Internetworking Matching of Network of Ontologies

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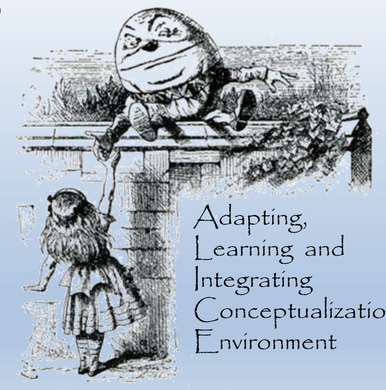

http://www2.uniriotec.br/ontologyalignment

Abstract

- A System-of-Systems (SoS) is a set of independent information systems that must communicate with each other towards providing a specific service.
- Considering that each system is conceptually described by a unique ontology, the conceptual support for the whole SoS demands the alignment of all ontologies, deriving a network of ontologies (NoN).
- A single SoS may embrace several domains, thus integration of 2 ou more SoS may require an alignment of 2 ou more NoN.
- Therefore, there is an increasing need for aligning networks of ontologies, a problem called internetwork matching (Figure 1).

Problem Statement

- A network of ontologies $\Gamma = <\Omega, \Lambda>$ is made of a finite set Ω of ontologies and a set Λ of alignments between these ontologies. We denote by $\Lambda(o,o')$ the set of alignments in Λ between o and o′ [4].
- Definition 1 (internetwork alignment). Given two networks of ontologies $\Gamma =< \Omega,\Lambda >$ and $\Gamma' =< \Omega',\Lambda' >$, an internetwork alignment $A_{i,j}$ is the set of inter-network correspondences between each ontology $O_i \in \Omega$ and each ontology $O_j \in \Omega'$.
- Example 1: In figure 2, $A_{2,2'} = \{< O_2.a_2, O_{2'}.a_{2'}, =>\}$, where $O_2 \in \Omega$ and $O_{2'} \in \Omega'$, and $A_{3,1'} = < O_3.d_3, O_{1'}.f_{1'}, \sqsubseteq>, < O_3.c_3, O_{1'}.b_{1'}, \sqsubseteq>$, where $O_3 \in \Omega$ and $O_{1'} \in \Omega'$. $A_{2,2'}$ and $A_{3,1'}$ are internetwork alignments.
- Definition 2 (Internetwork matching). An internetwork matching is the process of finding the internetwork alignments of a set of two or more networks of ontologies $\Psi = \{\Gamma_1, \Gamma_2, \ldots, \Gamma_n\}$.

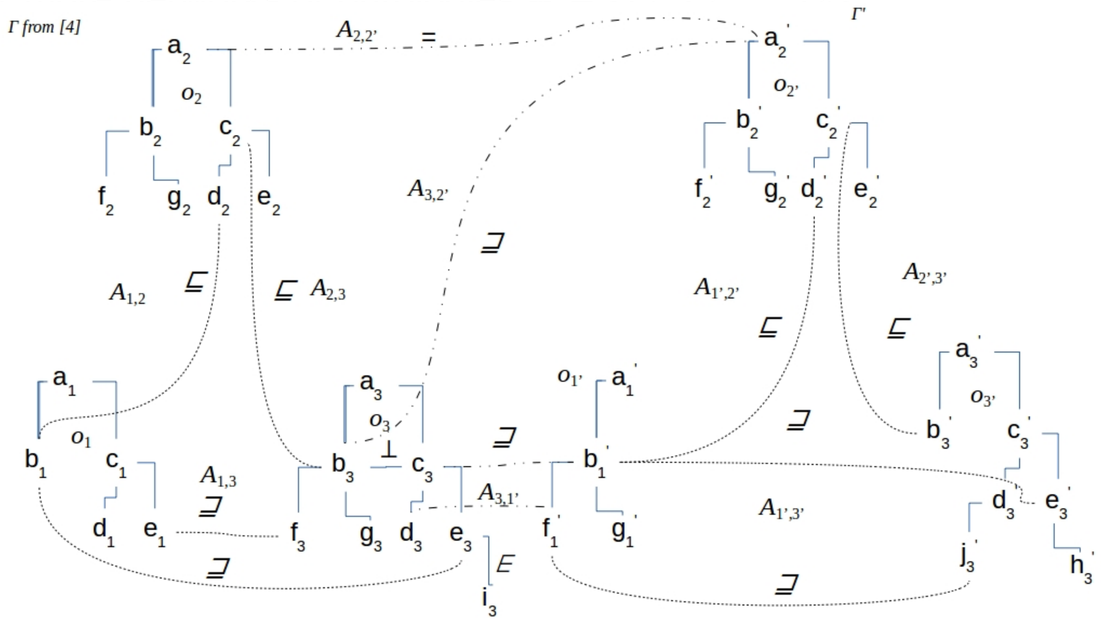

Figure 1: Internetwork matching

Relevance

- Existing ontology matching techniques may be used for the task; however, due to the recently increasing size of the ontologies and the potential number of ontologies being aligned, current approaches may suffer from scalability and performance issues.
- A systematic review was done to investigate related work in this research area [1].
- Challenges were proposed in a submission to OM-2017 [2].

