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INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team EXMO

Computer-mediated communication of structured knowledge

Grenoble - Rhône-Alpes

Theme : Knowledge and Data Representation and Management

Activity Report

2010

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2. Overall Objectives

2.1. Overall Objectives

Keywords: *ontology network*, *system of networked ontologies*, *Alignment API*, *CPRDF*, *CPSPARQL*, *OWL*, *OntoSim*, *PRDF*, *PSPARQL*, *Path RDF*, *RDF*, *SKOS*, *content representation*, *context*, *knowledge representation*, *knowledge transformation*, *linked data*, *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.

There is no reason why 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 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 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 [24], 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 alignments

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 an ontology network which is a set of ontologies and associated alignments. A model of such an ontology network 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 an ontology network, 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.

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 pervasive computing.

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" [25] 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 ontologies (see §6.1) in order to take advantage of them in ontology merging and bridging or message translation. Providing 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 (see §6.2). 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: in particular, we have developed an API for expressing ontology alignment (§5.1) and a library of ontology distances and similarities OntoSim (§5.2).

5.1. Alignment API: manipulating ontology alignments

Participants: Jérôme Euzenat [Contact], Jérôme David, François Scharffe, 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 five main interfaces (OntologyNetwork, 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 provide 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 (various generalisation of precision/recall, precision/recall graphs);
- 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 to plug-in new interfaces. The Alignment server can be accessed through HTML, web service (SOAP and REST) and agent communication interfaces.

This year we have fully integrated our expressive alignment language, called EDOAL, within the version 4 of the API. We have also worked at improving evaluation capabilities used in the SEALS project (see §8.2.1).

The *Alignment API* is used in the Ontology Alignment Evaluation Initiative data and result processing. It is also used by more than 30 other teams worldwide.

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, Giuseppe Pirrò.

OntoSim is a library offering similarity and distance measures between ontology entities as well as between ontology themselves. It materialises our work towards better ontology proximity measures (see §6.1.2).

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 queries to peers having closer ontologies because it will be easier to translate them and there are more chance that such a peer have the information of interest. OntoSim provides a framework for designing various kinds of similarities. In particular, we differentiate similarities in the ontology space from those in the alignment space. The latter ones make use of available alignments in an ontology network 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 [4]. In addition, the framework 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.

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

6. New Results

In the continuation of our previous work, in 2010 we obtained new results in ontology distances and similarities (§6.1.2) and developed our work on evaluation of ontology matching (§6.1.1). We also started new work on trust in semantic peer-to-peer systems (§6.2.2) and the use of the μ-calculus for evaluating RDF path queries (§6.2.1). We also started working on ontology matching for linking data (§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 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 15 different teams entered the evaluation which consisted of 6 different sets of tests. The participating systems and evaluation results were presented in the Fourth Workshop on Ontology Matching, that has been held in Shanghai, China [19][8].

The main activities carried out in 2010 were related to the automation and execution of the OAEI 2010 campaign, in the framework of the SEALS project (see §8.2.1). It involved the following main tasks:

- design and development a web-based evaluation service that allows for participants to run their own evaluations and manipulate the results in a direct feedback cycle [17][7];
- implementation of an OLAP-based tool for manipulating evaluation results ;
- support for helping participants to extend the required interface for running their tools in the evaluation service; and
- analysis and report of the evaluation campaign results.

This work has been used in OAEI 2010 evaluation campaign. More information on OAEI can be found at http://oaei.ontologymatching.org/.

6.1.2. Ontology distances

Participants: Jérôme David [Contact], Jérôme Euzenat, Giuseppe Pirrò.

Measuring similarity between ontologies can be very useful for different purposes, e.g., finding an ontology to replace another, or finding an ontology in which queries can be translated. This year, we have completed our new family of ontology measures computed in the alignment space, by contrast with more classical measures working in the ontology space [4]. Measures working in the alignment space evaluate the similarity between two ontologies with regard to the available alignments between them. We had introduced two sets of such measures relying on the existence of paths between ontologies or on the ontology entities that are preserved by the alignments. The former accounts for known relations between ontologies, while the latter reflects the possibility to perform actions such as instance import or query translation. These measures have all been implemented in the OntoSim library (§5.2), that has been used in experiments. The experiments showed that entity preserving measures are correlated with the best ontology space measures. Moreover they show a linear degradation with the alteration of alignments, testifying their robustness.

