



# Toolset for collaborative distributed web ontology development

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# Outline

- Introduction
  - Web Ontologies
  - Applications of Ontologies
  - Ontology Authoring (single-handed)
- Collaborative Ontology Development
  - Approaches
  - Current Challenges
  - Existing Tools
- The Proposed Solution
  - Approach
  - Components
  - Basic Algorithms
  - Screenshots



# Ontologies

Formal description of a domain  
understood by both humans and  
computers



# Web Ontologies

- Make up the Semantic Web





# Applications of Ontologies

- Biology, Genetics, Medicine, Healthcare
  - OBO, GALEN, Uberon, MedO, Gene Ontology, SNOMED-CT
- Oil-and-Gas Production
  - POSC Caesar Association, EPIM ReportingHub, ISO 15926
- Basis of large-scale webportals
  - BBC World Cup 2010 portal, PLOS Publishing
- Integration of heterogeneous distributed knowledge
  - SADI, NASA POPS, CRUZAR
- Describing entities in social networks
  - NASA POPS, Facebook Graph API
- Basis of knowledge search tools
- Optimization of traditional search engines
- Personal information management with semantic search

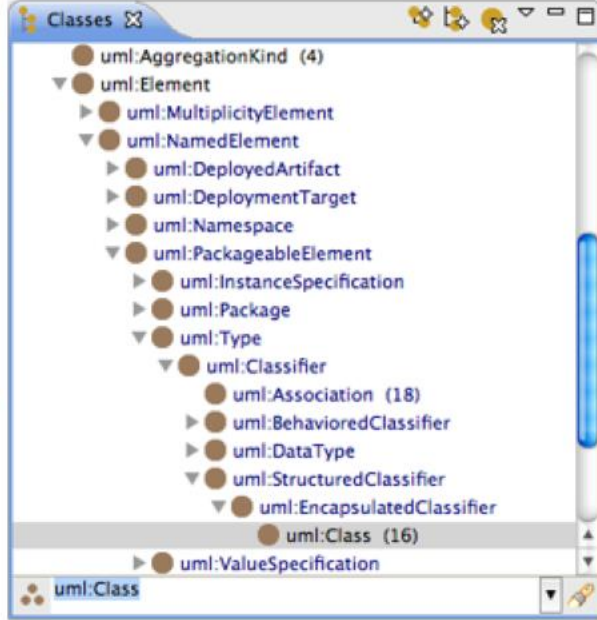


# Ontology Authoring



```


1 <rdf:RDF
2   xmlns:owl = "http://www.w3.org/2002/07/owl#"
3   xmlns:rdf = "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
4   xml:base = "http://www.example.org/"
5   xmlns = "http://www.example.org/#"
6   <owl:Class rdf:ID="Man"/>
7   <owl:Class rdf:ID="Woman">
8     <owl:disjointWith rdf:resource="#Man"/>
9   </owl:Class>
10  <Man rdf:ID="John"/>
11  <Woman rdf:ID="Linda"/>
  
```





# Collaborative Ontology Development

- Synchronous editing
  - One central repository
  - Changes are immediately seen by all developers
  - No special tools are required for comparing and merging
  - Persistent connection to the repository is required
  - Change logging tools are required



# Collaborative Ontology Development (continuation)

- Asynchronous editing
  - No need in persistent repository connection
  - It is possible to check changes before committing
  - Higher reliability
  - Is widely used in software development
  - Special tools for comparing and merging of ontologies are required





# Tasks

- Version control
  - Change log for an ontology
  - Change log for a single entity
  - Changes search by entity
  - Comparing versions of ontologies
- Collaborative editing
  - Three-way merging of ontologies
  - Conflict resolution
  - Issue tracking



# Existing Tools

- In-browser editors – synchronous editing
  - Web Protégé, Wiki@nt
- Distributed version control – asynchronous editing
  - Git, Mercurial, Bazaar, Darcs
- Ontology comparison tools
  - OWLDiff, OwlPatch, Ecco



# Version Control Systems

- Are already used for ontology development:
  - [Collections Ontology](#)
  - [Music Ontology](#)
  - [Math Model Ontology](#)
  - [Rat Genome Database](#)
  - [uberon](#) – uber-anatomy ontology
  - [ontoads](#) – astronomical ontologies
  - [LKIF](#) – basic legal concepts
  - [ogms](#) – general medical science ontology



