INRIA

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team EXMO

Computer-mediated communication of structured knowledge

Theme :

Activity Report

2009

Table of contents

1. Team

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2. Overall Objectives

Keywords: *system of networked ontologies*, *Alignment API*, *CPRDF*, *CPSPARQL*, *OWL*, *OntoSim*, *PRDF*, *PSPARQL*, *Path RDF*, *RDF*, *XSLT*, *content representation*, *context*, *knowledge representation*, *knowledge transformation*, *multimedia document adaptation*, *ontologies*, *ontology alignment*, *ontology alignment management*, *property preservation*, *semantic peer-to-peer system*, *semantic social network*, *semantic web*, *semantics of knowledge representation*, *semiotics*.

We assume that expressing formalised knowledge on a computer is useful, not especially for the need of the computer, but for communication. In future information systems, formalised knowledge will be massively exchanged. *Exmo*'s goal is the development of theoretical and software tools for enabling interoperability in formalised knowledge exchange. *Exmo* contributes to an emerging field called the semantic web which blends the communication capabilities of the web with knowledge representation.

However, there is no reason why this knowledge should be expressed in a single format or by reference to a single vocabulary (or ontology). In order to interoperate, these representations will have to be matched and transformed. Moreover, in the communication process computers can add value to their memory and medium role by formatting, filtering, classifying, consistency checking or generalising knowledge.

We currently build on our experience of alignments as representing the relationships between two ontologies on the semantic web. Ontology alignments express correspondences between entities in two ontologies. They allow for maximising sharing on the semantic web: various algorithms can produce alignments and various uses can be made of these alignments. Such alignments can be used for generating knowledge transformations (or any other kind of mediators) that will be used for interoperating. In order to guarantee properties of these transformations, we can consider the properties of alignments and generate transformations preserving them.

Our current roadmap focusses on the design of an alignment infrastructure and on the investigation of alignment properties (and especially semantic properties) when they are used for reconciling ontologies.

On a longer term, we want to explore "semiotic" properties, i.e., properties which concern the interpretation of the communicated representation by a human user. This goal should require an analysis of the extra-semantic rules that govern the choice of subsets of models.

Anticipated applications are in transformation system engineering (in which the information system is seen as a transformation flow) and semantic web infrastructure.

3. Scientific Foundations

3.1. Knowledge representation semantics

We usually work with semantically defined knowledge representation languages (like description logics [20], conceptual graphs and object-based languages). Their semantics is usually defined within model theory initially developed for logics. The languages dedicated to the semantic web (RDF and OWL) follow that approach. RDF is a knowledge representation language dedicated to the annotation of resources within the framework of the semantic web. OWL is designed for expressing ontologies: it offers the description of concepts and relations that can be used within RDF.

We consider a language L as a set of syntactically defined expressions (often inductively defined by applying constructors over other expressions). A representation ($o \subseteq L$) is a set of such expressions. It is also called an ontology. An interpretation function (I) is inductively defined over the structure of the language to a structure called interpretation domain (D). This expresses the construction of the "meaning" of an expression in function of its components. A formula is satisfied by an interpretation if it fulfills a condition (in general being interpreted over a particular subset of the domain). A model of a set of expressions is an interpretation satisfying all these expressions. An expression (δ) is then a consequence of a set of expressions (o) if it is satisfied by all of their models (noted $o \models \delta$).

A computer must determine if a particular expression (taken as a query, for instance) is the consequence of a set of axioms (a knowledge base). For that purpose, it uses programs, called provers, that can be based on the processing of a set of inference rules, on the construction of models or on procedural programming. These programs are able to deduce theorems (noted $o \vdash \delta$). They are said to be sound if they only find theorems which are indeed consequences and to be complete if they find all the consequences as theorems. However, depending on the language and its semantics, the decidability, i.e., the ability to create sound and complete provers, is not warranted. Even for decidable languages, the algorithmic complexity of provers may prohibit their exploitation.

