IN PARTNERSHIP WITH:
CNRS

Institut polytechnique de Grenoble

Université Pierre Mendes-France (Grenoble)

Université Joseph Fourier (Grenoble)

Activity Report 2013

Project-Team EXMO

Computer mediated exchange of structured knowledge

IN COLLABORATION WITH: Laboratoire d'Informatique de Grenoble (LIG)

RESEARCH CENTER
Grenoble - Rhône-Alpes

THEME
Data and Knowledge Representation and Processing

Table of contents

Project-Team EXMO

Keywords: Ontology Matching, Semantic Web, Knowledge Representation, Artificial Intelligence

Creation of the Project-Team: 2003 July 01.

1. Members

Research Scientist
Jérôme Euzenat [Team leader, Inria, Senior Researcher, HdR]

Faculty Members
Manuel Atencia Arcas [Univ. Grenoble II, Associate Professor]
Jérôme David [Univ. Grenoble II, Associate Professor]

Engineer
Nicolas Guillouet [Inria, from Sep 2013]

PhD Students
Zhengjie Fan [Inria]
Armen Inants [Inria]
Tatiana Lesnikova [Univ. Grenoble I]
Adam Sanchez Ayte [Inria, from Dec 2013]

Post-Doctoral Fellow
Luz Maria Priego-Roche [Inria, from Dec 2013]

Administrative Assistant
Marion Ponsot [Inria, 35%]

2. Overall Objectives

2.1. General Objectives

The semantic web blends the communication capabilities of the web with knowledge representation. Expressing formalised knowledge on a computer is useful, not exclusively for the need of the computer, but for communication. The goal of EXMO is the development of theoretical, experimental and software tools for communicating formalised knowledge.

There is no reason why knowledge expressed on the web should be in a single format or by reference to a single vocabulary (or ontology). In order to interoperate, the representations have to be matched and transformed. We currently build on our experience of alignments as representing the relationships between ontologies. Such alignments may be used for generating knowledge transformations (or any other kind of mediators) used for interoperating or interlinking data. We currently focus on the design of an alignment infrastructure and on the investigation of alignment properties when they are used for reconciling ontologies.

On a longer term, we want to study how a semantic web made of interrelated ontologies and datasets evolves and structures itself depending on its use. In particular, we aim at understanding how it influences and is influenced by its use in interpersonal communication.

Our work is naturally applied in all contexts in which ontologies are used for expressing knowledge that has to be communicated. It is more directly focussed on the infrastructure of the semantic web and the web of data.

2.2. Highlights of the Year

This year saw the publication of the second edition, largely revised and augmented, of our reference book *Ontology matching* [12].

3. Research Program

3.1. Knowledge representation semantics

We usually work with semantically defined knowledge representation languages (like description logics, conceptual graphs and object-based languages) [17]. 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 describes 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 the SPARQL query language and alignment 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 [3]. 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, holding between these entities.

An alignment between two ontologies o and o' is a set of correspondences $\langle e, e', r\rangle$ 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.

In addition, a correspondence may support various types of metadata, in particular measures of the confidence in a correspodence.

Given the semantics of the two ontologies provided by their consequence relation, we define an interpretation of two aligned ontologies as a pair of interpretations $\langle m, m' \rangle$, one for each ontology. Such a pair of interpretations is a model of the aligned ontologies o and o' if and only if each respective interpretation is a model of the ontology and they satisfy all correspondences of the alignment.

This definition is extended to networks of ontologies: a set of ontologies and associated alignments. A model of such an ontology network is a tuple of local models such that each alignment is valid for the models 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 pairwise 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 instantiation). Confidence measures are usually given a value between 0 and 1 and are used for expressing preferences between two correspondences.

4. Application Domains

4.1. Semantic web technologies

The main application context motivating our work is the “semantic web” infrastructure, but it can be applied in any context where semantic technologies are used: semantic social networks, ambient intelligence, linked data, etc.

Internet technologies support organisations and people 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 enables 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” [16] 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 requires 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.

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 (typically in the SmartCity context, [15]). 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 and Platforms

5.1. Alignment API

Participants: Jérôme Euzenat [Correspondent], Jérôme David, Nicolas Guillouet, Armen Inants, Luz Maria Priego-Roche.

We have designed a format for expressing alignments in a uniform way [1]. The goal of this format is to share available alignments on the web. It should help systems using alignments, e.g., mediators, 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.

