# Museum documentation in transdisciplinary perspective

## Introduction to OWL-DL, Tools, Semantic Web and the CRM OWL-DL implementation

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# OWL as recommendation

- OWL stands for Web Ontology Language
- Languages created for describing web contents
- Web today: contents and tags managing layout
- Semantic Web: additional tags to model the contents
- Future page at the internet $\longrightarrow$ „Content“, XHTML (incl. CSS), OWL
- Reason: processable by machines/algorithms
- World wide accepted W3C standard
- Three sublanguages: OWL lite (test), OWL Full (RDF/S), *OWL-DL* (Description Logic)

# Advantages of ontologies in *OWL-DL*

1. Syntax is readable for computers and humans
2. Formally defined semantics give expressions a clear meaning
3. Decidable inferences, but high expressivity
4. Computation of semantics supports modeling
5. Open World semantics
6. Tool support (editor, reasoner, semantic web software)

# *OWL-DL*

*T-Box* (Schema):

- Class/Concept and property/role constructors and constraints
- *subClassOf* builds concept hierarchy
- Object properties of superclasses are inherited; possibly restricted
- Object properties and datatype properties
- Properties: functional, inverse, symmetric, inverse-functional
- Restrictions: some, min, max, exactly

*A-Box* (Data):

- Individuals representing concrete data

# Syntax — *T-Box* (Example)

```
<owl:Class rdf:ID="Curator">
  <rdfs:subClassOf rdf:resource="#E21.Person"/>
  <rdfs:subClassOf><owl:Restriction>
    <owl:onProperty>
      <owl:ObjectProperty
        rdf:ID="is_current_keeper_of"/>
    </owl:onProperty>
    <owl:someValuesFrom>
      <owl:Class
        rdf:about="#Biological_Collection_Object"/>
    </owl:someValuesFrom>
  </owl:Restriction></rdfs:subClassOf>
</owl:Class>
```

# Syntax — *A-Box* (Example)

```
<Curator rdf:ID="K_H_Lampe">
  <is_current_keeper_of
    rdf:resource="#MesopolobusfagiCollObj01"
  />
</Curator>
```

# Semantics of *OWL-DL*

- Processible syntax, but also a processible semantics
- *OWL-DL* (V 1.0): syntactic variant of $SHOIN(D)$
- Each above mentioned language element has corresponding semantics in this special description logic
- Why description logic? $\longrightarrow$ decidable, expressive subset of (classical) First Order Logic
- Toolsupport

# Reasoner implementations

- FaCT++ = Fast Classification of Terminologies
  - Tableaux algorithm (*SROIQ*) (*OWL-DL* V 1.1)
  - DIG Interface and direct integration
- RACER = Renamed ABox & Concept Expression Reasoner
  - Tableaux algorithm (*SHOIN*(*D*))
  - DIG Interface (HTTP-based, nRQL)
- Pellet
  - Support for *SROIQ*, without n-ary datatypes
  - Direct integration

