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Context-based Ontology Matching: Concept and Application Cases

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Abstract: The Internet of Things (IoT) aims at linking smart objects that are relevant to the user and embedding intelligence into the environment. It is more and more accepted in the scientific community and expected by end users, that pervasive services should be able to adapt to the circumstances or situation in which a computing task takes place, and maybe even detect all relevant parameters for this purpose. Work presented in this paper addresses the challenge of bringing together concepts and experiences from two different areas: context modeling and ontology matching. Current work in the field of automatic ontology matching does not sufficiently take into account the context of the user during the matching process. The main contributions of this paper are (1) the introduction of the concept of "context" in the ontology matching process, (2) an approach for context-based semantic matching, which is building on different (weighted) levels of overlap for a better ranking of alignment elements depending on user's context, (3) an evaluation of the context-based matching in experiments and from user's perspectives.

Key Words: Internet of Things, context-aware computing, ontology matching
Category: H.3.2, H.3.3, M.4, M.5, M.7

1 Introduction

The Internet of Things (IoT) provides services through interacting with smart objects over the Internet [Haller et al. 2009]. IoT aims at linking smart objects that are relevant to the user and embedding intelligence into the environment. Context-computing plays an important role to enable services adapting situations in the IoT environment [Preuveneers and Berbers 2008][Zhang et al. 2011]. Context-computing is first introduced in 1994 about mobile host by [Schilit and Theimer 1994]. They consider the context as the information about located-object and the changes to object over time. [Dey 2001] defined context as "*Context is any information that can be used to characterize the situation of an entity*". With increasing mobility of users, increased performance and functionality of mobile devises and sensors, and increasing amount of information available, the way of adapting computing devices or information systems to personal needs by just using profiles or personal preferences seems no longer sufficient. It is more and more accepted in the scientific community and expected by end users, that pervasive services should be able to adapt to the circumstances or situation in which a computing task takes place, and maybe even detect all relevant parameters for this purpose. These circumstances and situations including the personal preferences and the task performed are often referred to as human related context. Many different approaches were developed for representing a context using a formal language (e.g., UML ([Henricksen et al. 2002]), OWL ([Wang et al. 2004]), etc.) or informal language (e.g., Dey's approach to use the Context Toolkit to define the context through a GUI [Dey 2001]).

Work presented in this paper addresses this challenge by bringing together approaches, concepts and experiences from two different areas: ontology matching and context computing. Although ontologies are developed for various purposes and domains, they often contain overlapping information. Ontology matching aims at finding similar entities or translation rules between two ontologies. Ontology matching is an important technique to creating a collaborative semantic web. However, currently existing approaches for automatic ontology matching do not sufficiently take into account context dependencies in the process of matching. This leads to situations where the results of automatic matching are of limited or no use for the task or application at hand. An increased user involvement can be a way to improve the quality of matching results [Shvaiko and Euzenat 2008]. In this paper, we propose a new way for user involvement by using a context ontology capturing both, tasks of the user and user preferences. From an ontology matching perspective, the research questions can be summarized as (1) how to integrate context in ontology matching? (2) what is the benefit/effects using context in ontology matching? From the context computing perspective, the pervasive services are provided by integrating context in the matching process instead of querying different/integrated knowledge base based on context.

The main contributions of this paper are (1) the introduction of the concept of "context" in the ontology matching process, (2) an approach for context-based semantic matching, which is building on different (weighted) levels of overlap for a better ranking of alignment elements depending on user's context, (3) an evaluation of the context-based matching in experiments and from user's perspectives. In the following sections we first discuss the motivation behind our approach. Then we briefly summarize the related work (section 2) and present relevant definitions (section 3). We discuss a case used for validation of our work with its scenario and ontologies (section 4). We explain our context based ontology matching approach (section 5) and its implementation (section 6). We discuss the evaluation approach, initial evaluation results (section 7) and threats to validity (section 8). The paper ends with a summary of the work and our conclusions (section 9).

2 Related Work

Currently, more and more systems are ontology-based models to represent context. For example, [Yu et al. 2008] propose an infrastructure to support the user context processing in ubiquitous learning. In their approach, they use three ontologies to model user context, knowledge about the content and domain knowledge. The services are provided by querying these three ontologies. In our case, the services are provided by matching these three ontologies instead of query.