To solve this problem a trade-off between the expressivity of the language and the complexity of its provers has to be found. These considerations have led to the definition of languages with limited complexity - like conceptual graphs and object-based representations - or of modular families of languages with associated modular prover algorithms - like description logics.

Exmo mainly considers languages with well-defined semantics (such as RDF and OWL that we contributed to define), and defines the semantics of some languages such as multimedia specification languages, in order to establish the properties of computer manipulations of the representations.

3.2. Ontology alignment

When different representations are used, it is necessary to identify their correspondences. This task is called ontology matching and its result is an alignment. It can be described as follows: given two ontologies, each describing a set of discrete entities (which can be classes, properties, rules, predicates, etc.), find the relationships, e.g., equivalence or subsumption, if any, that hold between these entities.

An alignment between two ontologies o and $o^{'}$ is a set of correspondences $\langle e, e^{'}, r, n\rangle$ in which

- e and $e^{'}$ are the entities between which a relation is asserted by the correspondence, e.g., formulas, terms, classes, individuals;
- r is the relation asserted to hold between e and $e^{'}$. This relation can be any relation applying to these entities, e.g., equivalence, subsumption.
- n is a degree of confidence in this particular correspondence (which will be omitted here).

Given the semantics of the two ontologies provided by their consequence relation, we define an interpretation of the two ontologies as a triple made of an interpretation for each ontology and an equalising function (γ) which maps the domain of each of the models to a common domain on which the relations are interpreted. Such a triple $\langle m, m^{'}, \gamma\rangle$ is a model of the aligned ontologies o and $o^{'}$ if and only if, for each correspondence $\langle e, e^{'}, r\rangle$ of the alignment A, $m \models o$, $m^{'} \models o^{'}$ and $\langle \gamma(m(e)), \gamma(m^{'}(e^{'}))\rangle \in r^{\gamma}$.

This definition is extended to a system of networked ontologies which is a set of ontologies and associated alignments. A model of such a system of networked ontologies is a tuple of local models and an equalising function such that each alignment is valid for the models and the equalising function involved in the tuple. In such a system, alignments play the role of model filters which will select the local models which are compatible with all alignments.

So, given a system of networked ontologies, it is possible to interpret it. However, given a set of ontologies, it is necessary to find the alignments between them and the semantics does not tell which ones they are. Ontology matching aims at finding these alignments. A variety of methods is used for this task. They perform pair-wise comparisons of entities from each of the ontologies and select the most similar pairs. Most matching algorithms provide correspondences between named entities, more rarely between compound terms. The relationships are generally equivalence between these entities. Some systems are able to provide subsumption relations as well as other relations in the support language (like incompatibility or instanciation). Confidence measures are usually given a value between 0 and 1 and are used for expressing preferences between two correspondences.

3.3. Transformations and properties

A transformation (τ) is an algorithmic manner to generate a representation ($\tau(o)$) from another one (o), not necessarily in the same language. We focus on transformations made by composition of more elementary transformations for which we only know the input, output and assumed properties. These transformations may have been generated from an alignment or by any other means.

A transformation system is characterised by a set of elementary transformations and a set of composition operators. A transformation flow is the composition of elementary transformation instances whose input/output are connected by channels. A transformation flow is itself a transformation.

The design of information systems like transformation flows requires the ability to express such flows and to determine their properties. A property is a boolean predicate about the transformation, e.g., "preserving information" is such a predicate - it is true or false of a transformation - which is satisfied if there exists an algorithmic mean to recover o from $\tau(o)$.