# Version Control Systems (continuation)

- Don't fit for ontology development
  - Use text representation of ontologies

Conflicts

Total number of conflicts: 908  
Nr of automatically solved conflicts: 510  
Nr of unsolved conflicts: 398

OK

Number of remaining unsolved conflicts: 398 (of which 0 are whitespace)



# The Proposed Solution

- Develop algorithms and tools for comparing and three-way merging of ontologies
- Integrate the tools with a DVCS
- Integrate the tools with an issue tracker

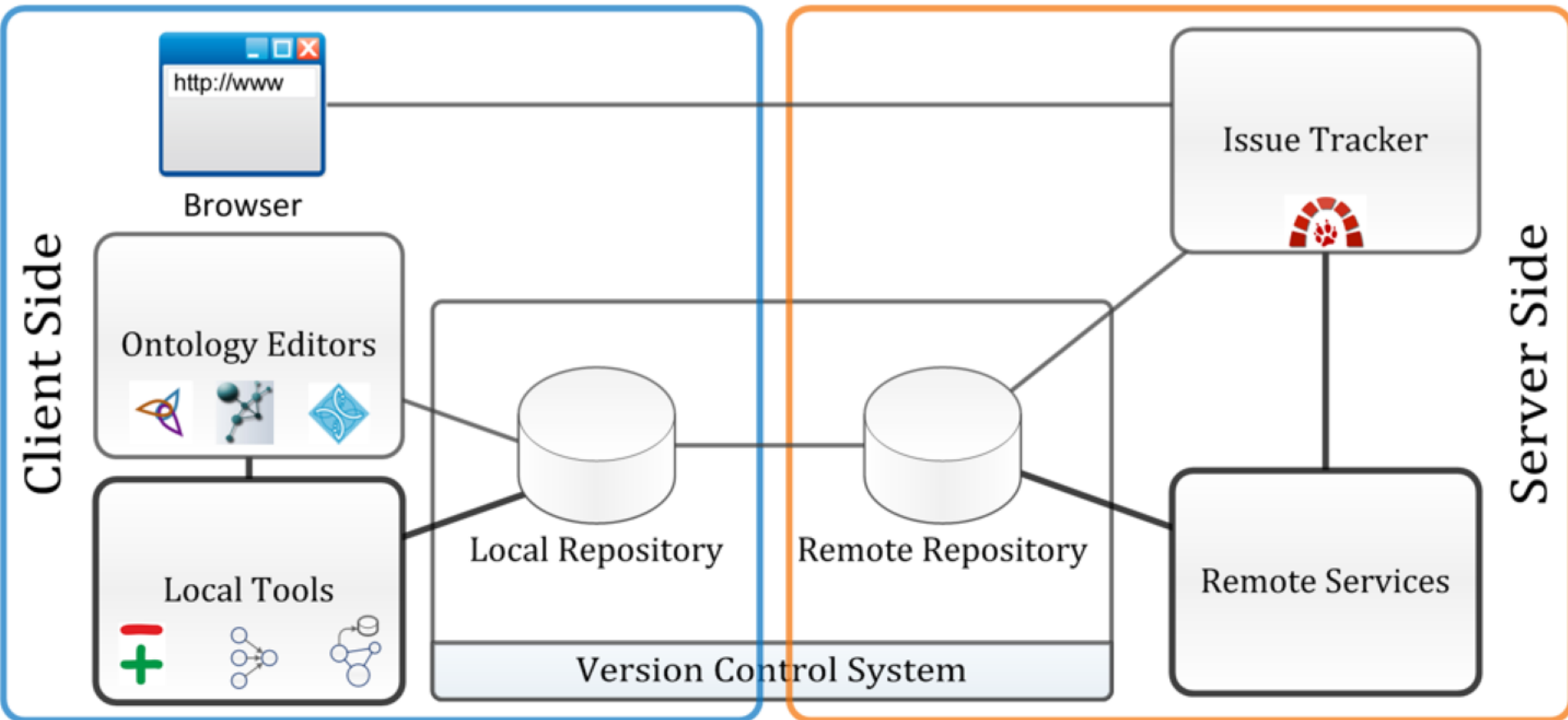


# The Proposed Solution (continuation)

- Allows for distributed ontology development
- Does not restrict language expressiveness
- Allows each developer to use his accustomed ontology editor
- Allows for integration with existing issue tracking systems