Increasing numbers of ontology matching systems are developed and available as research prototypes. OAEI [1] (Ontology Alignment Evaluation Initiative) organizes annual campaigns to offer a systematic and standardized way of evaluating these ontology matching systems. Different strategies (e.g., string similarity, synonyms, structure similarity and based on instances) for determining similarity between entities are used in current ontology matching systems. [Euzenat 2009] contains a good survey of current tools.

User involvement can improve the ontology matching results [Shvaiko and Euzenat 2008]. But there are only few systems focusing on how to involve users in ontology matching. Some systems involve users during design time [Do and Rahm 2007], other systems propose graphical visualization of result to the user [Sean M. Falconer 2007]. In this paper, we propose a new way of user involvement by using a context ontology (our context ontology definition can be found in section 3).

Only a few existing systems use context information in the ontology matching process, with different meaning of context. [Aleksovski et al. 2006], Zharko et al. use a background ontology as context to derive matching relationships between the source ontology and target ontology. However, in their case the source ontology and target ontology have no structure at all. Source ontology and target ontology match the background ontology first, based on the structure of the background ontology to acquire the semantic relationship between the source and target ontology, finally using these semantic relationship to find the mapping between them. In [Albertoni and De Martino 2008], the authors propose the asymmetric and context dependent semantic similarity among instances in an ontology. The user can set different parameters based on special format as the

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[1] http://oaei.ontologymatching.org/

context, the final matching result combines the context. However, this approach is focusing on comparing instances in one ontology. Our approach is comparing instances in two ontologies by involving a context ontology.

3 Definition

Since the source and target ontologies are developed for different purposes and applications, the ontology matching has to emphasize the application and task perspective. This research focuses on enterprise ontology matching with the target ontology. It means that the enterprise ontology is constructed for the intended application purposes. The context is important for improving the ontology matching result. Definitions of the terms enterprise ontology and context are given in the following sections.

3.1 Enterprise Ontology

We follow Blomqivst's enterprise ontology definition: *an enterprise ontology would typically contain parts describing different aspects of the organization, such as products and their features and functions, processes, organizational context, and other aspects relevant to the intended task* [Blomqvist 2009].

3.2 Context

The context aims at reflecting the information demand of a role in the enterprise. Role here means *a part of a larger organizational structure clearly defined by the responsibility it has within that structure* [Levashova et al. 2006].

The context is modeled in two levels: abstract context and operational context. Abstract context is an ontology-based model integrating information about the role. Operational context is the instance of the abstract context for a specific role. Normally the context consists of three parts:

- The information about the tasks of a role included in the enterprise ontology.
- Information about the tasks of role that is related to the enterprise but not inside the enterprise ontology. This is additional information provided by the role based on his/her knowledge.
- Additional information about the role, every individual having the role, for example, the competence of the individual having the role.

4 Case Study

In this section, we describe a case used for validation purposes of our approach, including the ontologies involved in our case study. We have three ontologies; the context ontology (CO), the enterprise ontology (EO) and the target ontology (TO).

This case is taken from ExpertFinder project. ExpertFinder is a research project at Jönköping University. This project aims at using semantic technologies to exploit and handle the diversity of information sources within the university. The framework proposed in the context of this project deals with finding an expert with respect to the specific needs of the user. Potential experts are chosen among the researchers and teachers, whose competence profiles are represented in the form of an ontology. Reliable information about the researchers and teachers at Jönköping University needs to be maintained and efficiently retrieved.

The ExpertFinder ontology is an enterprise ontology. It is implemented in the OWL langauge and developed incrementally. In the current version, the ontology's domain is restricted to researchers and teachers of the department of computer and electrical engineering. The ontology is mainly built based on the data sources available at the university: personal web pages (experts' profiles), DiVA [2](a database for storage of research publications and student theses in electronic format used at many Swedish universities), Neverlost (the software used for class scheduling at Jönköping University), course syllabi, and project description spreadsheets. The structure of the ExpertFinder ontology is shown in Figure 1.