In addition, we developed work on linguistically-grounded similarity between ontology concepts. While similarity only considers subsumption relations to assess how two objects are alike, relatedness takes into account a broader range of relations (e.g., part-of). In particular, we have presented a framework, which maps the feature-based model of similarity into the information theoretic domain. It introduces a new way to compute information content directly from an ontology structure taking into account the whole set of semantic relations defined in an ontology. The proposed framework enables to rewrite existing similarity measures that can be augmented to compute semantic relatedness. Upon this framework, a new measure called FaITH (Feature and Information THeoretic) has been devised. Extensive experimental evaluations confirmed the suitability of the framework [10].

Another aspect that has been investigated is how to compute similarity between sentences exploiting not only nous definitions but also other parts of speech, e.g., verbs, [9]. In this respect, as a source of linguistic knowledge, WordNet has been used. Ongoing research concerns how to extend the similarity framework to expressive knowledge representation languages such as Description Logics.

6.1.3. Instance matching for linked data

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

The web of data consists of using semantic web technologies to publish data on the web in such a way that they can be interpreted and connected together. It is thus critical to be able to establish links between these data, both for the web of data and for the semantic web that it contributes to feed. We have proposed a general framework for analysing the task of linking data and we have shown how the diverse techniques developed for establishing these links fit in the framework [14]. We have also proposed an architecture allowing to associate various interlinking systems and to make them collaborate with systems developed for ontology matching that present many commonalities with link discovery techniques. This work will be pursued in the context of the Datalift project (see §8.1.1).

6.1.4. Consistency-based argumentation for matching

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

We had used argumentation theory for reconciling different views on alignments. However, the argumentation process does not guarantee that the resulting (agreed) alignment is consistent. This year, we have worked on argumentation and consistency checking for alignment agreement. We have provided an argumentation model that combines both argumentation and logical consistency checking for proving consistent agreed alignments. We have evaluated our approach using the Conference dataset of OAEI. However, so far evaluations have shown that if argumentation or consistency checking alone provide definitely better agreed alignments, their combination does not improve on this [12].

6.1.5. Multilingual ontology matching

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

This year we had the occasion of considering matching resources, ontologies and thesauri, using different and multiple natural languages. Hence, we developed specific techniques for dealing with this.

We have specified a minimal API for multilingual ontology matching which offers two strategies, direct translation-based and indirect. The first strategy considers direct match between two ontologies, with the help of external resources [11], i.e., translators, while indirect alignment [15], proposed by Jung and colleagues, is based on composition of alignments. We have provided an implementation for both approaches. For evaluating them, we have extended the OAEI benchmark test case for including a Portuguese ontology.

We also had the opportunity to experiment with thesauri expressed in SKOS (Simple Knowledge Organization System) involving many different languages in the context of the TAE project (see §7.1.1). In this respect, we analysed linguistic properties of thesauri and the usage of semantic similarity measures to assess similarity between labels in concept definitions. We also developed techniques for finding consensus between matchers in different pairs of languages which have already shown interesting results. Current research concerns the definition of a strategy to identify anchors between SKOS concepts and ConceptScheme. Anchors may provide a relevant basis on which applying more sophisticated strategies.

6.2. Ontology networks

Dealing with the semantic web, we are interested in ontology networks, 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. Path queries and μ-calculus

Participants: Melisachew Wudage Chekol [Contact], Jérôme Euzenat, Pierre Genevès, Nabil Layaïda.

In the continuation of our previous work on path-based RDF querying and WAM's work on μ-calculus interpretation of XPATH, we are using the same techniques for interpreting SPARQL queries over RDF.