The API itself [1] 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, RDF, SKOS, SWRL, OWL, C-OWL, SPARQL);
- a library of evaluators (various generalisation of precision/recall, precision/recall graphs);
- a flexible test generation framework which allows for generating evaluation datasets;
- a library of wrappers 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.

The Alignment API is used in the Ontology Alignment Evaluation Initiative data and result processing (§6.1.1). 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 [Correspondent], Jérôme Euzenat.

OntoSim is a library offering similarity and distance measures between ontology entities as well as between ontologies themselves. It materialises our work towards better ontology proximity measures.

There are many reasons for measuring a distance between ontologies. For example, in semantic social networks, 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 it is more likely that such a peer has the information of interest. OntoSim provides a framework for designing various kinds of similarities. In particular, we distinguish similarities in the ontology space from those in the alignment space. The latter ones use 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. It also features original comparison methods such as agreement/disagreement measures. In addition, the framework embeds external similarity libraries which can be combined to our own.

OntoSim is based on an ontology interface allowing for using ontology parsed with different APIs. It is written in Java and is available, under the LGPL licence, at http://ontosim.gforge.inria.fr.

6. New Results

6.1. Ontology matching and alignments

We pursue our work on ontology matching and alignment support [5], [12] with contributions to evaluation and alignment semantics.

6.1.1. Evaluation

Participant: Jérôme Euzenat.

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 [2].

This year, we ran the OAEI 2013 evaluation campaign [7]. It offered 8 different test sets (7 of which under the SEALS platform). This issue brought the following results:

- Once again, more participants than ever (23);
- Most ontology matchers running on the SEALS platform (20);
- Increased performances in terms of precision and recall;
- Matchers are now faster and more scalable. There are also more matchers using networked resources.

We used again the our generator for generating new version of benchmarks [4]. The Alignment API was used for manipulating alignments and evaluating results.

A novelty of this year was the evaluation of interactive systems, included in the SEALS client. It brings interesting insight on the performances of such systems and should certainly be continued.

The participating systems and evaluation results were presented in the 8th Ontology Matching workshop, that was held in Sydney, Australia [13]. More information on OAEI can be found at http://oaei.ontologymatching.org/.

6.1.2. Algebras of relations in alignments

Participants: Armen Inants [Correspondent], Jérôme Euzenat.

We had previously shown that algebras of relations between concepts can be used for expressing relations in alignments. We have worked this year as extending them in two ways.

We increased the expressiveness of relations between concepts, not restricting the algebra to necessarily non empty concepts. This describes all taxonomical (as opposed to mereological) relation algebras, i.e., all those relations that have been used by matchers so far.

We also dealt with relations among different kinds of entities – individuals or concepts. For this, relation algebra structures are considered in an arbitrary one- or many-sorted logical theory. We established a sufficient condition for a set of dyadic formulas in a first-order theory to generate a relation algebra. This result is extended to many-sorted theories by means of Schröder categories.

This work is part of the PhD of Armen Inants.

6.2. Data interlinking

The web of data uses 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 consider this problem from different perspectives.

6.2.1. Interlinking cross-lingual RDF data sets

Participants: Tatiana Lesnikova [Correspondent], Jérôme David, Jérôme Euzenat.

Data interlinking is a difficult task in a cross-lingual environment like the Web. Even systems based on graph structure, ultimately rely on anchors based on language fragments. If languages are different, fragments have to be compared by more sophisticated techniques. In that context, we are developing an approach which represents RDF entities as (virtual) text documents and compare them using different strategies [9], [10]. We investigate two directions: (1) a translation-based approach where the virtual documents are automatically translated; (2) a language-independent approach where important terms found in documents are mapped to a terminological resource like Wordnet to compute document similarity.

This work is part of the PhD of Tatiana Lesnikova developed in the LINDICLE project (see §7.1.2).

6.2.2. Data interlinking from expressive alignments

Participants: Zhengjie Fan [Correspondent], Jérôme Euzenat.

In the context of the DATALIFT project, we are further developing the data interlinking module. We have developed an algorithm able to determine potential attribute correspondences of two classes depending on their features. For that purpose, we use k-means or k-medoids clustering. These correspondences are then used to construct a SILK script which generates an initial link set. Some of the links are presented to the user who assesses their validity. We then use an improvement of the disjunctive version space supervised learning method to learn a better script from the assessed links. Such a technique can be iterated until satisfactory links are found.