# Editor implementations

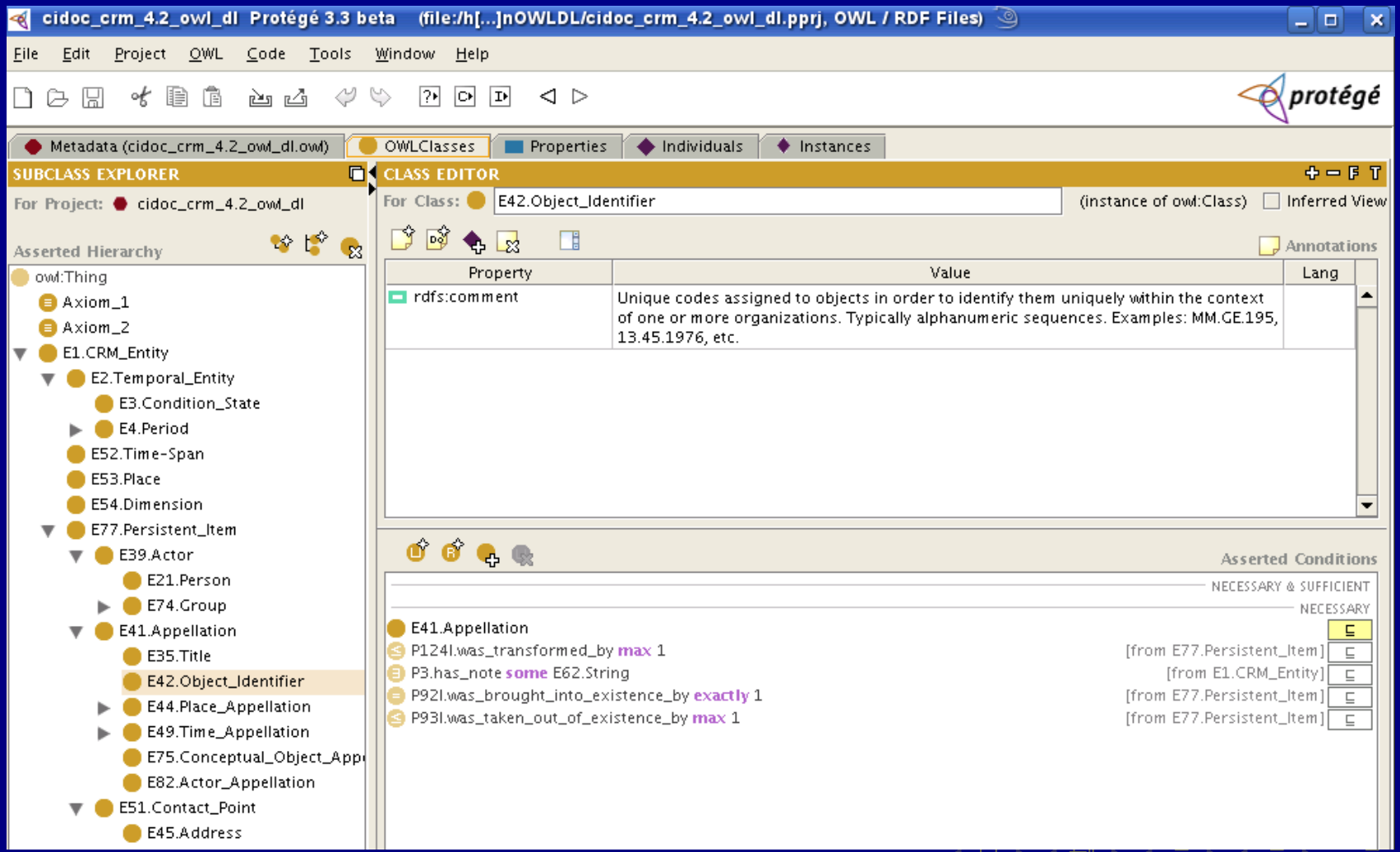
Open Source:

- Protege
- SWOOP
- OilEd (currently not available)

Commercial (with support):

