TOWARDS SEMI-AUTOMATIC GENERATION OF R2R MAPPINGS

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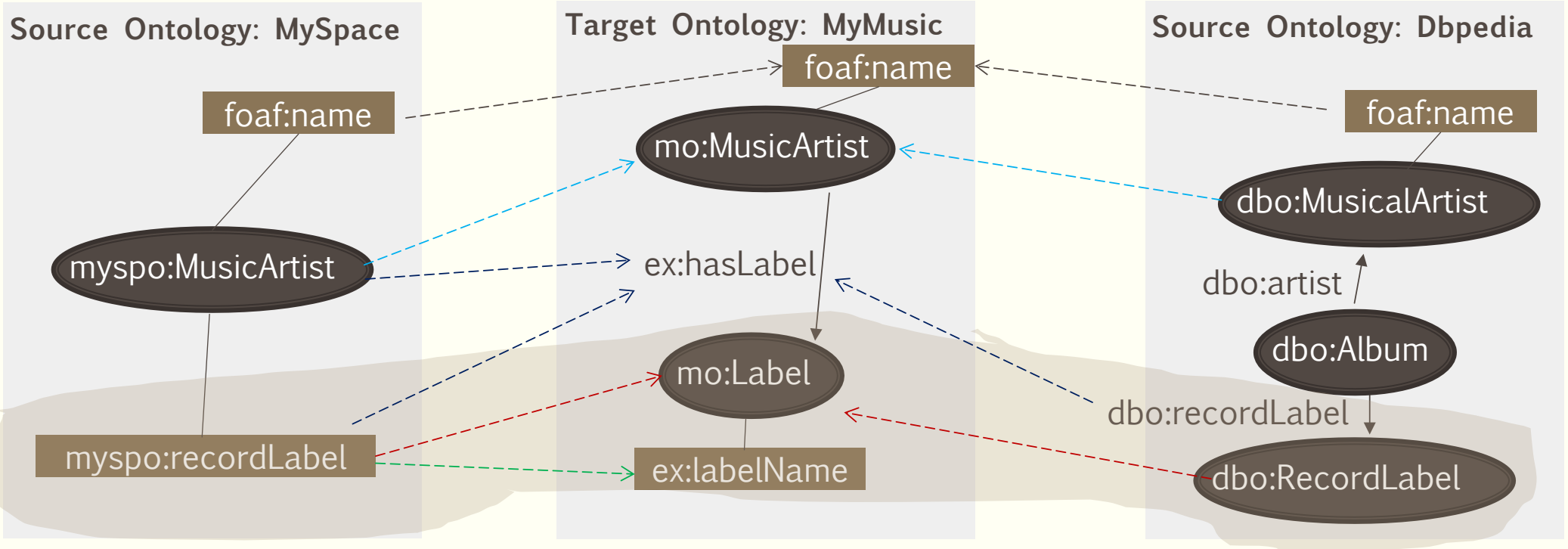
Introduction - Mapping

- A mapping specifies the equivalence between ontology terms in different ontologies
- Important when integrating multiple knowledge bases
  - different datasets use different vocabularies to represent the same concept of the real-world

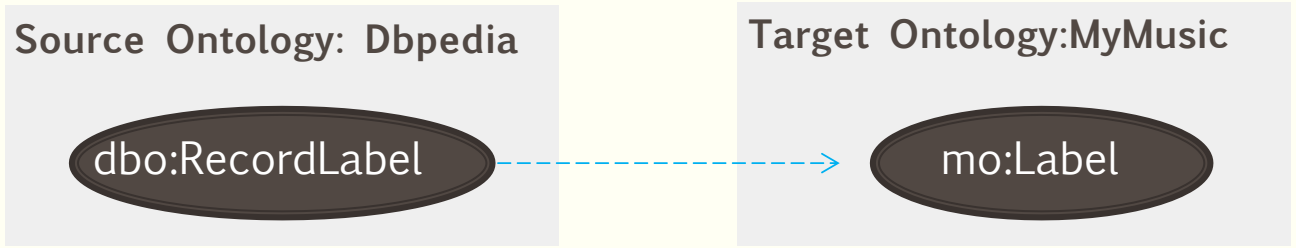


Introduction – R2R mappings

- Declarative language
- Based on SPARQL
  - Easy to the users understand the generated mapping
- For publish mappings between RDF vocabularies
- Ready for use
  - We can generate RDF triples to the target ontology from R2R mapping
  - The mappings can be published on the web

Introduction – R2R mappings

- Example 1:

