EVOCROS: Results for OAEI 2018

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Abstract. This paper describes EVOCROS, a cross-lingual ontology alignment system suited to create mappings between ontologies described in different natural language. Our tool combines semantic and syntactic similarity measures in a weighted average metric. The semantic is computed via NASARI vectors used together with *BabelNet*, which is a domain-neutral semantic network. The tool employs automatic translation to a pivot language to consider the similarity. EVOCROS was tested and obtained high quality alignment in the Multifarm dataset. We discuss the experimented configurations and the achieved results in OAEI 2018. This is our first participation in OAEI.

Keywords: cross-lingual matching · semantic matching · background knowledge

1 Presentation of the system

There is a growing number of ontologies described in different natural languages. The mappings among different ontologies are relevant for the integration of heterogeneous data sources to facilitate the exchange of information between systems. Although automatic monolingual ontology matching has been extensively investigated [6], cross-lingual ontology matching still demands further investigations aiming to automatically identify correspondences between ontologies described in different languages. EVOCROS is our attempt at automatic cross-lingual ontology matching, inspired from experiments on the influence of syntactic and semantic similarity measures in ontology matching algorithms [1].

In this section, we describe the system and techniques used.

1.1 State, purpose, general statement

EVOCROS is a cross-lingual ontology alignment tool based on a composed similarity measure relying on both syntactic and semantic similarity techniques. Syntactic similarity may be understood as a score calculated based on string analysis (extracted from labels of concepts), whereas the semantic similarity is computed taking into account background knowledge. Our approach computes a weighted mean of semantic and syntactic similarities.

1.2 Specific techniques used

The tool is developed in Python 3. It works by comparing the computed similarity between a concept from an ontology (in its automatically translated version) to another concept from a different ontology. The concept terms are translated to a pivot natural language aiming to use available external resources such as thesauri, corpora, dictionaries, *etc.* to overcome the language and alphabet barriers.

The workflow of the tool is represented by figure 1. The first step is the preprocessing of the source and target input ontologies, converting them into owlready2[3] objects. Each concept of the source ontology is compared to all concepts of the target ontology.

For syntactic similarity measure, the concept labels of both the source and target ontologies are first translated to a pivot language using automatic translation. We are using English as pivot language for OAEI 2018 though the tool accepts any language as pivot. The concepts are then compared to measure the syntactic similarity.

For semantic similarity, we use the concept label in its original language, without any translation. The tool retrieves from *Babelnet*[4] the synsets of the concept labels of both source and target ontologies and compare them to measure the semantic similarity. If the weighted similarity reaches a threshold, the concept pair is recorded to the output file, generated in RDF format. Otherwise, it is discarded.
The following similarity measures are used in EVOCROS:

Syntactic Similarity Measure. Leverages edit distance Levenshtein [3]) as a syntactic similarity measure.

Semantic Similarity Measure. Semantic similarity between terms is a metric to evaluate how similar two given terms are considering their meanings in a certain context. For example, the words “nail” and “hammer” are more similar considering the tool context than “nail” and “finger”. On the other hand, when we consider the anatomy context, “nail” and “finger” are more similar than “nail” and “hammer”.

There are a lot of algorithms to calculate semantic similarity. These algorithms usually explore an external resource such as vocabulary, dictionaries or thesauri,

[3] Python 3 library to manipulate ontologies as objects.