- TopBraid Composer
- Semantic Guide

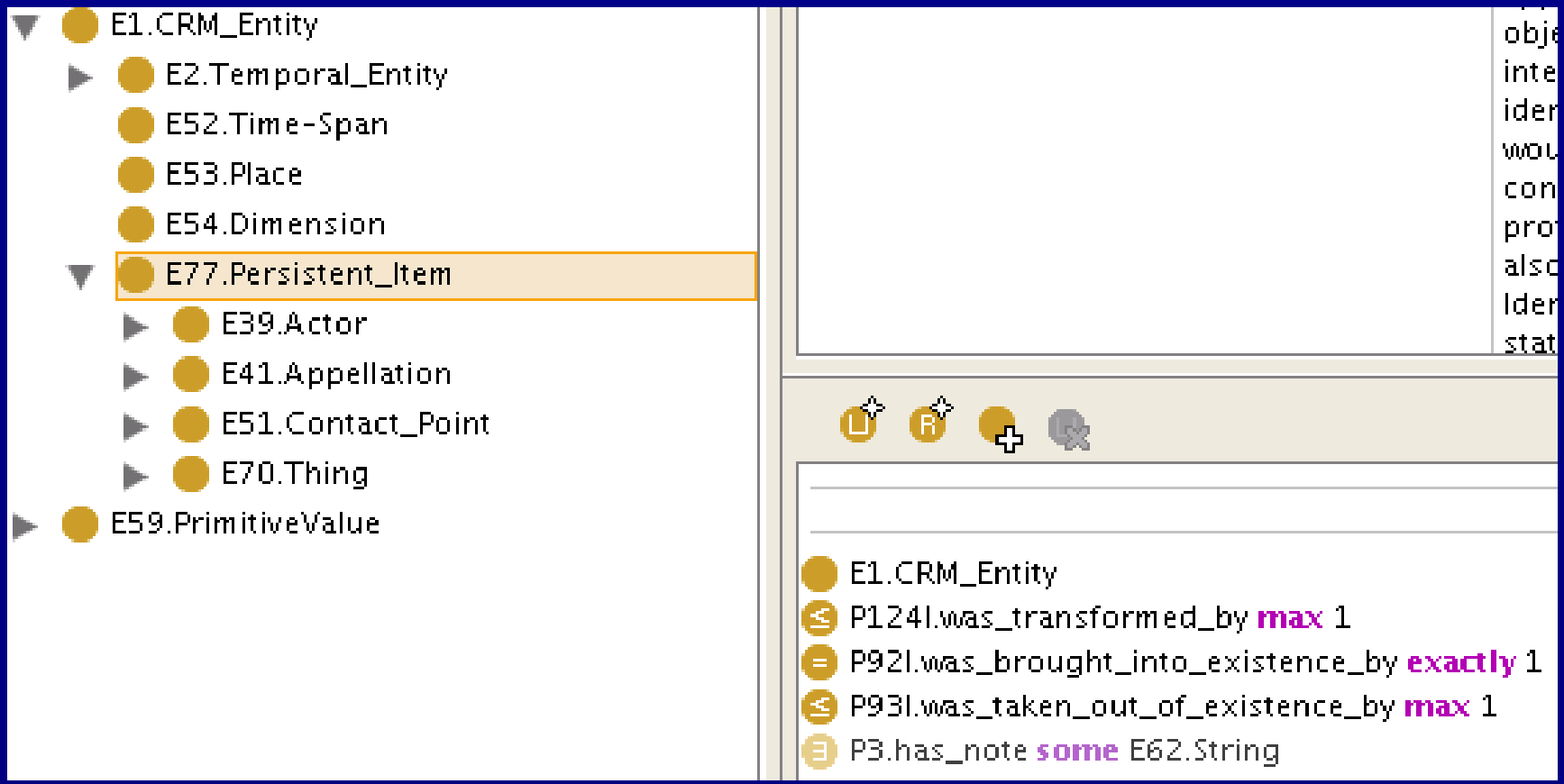
# Implementation in Protégé



# ISO Specification of *E77.Persistent_Item*

- Subclass of E1.CRM_Entity
- Superclass of E39.Actor, E41.Appellation, E51.Contact_Point, E70.Thing
- Scope Note: This class comprises items that have a persistent identity, sometimes known as endurants in philosophy. They can be repeatedly recognized within the duration of their existence by identity criteria rather than by continuity or observation. Persistent Items can be either physical entities, such as people, animals or things, or conceptual entities such as ideas, concepts, products of the imagination or common names.
- Examples: Leonardo da Vinci, Stonehenge, the hole in the ozon layer

# E77.Persistent_Item



# E77.Persistent_Item OWL-DL I

```
<owl:Class rdf:about="#E77.Persistent_Item">
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty>
        <owl:ObjectProperty rdf:about=
        "#P92I.was_brought_into_existence_by"/>
      </owl:onProperty>
      <owl:someValuesFrom>
        <owl:Class rdf:about=
        "#E63.Beginning_of_Existence"/>
      </owl:someValuesFrom>
    </owl:Restriction>
```

