfType(int clientId, String className, String name, BiositemapElementData data) throws BiositemapFormsException;
    public BiositemapElementData removeElementOfType(int clientId, String className, String name) throws BiositemapFormsException;
}
```

# Client-Server Communication

## - continuation -

- ... and asynchronous service handlers to be called on the client.

```
public interface BiositemapServiceAsync {  
    public void createBioSitemap(FileHandlingData data, AsyncCallback<FileHandlingData> cb);  
    public void openBioSitemap(FileHandlingData data, AsyncCallback<FileHandlingData> cb);  
    public void saveBioSitemap(FileHandlingData data, AsyncCallback<FileHandlingData> cb);  
    public void closeBioSitemap(int clientId, AsyncCallback<FileHandlingData> cb);  
  
    public void ping(FileHandlingData data, AsyncCallback<FileHandlingData> cb);  
  
    public void getFormConfiguration(String layoutConf, boolean isEditable, AsyncCallback<FormConfigurationData> cb);  
  
    public void getBROClassHierarchy(String layoutConf, String className, AsyncCallback<BROClassHierarchyData> cb);  
  
    public void getAllTopLevelElements(int clientId, AsyncCallback<BiositemapElementData[]> cb);  
    public void getElementsOfType(int clientId, String className, AsyncCallback<BiositemapElementData[]> cb);  
  
    public void createAnonymousElementOfType(int clientId, String className, AsyncCallback<BiositemapElementData> cb);  
    public void renameElementOfType(int clientId, String className, String oldName, String newName, AsyncCallback<BiositemapElementData> cb);  
    public void updateElementOfType(int clientId, String className, String name, BiositemapElementData newValue, AsyncCallback<BiositemapElementData> cb);  
    public void removeElementOfType(int clientId, String className, String name, AsyncCallback<BiositemapElementData> cb);  
}
```

# The Server Side

- Use API calls to operate on ontology content
- Implement any complex operation on the server
- Maintain Pool of OWL models to serve multiple clients
- Implement server-side caching
- Implement time-out mechanism

# The Client Side

- Use appropriate client-side widget libraries:  
“standard” GWT widget library, 3<sup>rd</sup> party widget libraries (GWT-Ext, getting replaced by SmartGWT; Ext GWT; etc.) or even native JavaScript
- Implement client-side caching if appropriate
- Make client configurable if possible

# Lessons learned

- Keep it simple!
- Send to the client only what it really needs
- Use as much as possible the GWT features:
  - Modules, internationalization, RPC, internal viewer, debugger, etc.
- Split your services in logical modules
- Theoretically, it is only Java, but...some JS knowledge never hurts

# Summary

- GWT offers a convenient way to quickly build web application to create lightweight, easily accessible Protégé “interfaces”
- The Biositemap Editor is accessible at:  
<http://biositemaps.bioontology.org/editor/>
- Biositemap Browser: <http://biositemaps.bioontology.org/browser/>
- Open source project. Source code available at:  
[https://bmirgforge.stanford.edu/gf/project/biositemaps/scmsvn/?path=Biositemap Editor](https://bmirgforge.stanford.edu/gf/project/biositemaps/scmsvn/?path=Biositemap+Editor)



**Thank You!**