This work is part of the PhD of Zhengjie Fan, co-supervised with François Scharffe (LIRMM), and developed in the DATALIFT project (see §7.1.1).

6.2.3. Key and pseudo-key detection for web data set interlinking

Participants: Jérôme David [Correspondent], Manuel Atencia Arcas, Anthony Delaby, Jérôme Euzenat.

Keys are sets of properties which uniquely identify individuals (instances of a class). We have refined the notion of database keys in a way which is more adapted to the context of description logics and the openness of the semantic web. We have also refined the weaker notion of a linkkey introduced in [12]. Then we have shown how such keys, together with ontology alignments, and linkkeys may be used for deducing equality statements (links) between individuals across data sources in the web of data.

However, ontologies do not necessarily come with key descriptions, and never with linkkey assertions (which would hold across ontologies). But, these can be extracted from data by assuming that keys holding for specific data sets, may hold universally. We have extended these classical key extraction techniques for extracting linkkeys.

This work is developed partly in the LINDICLE and DATALIFT projects. A proof of concept implementation is available at http://rdfpkeys.inrialpes.fr/.

6.3. 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.

6.3.1. *Path queries and μ-calculus*

Participant: Jérôme Euzenat.

Querying the semantic web is mainly done through the SPARQL language or its extensions through paths and entailment regimes [14]. Query containment is the problem of deciding if the answers to a query are included in those of another query for any queried data sources. This problem is very important for query optimisation purposes. In the SPARQL context, it can be equally useful for distributing federated queries or for implementing schema-based access control. In order to experimentally assess implementation strengths and limitations, we provided a first SPARQL containment test benchmark. We studied the query demographics on DBPEDIA logs to design benchmarks for relevant query containment solvers. We tested available solvers on their domain of applicability on three different benchmark suites [6] and found that (i) tested solutions are overall functionally correct, (ii) in spite of its complexity, SPARQL query containment is practicable for acyclic queries, (iii) state-of-the-art solvers are at an early stage both in terms of capabilities and implementation.

This work has been developed in collaboration with the TYREX team and within the PhD thesis of Melisachew Wudage Chekol now in the ORPAILLEUR team. The benchmarks, results and software are available at http://sparql-qc-bench.inrialpes.fr.

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. *ANR Datalift*

Program: ANR-ContInt

Project acronym: Datalift

Project title: DATALIFT

Instrument: platform

Duration: September 2010 - March 2014

Coordinator: Inria EXMO/François Scharffe

Participants: Jérôme Euzenat, Zhengjie Fan, Jérôme David

See also: http://www.datalift.org

Abstract: 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 (see §6.2).

7.1.2. *ANR Lindicle*

Program: ANR-Blanc international 2

Project acronym: LINDICLE

Project title: Linking data in cross-lingual environment

Duration: January 2013 - December 2016

Coordinator: Inria EXMO/Jérôme David

Participants: Jérôme Euzenat, Manuel Atencia Arcas, Jérôme David, Tatiana Lesnikova, Adam Sanchez Ayte

Other partners: Tsinghua university (CN)

See also: http://lindicle.inrialpes.fr

Abstract: The LINDICLE project investigates multilingual data interlinking between French, English and Chinese data sources (see §6.2).

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. Ready4SmartCities

Type: CAPACITIES

Defi: ICT-2013.6.4 - Optimising Energy Systems in Smart Cities

Instrument: Coordination and Support Action

Project acronym: Ready4SmartCities

Project title: ICT Roadmap and Data Interoperability for Energy Systems in Smart Cities

Duration: October 2013 - September 2015

Coordinator: D'appolonia Spa (Italy)

Partner: D'appolonia (Italiy) Universidad Politecnica de Madrid (Spain) CSTB (France), CERTH (Grèce), VTT (Finland), Inria (France), AIT (Austria), AEC3 (UK), Politecnico di Torino (Italy), Empirica (Germany)

Inria contact: Jérôme Euzenat

Participants: Jérôme Euzenat, Luz Maria Priego-Roche, Jérôme David

See also: http://www.ready4smartcities.eu

Abstract: The READY4SmartCities project intends to increase awareness and interoperability for the adoption of ICT and semantic technologies in energy system to obtain a reduction of energy consumption and $CO2$ emission at smart cities community level through innovative relying on RTD and innovation outcomes and ICT-based solutions.