To that extent, we proposed a μ-calculus encoding of RDF graphs and SPARQL queries. They allows to translate query evaluation to graph traversing through the modalities of the logics. μ-calculus offers the opportunity to encode more interesting contexts such as querying with path or querying module ontologies. We are studying the query containment and equivalence problem for various forms of SPARQL fragments, both from the standpoint of complexity bounds and effective evaluation strategies.

6.2.2. Trust in peer-to-peer semantic systems

Participants: Manuel Atencia [Contact], Jérôme Euzenat, Marie-Christine Rousset.

In a semantic peer-to-peer network where peers resort to different ontologies, links between peers are then realised by means of alignments. So queries (and their answers) are successively translated before peers receive them. However, even when alignments have been computed with human intervention, there is no guarantee that peers will obtain satisfactory answers to their queries.

A trust mechanism can assist peers to select those paths in the network that are better suited to their queries. We have put forward a probabilistic approach for trust which takes into account ontological information, alignments and past experiences to compute trust values. Bayesian inference is performed when approximating probability values.

7. Contracts

7.1. Contracts with industry

7.1.1. Thesaurus alignment environment

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

Exmo is subcontractor of the *Mondeca* company in a project for the OPOCE (the office for the official publications of the european union) which aims at developing a matching environment for thesauri. *Exmo*'s role is the integration of the Alignment API technology within *Mondeca*'s thesaurus edition environment and the development and evaluation of new matchers adapted to thesauri matching.

Concerned thesauri are large multilingual vocabularies expressed in SKOS, such as Eurovoc.

8. Other Grants and Activities

8.1. National grants and collaborations

8.1.1. Datalift ANR contint platform

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

Exmo coordinates with LIRMM the Datalift project whose goal is to produce a platform for publishing governmental data as linked data. *Exmo* is particularly involved in the generation of links between datasets.

More information on *Datalift* can be found at http://www.datalift.org.

8.1.2. DataRing ANR Verso Project

Participants: Manuel Atencia [Contact], Jérôme Euzenat [Contact].

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

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

8.2. European initiatives

8.2.1. SEALS infrastructure project: Evaluating semantic technologies

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

Exmo is a partner of the SEALS European commission infrastructure project whose goal is to provide the infrastructure for evaluating semantic technologies. Jérôme Euzenat is vice-coordinator in charge of the research area.

More particularly, *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 second SEALS evaluation campaign and designed a fully automated evaluation process [21][22]. We have also organised the OAEI 2010 campaign (§6.1.1) [23].

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

8.2.2. NeOn integrated project: Networked ontologies

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

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

For the end of the project, we have delivered the final version of our Alignment plug-in for the NeOn toolkit and studied the reengineering of context-based matching [20].

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

8.3. International Initiatives

8.3.1. Collaboration with Universidade Federal de Pernambuco

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

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

Marcelo Siqueira visited *Exmo* from January to May 2010.

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

Participants: Jérôme Euzenat, Jérôme David [Contact].

We collaborate with Jason Jung of Yeungnam University (Gyeongsan, South Korea) about the application of ontology similarities to semantic social networks. We have carried out experiments with students aiming at assessing the correlation between their affinity and the similarity between the ontology they design for annotating resources (pictures).

Jason Jung visited *Exmo* in February 2010; Jérôme Euzenat visited Yeungnam university in October 2010.

9. Dissemination

9.1. 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.

9.2. 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 2010 issues of the conferences Worldwide Web Conference (WWW), European Conference on Artificial Intelligence (ECAI), Formal Ontologies for Information Systems (FOIS), International conference on Knowledge Engineering and Knowledge Management (EKAW), International Conference on Artificial Intelligence: Methodology, Systems, Applications (AIMSA), and Reconnaissance des Formes et Intelligence Artificielle (RFIA). Jérôme Euzenat has also been programme committee member for the Data semantics workshop of EDBT/ICDT 2010, Automated reasoning about context and ontology evolution (ARCOE) workshop of ECAI 2010, and the 1st International Workshop on Evaluation of Semantic Technologies (IWEST) of ISWC 2010.
- Giuseppe Pirrò has been programme committee member IASTED International Conferences on Parallel and Distributed Computing and Systems (PDCS).
- Cássia Trojahn dos Santos has been programme committee member for the 2009 issue of the Ontology Matching Workshop (OM) and the 1st International Workshop on Evaluation of Semantic Technologies (IWEST).