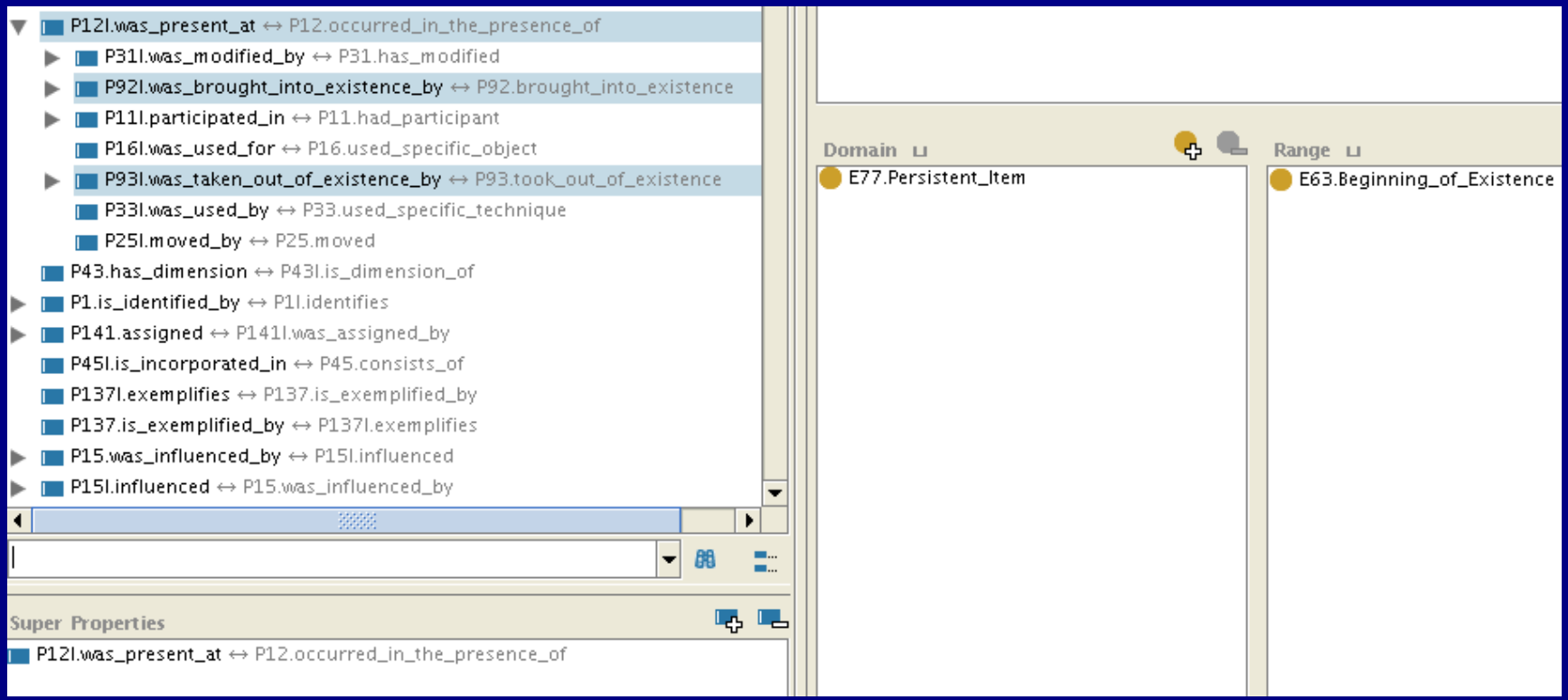
# *E77.Persistent_Item OWL-DL* II

```
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Restriction>
        <owl:cardinality rdf:datatype="#int"
        >1</owl:cardinality>
        <owl:onProperty>
          <owl:ObjectProperty rdf:about
          ="#P92I.was_brought_into_existence_by"/>
        </owl:onProperty>
      </owl:Restriction>
    </rdfs:subClassOf>
    <rdfs:subClassOf rdf:resource="#E1.CRM_Entity"/>
...
```