Related Work

- The pairwise internetwork matching sequentially computes the alignment of each pair of ontologies from each pair of networks from this set. For example, given two networks of ontologies $\Gamma =< \Omega, \Lambda >$ and $\Gamma' =< \Omega',\Lambda' >$, in which $\Omega = \{O_1,O_2\}$ and $\Omega' = \{O_3\}$, the pairwise internetwork matching is obtained by computing $(((O_1 \times O_2) \cup (O_1 \times O_3)) \cup (O_2 \times O_3))$. (Figure 2).
- The holistic internetwork matching creates a global solution instead of aggregating one network after other. (Figure 3) [7].
- In both cases, all pairs of entities from each ontology that composes the networks are analyzed, which poses a severe restriction in terms of scalability.

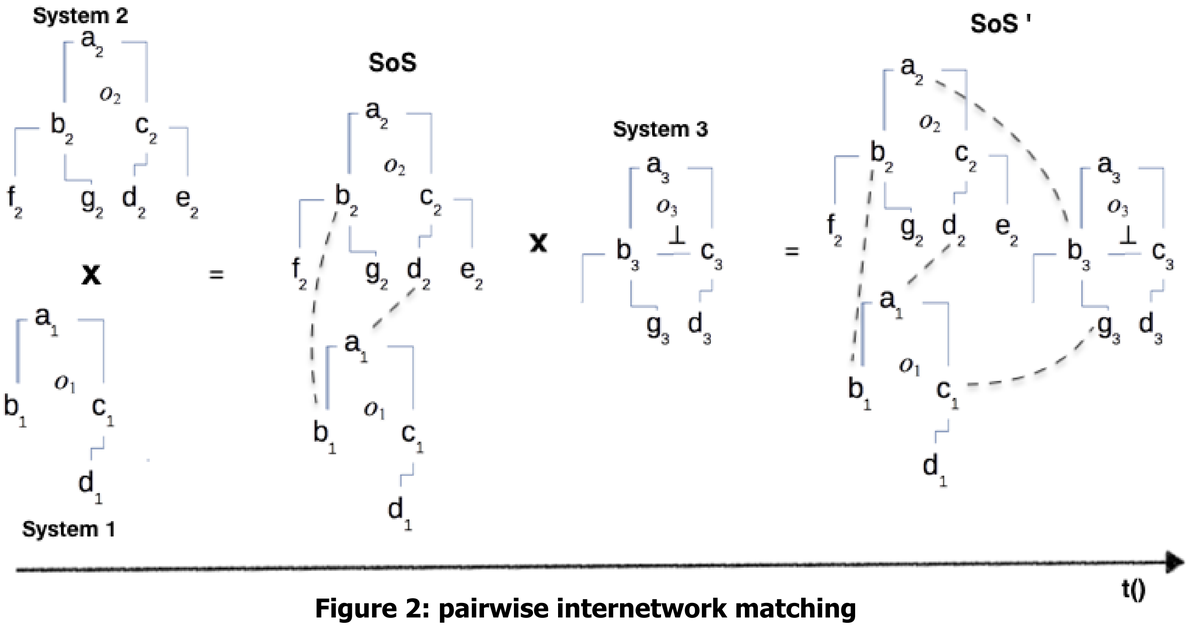

Figure 2: pairwise internetwork matching

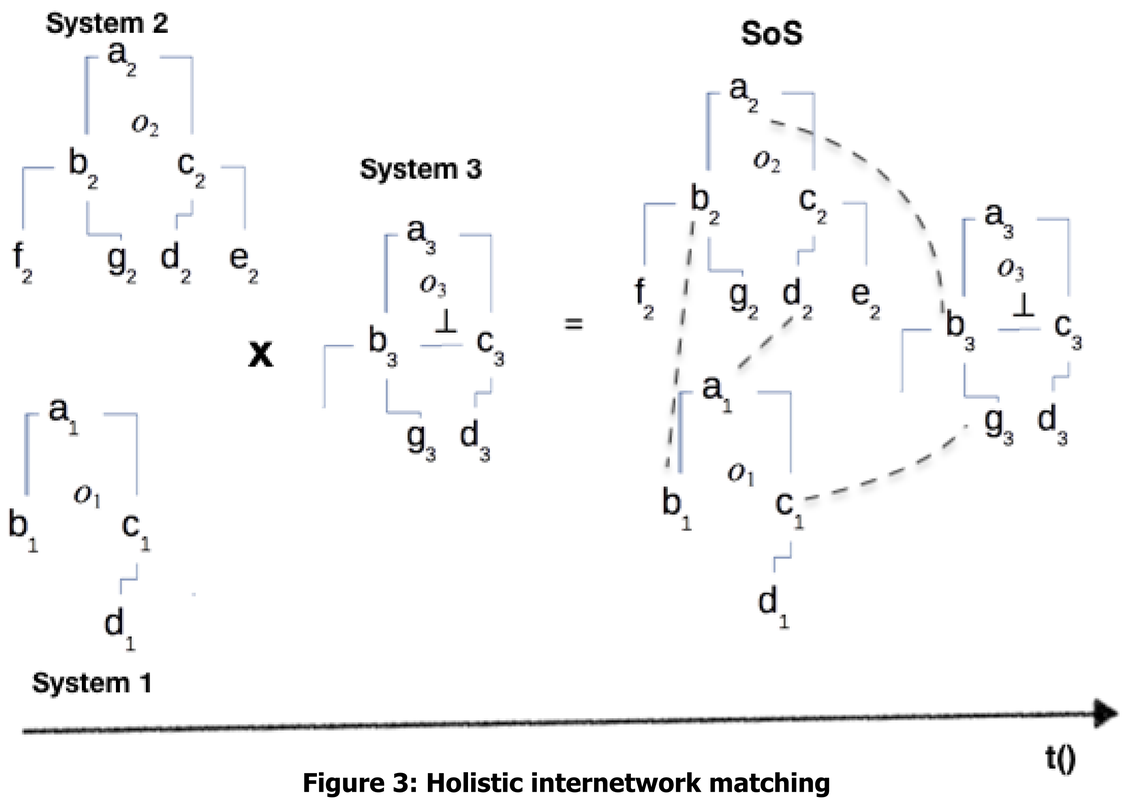

Figure 3: Holistic internetwork matching

Research Questions and Hypotheses

Table 1: Research Questions and Hypotheses

RQ	Pairwise
RQ1	Given n (n > 2) networks of ontologies, is it possible to reduce the cost required to calculate the internetwork alignment between them, without recalculating all possible matchings?
RQ1.1	What type of techniques may be used to avoid the cartesian product needed to compute all possible alignments?
RQ2	Is it possible to identify internetwork closures looking to existing closures in each networks without recalculation?
RQ3	Is it possible to check the inconsistencies of an internetwork matching looking to the existing closures in each network of ontologies?
H1	If we are able to identify identical subsumed networks with entities and alignments we will reduce the effort to match networks of ontologies
H2	If we are able to identify internetwork closures without recalculation we can identify inconsistencies with lower costs

Approach and Preliminary Results

- Experiments are been conducted using a pre processing step to detect entities that do not need to be aligned. After an matcher will finish the alignment only with the remaining entities [3].
