Converting UML-based ontology conceptualizations to OWL with Chowlk[⋆]

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Abstract. During the ontology conceptualization activity, developers usually generate preliminary models of the ontology in the form of diagrams. Such models drive the ontology implementation activity, where the models are encoded using an implementation language, typically by means of ontology editors. The goal of this demo is to take advantage of the developed ontology conceptualizations in order to accelerate the ontology implementation activity. For doing so we present Chowlk, a converter to transform digital UML-based ontology diagrams into OWL. This system aims at supporting users in the generation of the first versions of ontologies by reusing the ontology conceptualization output.

Keywords: Ontology engineering · ontology conceptualization · Ontology implementation

1 Introduction

One important step in ontology development is the conceptualization one, during which the ontology development team defines a set of concepts and properties to represent the knowledge of an specific domain. Often, this conceptualization is materialized in a diagram that displays the ontology elements and their connections. From this model, the ontology implementation is carried out normally using an ontology editor, encoding the model in OWL. In this process the diagram is in most of the cases only used as a guideline to manually implement the ontology. To address this issue, some tools have been proposed to allow the graphical creation or modification of ontologies[5, 2, 4, 3].

The presented work aims at leveraging the above-mentioned diagrams in order to allow for a smoother transition from the conceptualization activity to the actual implementation, that is transforming XML diagrams following a UML-based ontology visual notation into OWL. For doing so, rather than building a graphical ontology editor, the process builds on top of well-adopted system as diagrams.net which allows collaborative and synchronous edition of the conceptualization models.

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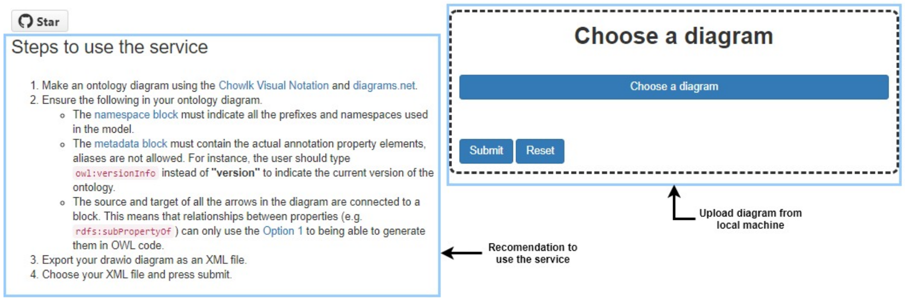
2 Chowlk features

Chowlk is a web application that takes as input an ontology conceptualization created with diagrams.net and generates the OWL implementation. The service is available online[1] (See Figure 1) and the source code is shared in a GitHub repository[2] under the Apache 2.0 license.

The conceptualization should follow the Chowlk visual notation[3] which is also provided as a diagrams.net library[4] to allow users to easily reuse the correct shapes to avoid problems during the transformation and save to time during the conceptualization.

The converter is able to identify concepts, object properties, datatype properties, and restrictions between those elements. Also, the converter identifies ontology metadata, namespaces and the prefixes being used in the model, due to specific blocks dedicated to this type of information. Labels to each ontology element are added during the detection process. Once the XML diagram is loaded into the system, Chowlk starts searching for all the ontology elements in the conceptualization ignoring shapes not included in the specification. After the detection and creation of the corresponding associations between the ontological elements, Chowlk proceeds to write the implementation using the OWL language. Finally, the ontology is provided in two downloadable formats: Turtle and RDF/XML. (See Figure 2).



Steps to use the service

1. Make an ontology diagram using the Chowlk Visual Notation and diagrams.net.
2. Ensure the following in your ontology diagram.
   - The namespace block must indicate all the prefixes and namespaces used in the model.
   - The metadata block must contain the actual annotation property elements, aliases are not allowed. For instance, the user should type `owl:versionInfo` instead of **"version"** to indicate the current version of the ontology.
   - The source and target of all the arrows in the diagram are connected to a block. This means that relationships between properties (e.g. `rdfs:subPropertyOf`) can only use the Option 1 to being able to generate them in OWL code.
3. Export your drawio diagram as an XML file.
4. Choose your XML file and press submit.

Choose a diagram

Choose a diagram
Submit
Reset
Upload diagram from local machine
Recomendation to use the service

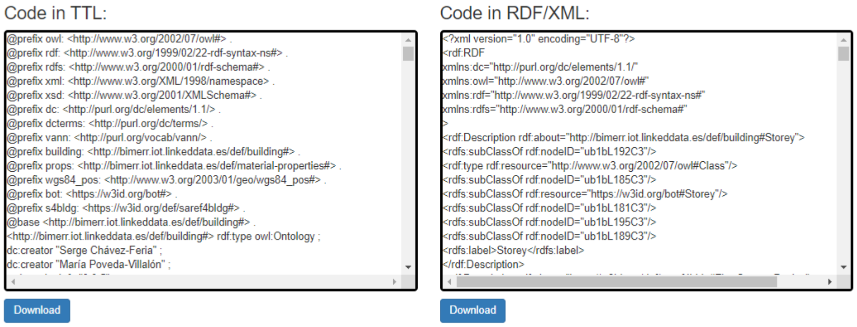
Fig. 1: Screenshot excerpt of Chowlk home page