# *E77.Persistent_Item OWL-DL* III

```
</owl:Class>
```

# Properties of *E77.Persistent_Item*



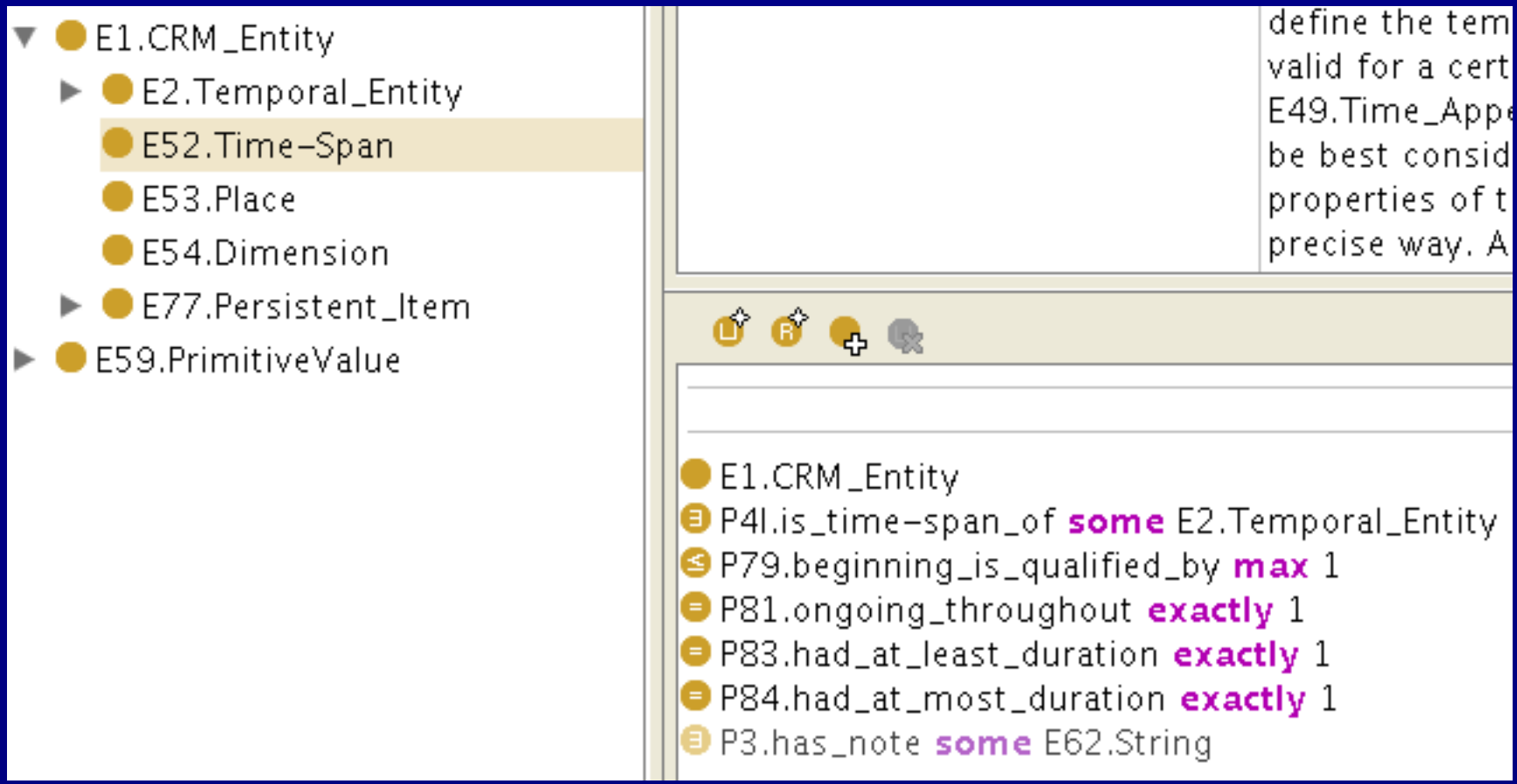
# P92I.was_brought_into_existence_by OWL-DL

```
<owl:ObjectProperty
 rdf:about="#P92I.was_brought_into_existence_by">
  <rdfs:range
   rdf:resource="#E63.Beginning_of_Existence"/>
    <rdfs:subPropertyOf
     rdf:resource="#P12I.was_present_at"/>
    <owl:inverseOf>
      <owl:ObjectProperty
       rdf:about="#P92.brought_into_existence"/>
    </owl:inverseOf>
    <rdfs:domain
     rdf:resource="#E77.Persistent_Item"/>
</owl:ObjectProperty>
```

