

## Motivation

In networked ontologies, the relationships between ontologies are as important as the ontologies themselves. Yet, very little support exists for such the activity of establishing such relationships at the methodological or at the tool level. In this chapter we will describe the work carried out within the NeOn project to achieve a better support for establishing these links.

## Alignments and formats

Ontology alignments are sets of relationships between ontology entities called correspondences. Such relations may tell that a “district” in one ontology is the same as a “kreis” in other ontology, or that “fishery” in an ontology is a subclass of “company” in another. An alignment can be used to link an ontology with its background (set it in a more general context), which is typically achieved by providing an alignment with an upper level ontology. An alignment can also be used to link an ontology with its previous versions or alternative ontologies in other applications.

Alignments can be expressed in various languages. For instance, the two relations mentioned above can be expressed in OWL through `owl:equivalentClass` and `rdfs:subClassOf`, but they can also be expressed in SKOS through `skos:exactMatch` and `skos:broaderMatch`. However, in order to avoid early committing to a particular type of usage, it is preferred to keep the alignments in a declarative language, such as the Alignment format used in the NeOn toolkit alignment plugin. This language allows generating the required representation (OWL, SKOS and others) when necessary.

Indeed, when the alignment is expressed in OWL, its only possible use is to “merge” two OWL ontologies, thus it cannot be used to import data from one ontology to another or to export `owl:sameAs` links between instances. Using a neutral and declarative representation provides the opportunity to distribute and share alignments among applications.

## NeOn support for linking ontologies

NeOn supports ontology alignments in both the NeOn toolkit and the Cupboard ontology server.

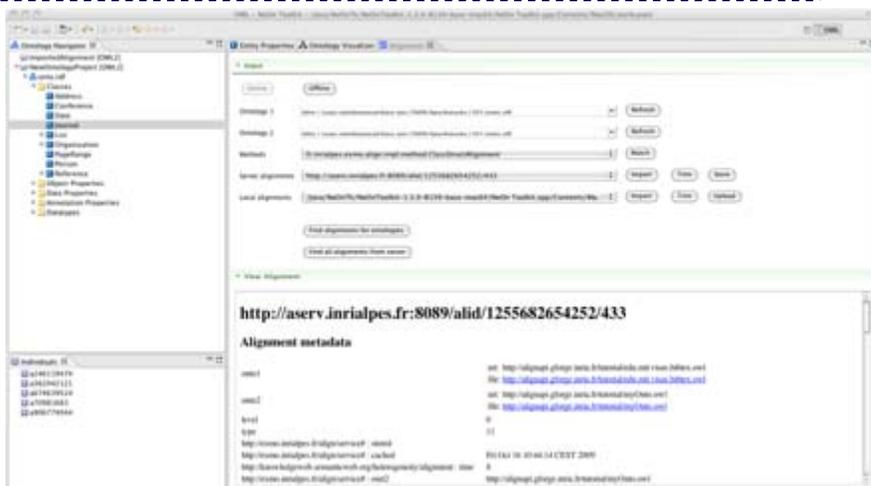
The **NeOn toolkit alignment plug-in** works in two modes: offline and online. In the former, the user can work locally on the alignments. Users can run the matchers which are embedded in a particular toolkit against ontologies in the NeOn toolkit and manipulate alignments which are in their local environment. The online mode connects the NeOn toolkit to an alignment server that permits sharing ontologies and applying the same operations on alignments stored on the server. Of course, alignments can move back and forth from the server to the local environment.

Both online and offline modes provide the functions of the Alignment API: retrieving alignments, matching ontologies, trimming alignments under various thresholds, storing them in permanent stores, and rendering them in numerous output formats. These operations support the whole alignment lifecycle.

The **Cupboard ontology** server allows indexing alignments available from alignment servers. Hence, these alignments can be available to each Cupboard user so that they can be stored and, just like the ontologies, rated and annotated. The Cupboard provides direct access to alignments as well as indirect access to the Alignment server to generate new alignments when they are missing.

