Reusable Ontology Modelling Patterns for Biodiversity Data with Reasonable Ontology Templates (OTTR)

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Abstract

The Norwegian Biodiversity Information Centre (NBIC) is currently building a traitbank for Norwegian species. The purpose of the NBIC TraitBank is to enhance sharing of traits and other information about species to support conservation actions and ecological research. The traitbank will cover a subset of traits for all multicellular species and taxa that are found in Norway. Observations of traits, collected through citizen science as well as by experts, are connected to the NBIC TraitBank ontology, forming a knowledge base. We have modeled TraitBank's ontology in accordance with NBIC's data management requirements, focusing on the domain knowledge necessary for ontology-based data integration of internal databases and queries specified by use cases. Our initial steps in ontology construction included outlining competency questions, which are natural language sentences expressing the questions system users expect an ontology to answer (Bezerra et al. 2013, Ren et al. 2014). The ontology for the TraitBank is populated using expert input (manual entry) and through harvesting of traits from existing internal databases at NBIC.

We will present our experiences with implementing Reasonable Ontology Templates (OTTR) (Skjæveland et al. 2021) as the means for modeling the ontology and populating the TraitBank ontology. OTTR is a language for formally representing and instantiating ontology modeling patterns and is designed to support knowledge base construction and interaction at a higher level of abstraction. In the case of the TraitBank, ontology patterns are edited and published using a Semantic MediaWiki (SMW) extension for OTTR (FloSchroeder 2022), thereby providing a tool for the domain expert to work directly with templates. We build the TraitBank ontology by instantiating the templates directly in SMW as wiki pages.

We argue that templates are an effective means to support the integration and use of digital biodiversity data in transparent ways, leading to successful collaboration and reuse of data. Following the "*Don't repeat yourself*" (DRY) principle of software development (

Hunt and Thomas 1999), OTTR templates lend themselves well to easier ontology maintenance, allowing updates to occur through changes in individual template definitions rather than to repeated statements spread throughout the ontology. OTTR reshapes how domain experts work with ontologies and the data connected to the knowledge base, lifting the biodiversity expert away from dealing directly with logical axioms and Web Ontology Language (OWL). The template libraries have the power to improve international collaboration, making it easier to exchange and reuse specific templates and suggest improvements. Our templates include mappings to standards developed by Biodiversity Information Standards (TDWG) and biodiversity-related ontologies, linking to the international community. Use of OTTR supports the principles of Findable, Accessible, Interoperable, and Reusable (FAIR) data and demonstrates a new technology that can support the creation of an extensive online network of knowledge.

Example: Scientific Name

The NBIC uses Scientific Name as the main identifier and means to track a species. The OTTR template shown below captures the NBIC's modelling pattern for Scientific Name. The *signature* of the template specifies the Internationalized Resource Identifier (IRI) of the template (adb-t:ScientificName), and six parameters (where ?iri is the 1st parameter). The parameters are used in the *body* of the template and define how instances of the template are *expanded* to Resource Description Framework (RDF) statements. Template instance expansion is done in a recursive manner, similar to many macro programming languages.

With the OTTR template definition given in Fig. 1, a template instance can be expanded, as shown in the example for *Metopa glacialis* Fig. 2.

The benefits of using the OTTR framework is that modeling patterns are explicitly represented as an OTTR template, allowing for instances of patterns to be compactly and consistently captured. The format of template instances lends itself to instantiation from tabular data sources like spreadsheets and databases.

Keywords

ontology patterns, FAIR principles, Reasonable Ontology Templates (OTTR)

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Presented at

TDWG 2022

Conflicts of interest

References

- Bezerra C, Freitas F, Santana F (2013) Evaluating Ontologies with Competency Questions. 2013 IEEE/WIC/ACM International Joint Conferences on Web Intelligence (WI) and Intelligent Agent Technologies (IAT) https://doi.org/10.1109/wi-iat.2013.199
- FloSchroeder (2022) OttrParser Extension for MediaWiki. https://www.mediawiki.org/wiki/Extension:OttrParser. Accessed on: 2022-6-29.
- Hunt A, Thomas D (1999) *The Pragmatic Programmer : From Journeyman to Master* (1 ed.). USA: Addison-Wesley, 320 pp. URL: https://archive.org/details/isbn_9780201616224/page/320
- Ren Y, Parvizi A, Mellish C, Pan J, van Deemter K, Stevens R (2014) Towards Competency Question-Driven Ontology Authoring. Lecture Notes in Computer Science752-767. https://doi.org/10.1007/978-3-319-07443-6_50
- Skjæveland M, Lupp D, Karlsen LH, Klüwer J (2021) Chapter 22. OTTR: Formal Templates for Pattern-Based Ontology Engineering. Studies on the Semantic Web https://doi.org/10.3233/ssw210025

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adb-t:ScientificName[ottr:IRI ?iri, xsd:string ?label, xsd:integer ?id,
xsd:string ?author, xsd:date ?authordate, ottr:IRI ?citation] :: {
 rdf-o:Type(?iri, adb-o:ScientificName),
 rdfs-o:Label(?iri, ?label),
 ottr:Triple(?iri, adb-o:hasScientificNameId, ?id),
 ottr:Triple(?iri, adb-o:hasAuthor, ?author),
 ottr:Triple(?iri, adb-o:hasDate, ?authordate),
 ottr:Triple(?iri, adb-o:hasCitation, ?citation)
}.
```

Figure 1.

OTTR template for ScientificName.

```
Instance:

adb-t:ScientificName(adb:Metopa_glacialis, "Metopa glacialis", 2357,
"Krøyer", "1842-01-01"^^xsd:date,
<https://www.marinespecies.org/aphia.php/aphia.php?p=sourcedetails&id=17151>
) .

Expanded result:

adb:Metopa_glacialis  rdf:type     adb-o:ScientificName ;
       adb-o:hasScientificNameId  2357 ;
       adb-o:hasDate              "1842-01-01"^^xsd:date ;
       rdfs:label                 "Metopa glacialis" ;
       adb-o:hasAuthor            "Krøyer" ;
       adb-o:hasCitation          <https://www.marinespecies.org/
                                    aphia.php/aphia.php?p=sourcedetails&id=17151>
```

Figure 2.

Example instance for *Metopa glacialis* with expansion.