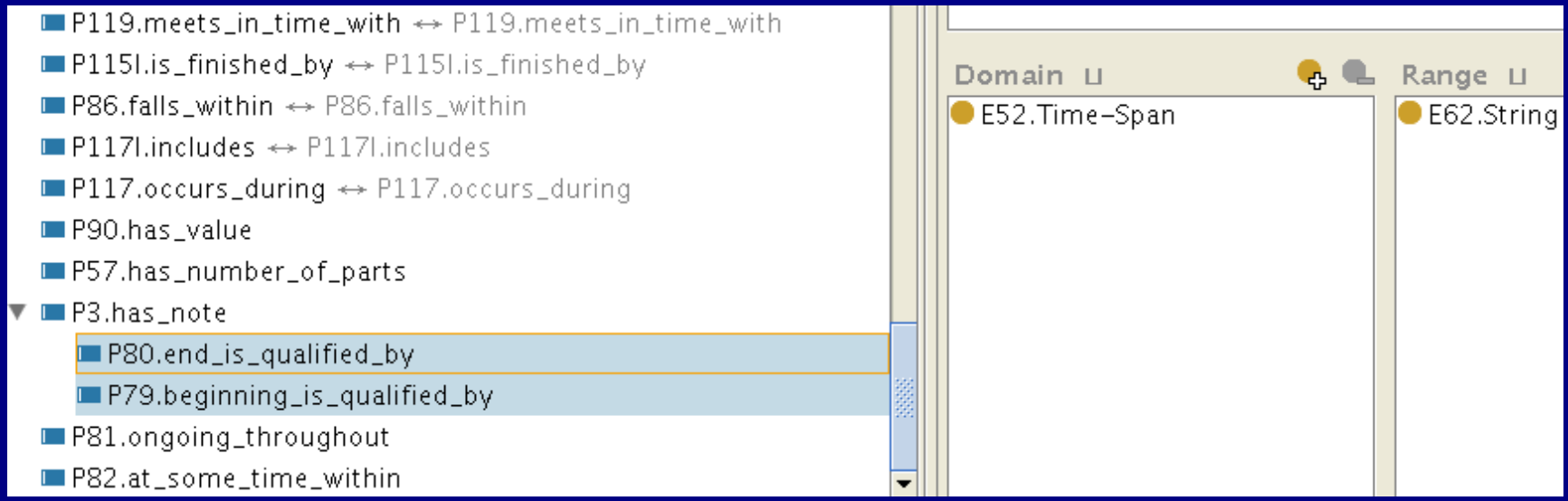
# Datatypes in CRM

- Datatypes are used as representation of strings, etc.
- Datatype properties as inverse-functional properties
- Not permitted in OWL-DL, only in OWL Full
- Required to stay within OWL-DL for decidable reasoning:
  - Entities point to E59.Primitive_Value or subclasses via inverse-functional object properties
  - Subclasses of E59.Primitive_Value have datatype properties
  - Datatype properties point to xsd datatypes of XML Schema
- Example on following slides