- Jérôme David has been programme committee member for the 2010 issues of the Ontology matching workshop (OM) and the Web Social workshop of the Extraction and Gestion de Connaissances conference (EGC).
- François Scharffe has been programme committee member for the 2010 issues of the Ontology matching workshop (OM) and Ingénierie des Connaissances conference (IC).

9.3. Conferences, meetings and tutorial organisation

- Jérôme Euzenat has organised (with Pavel Shvaiko, Fausto Giunchiglia, Heiner Stuckenschmidt, Ming Mao, and Isabel Cruz) the 5th "Ontology matching" workshop of the 9th ISWC, Shanghai (CN), 2010 [19].
- François Scharffe has organised (with Valentina Presutti and Vojtech Svátek) the "Knowledge Injection to and Extraction from Linked Data" workshop of the 17th EKAW, Lisboa (PT), 2010 [18].
- Jérôme Euzenat, Cássia Trojahn dos Santos and François Scharffe have organised (with many other colleagues) the Ontology Alignment Evaluation Initiative 2010 at the "Ontology matching" workshop of the 9th ISWC, Shanghai (CN), 2010 [7].

9.4. Visits

- Giuseppe Pirrò visited KRDB, Free University of Bolzano, November, 16-24.
- Giuseppe Pirrò visited LOA CNR, Trento, October, 18-23.
- Melisachew Wudage Chekol spent three months at the National Institute of Technology (NII) in Tokyo working with Prof. Ryutaro Ichise on producing and consuming linked data from social media networks.
- Jérôme Euzenat spent 3 weeks (October, 3-25) at Yeungnam university (Gyeongsan, Korea) working with Pr. Jason Jung on evaluating ontology distance measures in the context of semantic peer-to-peer networks.

9.5. Invited conferences and other talks

- Ontology matching evaluation, Seminar Faculty of informatics, PUCRS, Porto Alegre (BR), 27/04/2010 (Cássia Trojahn dos Santos)
- Distributed semantics for distributed argumentation, 3rd agreement technology COST joint workshop, Hersounisos (GR), 4/6/2010 (Jérôme Euzenat)
- Computing Semantic Similarity with FaITH, LOA-CNR, Trento (IT), 22/10/2010 (Giuseppe Pirrò)
- Semantic web technologies, Seminar Yeungnam university, Gyeongsan (KR), 11/10/2010 (Jérôme Euzenat)
- Improved access to EU content through thesaurus matching, Eurovoc workshop, Luxembourg (LU), 18/11/2010 (Jérôme Euzenat with Laurent Bégin)
- Consistency-driven argumentation for alignment agreement, 4rd agreement technology COST joint workshop, Paris (FR), 15/12/2010 (Cássia Trojahn dos Santos)

9.6. Teaching

- Jérôme Euzenat Co-ordinates with Éric Gaussier of the "AI and the web" option of the second year of informatics research master, Joseph Fourier university and INP, Grenoble.

- Jérôme Euzenat teaches "Semantic web: from XML to OWL" (with Pierre Genevès, Nabil Layaïda and Marie-Christine Rousset) at the second year of informatics research master, Joseph Fourier university and INP, Grenoble (18h).
- Tutorial on "Semantic Web Technology Evaluation" (Jérôme Euzenat 1h, with Ulrich Küster, Raul Garcia-Castro and Giorgos Stoilos): European Semantic Web Conference, Hersounisous (GR), resp. Raul Garcia-Castro

9.7. Miscellaneous

- Jérôme Euzenat has been reviewer on the ANR Verso funding demands.
- Jérôme Euzenat has been book proposal reviewer for the MIT press.

10. Bibliography

Major publications by the team in recent years

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