# Components of the System





# Change Log

The screenshot shows the TortoiseHg Workbench interface. The title bar reads "example - TortoiseHg Workbench". The menu bar includes "File", "View", "Repository", and "Help". The toolbar contains various icons for repository operations. The main area displays a change log table with the following data:

Graph	Rev	Branch	Description	Authc	Age	Tags
	7+	default	★ Working Directory ★	i	1 second ago	
	7	default	default tip Merge	Ivan	6 months ago	tip
	6	default	Changed format of pizza.owl to Functional Syntax	Ivan	7 months ago	
	5	default	New Country: Russia	Ivan	6 months ago	
	4	default	Added pizza.owl	Ivan	7 months ago	

Below the table, there is a section for the selected changeset (5). It shows the changeset ID and description: "Changeset: 5 (4d459fd3b1e1) New Country: Russia". The file "pizza.owl" is listed in the left pane, and the corresponding change is shown in the right pane: "New Country: Russia".





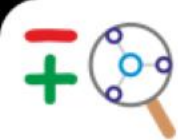
# Change Log in an Issue Tracker

## Latest revisions

#	Date	Author	Comment
7:e5558c96ca30	09/02/2011 03:11 pm	Ivan	Merge
6:d7f952a3934a	08/23/2011 10:35 am	Ivan	Changed format of pizza.owl to Functional Syntax
5:4d459fd3b1ef	08/23/2011 11:45 am	Ivan	New Country: Russia
4:c67844c07976	08/23/2011 11:19 am	Ivan	Added pizza.owl
3:50e082c38d7f	08/15/2011 01:12 pm	i	M test.owl
2:8f0ce19e0940	08/15/2011 01:10 pm	i	M test.owl
1:606a52fd49d9	08/15/2011 01:08 pm	i	test.owl
0:7c839490080d	08/15/2011 12:58 pm	i	Added stub for checker

[View differences](#)

[View all revisions](#) | [View revisions](#)



# Creating a New Ontology Version

example - commit

### filter text ### Status Copy message Branch: default Options

* S	Filename	Type	Size (K)
<input checked="" type="checkbox"/>	M pizza.owl	owl	207
<input type="checkbox"/>	? .hgignore		1
<input type="checkbox"/>	? catalog-v001.xml	xml	1

Parent: 7 (e5558c96ca30) Merge

Modified:

```
Class: pizza:Country
Class: pizza:DomainConcept
NamedIndividual: pizza:America
NamedIndividual: pizza:England
NamedIndividual: pizza:France
NamedIndividual: pizza:Germany
NamedIndividual: pizza:Italy
NamedIndividual: pizza:Russia
```

```
+ Prefix(skos:=<http://www.w3.org/2004/02/skos/core#>)
- EquivalentClasses(pizza:Country ObjectIntersectionOf
+ EquivalentClasses(pizza:Country ObjectIntersectionOf
```

Total additions: 2  
Total removals: 1

All None Checked count: 1

Commit Undo Cancel



# Ontology Versions Comparison

Overview

Activity

Issues

New issue

Gantt

Calendar

News

## Revision 5:4d459fd3b1ef pizza.owl

```
- Prefix(owl11:=<http://www.w3.org/2006/12/owl11#>)
- Prefix(owl11xml:=<http://www.w3.org/2006/12/owl11-xml#>)
+ Declaration(NamedIndividual(Russia))
+ ClassAssertion(owl:Thing Russia)
+ ClassAssertion(Country Russia)
+ DifferentIndividuals(America England France Germany Italy Russia )
+ Declaration(AnnotationProperty(owl:versionInfo))
- DifferentIndividuals(America England France Germany Italy )
+ Declaration(NamedIndividual(America))
+ Declaration(NamedIndividual(England))
+ Declaration(NamedIndividual(France))
+ Declaration(NamedIndividual(Germany))
+ Declaration(NamedIndividual(Italy))
+ Declaration(AnnotationProperty(rdfs:comment))
+ Declaration(AnnotationProperty(rdfs:label))
```