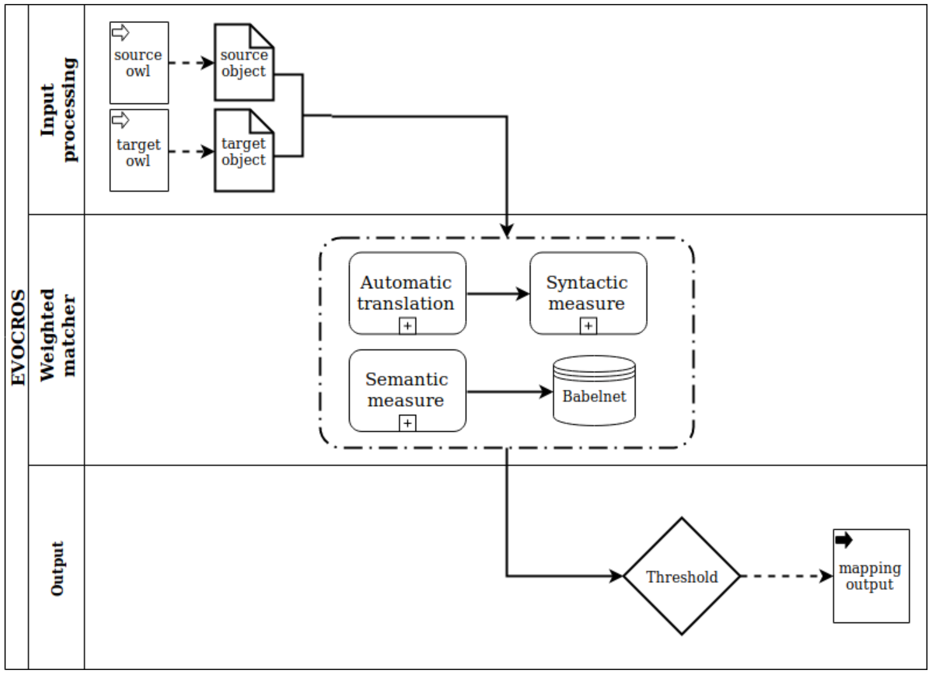

Fig. 1. EVOCROS workflow.

in order to help to compute the similarity between two words. EVOCROS explores a *Weighted Overlap* measure [5] relying on the neutral-domain semantic network *BabelNet*.

1.3 Adaptations made for evaluation

EVOCROS uses a configuration file with the source and target ontologies, and their respective language. In order to participate in OAEI, we modified the tool to receive the source and target ontologies as input parameters and retrieve the ontology language from the *lang* XML tag. The bridge created for SEALS platform is written in Java and executed system calls to run the tool, written in Python 3. Although the tool executed locally using the SEALS client, there were issues during evaluation on SEALS platform and only local results are available in this report.

2 Results

In this section, we describe the results obtained from local experiments using a sub-set of Multifarm with the same configuration used in OAEI 2018 evaluation.

2.1 Multifarm

Several weights for similarity measures and different similarity thresholds were evaluated locally. For OAEI 2018, only the following configuration was submitted: **threshold:** 0.66, **syntactic similarity weight:** 0.75, **semantic similarity weight:** 0.25. This was the configuration with the most interesting results. The table 2.1 presents the configuration used and the results for conference-conference alignment for languages spanish-portuguese (es-pt), english-portuguese (en-pt) and german-portuguese (de-pt).

Table 1. Cross-lingual mapping of conference-conference ontologies from MultiFarm.

Languages	Threshold	Syntactic similarity weight	Semantic similarity weight	Precision	Recall	F-measure
es-pt	0.66	0.75	0.25	0.68	0.33	0.44
en-pt	0.66	0.75	0.25	0.72	0.41	0.52

There is a great variation of results using different settings. Tables 2 and 3 illustrate this behavior.

3 General comments

In this section, we comment our results and discuss ways to improve the system.

3.1 Comments on the results (strength and weaknesses)

The tool had satisfactory results but the execution time was exceedingly long due to constant RestAPI calls to *Babelnet*.

3.2 Discussions on the way to improve the proposed system

This was the first evaluation of the system and although there was issues during the evaluation phase of OAEI, preventing the system to be executed in SEALS platform, the local results are encouraging. Our main goals for future works:

Reduce execution time: the tool has a long execution time due to constant RestAPI calls to *Babelnet* and needs to be optimized with local caches.

Bag of graphs: ontologies can be represented as graphs, thus allowing for partitioning[2] and comparison of sub-graphs. Bag-of-graphs[7] is a graph matching approach, similar to bag-of-words. It represents graphs as feature vectors, highly simplifying the computation of graph similarity and reducing execution time, proposes a simple vector-based representation for graphs.

Table 2. MultiFarm alignment of Conference [ES] - Conference [PT] ontologies, using different threshold and weight.