The target ontology is the course ontology covering the course syllabus of the master program "Information Technology and Management". One purpose of the course ontology is to support students in course selection. This ontology can also provide additional background knowledge for further developing courses or creating new ones. The structure of the course ontology is shown in Figure 2. The manager of the master program "Information Technology and Management" gets the task to develop a new course on "Software Quality and Project Management" and needs to find an expert supporting this. Matching only the enterprise ontology (ExpertFinder ontology) against the target ontology (Course ontology) will insufficiently take the context of this task into account. The context ontology is a task related ontology. Some parts are coming from the EO, for example, the collection of publications, projects and courses of the available experts. Some parts are not inside the EO but related to the task, for example, the course participants need have prerequisite, like certain knowledge and a given language. The language also is additional requirement of the wanted expert. The structure of the context ontology is shown in Figure 3. The operational context

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[2] http://www.diva-portal.org/smash/search.jsf?rvn=1

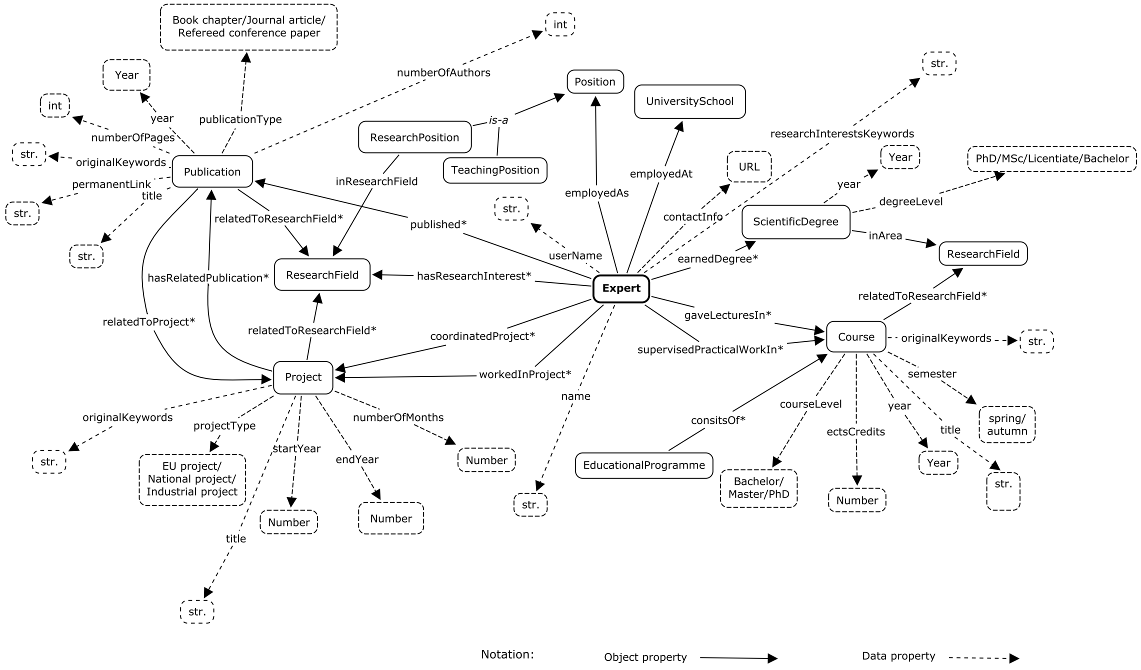

Figure 1: The Structure of the ExpertFinder Ontology (EO)

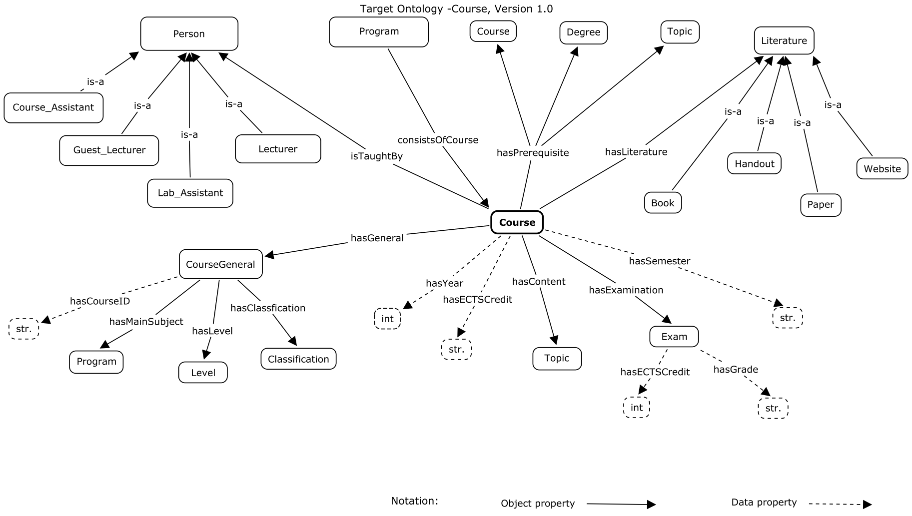

Figure 2: The Structure of the Course Ontology (TO)

illustrates the instances of *course* but not *Expert*. The master program manager would like to know what persons are suitable for teaching the new course, he marks concept *Expert* with label "(CODISPLAY)". The final matching instances of *Expert* between EO and TO will be presented to the program manager. The elements in the context ontology can be marked as final result elements with the label "(CODISPLAY)". Different weights can be assigned to the elements with the start label "(COWEIGHT)" then following the weight from number 1 to 5.