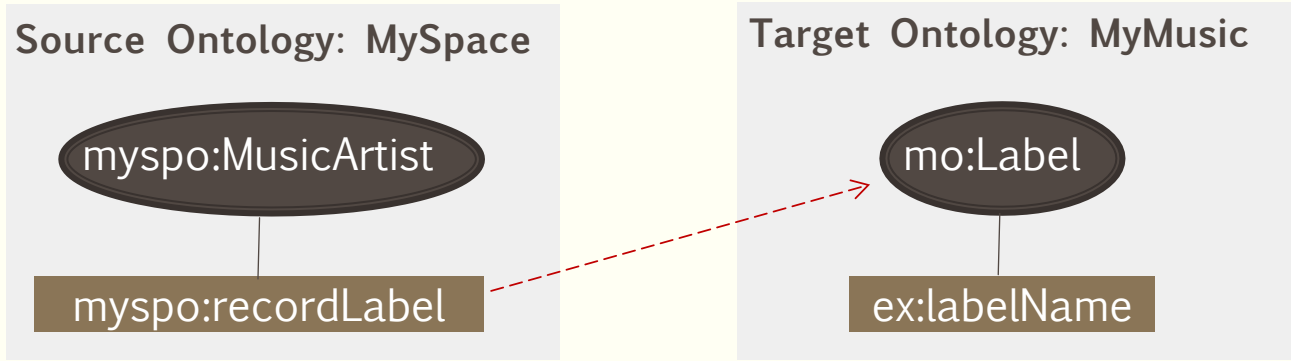



```
mp: CMA1
   a r2r:classMapping;
   r2r:prefixDefinitions "dbo: <http://...> . mo:<http://...>";
   r2r:sourcePattern "?SUBJ a dbo:RecordLabel";
   r2r:targetPattern "?SUBJ a mo:Label".
```

< s rdf:type dbo:RecordLabel > → < s rdf:type mo:Label >

Introduction - Problem

- When more complex mapping is necessary



Deep knowledge about the ontologies

Deep knowledge about the R2R language

```
mp: MCA2
   a r2r:ClassMapping;
   r2r:prefixDefinitions "mo:<···>.myspo:<···>";
   r2r:sourcePattern "?SUBJ a myspo:MusicArtist;
                      myspo:recordLabel ?r;
   r2r:targetPattern "?u a mo:Label";
   r2r:transformation "?u= concat(?SUBJ, xpath-encode-for-uri(?r))" .
```