We consider more closely preservation properties that capture the preservation (or anti-preservation) of an order relation between the source representations and the target representations. For instance, one can identify:

- Syntactic properties: based on the organisation of syntactic elements, like the completion ($\tau(o) \leq o$, in which $\leq$ denotes structural subsumption between representations);
- Semantic properties: based on the concepts of model and consequence, like consequence preservation ($\forall o \subseteq L, \forall \delta \in L, o \models_L \delta \Rightarrow \tau(o) \models_{L'} \tau(\delta)$);
- Semiotic properties: based on the interpretation of the manipulated objects as signs, like interpretation preservation (let σ be the interpretation rules and $\models_{L,i}$ be the interpretation of individual i, $\forall o \subseteq L, \forall \delta \in L, \forall i, j, o, \sigma \models_{L,i} \delta \Rightarrow \tau(o), \tau(\sigma) \models_{L',j} \tau(\delta)$).

Our goal is to study transformations based on transformation properties rather than on representations or transformation structures. This does not deal only with semantics but considers various properties, e.g., content or structure preservation, traceability, and confidentiality. However, we more specifically address semantic properties. We also consider properties of transformation systems (given a transformation system, is information preservation decidable and at what cost?). We try to characterise, given a particular type of property, which transformations leave them invariant and what is the action of composition operators.

4. Application Domains

The main application context motivating our work is the "semantic web" infrastructure (§4.1) but we are trying to apply our technologies as well to ambient intelligence.

4.1. Semantic web technologies

Internet technologies support organisations in accessing and sharing knowledge, often difficult to access in a documentary form. However, these technologies quickly reach their limits: web site organisation is expensive and full-text search inefficient. Content-based information search is becoming a necessity. Content representation will enable computers to manipulate knowledge on a more formal ground and to carry out similarity or generality search. Knowledge representation formalisms are good candidates for expressing content.

The vision of a "semantic web" [21] supplies the web, as we know it (informal) with annotations expressed in a machine-processible form and linked together. In the context where web documents are formally annotated, it becomes necessary to import and manipulate annotations according to their semantics and their use. Taking advantage of this semantic web will require the manipulation of various knowledge representation formats. *Exmo* concerns are thus central to the semantic web implementation. Our work aims at enhancing content understanding, including the intelligibility of communicated knowledge and formal knowledge transformations.

The semantic web idea is essentially based on the notion of ontology (that can be quickly described as conceptual schemes or knowledge bases). Even if a standard knowledge representation language emerges, it will still be necessary to import and exchange ontologies in such a way that the semantics of their representation language is taken care of. We work on finding correspondences between various knowledge representation languages and ontologies (see §6.1) in order to take advantage of them in ontology merging and bridging or message translation. Bringing solutions to this problem is part of the ambition of *Exmo*.

In addition, *Exmo* also considers a more specific use of semantic web technologies in semantic peer-to-peer systems, social semantic networks and ambient intelligence [3]. In short, we would like to bring the semantic web to everyone's pocket. Semantic peer-to-peer systems are made of a distributed network of independent peers which share local resources annotated semantically and locally. This means that each peer can use its own ontology for annotating resources and these ontologies have to be confronted before peers can communicate. In social semantic networks, relationships between people are infered from relationships between knowledge they use. In ambient intelligence, applications have to reconcile device and sensor descriptions provided by independent sources.

5. Software

Exmo's work can be implemented in software: we have proposed an API for expressing ontology alignment (§5.1) which is the basis for several systems. This year we have split the similarity part of the API into OntoSim, a library of ontology distances and similarities (§5.2).

5.1. Alignment API: manipulating ontology alignments

Participants: Jérôme Euzenat [Contact], Chan Le Duc, Cássia Trojahn dos Santos.

We have designed a format for expressing alignments in a uniform way [1]. The goal of this format is to be able to share on the web the available alignments. It should help systems using alignments, e.g., mergers, translators, to take advantage of any alignment algorithm and it will help alignment algorithms to be used in many different tasks. This format is expressed in RDF, so it is freely extensible, and has been defined by a DTD (for RDF/XML), an OWL ontology and an RDF Schema.