[1] `https://chowlk.linkeddata.es`

[2] `https://github.com/oeg-upm/Chowlk`

[3] `https://chowlk.linkeddata.es/chowlk_spec`

[4] `https://github.com/oeg-upm/chowlk_spec/blob/master/chowlk-drawio-library.xml`



Code in TTL:

```
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix xml: <http://www.w3.org/XML/1998/namespace> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix dc: <http://purl.org/dc/elements/1.1/> .
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix vann: <http://purl.org/vocab/vann/> .
@prefix building: <http://bimerr.iot.linkeddata.es/def/building#> .
@prefix props: <http://bimerr.iot.linkeddata.es/def/material-properties#> .
@prefix wgs84_pos: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
@prefix bot: <https://w3id.org/bot#> .
@prefix s4bldg: <https://w3id.org/def/saref4bldg#> .
@base <http://bimerr.iot.linkeddata.es/def/building#> .
<http://bimerr.iot.linkeddata.es/def/building#> rdf:type owl:Ontology ;
dc:creator "Serge Chávez-Feria" ;
dc:creator "María Poveda-Villalón" ;
```

Code in RDF/XML:

```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:owl="http://www.w3.org/2002/07/owl#"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
>
<rdf:Description rdf:about="http://bimerr.iot.linkeddata.es/def/building#Storey">
<rdfs:subClassOf rdf:nodeID="ub1bL192C3"/>
<rdf:type rdf:resource="http://www.w3.org/2002/07/owl#Class"/>
<rdfs:subClassOf rdf:nodeID="ub1bL185C3"/>
<rdfs:subClassOf rdf:resource="https://w3id.org/bot#Storey"/>
<rdfs:subClassOf rdf:nodeID="ub1bL181C3"/>
<rdfs:subClassOf rdf:nodeID="ub1bL195C3"/>
<rdfs:subClassOf rdf:nodeID="ub1bL189C3"/>
<rdfs:label>Storey</rdfs:label>
</rdf:Description>
```

Fig. 2: Screenshot of the web GUI showing the output serializations.

3 Architecture

The architecture of the Chowlk converter can be shown in Figure 3. It was developed as a web application that takes as input an ontology conceptualization, created with diagrams.net, and the Chowlk visual notation to generate the OWL implementation. Figure 3 also shows the modules composing the system, namely: the detection module, the association module, and the writing module. The detection modules identifies all the building blocks represented in the diagram that follow the Chowlk visual notation, discarding any shape that does not correspond to the notation ones. This detection is done by analyzing the attributes of the XML data structure. The association module performs the connection between the ontological elements found in the detection module. This association is done by taking the classes of the ontology as the core elements. For each class, the module iterates over the object properties and datatype properties found in the conceptualization and performs the association based on the proximity of the shapes. Finally, the writing module takes all the ontology elements detected in the previous steps and serializes them in RDF, along with the respective restrictions between them.

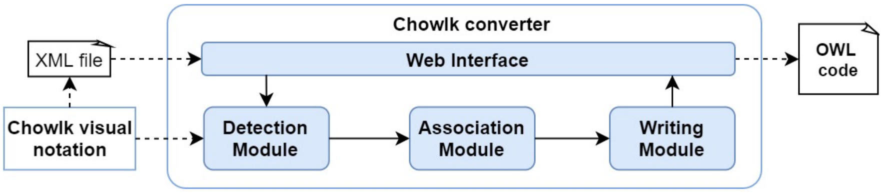


Fig. 3: Chowlk architecture.

4 Demonstration

During the demonstration,[5] some examples will be developed to show the participants how to use Chowlk. First, the conceptualization will be developed using diagrams.net following the Chowlk visual notation. The shapes for the construction of the model will be provided as a diagrams.net library that can be loaded into the diagramming tool. The final conceptualization will be exported an uploaded into the Chowlk web app that will generate the corresponding OWL implementation. The GUI will return the ontology in two formats: RDF/XML and Turtle. As a final step, the ontology will be uploaded into Protégé to demonstrate the syntax correctness of the exported implementation.

5 Conclusions and future work

This paper presents the Chowlk converter that facilitates the ontology development process by leveraging the ontology conceptualization diagrams to transform them into OWL. The system is currently being used within the authors research group[6] and also by researchers from other institutions[7]. Next steps involve the announcement and promotion of the system to get feedback from users. Additionally, we plan to develop a REST API so that Chowlk can be easily integrated within third-party software such as OnToology [1]. It is also planned to develop a plugin for diagrams.net in order to embed the ontology generation feature into the diagramming tool. Besides, we plan to integrate the prefix.cc[8] service to suggest an URI for prefixes not declared. Including support for including additional metadata, such as comments and labels, is also being explored.

References

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[5] A demo video of Chowlk is available at `https://youtu.be/1oF0qDhParA`

[6] See the BIMERR European project `https://bimerr.iot.linkeddata.es/` or contributions to the W3C WoT-discovery task `https://tinyurl.com/w653me9f`

[7] `http://mired.uspceu.es/microrrelatos/`

[8] `http://prefix.cc/`