< s myspo:recordLabel “apple” > ⟹ < u rdf:type mo:Label >

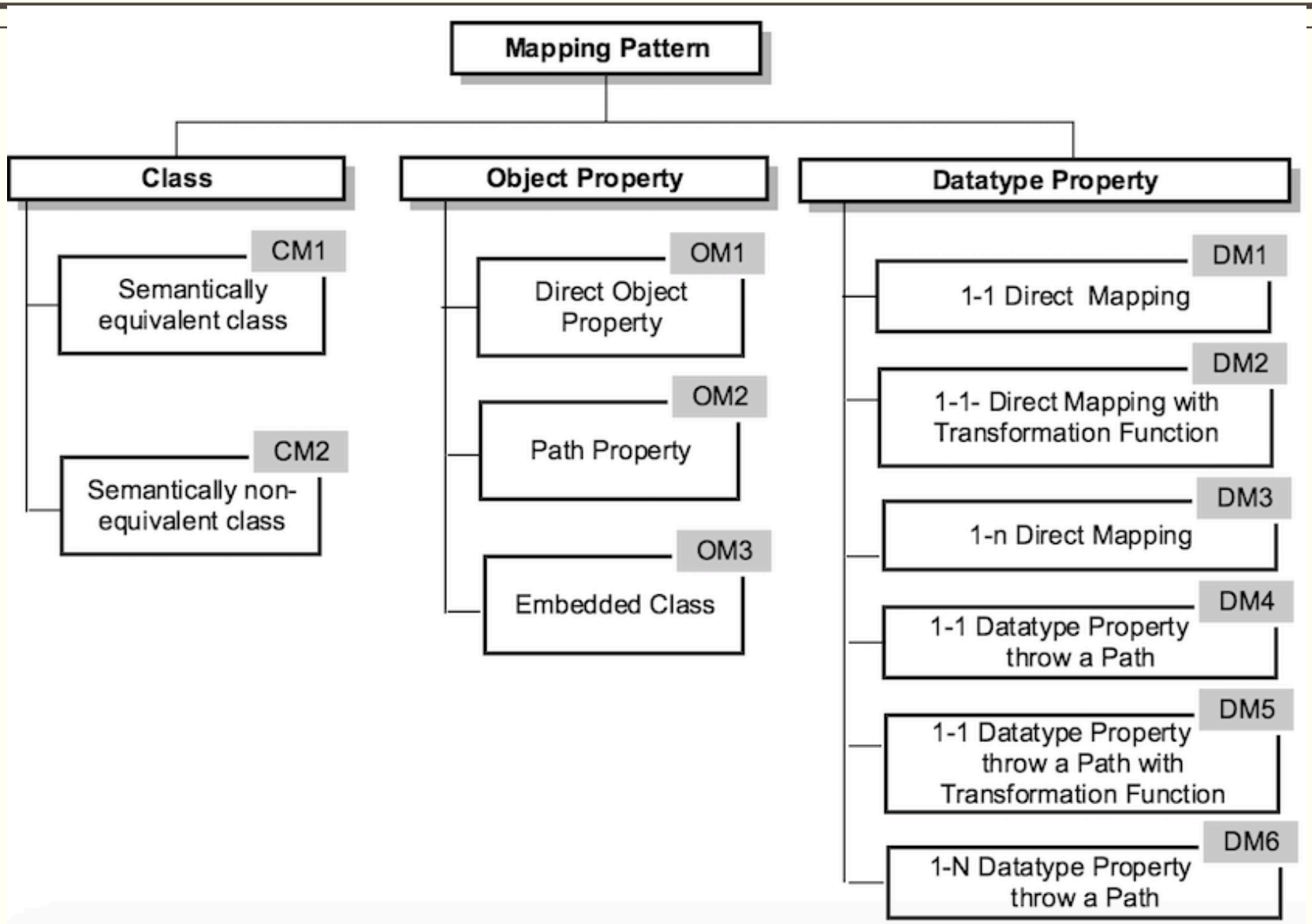
Our Proposal

- A mapping pattern library that:
  - Describe usual mapping problems between RDF vocabularies
  - Provides solutions that facilitates the generation of mappings
    - For example, semi-automatically generate R2R mappings
  - Provides templates handle with simple and complex mappings
  - Present constraints between the different mappings to guarantee that the whole set of mappings between the source and the target ontologies generate correct instances

Our Proposal

- Definition of a formal language (mapping assertions) that:
  - Declaratively define mappings
  - Highest level of abstraction than R2R mapping
  - Concise
  - Support the most part of the data alignment usually necessary to transform RDF data

Mapping Pattern - Library



Mapping Pattern - Template

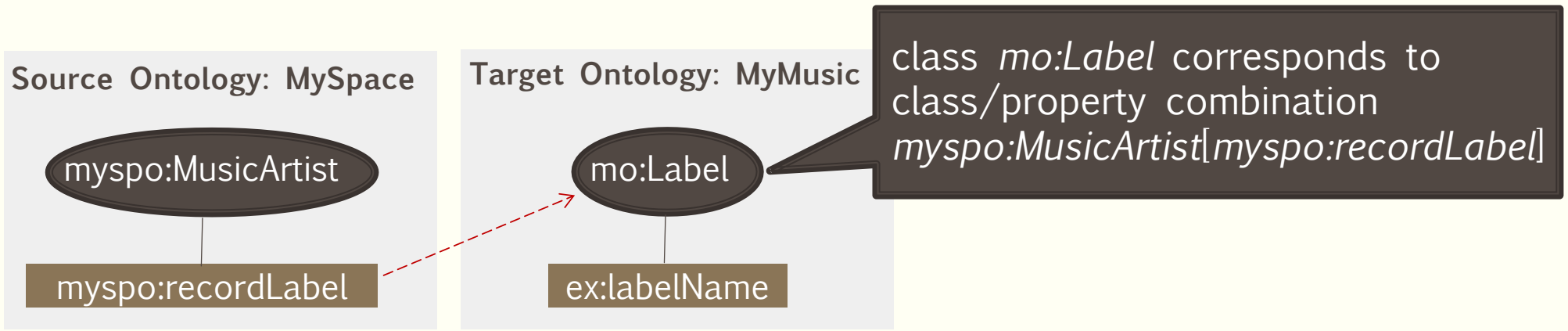
- Name (of the pattern)
- Alias
  - Alternative names or synonyms for the pattern
- Problem
  - Description of the goals of the pattern
- Context
  - The applicability of the pattern
- Force
- Solution
  - Description of the solution using Mapping Assertions, Mapping Rules and R2R Mapping
- Examples of use

Mapping Pattern - Example

- **Name:** Semantically Non-Equivalent Class Mapping
- **Alias:** CM2
- **Problem:** How should we specify the mapping of the instances of a class C_S in V_S into instances of a class C_T in V_T?

Mapping Pattern – CM2 (cont.)

- **Context:**
  - C_T and C_S are classes in vocabularies V_T and V_S, respectively
  - A_1,. . . , A_n are datatype properties whose domain is C_S
  - C_T and C_S are NOT semantically equivalent, i.e. they do not represent the same object of the real world
  - f is a condition of selection (a predicate) over instances of C_S (f is optional)
  - The terms may have the same name or different names in the different ontologies
- Example:



Mapping Pattern – CM2 (cont.)