The API itself is a *Java* description of tools for accessing the common format. It defines four main interfaces (Alignment, Cell, Relation and Evaluator) and proposes the following services:

- Storing, finding, and sharing alignments;
- Piping matching algorithms (improving an existing alignment);
- Manipulating alignments (thresholding and hardening);
- Generating processing output (transformations, axioms, rules);
- Comparing alignments.

We have provided an implementation for this API which can be used for producing transformations, rules or bridge axioms independently from the algorithm which produced the alignment. The proposed implementation features:

- a base implementation of the interfaces with all useful facilities;
- a library of sample matchers;
- a library of renderers (XSLT, SWRL, OWL, C-OWL, SEKT mapping language);
- a library of evaluators (precision/recall, generalised precision/recall, precision/recall graphs and weighted Hamming distance);
- a library of wrapper for several ontology API;
- a parser for the format.

To instanciate the API, it is sufficient to refine the base implementation by implementing the `align()` method. Doing so, the new implementation will benefit from all the services already implemented in the base implementation.

We have developed on top of the *Alignment API* an Alignment server that can be used by remote clients for matching ontologies and for storing and sharing alignments. It is developed as an extensible platform which allows for pluging-in new interfaces. The Alignment server can be accessed through HTML, web service (SOAP and REST) and agent communication interfaces.

This year we have further developed the REST interface of the server and integrated it with the Cupboard ontology management service [11]. We have also worked on integrating fully within the system the expressive alignment language called EDOAL. We have also started developping an ontology network abstraction which has been used in our work on ontology distances and our work on distributed reasoning. Another important piece of work has been to separate the similarity and distance computation parts in the OntoSim library.

The *Alignment API* is used in the Ontology Alignment Evaluation Initiative data and result processing. It is also used as input or output by several alignment tools (among which OLA that we develop jointly with the Université du Québec à Montréal (§7.3.1) or Aroma [6]).

The *Alignment API* is freely available since december 2003 under the LGPL licence at http://alignapi.gforge.inria.fr

5.2. The OntoSim library

Participants: Jérôme David [Contact], Jérôme Euzenat.

OntoSim is a library offering similarity and distance measures betwwen ontology entities as well as between ontology themselves. It materialise our work towards better ontology proximity measures [18].

There are many reasons for measuring a distance between ontologies. For example, in semantic social network when a peer looks for a particular information, it could be more appropriate to send to query peers having quite close ontology because it will be easier to translate query and there are more chance that such a peer have the information of interest [15]. OntoSim provides a framework for designing various kinds of similarities. In particular, we differentiated similarities in the ontology space from those in the alignment space. The latter ones make use of available alignments in a network of ontologies while the former only rely on ontology data. OntoSim is provided with 4 entity measures which can be combined using various aggregation schemes (average linkage, Hausdorff, maximum weight coupling, etc.), 2 kinds of vector space measures (boolean and TF.IDF), and 4 alignment space measures. In addition, the framework can embeds external similarity libraries which can be combined to our owns.

OntoSim is based on an ontology interface allowing for using ontology parsed with different API.

The OntoSim is written in Java and is available under the LGPL license at http://ontosim.gforge.inria.fr.

6. New Results

2009 has been a year of transition with three PhD students and one post-doctoral researcher leaving the group and three post-doctoral researchers joining it. This has led us to reduce our portfolio of activities.

Our results, this year, are mostly related to the development of ontology similarities in the alignment space (§6.1.2) and the introduction of pattern-based ontology matching (§6.1.3).

6.1. Ontology matching and alignment

We pursue our work work on ontology matching and alignment support with basic contributions.

6.1.1. Evaluation

Participants: Cássia Trojahn dos Santos [Contact], Jérôme Euzenat, Jérôme David.