7.3. International Research Visitors

7.3.1. Visits of International Scientists

- **Esther Lozano (Universidad Politecnica de Madrid)** visited EXMO from January 8th to May 8th, 2013 working on the combination of context-based matching with semantic modelling systems;
- **Jorge Gracia (Universidad Politecnica de Madrid)** visited EXMO from May 1st to July 27th, 2013, working on multilingual ontology/instance matching and expressive ontology matching;
- **Daniel Vila (Universidad Politecnica de Madrid)** visited EXMO from June 2nd to July 23rd, 2013 working on data interlinking and ontology inference;
- **Angela Locoro (Universita deggli Studi di Genova)** visited EXMO from June 1st to 29th, 2013 working on context-based ontology matching and generalised the notion of context;
- **Lihua Zhao (NII, Tokyo)** visited EXMO from August 17th to September 21st, 2013 on combining data interlinking from ontology matching with ontology matching from links.

7.3.2. Visits to International Teams

- Jérôme David Visited Tsinghua University (Juanzi Li group), Beijing, China. 5/11 – 21/11/2013. He worked in the framework of the LINDICLE project on the refinement of ontologies extracted from online encyclopedia.

8. Dissemination

8.1. Scientific Animation

8.1.1. Editorial boards and programme committees

- Jérôme Euzenat is founding member of the "Semantic Web Science Association" (steering committee for the ISWC conference series).
- Editorial board of *Journal of Web Semantics*, *Journal on Data Semantics* and *Semantic web journal* (Jérôme Euzenat).
- Jérôme Euzenat has been programme committee member for the 2013 issues of the conferences International Joint Conference on Artificial Intelligence (IJCAI), International Semantic Web Conference (ISWC) main and evaluation track, Worldwide Web Conference (WWW), National Conference on Artificial Intelligence (AAAI), IA and the web track, ACM conference on Knowledge capture (KCap), International and Interdisciplinary Conference on Modeling and Using Context (Context), European Semantic Web Conference (ESWC), Ingénierie des connaissances (IC), Brazilian Conference on Ontological Research (OntoBras).
- Jérôme David has been programme committee member for the 2013 issues of the ingénierie des connaissances (IC) conference.
- Jérôme David has been programme committee member for the 2013 issues of the Ontology matching workshop (OM) and the Graph Based Structures for Knowledge Representation and Reasoning Workshop (GKR@IJCAI).
- Manuel Atencia has been programme committee member for the 2013 issues of the International Semantic Web Conference (ISWC), the Ontology matching workshop (OM), and the Graph Based Structures for Knowledge Representation and Reasoning Workshop (GKR@IJCAI).
- Jérôme Euzenat has also been programme committee member for the IJCAI workshop on “Acquisition, Representation and Reasoning with Contextualized Knowledge (ARCOE-Logic)”.
- Jérôme Euzenat has co-organised (with Pavel Shvaiko, Jérôme Euzenat, Kavitha Srinivas, Ming Mao and Ernesto Jiménez-Ruiz) the 8th "Ontology matching" workshop of the 12th ISWC, Sydney (NSW AU), 2013 [13].
- Jérôme Euzenat has co-organised (with many other colleagues) the Ontology Alignment Evaluation Initiative 2013 at the "Ontology matching" workshop of the 12th ISWC, Sydney (NSW AU), 2013 [7].

8.1.2. Seminars

- Seminar on “Data mediation in SPARQL from alignments”, CrEDiBle (fédération de données et de ConnaissancEs Distribuées en Imagerie BiomédicaLE) workshop, Sophia-Antpolis (FR), 4/10/2013 (Jérôme Euzenat)
- Seminar on “The dynamic knowledge medium”, Inria/I3S, Sophia-Antpolis (FR), 29/11/2013 (Jérôme Euzenat)
- Seminar on “A Framework for Interlinking RDF Datasets Based on Pseudo-Keys Discovery”, Tsinghua university, Beijing (CN), 20/11/2013 (Jérôme David)

8.2. Teaching - Supervision - Juries

8.2.1. Teaching

- Licence: Manuel Atencia, Introduction à la programmation fonctionelle, 36, L1, UJF, France
- Licence: Jérôme David, Outils Informatique (c2i), 24, L1, UPMF, France
- Licence: Jérôme David, Développement Mobile, 30, L3, UPMF, France
- Master: Jérôme David, Programmation Java 2, 30, M1-M2, UPMF, France