- **Force:**
  - The mapping can be complete or partial
- **Solution:**
  - **Mapping Rule:** $C_T(u) \leftarrow C_S(s)$; $\mathbf{f}(s)$; hasUri[$A1$,...,An](s, u)

If $\langle s$ *rdf:type* $C_S \rangle$ *such that* $f(s)$ = *true and* u = hasUri[$A1$,...,An](s), then $\langle u$ *rdf:type* $C_T \rangle$

Mapping Pattern – CM2 (Example)

- **Force:**
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- **Solution:**
  - **Mapping Rule:** $C_T(u) \leftarrow C_S(s)$; $f(s)$; hasUri[$A1$,...,An](s, u)

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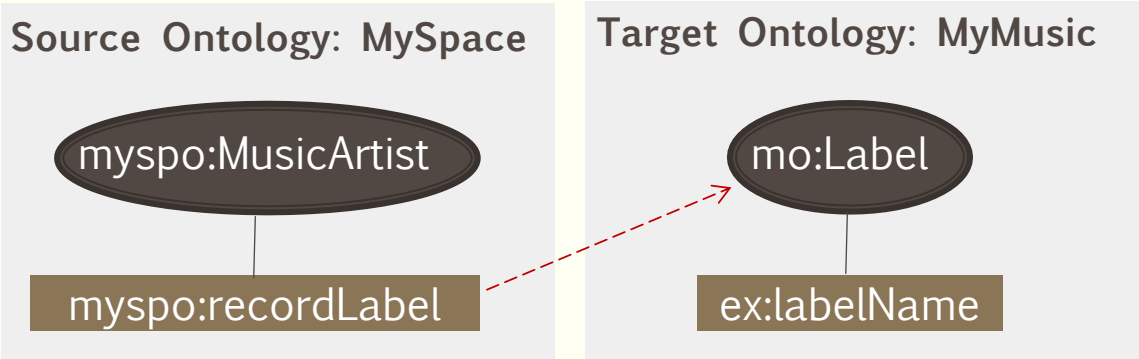
  - **Example:**



Mapping Rule:

R_1: mo:Label(u) ← myspo:MusicArtist(s) ;
hasUri[myspo:recordLabel](s, u)

Mapping Pattern – CM2 (cont.)

- **Force:**
  - The mapping can be complete or partial
- **Solution:**
  - **Mapping Rule:** $C_T(u) \leftarrow C_S(s)$; $f(s)$; hasUri[$A1,...,An$](s, u)

If $\langle s$ *rdf:type* $C_S \rangle$ *such that* $f(s) = true$ *and* u = hasUri[$A1,...,An$](s,), then $\langle u$ *rdf:type* $C_T \rangle$

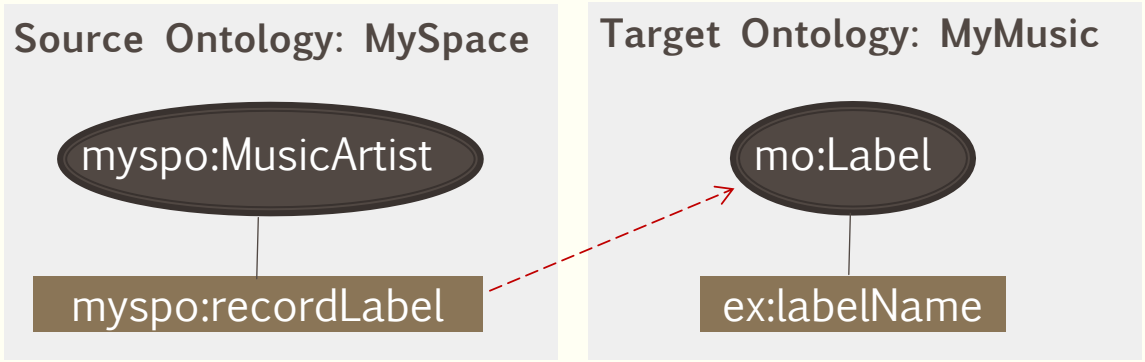
  - **Mapping Assertion:** ψ: $C_T \equiv C_S[A_1, \ldots, A_n] \ / \ f$

Mapping Pattern – CM2 (cont.)

- **Force:**
  - The mapping can be complete or partial
- **Solution:**
  - **Mapping Rule:** $C_T(u) \leftarrow C_S(s)$; $\mathbf{f}(s)$; hasUri[$A1$,...,An](s, u)

If $\langle s$ *rdf:type* $C_S \rangle$ *such that* $f(s)$ = *true and* u = hasUri[$A1$,...,An](s,), then $\langle u$ *rdf:type* $C_T \rangle$

  - **Mapping Assertion:** ψ: $C_T \equiv C_S[A_1, \ldots, A_n] \ / \ \mathbf{f}$
  - **Example:**



Mapping Rule:

R_1: mo:Label(u) ← myspo:MusicArtist(s) ;
hasUri[myspo:recordLabel](s, u)

Mapping Assertion:

***CMA_2*:** mo:Label ≡ myspo:MusicArtist[myspo:recordLabel]

Mapping Pattern – CM2 (cont.)