Threshold	Syntactic weight	Semantic weight	Precision	Recall	F-measure
0.66	0.50	0.50	0.49	0.15	0.23
	0.33	0.67	0.40	0.10	0.16
	0.25	0.75	0.33	0.15	0.21
	0.20	0.80	0.30	0.15	0.20
	0.67	0.33	0.69	0.30	0.42
	0.75	0.25	0.68	0.33	0.44
	0.80	0.20	0.59	0.31	0.40
0.75	0.50	0.50	0.58	0.16	0.25
	0.33	0.67	0.48	0.16	0.24
	0.25	0.75	0.45	0.18	0.25
	0.20	0.80	0.40	0.17	0.24
	0.67	0.33	0.65	0.16	0.26
	0.75	0.25	0.75	0.31	0.44
	0.80	0.20	0.72	0.33	0.45
0.80	0.50	0.50	0.65	0.16	0.26
	0.33	0.67	0.58	0.16	0.25
	0.25	0.75	0.50	0.17	0.26
	0.20	0.80	0.45	0.18	0.25
	0.67	0.33	0.65	0.16	0.26
	0.75	0.25	0.65	0.16	0.26
	0.80	0.20	0.75	0.31	0.44
0.95	0.50	0.50	0.64	0.11	0.18
	0.33	0.67	0.67	0.15	0.24
	0.25	0.75	0.69	0.16	0.26
	0.20	0.80	0.65	0.16	0.26
	0.67	0.33	0.64	0.11	0.18
	0.75	0.25	0.64	0.11	0.18
	0.80	0.20	0.64	0.11	0.18

Table 3. MultiFarm alignment of Conference [EN] - Conference [PT] ontologies, using different threshold and weight.

Threshold	Syntactic weight	Semantic weight	Precision	Recall	F-measure
0.66	0.50	0.50	0.57	0.18	0.27
	0.33	0.67	0.42	0.21	0.28
	0.25	0.75	0.32	0.18	0.23
	0.20	0.80	0.28	0.17	0.21
	0.67	0.33	0.69	0.34	0.45
	0.75	0.25	0.72	0.41	0.52
	0.80	0.20	0.68	0.21	0.32
0.75	0.50	0.50	0.60	0.17	0.26
	0.33	0.67	0.52	0.23	0.32
	0.25	0.75	0.50	0.22	0.31
	0.20	0.80	0.43	0.21	0.28
	0.67	0.33	0.58	0.21	0.31
	0.75	0.25	0.70	0.15	0.25
	0.80	0.20	0.75	0.17	0.27
0.80	0.50	0.50	0.58	0.16	0.25
	0.33	0.67	0.57	0.23	0.32
	0.25	0.75	0.52	0.23	0.32
	0.20	0.80	0.50	0.22	0.31
	0.67	0.33	0.61	0.21	0.32
	0.75	0.25	0.61	0.09	0.15
	0.80	0.20	0.73	0.15	0.25
0.95	0.50	0.50	0.64	0.19	0.29
	0.33	0.67	0.61	0.21	0.32
	0.25	0.75	0.61	0.21	0.32
	0.20	0.80	0.61	0.21	0.32
	0.67	0.33	0.64	0.19	0.29
	0.75	0.25	0.64	0.07	0.13
	0.80	0.20	0.64	0.07	0.13

3.3 Comments on OAEI

There were issues during the evaluation phase, preventing the system to participate in Multifarm track. For future editions of OAEI, we plan to participate submitting EVOCROS on the newly available HOBBIT platform, using a docker image, to ensure system compatibility during evaluation.

4 Conclusion

EVOCROS proposed an approach to cross-lingual ontology matching by combining semantic and syntactic similarity measures. This is the first participation of the system in OAEI. The evaluation with the Multifarm dataset confirmed the quality of mappings generated by our technique. For future work, we plan to improve our cross-lingual ontology alignment proposal considering different combinations of background knowledge, such as specific-domain thesauri to evaluate the semantic similarity. We also plan to further evaluate runtime optimization aspects to fix issues found during the evaluation phase.

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