5 Context-based Semantic Matching Approach

The scheme of our matching approach is shown in Figure 4. Since some parts of CO come from EO, we know the matching parts between CO and EO. Our approach consists of several steps. First, we match EO and TO using the expanding tree method [Lin and Sandkuhl 2007] or another automatic ontology matching method. Then we match TO and CO using expanding tree method or another automatic ontology matching method (see section 6.1). Based on the above overlap, we do instance level matching and show the final results to the user depending on his/her demand. In the following sections we show the details of the process. If we use automatic methods to match EO to TO, we get some overlapping elements shown as A+B in Figure 5. Area B+C, denotes the overlapping elements that exist between the EO and CO. Area B+D denotes the overlap in concepts and relations that exists between the CO and the TO. Area

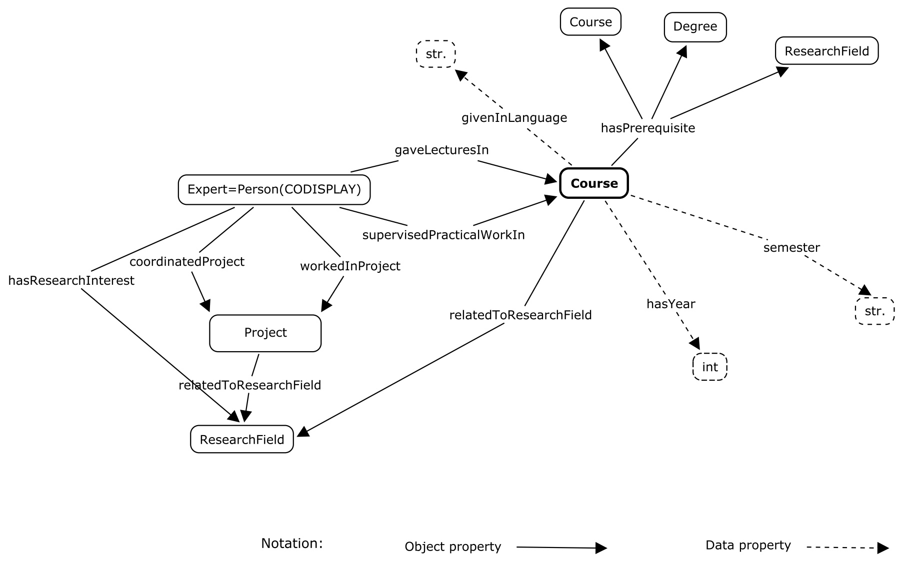

Figure 3: The Abstract Structure of the Context Ontology (CO)

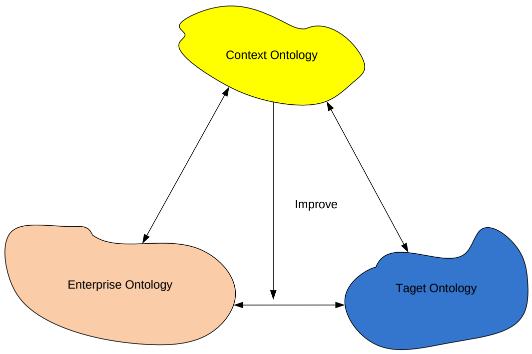

Figure 4: Context-based Semantic Matching Approach

B, denotes the elements that are common between all three ontologies (EO, TO and CO). Elements in area B could be used to affect the size of area A. For example, extra concepts could be matched or incorrect matches could be removed, also, the match could be made more specific to the task.