- **Force:**
  - The mapping can be complete or partial
- **Solution:**
  - **Mapping Rule:** $C_T(u) \leftarrow C_S(s)$; **f**(s) ; hasUri$[A1,...,An](s, u)$

If *⟨s rdf:type* C_S*⟩ such that f(s) = true and u =* hasUri$[A1,...,An](s,)$, then *⟨u rdf:type* C_T*⟩*

  - **Mapping Assertion:** ψ: $C_T \equiv C_S[A_1, \ldots, A_n]$ / **f**
  - **R2R Mapping:** template T2

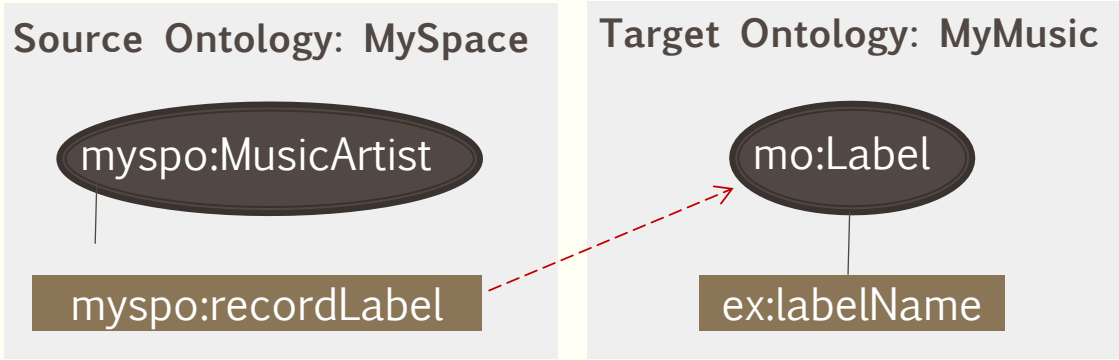
```
#Class Mapping
#CMA Ψc: C_T ≡ C_S[A_1, …, A_n] / f
mp: mca2
   a r2r: ClassMapping ;
   r2r:prefixDefinitions "prefixExp" ;
   r2r:sourcePattern "?SUBJ a s:C_S sQuery" ;
   r2r:targetPattern "?s a s:C_T";
   r2r:transformation "?s = generateUri(?SUBJ, A_1, …, A_n)".
```

Mapping Pattern – CM2 (cont.)

- **R2R Mapping (Example):**
  Template T2

CMA_2: mo:Label ≡ myspo:MusicArtist[myspo:recordLabel]

```
#Class Mapping
#CMA Ψc: C_T ≡ C_S[A_1, …, A_n] / f
mp: mca2
   a r2r: ClassMapping ;
   r2r:prefixDefinitions "prefixExp" ;
   r2r:sourcePattern "?SUBJ a s:C_S sQuery" ;
   r2r:targetPattern "?s a s:C_T";
   r2r:transformation "?s = generateUri(?SUBJ, A_1, …, A_n)".
```




```
Mp: AMC2
   a r2r:ClassMapping;
   r2r:prefixDefinitions "myspo:<http://> . mo:<http://>" ;
   r2r:sourcePattern "?SUBJ a myspo:MusicalArtist; myspo:recordLabel ?x";
   r2r:targetPattern "?s a mo:Label";
   r2r:transformation "?s = generateUri(?SUBJ, ?x)".
```

APPLYING MAPPING PATTERNS TO GENERATE R2R MAPPINGS

- Based on our pattern library, we created algorithms to semi-automatically generate R2R mappings
- The process to create R2R mappings to transform instances from an ontology into another one consists of two steps:

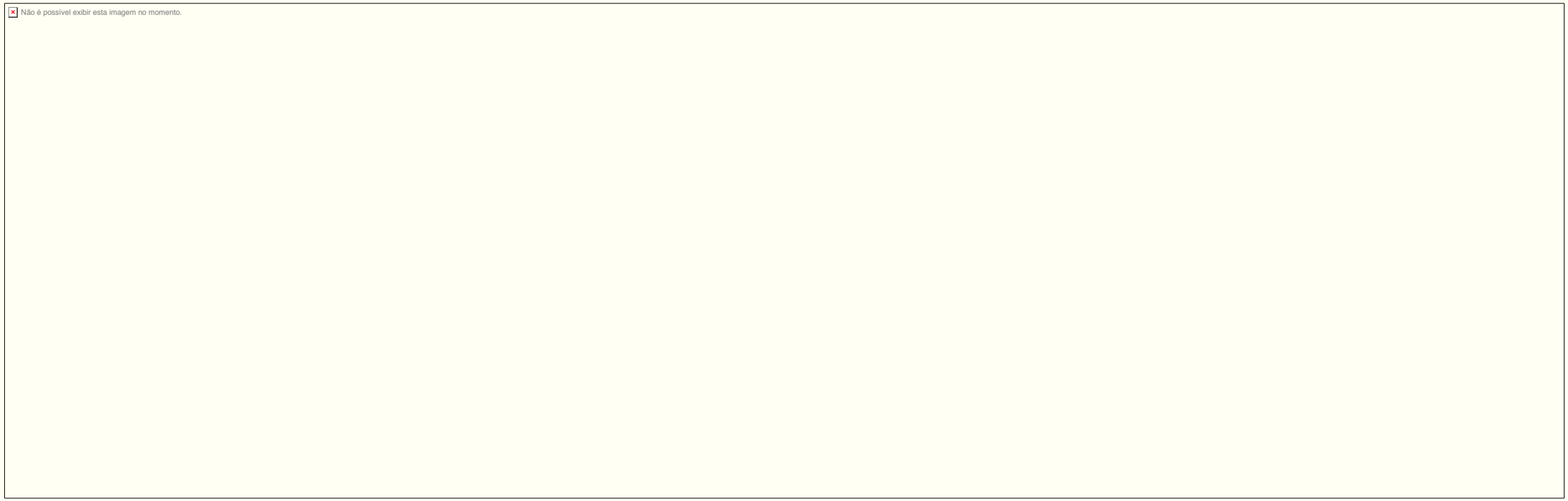
1. Define the MAs that formally specify the relationships between the target ontology and the source ontology
2. Generate a set of R2R mappings based on the MAs generated in step 1, in order to populate the target ontology with values from the source(s) ontology(ies)

- RBA (R2R by Assertions)
  - A tool for helping the designer in the process of definition of the mappings, which uses the proposed patterns

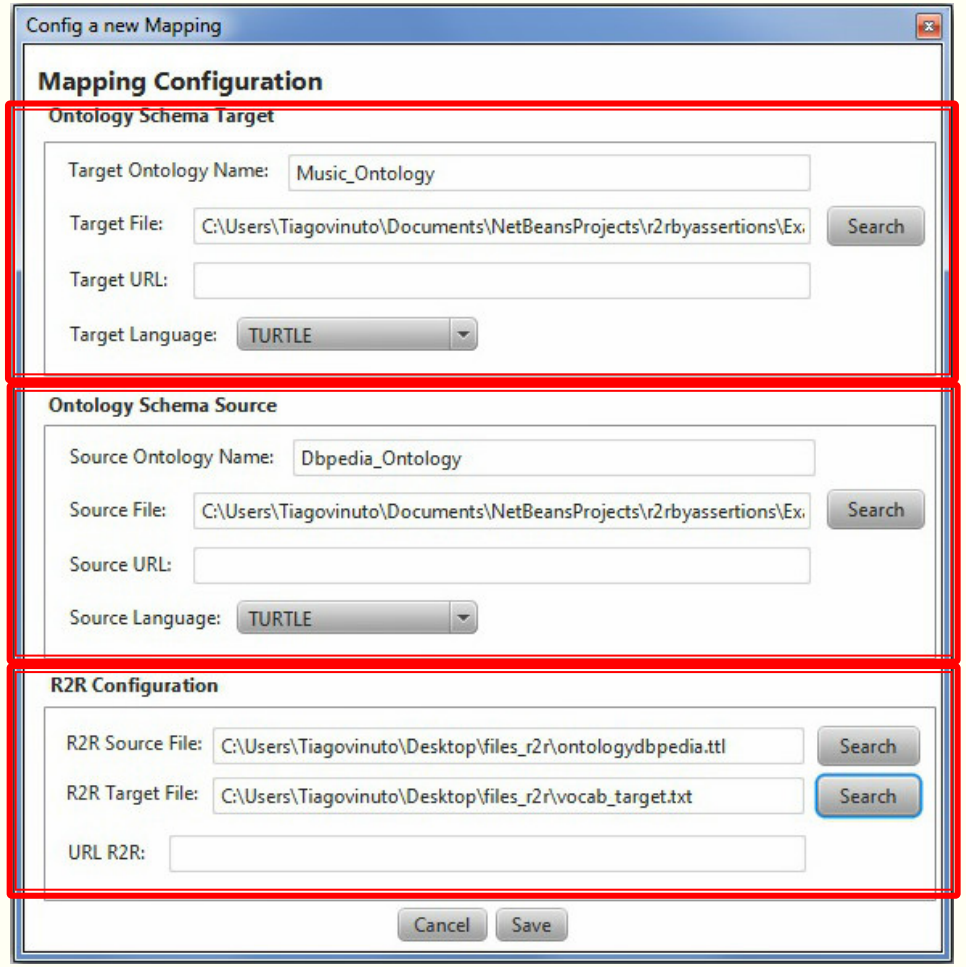
Conclusions

- We presented a proposal to semi-automatically generate R2R mappings using mapping patterns
- The current proposal allows us:
  - To specify mappings between terms of different ontologies in a clear and concise way
  - generate mappings that are ready to use in real scenarios
  - Group the most common mapping problems
- We had developed a tool, the RBA
- We intend to carry out a deep study to show how our proposal is generally useful

Thank you very much for your attention!