# Change Log for Single Entity

Class: <<http://www.co-ode.org/ontologies/pizza/pizza.owl#Country>>

Modified in 5:4d459fd3b1ef : /pizza.owl  
+ ClassAssertion(Country Russia)

Added in 4:c67844c07976 : /pizza.owl  
+ ClassAssertion(Country America)  
+ Declaration(Class(Country))  
+ ClassAssertion(Country Italy)  
+ ClassAssertion(Country France)  
+ EquivalentClasses(Country ObjectIntersectionOf(DomainConcept ObjectOneOf(America England France Germany Italy)) )  
+ ClassAssertion(Country Germany)  
+ ClassAssertion(Country England)



# Three-Way Merge Tool

owl2merge

File Changes Tools

Common changes: 2 Conflicting changes: 0 Other changes: 9 Result

- OntologyFormat(RDF/XML)
- Prefix(:=<http://www.co-ode.org/ontologies/pizza/pizza.owl#>)
- Prefix(owl11:=<http://www.w3.org/2006/12/owl11#>)
- Prefix(owl11xml:=<http://www.w3.org/2006/12/owl11-xml#>)
- Prefix(pizza:=<http://www.co-ode.org/ontologies/pizza/pizza.owl#>)
- DifferentIndividuals(pizza::America pizza::England pizza::France pizza::Germany pizza::Italy )
- + OntologyFormat(OWL Functional Syntax)
- + Prefix(xml:=<http://www.w3.org/XML/1998/namespace>)
- + ClassAssertion(pizza::Country pizza::Russia)
- + ClassAssertion(owl::Thing pizza::Russia)
- + DifferentIndividuals(pizza::America pizza::England pizza::France pizza::Germany pizza::Italy pizza::Russia )



# Issue Tracking

Activity Issues **New issue** Gantt Calendar News Documents Wiki Files Owlmine Repository

Tracker \*

Private

Subject \*

Description

**B** *I* U ~~S~~ **C** H1 H2 H3 pre

Text formatting

The name of the [<http://www.co-ode.org/ontologies/pizza/pizza.owl#russia> russia] individual is mistyped it should begin with a capital letter.

Status \*

Parent task

Priority \*

Start date

Assignee

Due date

Estimated time  Hours



# Issue Tracking

✓ Issue #2 created.

## Ontologies #2

Update Log time Watch Copy Delete

- Issues
- [View all issues](#)
- [Summary](#)
- [Calendar](#)
- [Gantt](#)

Watchers (0)

**Typo** « Previous | 1 of 2 | Next »

Added by Redmine Admin less than a minute ago.

<b>Status:</b>	New	<b>Start date:</b>	09/03/2012
<b>Priority:</b>	Normal	<b>Due date:</b>	
<b>Assignee:</b>	-	<b>% Done:</b>	<div style="width: 0%; background-color: #ccc; border: 1px solid #ccc;"></div> 0%
<b>Category:</b>	-	<b>Spent time:</b>	-
<b>Target version:</b>	-		

**Description**  Quote

The name of the russia entity is mistyped. It should begin with a capital letter.

**Subtasks** Add

**Related issues** Add



# Conclusion

- Collaborative Distributed Web Ontology Development
  - Version Control
  - Collaborative Editing
- Increases ontology development efficiency
- Was used in the “Intellectual Field” project





# Cognitive Systems and Knowledge Management Group

- Collaborative ontology development tools
- Security of ontological knowledge bases
- Information systems based on ontological knowledge bases and Semantic Web technologies
  - Decision support system
  - E-library system

<http://portal.tpu.ru/SHARED/i/l/eng/research/group>



# Horizon 2020

- Priority: Industrial Leadership
  - Leadership in enabling and industrial technologies
- Theme:  
Information and Communication Technologies
- Prospective content of Calls for Proposals:  
Future and Emerging Technologies
  - Radical breakthroughs in ICT increasingly rely on deep synergies with other disciplines (for instance, biology, chemistry, nanoscience, neuro- and **cognitive science**, ethology, social science, economics) and with the arts and humanities.



# Russian Foundation for Basic Research

- Continuous joint competitions of the Russian Foundation for Basic research (RFBR) and Austrian Science Fund (FWF)
  - (07) Information and Telecommunication systems
  - No time limits for submitting the applications
  - Duration of project: 3 years
  - Examination of applications: 4-5 months



# Questions?

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