Depending on which area elements fall into, different weights could be assigned or used to alter matching algorithms. For example, those elements that fall into area B are very important, as they describe the common view of EO, TO and CO. We could further analyze the elements that are directly connected

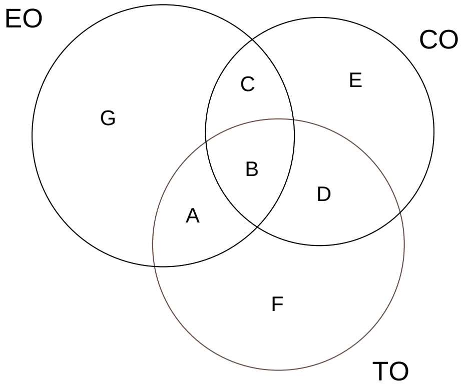

Figure 5: Ontology Matching Overlap

to elements in B. For example, elements in area E that have not been matched in EO or TO but are directly connected to elements from region B. For example, in our case (see section 4), concept *Course* is in area B, relationship *giveInLanguage* is in area E which does not belong to EO and TO but is connected to concept *Course*. It indicates that important information is required in the application but is not available. We can give this feedback to the ontology developer that includes the relationship *giveInLanguage*.

We divide area A, B, C, D, E and F into three layers. Area B is layer 1. Area A, C and D is layer 2. Area E, F and G is layer 3. We set different weights for different layers' relationship.

1. Layer 1: Every matched instance in this layer will be accounted as 3. For example, concept *Topic* (TO) and concept *ResearchField* (EO and CO) are matched, every instance of the matched ones are accounted as 3.

2. Layer 1 to layer 2: every matched instance in this situation will be accounted as 2. For example, for concept *ResearchField*, there are several paths from B to C or D shown as Figure 6. Some content of the new course "Software Quality and Project Management" is related to *software project management*. If an expert has publications (in area C) about *software project management* , every matched instance will be calculated as 2.

3. Layer 1 to layer 3: every matched instance in this situation will be accounted as 1. For example, for concept *ResearchField*, there is a path from B to G shown as Figure 6. Some content of the new course "Software Quality and Project Management" is related to *software project management*, if the expert has worked in the project (in area G) related *software project management* , every matched instance will be calculated as 1.

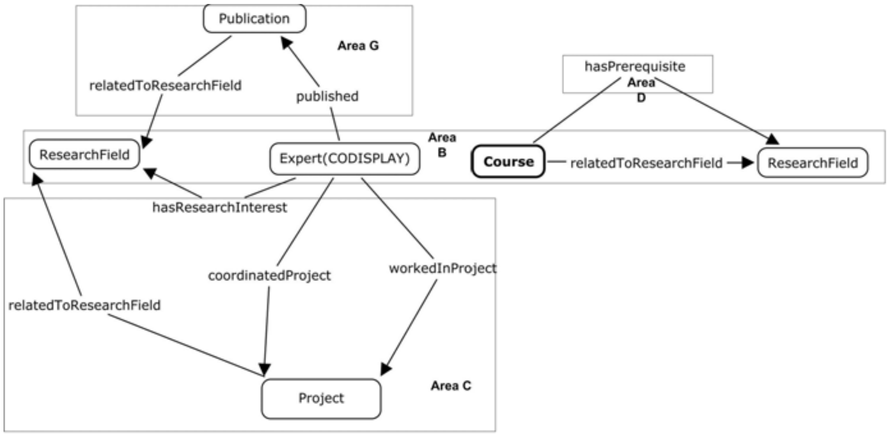

Figure 6: Concept ResearchField in the different Area

The layers' weights can be changed in the future based on the results and conclusions from future experiments.

6 Implementation

Our COMS (Context-base Ontology Matching System) system consists of two parts: automatic ontology matching and context-based ontology matching.

6.1 Automatic Ontology Matching Strategy

Currently, COMS just finds the corresponding elements and presents the result as "elementA = elementB similarity measure (float)". The super, sub and inverse relationships are not included. Figure 7 shows two ontologies' automatic matching strategy and evaluation. Jena [3]is used to parse ontology elements. The automatic ontology matching consists of the following matching strategies.

6.1.1 Translation Implementation

If the ontologies are presented in different languages, there are different strategies related to multilingual ontology matching [Dos Santos et al. 2010]: (1) the indirect alignment strategy based on composition of alignments, (2) the direct matching between two ontologies, i.e., without intermediary ontologies and with the help of external resources (translations). COMS uses the later strategy. External resources Google Translate API [4] and the data of the English Wiktionary

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[3] http://jena.sourceforge.net