The RBA



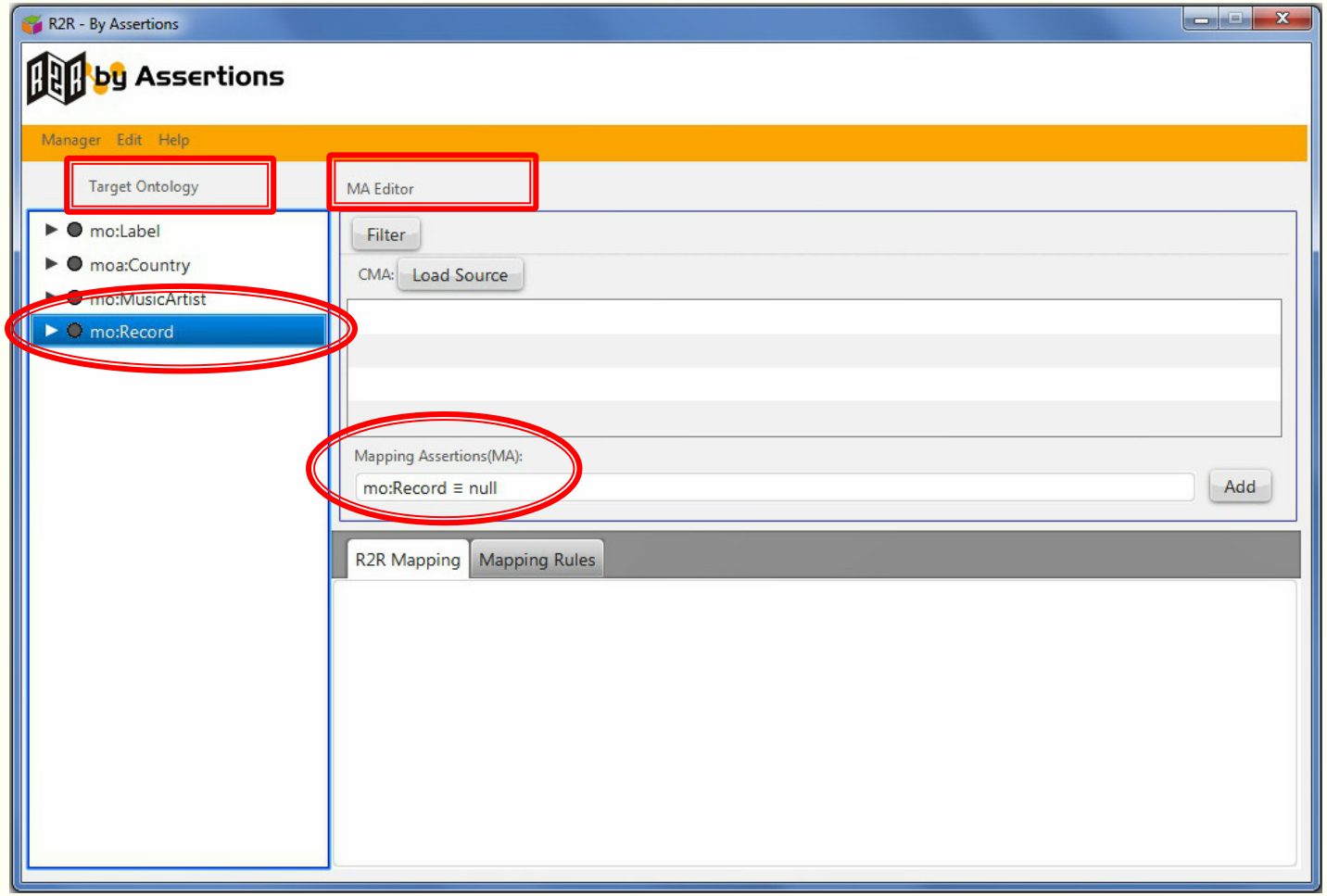
The target ontology's schema

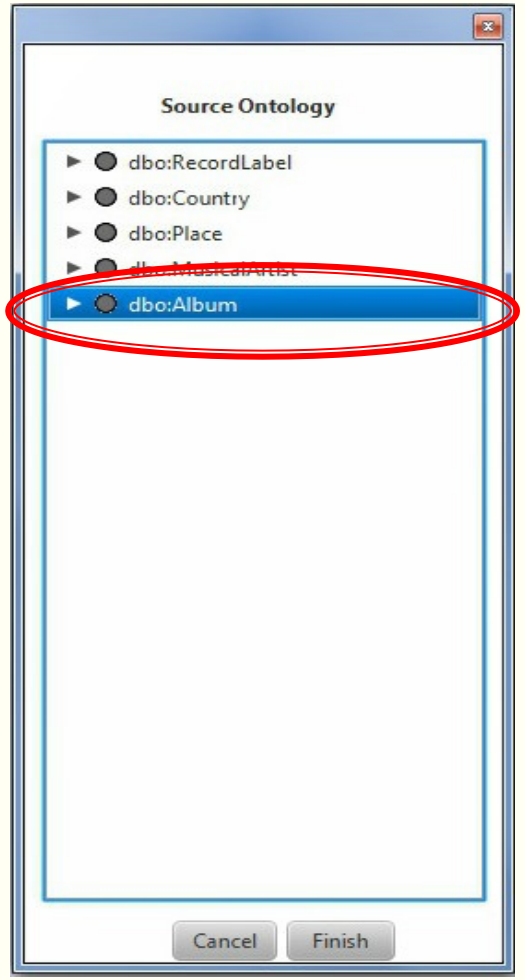
The source ontology's schema

The source ontology

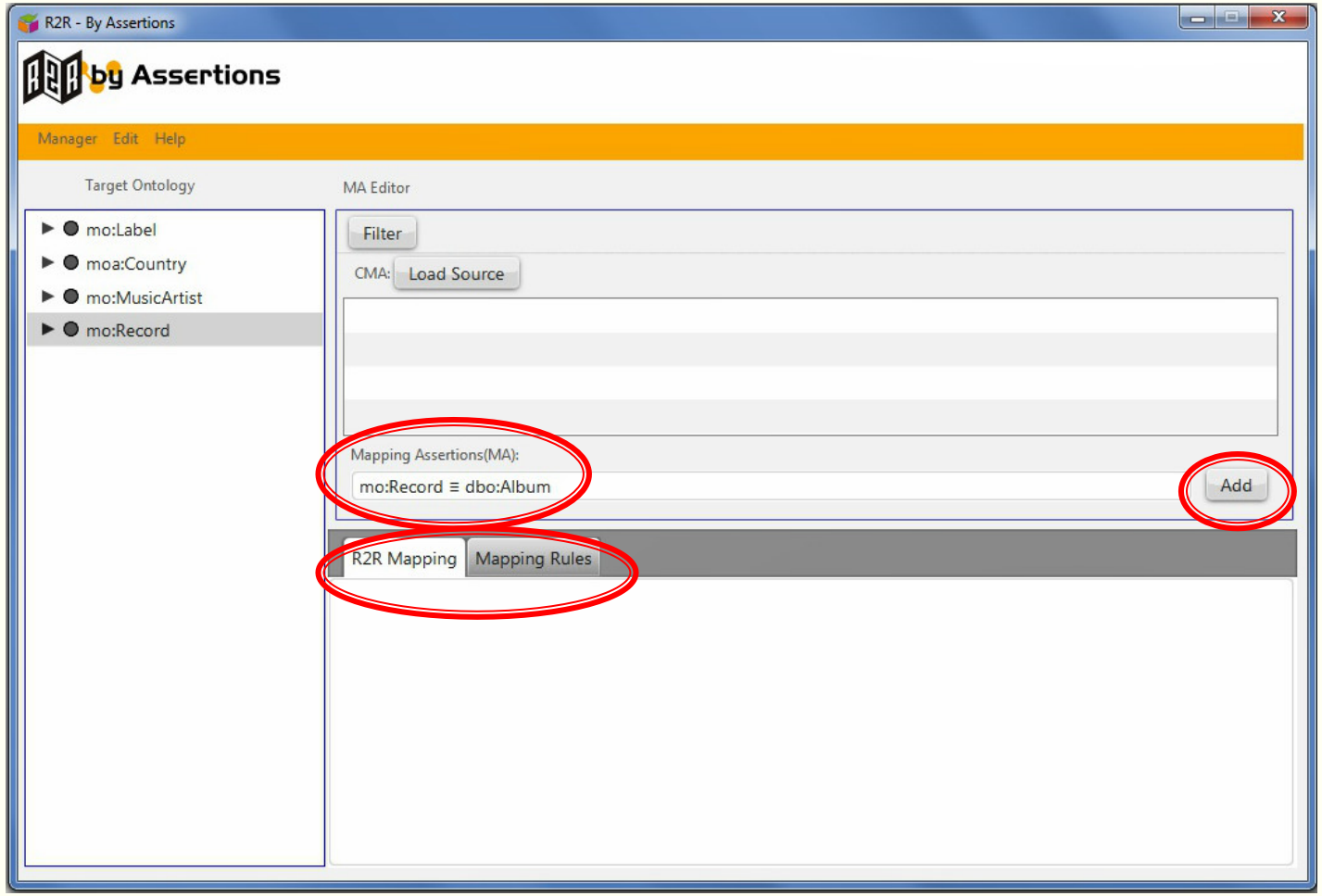
- The RDF triples of the source ontology
- The file's name to keep the RDF triples of the target ontology

RBA – Mapping's specification





RBA – Mapping's specification



RBA – Generating R2R Mappings