Evaluation of ontology matching algorithms involves to confront them with test ontologies and to compare the results. Since 2004, we run the the Ontology Alignment Evaluation Initiative (OAEI) which organises evaluation campaigns for assessing the degree of achievement of actual ontology matching algorithms. This year, the evaluation campaign had 16 different teams entered the evaluation which consisted of 9 different sets of tests. The participating systems and evaluation results were presented in the Fourth Workshop on Ontology Matching, that has been held in Virginia, USA [17][7].

More information on OAEI can be found at http://oaei.ontologymatching.org/.

6.1.2. Ontology distances

Participants: Jérôme David [Contact], Jérôme Euzenat, Ondrej Zamazal.

Measuring similarity between ontologies can be very important in various tasks with different purposes. Last year we have implementated and experimented with classical measures; this year, we have introduced a new family of ontology measures: they are said to be computed in the alignment space, by contrast with more classical measures working in the ontology space. Measures working in the alignment space evaluate the similarity between two ontologies with regard to the available alignments between them. We introduce two sets of such measures relying on the existence of path between ontologies or on the ontology entities that are preserved by the alignments. This reflects the possibility to perform actions such as instance import or query translation. These measures have all been implemented in a library, OntoSim (§5.2), that has been used in experiments. The experiments shown that entity preserving measures are correlated with the best ontology space measures. Moreover they show a linear degradation with the alteration of alignments, witnessing their robustness [18].

6.1.3. Pattern-based ontology matching

Participants: François Scharffe [Contact], Jérôme David, Ondrej Zamazal.

Ontology patterns are abstractions of typical configurations within ontologies. They can be instantiated in particular ontologies. We have developed correspondence patterns which abstract typical correspondences between ontologies. They can be expressed in an expressive alignment language like the one embedded in the Alignment API (§5.1)).

We have shown how correspondence patterns can be used for guiding the matching process [13], for normalising ontologies before alignments or for transforming ontologies.

We have introduced the notion of an ontology transformation service. This service is supported by ontology transformation patterns consisting of corresponding ontology patterns, capturing alternative modelling choices, and an alignment between them. The transformation process is made of two steps: a pattern detection and an ontology transformation process. Pattern detection is based on SPARQL [10] and transformation is based on an ontology alignment representation with specific detailed information about the transformation [14].

We also plan to apply such ontology matching techniques to instance matching for the inference in linked data [12].

6.2. Systems of networked ontologies

Dealing with the semantic web, we are interested in systems of networked ontologies, i.e., sets of distributed ontologies that have to work together. One way for these systems to interact consists of exchanging queries and answers. For that reason, we pay particular attention to query systems.

6.2.1. Constrained Path RDF as a query language for RDF and RDFS

Participants: Faisal Alkhateeb [Contact], Jérôme Euzenat.

This year we have improved our use of PSPARQL [4] for answering queries modulo RDFS. We have shown that using a query transformation form SPARQL to PSPARQL was an effective way to answer queries modulo RDFS.

7. Other Grants and Activities

7.1. National grants and collaborations

7.1.1. WebContent RNTL platform

Participants: François Scharffe [Contact], Jérôme Euzenat.

Exmo is involved in the development of the *WebContent* platform supported by the Agence Nationale de la Recherche (ANR). Its goal is to build a national platform for knowledge retrieval involving natural language and semantic web technologies. *Exmo* is co-responsible with Gémo (Chantal Reynaud) of work-package 3.2 : Ontology matching. It aims at integrating ontology matching solutions from several partners on the platform. We have integrated the Alignment server within the platform and integrated other matchers from partners in the Alignment server. This year we have extended the service interface to cover all the capabilities of the Alignment Server.

More information on *WebContent* can be found at http://www.webcontent.fr.

7.1.2. DataRing ANR Verso Project

Participant: Jérôme Euzenat [Contact].

Exmo participates, as part of the LIG partner, in the *DataRing* project about P2P data sharing for online communities. We work more directly with Marie-Christine Rousset on trust in semantic peer-to-peer netwoks.

More information on *DataRing* can be found at http://www.lina.univ-nantes.fr/projets/DataRing/.