[4] http://code.google.com/intl/sv-SE/apis/language/translate/overview.html

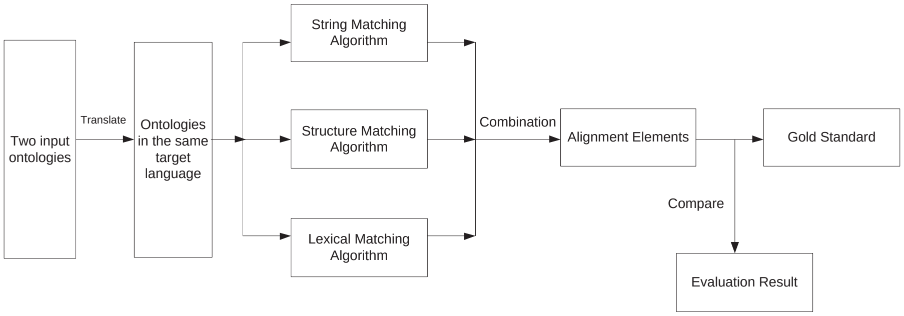

Figure 7: Automatic Ontology Matching Strategy and Evaluation

and SPARQL technology [5] are applied to translate multilingual ontologies in the same language. [Lin and Krizhanovsky 2011] presents multilingual ontology matching experiments comparison results between Google Translate API and the data of the English Wiktionary and SPARQL technology.

6.1.2 String Matching Strategy

Different string matching algorithms can be used for matching strings. For string similarity, [Cohen et al. 2003] has good survey of the different methods to calculate string distance from edit-distance, like functions (e.g. Levenstein distance, Monger-Elkan distance, Jaro-Winkler distance) to token-based distance functions (e.g. Jaccard similarity, TFIDF or cosine similarity, Jense-Shannon distance). SimMetrics [6] and SecondString [7] are open-source package of string matching methods based on the Java language.

We use the Jaro-Winkler distance [Winkler 1999] and SmithWaterman algorithm [Smith and Waterman 1981] implemented by SimMetrics as our string matching methods. The threshold for Jaro-Winkler distance is 0.9. SmithWaterman algorithm can help find the similar region for two strings. For example, Jaro-Winkler distance between "swedish_credit" and "credit" is 0.5714, Smith-Waterman algorithm distance is 1 since "credit" is part of "swedish_credit".

6.1.3 Structure Matching Strategy

Different structure matching strategies are implemented as following:

- If two elements of two ontologies' triples (subject, predicate and object) are the same, the third element is assumed the same. For example, if the range

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[5] http://code.google.com/p/wikokit/wiki/ d2rqMappingSPARQL
[6] http://sourceforge.net/projects/simmetrics/
[7] http://secondstring.sourceforge.net/

and domain of two relations are the same, it means that the relations are the same. In future work, this will be extended to compare the common triples in the hierarchy.

- If the subclasses of two classes are the same, these two classes are assumed the same. In future work, this will be extended to compare the common classes in the hierarchy.
- Expanding tree method [Lin and Sandkuhl 2007]. Ontology is expanded as a tree and set weights in the tree to calculate ontology concept similarity. The different levels are given different weights depending on the depth of the compared classes. The first level concepts, which get the weight as 3 are the class' subclasses and each relationship where it is domain or range. The second level concepts which get weight 2, are depending on the first level concepts' subclasses and their relationship's ranges. Similarity we can get the third level concepts, with weight 1, based on the second level concepts. We treat ontology matching as asymmetric. For example, a small ontology may perfectly match some parts of large ontology, the similarity between the small ontology and large ontology is 1.0 then, but not vice versa. The similarity between two concepts is computed as: $sim(x, y) = \frac{\sum w_{matched-concepts}}{\sum w_x}$

6.1.4 Lexical Matching Strategy

WordNet[8] is based on psycholinguistic theories to define word meaning and models not only word meaning associations but also meaning-meaning associations [Ferrer-i-Cancho 2005]. WordNet consists of a set of synsets. Synsets have different semantic relationships such as synonymy (similar) and antonymy (opposite), hypernymy (superconcept)/hyponymy (subconcept)(also called Is-A hierarchy / taxonomy), meronymy (part-of) and holonymy (has-a). [Lin and Sandkuhl 2008] provides an overview of how to apply WordNet in the ontology matching. We use WordNet as the lexical dictionary.