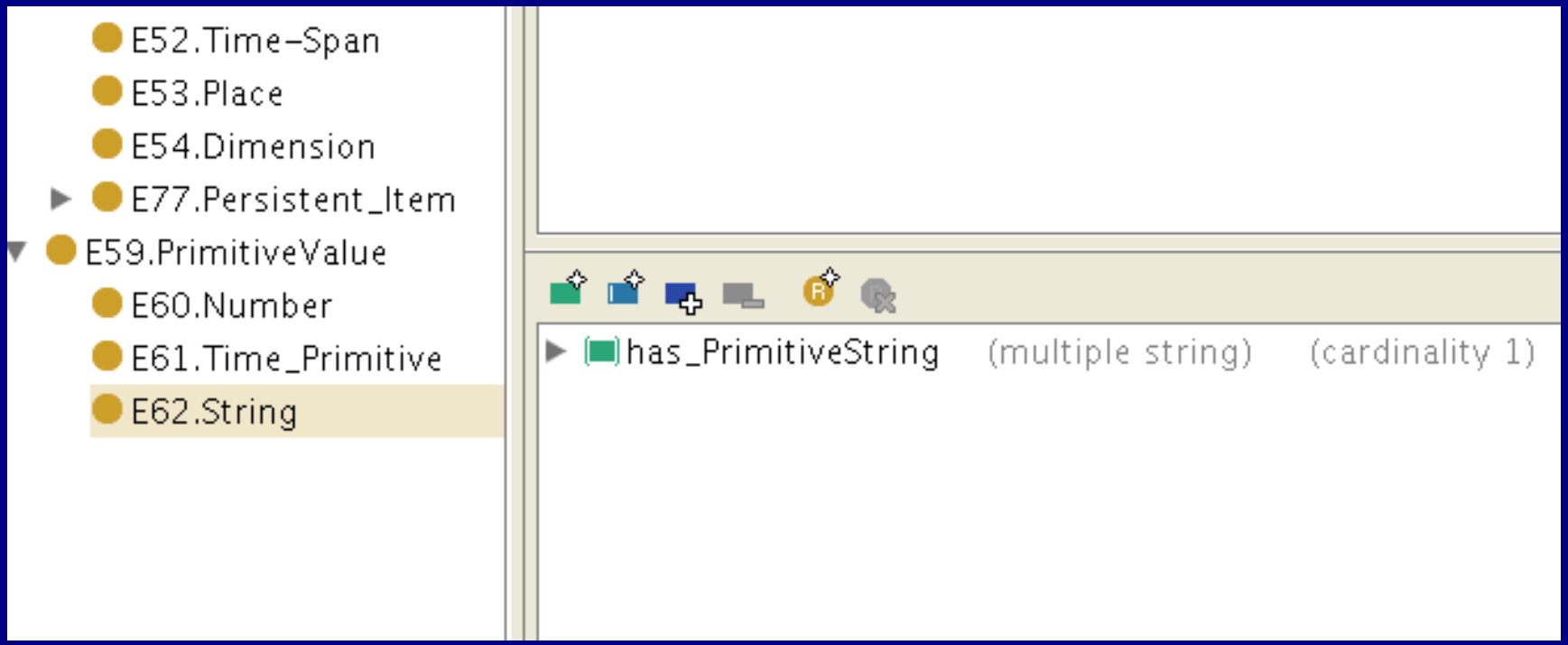
# E52.Time_Span



# Properties of E52.Time_Span



# E62.String


E52.Time-Span
E53.Place
E54.Dimension
E77.Persistent_Item
E59.PrimitiveValue
E60.Number
E61.Time_Primitive
E62.String
has_PrimitiveString (multiple string) (cardinality 1)

# Implementation scheme for museums

- Use CRM OWL-DL as the reference ontology
- Model the application ontology (AO) with subconcepts of CRM
- Concept hierarchy corresponds to DB schema
- Individuals correspond to database entries
- Consistency checks: DL reasoners, e.g. RACER
- Use AO as basis for new applications
- Integration of data from other museums with specialised CRM OWL-DL on CRM level
- CRM should become Reference Ontology

# Literature & Links

- Protege: http://protege.stanford.edu/
- TopBraid: http://www.topquadrant.com/topbraid/composer/index.html
- OilEd: http://oiled.man.ac.uk/
- Semantic Guide: http://www.ontoprise.de/index.php?id=34
- SWOOP: http://code.google.com/p/swoop/
- RACER: http://www.racer-systems.com/
- FaCT++: http://owl.man.ac.uk/factplusplus/
- Pellet: http://pellet.owldl.com/

# Literature & Links


- Web Ontology Language (OWL) Guide Version 1.0 W3C Working Draft 4 November 2002
- W3C OWL Abstract Syntax and Semantics http://www.w3.org/TR/owl-semantics/
- I. Horrocks: „Reasoning with DAML+OIL: What can it do for YOU?“
- SWRL: I. Horrocks, P. F. Patel-Schneider, H. Boley, S. Tabet, B. Grosof, and M. Dean. Swrl: A semantic web rule language combining owl and ruleml, 2003. Available at http://www.daml.org/2003/11/swrl/

# Summary

# Thank you!

- For your Attention!
- Questions?