7.1.3. *Réseau régional Web intelligence*

Participants: Jérôme Euzenat [Contact], Jérôme David, François Scharffe.

Exmo is involved in the *Web intelligence* project supported by the Rhône-Alpes region. *Exmo* is more specifically involved in ontology matching in peer-to-peer systems with Marie-Christine Rousset (LIG) and Jean-Marc Petit (LIRIS).

More information on *Web intelligence* can be found at http://www.web-intelligence-rhone-alpes.org/.

7.2. European initiatives

7.2.1. *SEALS infrastructure project: Evaluating semantic technologies*

Participants: Jérôme Euzenat [Contact], Cássia Trojahn dos Santos [Contact].

Exmo is in charge of providing an infrastructure for evaluating ontology matching systems and algorithms, to be aggregated in the *SEALS* platform. This task involves:

- designing evaluation campaigns, what includes identifying criteria, metrics, datasets, and tools to be used in each campaign,
- designing and implementing services for automatic evaluation of systems and algorithms,
- analysing the results of evaluation campaigns and use them to produce a detailed report on both the effectiveness of the testing methodologies, and the systems that have been tested.

This year we have prepared the first SEALS evaluation campaign and the reengineering of the evaluation process [19]. We have also organised the OAEI 2009 campaign (§6.1.1).

More information on *SEALS* can be found at http://www.seals-project.eu/.

7.2.2. *NeOn integrated project: Networked ontologies*

Participants: Jérôme Euzenat [Contact], Chan Le Duc, Patrick Hoffmann, François Scharffe.

Exmo contributes to the *NeOn* integrated project considering all the aspects of "networked ontologies", i.e., the ontologies considered with their links to other ontologies. We work on the aspects of providing semantics to these networked ontologies (through alignments and ontology modules) and using ontology matching to recontextualise ontologies.

We have worked this year on the OntoSim library (§5.2) and the redesign of the Scarlet context-based ontology matcher.

More information on *NeOn* can be found at http://www.neon-project.org.

7.3. International Initiatives

7.3.1. *Collaboration with Université du Québec à Montréal*

Participants: Jérôme Euzenat [Contact], Petko Valtchev.

Exmo collaborates with Petko Valtchev at the Université du Québec à Montréal. We develop together a matching algorithm called OLA. We have this year worked at improving the scalability of the system.

Petko Valtchev visited *Exmo* in June 2009.

7.3.2. *Collaboration with Universidade Federal de Pernambuco*

Participant: Jérôme Euzenat [Contact].

We collaborate with Frederico Freitas and his team of the Universidade Federal de Pernambuco (Recife) on ontology modules and composition [5].

Frederico and Camila Bezzera visited *Exmo* in January and from January to April, respectively.

7.3.3. STAR (MAE-PHC) project with Yeungnam University

Participants: Jérôme Euzenat, Jérôme David [Contact].

We have started a collaboration with Jason Jung of Yeungnam University (Gyeongsan, South Korea) about the application of ontology similarities on semantic social networks. We begun to apply ontology space measures on Flickr social network.

Jason Jung visited *Exmo* in August 2009; Jérôme David visited Yeungnam university in November 2009.

8. Dissemination

8.1. Leadership within scientific community

- Jérôme Euzenat is founding member of the "Semantic Web Science Association" (steering committee for the ISWC conference series) and member of the steering committee of the LMO conference series.
- Jérôme Euzenat has been co-workshop chairperson (with Valentina Presutti) of the 6th European Semantic Web Conference (ESWC) held in Herssounisos, Greece.