WordNet-Similarity[9] has implemented several WordNet-based similarity measures in a Perl package. Java WordNet::Similarity[10] is a Java implementation of WordNet::Similarity. Jiang-Conrath [Jiang and Conrath 1997] measure is chosen with threshold 1.0 to find corresponding classes in ontology matching. Jiang-Conrath measure is derived from the edge-based notion by adding the information content as a decision factor.

$$jcn = 1/(IC(synset1) + IC(synset2) - 2 \times IC(lcs))), \tag{1}$$

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[8] http://wordnet.princeton.edu

[9] http://www.d.umn.edu/ tpederse/similarity.html

[10] http://www.cogs.susx.ac.uk/users/drh21/

where lcs is the super concept of $synset1$ and $synset2$, IC is the information content (of a synset).

6.2 Context-based Ontology Matching Strategy

COMS is implemented as following steps:

- Find the additional matches based on context ontology. For example,"Expert = Person" in the Figure 3.
- Do automatic ontology matching between CO and EO, CO and TO, EO and TO with considering the context's additional matches. Determine areas A, B, C and D (see section 5).
- Check the context ontology's intension, for example, compare all instances of "(CODISPLAY)" elements between EO and TO that are related to the instances of CO in the Area B, based on the weight of the different areas (see section 5, the highest weight instance is displayed first).

7 Evaluation

The evaluation of the proposed approach for context-based ontology matching is working on three major levels of evaluation: theoretical evaluation, experimental evaluation, and user perception.

7.1 Theoretical Evaluation

Theoretical evaluation against state-of-research: on this level, the grounding of the approach as such by analyzing existing approaches in the literature, elaborating the advantages and strengths of the context-based approach, discussing the new approach with experts in the community and implementing first feasibility studies have to be performed. This stage is considered as finished.

7.2 Experimental Evaluation

Based on the results from the theoretical evaluation, the implementation of the approach and experiments comparing the results of actual context-based ontology matching with non-context-oriented approaches is necessary.

Table 1: Compare COMS with Other Ontology Matching Systems Based OAEI Benchmark

system	COMS	edna	aflood	AgrMaker	AROMA	ASMOV	DSSim
test	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.
1xx	1.00 0.95	0.96 1.00	1.00 1.00	0.98 0.98	1.00 1.00	1.00 1.00	1.00 1.00
3xx	0.79 0.86	0.47 0.82	0.90 0.81	0.92 0.79	0.85 0.78	0.81 0.82	0.94 0.67

system	GeRoMe	kosimap	Lily	MapPSO	RiMOM	SOBOM	TaxoMap
test	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.	Prec.Rec.
1xx	1.00 1.00	0.99 0.99	1.00 1.00	1.00 1.00	1.00 1.00	0.98 0.97	1.00 0.34
3xx	0.68 0.60	0.72 0.50	0.84 0.81	0.54 0.29	0.81 0.82	0.92 0.55	0.77 0.31

7.2.1 Compare COMS with Other Systems

The Ontology Alignment Evaluation Initiative (OAEI) was launched in 2004 with the goal of estimating and comparing different techniques and systems related to ontology alignment. There are different evaluation measures proposed in the OAEI, e.g., compliance and performance measures. The compliance measures consist of Precision, Recall, Fallout, F-measure, Overall, etc. OAEI provides different data sets. The benchmark consists of the pairs of ontologies and reference alignments. The participants will compare the their generated alignments in the alignment format to the reference alignments. COMS's automatic ontology matching part is evaluated by the OAEI benchmark 1xx set and 3xx set. Table1 shows the COMS precision and recall compared with other ontology matching systems based on the OAEI benchmark. The other ontology matching systems's evaluation results come from [Euzenat et al. 2009].

Since COMS doesn't support super, sub and inverse relationships of two elements, for example, COMS finds $Chapter = InBook$, but the reference alignment is $Chapter < InBook$, the precision and recall is not so high. COMS will include super, sub and inverse relationships in the future version.

7.2.2 Compare COMS with and without Context in ExpertFinder Project

To achieve better matching results from the user's perception is a major intention of the context-based approach. To better reflect the actual work situation and tasks of end users, our evaluation massively involves such potential end users. The main line of work will be to capture and evaluate the perceived quality of matching results of context-based and non-context based approaches.

To capture the end user's requirement, we interviewed two colleagues. One colleague is master program manager with teaching experience. He works in ontology engineering area. The other colleague works in the software engineering area and has teaching experience. We presented our context ontology and checked it with them. We wrote down and documented their requirements to the course.

In order to set up the gold standard, we also involved three other experts. These experts are researchers and teachers with experience in ontology engineering. We provided the owl file and images of enterprise, target and context ontologies. We provided the detailed end user requirements document, which is a result of the interviews discussed above. First, the three experts manually identified corresponding elements (alignment1) of enterprise and target ontology. Second, based on user requirements and context ontology, experts manually identified corresponding elements (alignment2) of enterprise and target ontology. Their alignment results were combined manually as the gold standard.

