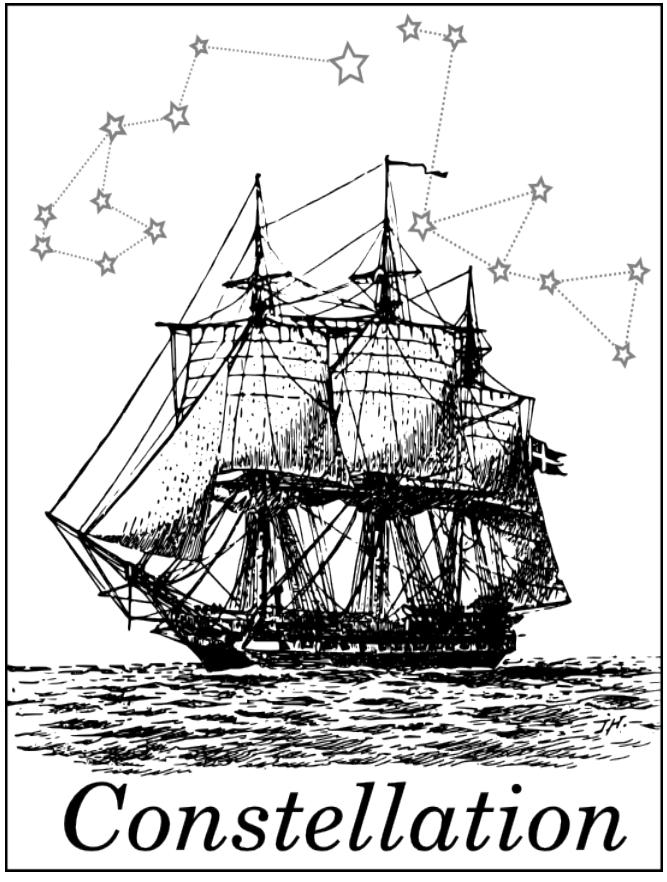


Gramm Richardson - U.S. Department of Defense
Elli Schwarz - SRA International, Inc.

30 May, 2012

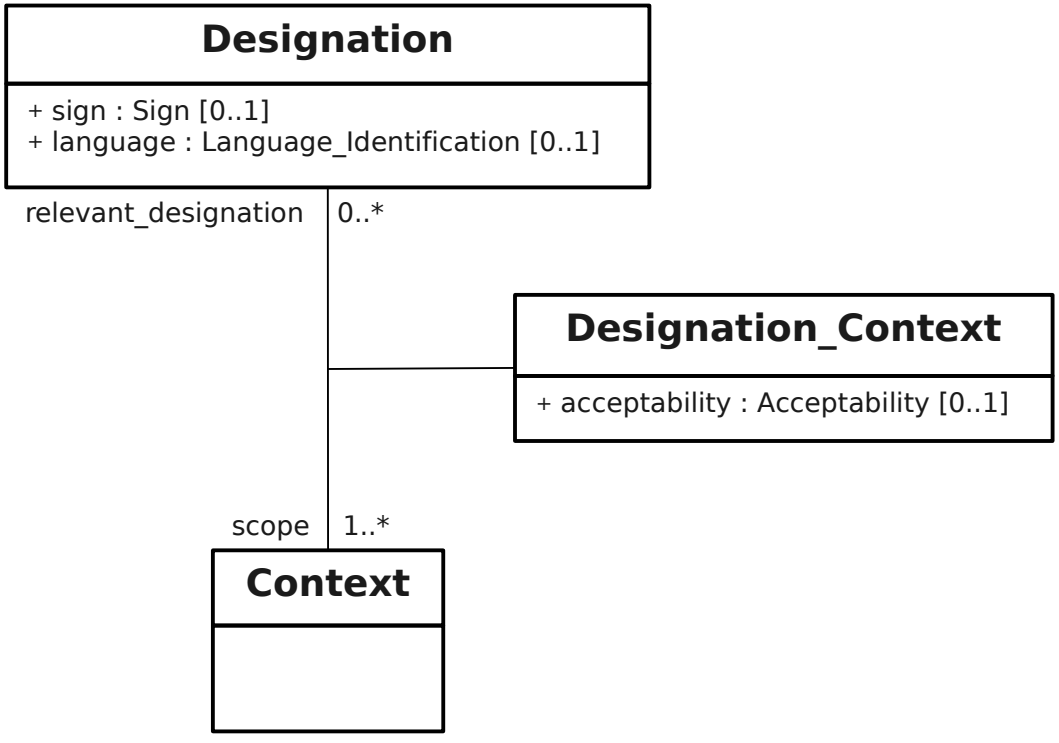
ISO/IEC 11179-3 Metamodel OWL Ontology

- 58 Classes
- 74 Datatype properties
- 113 Object properties
- Inspired by Kevin Keck's 11179 OWL Ontology
- Implementation Decision
  - XML Schema Datatypes
  - Implementation-specific subclassing
- Implemented
  - Concepts metamodel region
  - Conceptual and Value_Domain region
  - Designation and Definition metamodel region