- Master: Jérôme David, JavaEE, 30, M2, UPMF, France
- Master: Jérôme David, Développement Web Mobile, 30, M2, UPMF, France
- Master: Jérôme David, Interface Homme Machine 2, 30, M2, UPMF, France
- Master: Manuel Atencia & Jérôme David, Introduction au Web Sémantique, 30, M2, UPMF, France
- Master: Jérôme Euzenat, Semantic web: from XML to OWL, 22heqTD, M2R, Université Joseph Fourier & INPG, France
- Post-graduate level: Jérôme Euzenat, Ontology matching, 4heqTD, European Summer School on Ontology Engineering and the Semantic Web, Cercedilla, Spain

8.2.2. Supervision

- PhD in progress: Zhengjie Fan, Ontology-based data interlinking, 1/1/2011, supervisors: Jérôme Euzenat and François Scharffe
- PhD in progress: Mustafa Al-Bakri, Modélisation et calcul de la confiance dans les réseaux pair-à-pair de partage de données, 1/1/2011, supervisors: Marie-Christine Rousset and Manuel Atencia
- PhD in progress: Tatiana Lesnikova, Multilingual data interlinking, 1/10/2012, supervisors: Jérôme Euzenat and Jérôme David
- PhD in progress: Armen Inants, Ontology alignment algebra, 1/12/2012, supervisor: Jérôme Euzenat
- PhD in progress: Adam Sanchez Ayte, Ontology alignment and data interlinking evolution on the web of data, 1/12/2013, supervisor: Jérôme Euzenat and Jérôme David

8.2.3. Juries

- Jérôme Euzenat chaired the HDR committee of Nabil Layaïda, Representation and analyses of web content and processing, Université de Grenoble, 23/4/2013
- Jérôme Euzenat has reviewed the HDR of Noël Conruyt, Gestion des signes: de la représentation des connaissances à leur signification pour les e-services, Université de la Réunion, 25/10/2013
- Jérôme Euzenat has reviewed the PhD dissertation of Luca Costabello, Context-aware access control and presentation of linked data, Université de Nice-Sophia Antipolis, 29/11/2013, Fabien Gandon and Ivan Hermann

8.3. Popularization

- Jérôme Euzenat gave a presentation on *Les données liées ouvertes (linked open data): publier des données réutilisables* at the open data days of the FREMIT Federation, IMT/IRIT, Toulouse (FR), 5/11/2013.
- Jérôme Euzenat coordinated the CNRS development days (JDEV) sessions on *web programming*, 4 presentations, 6 tutorials, 5 worshops, 80 participants, Palaiseau, 4-6/9/2013.

9. Bibliography

Major publications by the team in recent years

[1] JÉRÔME. DAVID, JÉRÔME. EUZENAT, FRANÇOIS. SCHARFFE, CÁSSIA. TROJAHN DOS SANTOS. *The Alignment API 4.0*, in "Semantic web journal", 2011, vol. 2, n^{o} 1, pp. 3-10, http://dx.doi.org/10.3233/SW-2011-0028

[2] JÉRÔME. EUZENAT, CHRISTIAN. MEILICKE, PAVEL. SHVAIKO, HEINER. STUCKENSCHMIDT, CÁSSIA. TROJAHN DOS SANTOS. *Ontology Alignment Evaluation Initiative: six years of experience*, in "Journal on data semantics", 2011, vol. XV, n^{o} 6720, pp. 158-192, http://dx.doi.org/10.1007/978-3-642-22630-4_6

[3] JÉRÔME. EUZENAT, PAVEL. SHVAIKO. , *Ontology matching*, Springer-VerlagHeidelberg (DE), 2007, http://book.ontologymatching.org

Publications of the year

Articles in International Peer-Reviewed Journals

[4] J. EUZENAT, M. ROSOIU, C. TROJAHN DOS SANTOS. *Ontology matching benchmarks: generation, stability, and discriminability*, in "Journal of Web Semantics", 2013, vol. 21, pp. 30-48 [*DOI :* 10.1016/J.WEBSEM.2013.05.002], http://hal.inria.fr/hal-00917906

[5] P. SHVAIKO, J. EUZENAT. *Ontology matching: state of the art and future challenges*, in "IEEE Transactions on Knowledge and Data Engineering", 2013, vol. 25, n° 1, pp. 158-176 [*DOI :* 10.1109/TKDE.2011.253], http://hal.inria.fr/hal-00917910