8.2. Editorial boards, conference and workshop committees

- Editorial board of the journal "Journal of Web Semantics" and "Journal on Data Semantics" (Jérôme Euzenat).
- Jérôme Euzenat has been programme committee member for the 2009 issues of the conferences International Semantic Web Conference (ISWC), Worldwide Web Conference (WWW), International Joint Conference on Artificial Intelligence (IJCAI), and Langages et Modèles à Objets (LMO).
- Cassia Trojahn dos Santos has been programme committee member for the 2009 issue of the International Semantic Web Conference (ISWC).
- Jérôme David has been programme committee member for the 2009 issues of the International Semantic Web Conference (ISWC) and the Ontology matching workshop (OM).
- François Scharffe has been programme committee member for the 2009 issue of the Ontology matching workshop (OM).

8.3. Conferences, meetings and tutorial organisation

- François Scharffe has organised (with Eva Blomqvist, Kurt Sandkuhl and Vojtech Svatek) the 1st Workshop on "Ontology Patterns" (WOP 2009) of the 8th ISWC, Chantilly (VA US), 2009 [16].
- Jérôme Euzenat has organised (with Pavel Shvaiko, Fausto Giunchiglia, Heiner Stuckenschmidt, Natasha Noy and Arnon Rosenthal) the 4th "Ontology matching" workshop of the 8th ISWC, Chantilly (VA US), 2009 [17].
- Jérôme Euzenat, Cássia Trojahn dos Santos and François Scharffe have organised (with many other colleagues) the Ontology Alignment Evaluation Initiative 2009 at the "Ontology matching" workshop of the 8th ISWC, Chantilly (VA US), 2008 [18].

8.4. Invited conferences and other talks

- Interoperability in semantic distributed systems: Semantics of networks of aligned ontologies, University of Edinburgh (UK), 27 January 2009 (Jérôme Euzenat)
- Interoperability in semantic distributed systems: The case for alignments, University of Liverpool (UK), 29 January 2009 (Jérôme Euzenat)

- Context-based matching: Using external resources for matching ontologies, Invited talk, 1st Data integration through the semantic web (DIST) workshop, Bangkok (TH), 2 February 2009 (Jérôme Euzenat)
- Technologies du web sémantique et quelques applications, Groupe de travail MIRO, réseau Web intelligence, Grenoble (FR), 12 February 2009 (Jérôme Euzenat)
- Structured data interoperability on the web, Stanford Logic group, Stanford (CA US), A9 Août 2009 (François Scharffe)
- Méthodes et outils pour interrelier le web des données, Séminaire Médiation/Web intelligence, Villeurbanne (FR), 24 Novembre 2009 (François Scharffe)
- Construction automatique d'alignements entre ontologies, WebContent Open workshop, Saclay (FR), 14 December 2009 (François Scharffe)
- Melinda: Methods and tools for Web Data Interlinking, STI Innsbruck (AT), 17 December 2009 (François Scharffe)

8.5. Teaching

- Co-ordination with Éric Gaussier of the "AI and the web" option of the second year of informatics research master, Information track, Joseph Fourier university and INP, Grenoble.
- Tutorial on "Semantic Web Technology Evaluation" (Jérôme Euzenat 1h, with Ulrich Küster, Raul Garcia-Castro and Chris Bizer): European Semantic Web Conference, Hersounisous (GR), resp. Raul Garcia-Castro
- Tutorial on "Extreme Design (XD): Pattern-based ontology design" (François Scharffe 1h, with Eva Blomqvist, Valentina Presutti and Aldo Gangemi): Knowledge Capture conference, Redondo Beach (CA US), resp. Raul Garcia-Castro
- Ontology matching lecture and hands-on session (Jérôme Euzenat, 3h): European Summer School on Ontology Engineering and the Semantic Web, Cercedilla (ES), resp. Enrico Motta.

8.6. Miscellaneous

- Jérôme Euzenat has been expert on NWO (NL) funding demands.
- Jérôme Euzenat has been invited to the Dagstuhl seminar "Semantic Web Reflections and Future Directions" (June 2009) where he defended the "semantic web for the people" point of view and led one of the synthesis meeting about "Infospheres".

9. Bibliography

Major publications by the team in recent years

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