The result of COMS without context compared to alignment1 is precision 95% and recall 86%. The result of COMS using context additional corresponding (e.g., Expert = Person) compared to alignment1 is precision 97% and recall 91%. The result of COMS using context compared to alignment2 is precision 90% and recall 79%. The result of COMS without context compared to alignment2 is precision 85% and recall 72%.

8 Threats to Validity

Research including empirical studies has threats regarding its validity, and so has the study performed for evaluating context-based ontology matching presented in this paper regarding the user perception part. However, to early identify such threats and to take actions taken to mitigate the threats can minimize the effect on the findings. Common threats to empirical studies are discussed, for example in [Wohlin et al. 2000] and [Yin 2002]. The threats to validity can be divided into four categories: construct validity, internal validity, external validity and conclusion validity.

8.1 Construct Validity

Construct validity is concerned with obtaining the right indicators and measures for the concept being studied. Internal validity primarily is important for explanatory studies with the objective to identify causal relationships. External validity is addressing the question about to which extent the findings in a study can be generalized. Conclusion validity addresses repetition or replication, i.e. that the same result would be found if performing the study again in the same setting.

With respect to construct validity, the following threats were identified and actions taken:

- Selection of participants: The results are highly dependent on the people being interviewed. Only persons experienced in information searching and the application domain under consideration will be able to identify differences in quality and relevance of the results. To obtain the best possible sample, only people having worked in this area for a long time and hence having the required background were selected.

- Reactive bias: A common risk in studies is that the presence of a researcher influences the outcome. Since the selected participants in the study and the researcher performing the study have been collaborating for a long time, this is not perceived as a large risk. However, as the new matching approach was developed by the researcher there is the risk that the interviews are biased towards the new matching approach to find evidence for its innovative character. In order to reduce this threat, the interviewees were informed that the new approach can be configured in different ways and the purpose of the study was to test a certain configuration.

- Correct interview data: There is a risk that the questions of the interviewer may be misunderstood or the data may be misinterpreted. In order to minimize this risk, pilot interviews were conducted to ensure a correct interpretation of the questions by the interviewees. Furthermore, the interviews were documented and recorded, which allowed the researcher to listen to the interview again if potions seemed unclear.

8.2 Internal Validity

Confounding factors: In many studies, there is a risk that changes detected by measurements or observations are not solely due to the new approach, but also due to confounding factors. Since we only changed the matching approach and kept all other elements stable, we made all efforts possible to rule out confounding factors as an influence on the measurement outcome.

Ability to make inferences: Another potential threat to internal validity is that the data collected in the interviews did not capture the change due to the new matching approach. However, this threat was reduced by explicitly comparing the old and the new approach. Thus, this threat to validity is considered being under control.

8.3 External Validity

A potential threat of the study is of course that the actual interviews have been conducted with members of only one research group. It will be part of the future work, to conduct a study with more participants and with members from other academic contexts.

8.4 Conclusion Validity

Interpretation of data: The outcome of the study potentially could be affected by the interpretation of the researcher. To minimize this threat, the study design includes capturing the relevant aspects by different data, i.e. to conduct triangulation to check the correctness of the findings. Furthermore, another risk could be that the interpretation of the data depends on the researcher and is not traceable. To reduce the risk the data interpretation was discussed with other researchers and validated by them.

8.5 Summery COMS Validity

In summary, actions have been taken to mitigate the risks identified, which from our perspective results in an appropriate confidence level regarding construct and internal validity. Future work (i.e. an extension of the study) will contribute to increasing the confidence level regarding external validity and also conclusion validity.

9 Conclusions and Future Work

In this paper, we explore the use of context in semantic ontology matching. Context is defined based on the task and information demand of an organizational role and, in its operational form, the individual having this role. The context approach implements a way to easily adapt ontology matching approaches to different tasks and roles in different applications. The pervasive services are provided by involving context in the ontology matching process. We show the implementation and evaluation of context-based ontology matching. The evaluation results are promising; threats to validity were mitigated.

In our future work, we will focus on how to further evaluate the application based ontology matching in order to identify possibilities for improvement. For example, does the quality of context ontology effect the matching result. We will explore and evaluate more applications and data sets using context-based ontology matching approach.

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