## Why setting links in networked ontologies

Relationships between ontologies are the basis of networked ontologies. Methodologically, it is worthwhile to express relations between ontologies since this facilitates (a) working with small and self sufficient modules rather than with monolithic ontologies and (b) expressing the links between two versions of the same ontology, thus allowing the upgrade of data from one ontology to another; it also makes easier putting back an ontology in the context of an upper-level ontology so as to better handle other ontologies.





## What is the process for Ontology Matching

The task of establishing alignments between ontologies is called **ontology matching**. Ontology matching has been the focus of a great deal of attention in recent years. However, little work has been carried out on the methodological support for finding alignments. Here we provide the outline for such a methodology.

The first task when searching alignments is to identify the ontologies to be matched and to characterise the alignment needed. Indeed, the type of alignment required will be different if the goal is to merge two ontologies in a knowledge-based system or to add another data source to a query mediator. In the former case, the alignment will have to be absolutely correct; otherwise the system may draw incorrect inferences. In the latter case the lack of completeness is not a problem since other sources may return the missing answers, but relations other than equivalence are not straightforwardly used in query mediation. It is also useful to characterise the kind of ontologies by answering the following questions: Are they labelled in the same natural language? What is their expressiveness? Are individuals related to the ontologies available?

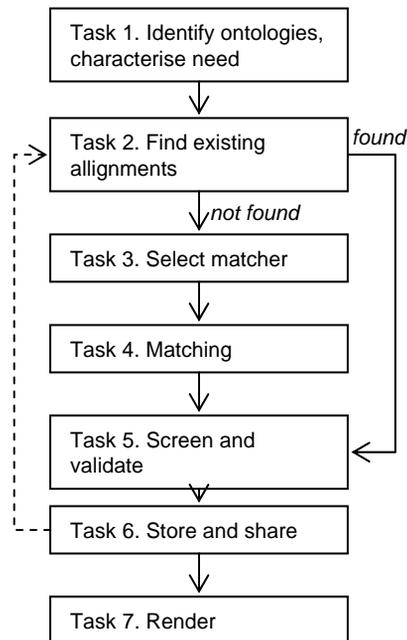
Finding existing alignments which satisfy the need of the application is the second step. Alignments may be published directly on the web or on specialised alignments servers. They ideally should come with annotations characterising their level of trustworthiness, the purpose for which they have been built and the type of relations they use. If apparently suitable alignments are available, the user can directly go to the validation step.

Otherwise, it will be necessary to build a new alignment from the ontologies. For that purpose, a suitable matcher has to be found. Several studies have tackled how to choose a matcher depending on the characteristics of the ontologies and those of the expected alignments. They are worth taking into account. However, what should be considered is the result of the various matcher evaluation campaigns that have been run. Of course, the chosen matcher should be available, but it should above all be adapted to the current task.

The next step consists in running the matcher against the ontologies and collecting the resulting alignment. The user should not hesitate to run the matcher several times or to run several matchers, trying different sets of parameters and different thresholds. It may be useful to test the results with consistency checking tools. It is also useful to process the matching incrementally by refining the returned alignment and feeding it again to the matcher for improving it. Once a satisfying alignment has been obtained, it is necessary to perform a final screening and validation. Ideally, this should be done by asking an independent expert to assess the quality of the alignment and perform some manual editing. This step can also be applied on the alignments found

An extra step is to save the alignment obtained in a declarative format so that it can be shared and to give it proper annotations to record its provenance and purpose. This will help others to reuse it. Finally, the alignment can be "rendered" in the format that best corresponds to its expected use.

## What is the process?



## Additional Information

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- ❑ Jérôme Euzenat, Pavel Shvaiko, *Ontology matching*, Springer-Verlag, Heidelberg (DE), 2007
- ❑ Jérôme Euzenat, Adrian Mocan, François Scharffe, *Ontology alignments: an ontology management perspective*, in: Martin Hepp, Pieter De Leenheer, Aldo De Moor, York Sure (eds), *Ontology management: semantic web, semantic web services, and business applications*, Springer, New-York (NY US), 2008, pp177-206