International Conferences with Proceedings

[6] M. W. CHEKOL, J. EUZENAT, P. GENEVÈS, N. LAYAÏDA. *Evaluating and benchmarking SPARQL query containment solvers*, in "Proc. 12th International semantic web conference (ISWC)", Sydney, Australia, H. ALANI, L. KAGAL, A. FOKOUE, P. GROTH, C. BIEMANN, J. X. PARREIRA, L. AROYO, N. NOY, C. WELTY, K. JANOWICZ (editors), Lecture notes in computer science, Springer Verlag, 2013, vol. 8219, pp. 408-423 [*DOI :* 10.1007/978-3-642-41338-4_26], http://hal.inria.fr/hal-00917911

[7] B. CUENCA GRAU, Z. DRAGISIC, K. ECKERT, J. EUZENAT, A. FERRARA, R. GRANADA, V. IVANOVA, E. JIMÉNEZ-RUIZ, A. O. KEMPF, P. LAMBRIX, A. NIKOLOV, H. PAULHEIM, D. RITZE, F. SCHARFFE, P. SHVAIKO, C. TROJAHN DOS SANTOS, O. ZAMAZAL. *Results of the Ontology Alignment Evaluation Initiative 2013*, in "Proc. 8th ISWC workshop on ontology matching (OM)", Sydney, Australia, No commercial editor., 2013, pp. 61-100, http://hal.inria.fr/hal-00918494

[8] J. EUZENAT. *Uncertainty in crowdsourcing ontology matching*, in "Proc. 8th ISWC workshop on ontology matching (OM)", Sydney, Australia, No commercial editor., 2013, pp. 221-222, http://hal.inria.fr/hal-00918495

[9] T. LESNIKOVA. *Interlinking cross-lingual RDF data sets*, in "Proc. 10th European semantic web conference (ESWC)", Montpellier, France, P. CIMIANO, Ó. CORCHO, V. PRESUTTI, L. HOLLINK, S. RUDOLPH (editors), Lecture notes in computer science, Springer Verlag, 2013, vol. 7882, pp. 671-675 [*DOI :* 10.1007/978-3-642-38288-8_49], http://hal.inria.fr/hal-00917908

[10] T. LESNIKOVA. *NLP for interlinking multilingual LOD*, in "Proc. ISWC Doctoral consortium", Sydney, Australia, L. AROYO, N. NOY (editors), No commercial editor., 2013, pp. 32-39, http://hal.inria.fr/hal-00918496

[11] A. MERCERON, J.-M. ADAM, D. BARDOU, J. DAVID, S. LUJÁN-MORA, M. MILOSZ. *Training Sessions in a Master Degree "Informatics as a Second Competence"*, in "EDUCON 2013 - IEEE Global Engineering Education Conference", Berlin, Germany, O. PFEIFFER, M. E. AUER, M. LLAMAS (editors), IEEE, March 2013, pp. 190-199, ISSN: 2165-9559; ISBN: 978-1-4673-6110-1 [*DOI :* 10.1109/EDUCON.2013.6530105], http://hal.inria.fr/hal-00871562

Scientific Books (or Scientific Book chapters)

[12] J. EUZENAT, P. SHVAIKO. , *Ontology matching*, Springer-Verlag, 2013, 520 p. , 2nd edition [*DOI :* 10.1007/978-3-642-38721-0], http://hal.inria.fr/hal-00918122

Books or Proceedings Editing

[13] P. SHVAIKO, J. EUZENAT, K. SRINIVAS, M. MAO, E. JIMÉNEZ-RUIZ (editors). , *Proc. 8th ISWC workshop on ontology matching (OM)*, 2013, pp. 1-249, http://hal.inria.fr/hal-00918492

Research Reports

[14] F. ALKHATEEB, J. EUZENAT. , *Answering SPARQL queries modulo RDF Schema with paths*, Inria, November 2013, n^{o} RR-8394, 46 p. , http://hal.inria.fr/hal-00904961

[15] L. M. PRIEGO, J. EUZENAT, R. GARCÍA CASTRO, M. POVEDA VILLALÓN, F. RADULOVIC, M. WEISE. , *Strategy for Energy Management System Interoperability*, December 2013, 25 p. , http://hal.inria.fr/hal-00925628

References in notes

[16] T. BERNERS-LEE, J. HENDLER, O. LASSILA. *The Semantic Web*, in "Scientific American", May 2001, vol. 284, n^{o} 5, pp. 34–43

[17] J. EUZENAT. , *Semantic web semantics*, 2007-2013, Lecture notes, Master, http://exmo.inria.fr/teaching/sw/poly/semwebsem.pdf