- The Alin matcher was chosen to make the alignments [5,6].

Evaluation Plan and Reflections

- The evaluation will compare costs needed to match the networks with the proposed approach and using related work techniques
- The costs may me measured with number of comparisons, time of processing and algorithm complexity of the approaches.

[1] - Santos, F., Revoredo, K., Baiao, F., Network of Ontologies – A Systematic Mapping Study and Challenges Comparison, Technical Report. Relate-DIA/UNIRIO, RT-0005/2017, 2017. http://www.seer.unirio.br/index.php/monografiasppgi/article/view/6833

[2] - de Abreu Santos, F.M., Revoredo, K., Baĩao, F.A.: Paving a research roadmap on network of ontologies. In: Proceedings of the 12th International Workshop on Ontology Matching co-located with the 16th International Semantic Web Conference (ISWC 2017), Vienna, Austria, October 21, 2017. pp. 221–222 (2017), http:// ceur- ws.org/Vol- 2032/om2017_poster8.pdf

[3] - Santos, F., Revoredo, K., & Baiao, F. A Proposal for Optimizing Internetwork Matching of Ontologies. Will appear at OM-2018

[4] - Euzenat, J.: Revision in networks of ontologies. Artificial intelligence 228, 195–216 (2015), ftp://ftp.inrialpes.fr/pub/exmo/publications/euzenat2015a.pdf

[5] - Da Silva, J., Baiao, F. A., Revoredo, K., & Euzenat, J. (2017, October). Semantic interac- tive ontology matching: synergistic combination of techniques to improve the set of candidate correspondences. In OM 2017-12th ISWC workshop on ontology matching (pp. 13-24). No commercial editor.

[6] - da Silva, J., Baiao, F. A., & Revoredo, K. (2017). ALIN Results for OAEI 2017. In OM- 2017: Proceedings of the Twelfth International Workshop on Ontology Matching (p. 114).

[7] - Megdiche, I., Teste, O., & Trojahn, C. (2016, October). An extensible linear approach for holistic ontology matching. In International Semantic Web Conference (pp. 393-410). Springer, Cham.

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