Assertion
    Link
Classifiable_Item
Classification
Concept
    Conceptual_Domain
        Described_Conceptual_Domain
        Enumerated_Conceptual_Domain
    Data_Element_Concept
    Dimensionality
    Object_Class
    Property
    Relation
        Binary_Relation
    Relation_Role
    Unit_of_Measure
    Value_Meaning
Concept_System
Contact
    Registrar
Context
Data_Element
Data_Element_Derivation
Data_Element_Example
Datatype
Definition
Definition_Context
Derivation_Rule
Designatable_Item
Designation
Designation_Context
Document_Type
Identified_Item
    Registered_Item
        Administered_Item
        Attached_Item
Individual
Language_Identification
Link_End
Namespace
Naming_Convention
Organization
    Registration_Authority
Permissible_Value
Reference
Reference_Document
Registration
Registration_Authority_identifier
Registration_State
Registry_Specification
Role
Scoped_Identifier
Slot
Stewardship_Record
Submission_Record
Value_Domain
    Described_Value_Domain
    Enumerated_Value_Domain

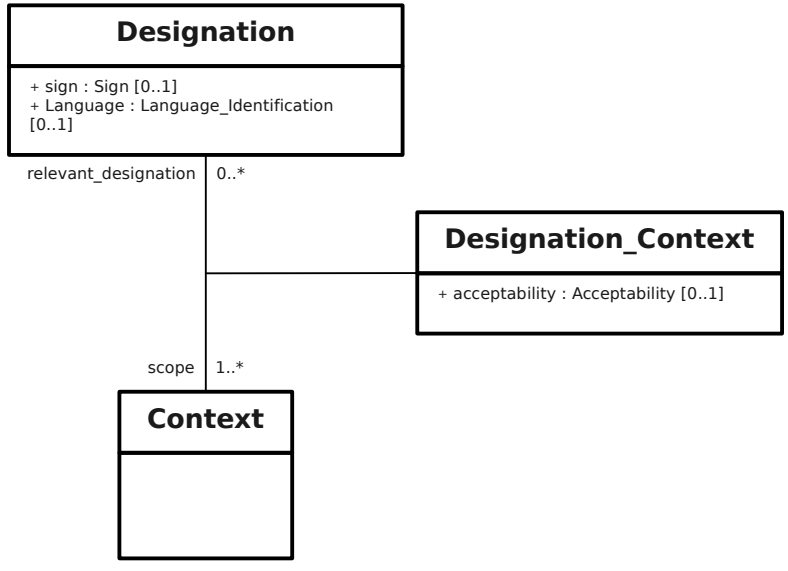
ISO/IEC 11179-3 Metamodel OWL Ontology

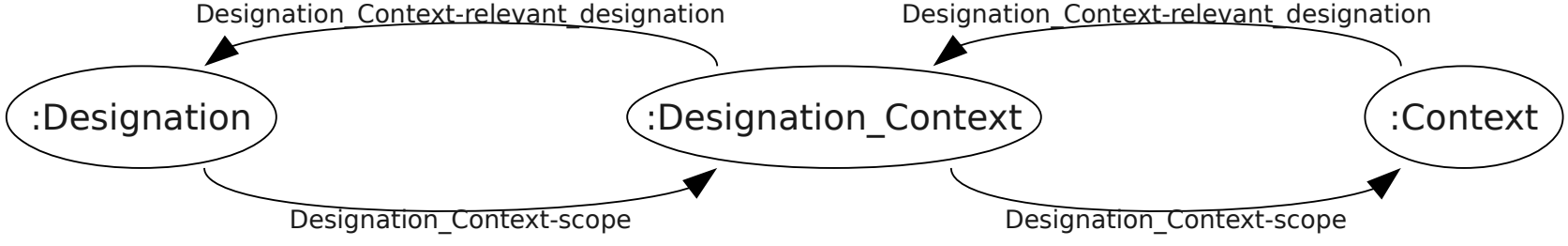
- Association classes
- Implemented in OWL 1 and RDF as a class with additional properties



ISO/IEC 11179-3 Metamodel OWL Ontology

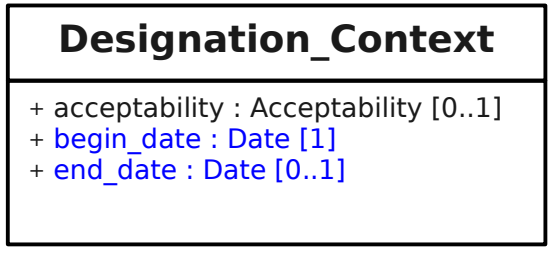
- Association classes
- Implemented in OWL 1 and RDF as a class with additional properties
- OWL object properties created from a combination of metamodel association and role





ISO/IEC 11179-3 Metamodel OWL Ontology

- begin_date and end_date extension for Designation_Context
- at first, an accommodation for difficulties in removing RDF triples from the graph store
- Supports management of the history of a term's acceptability in a context

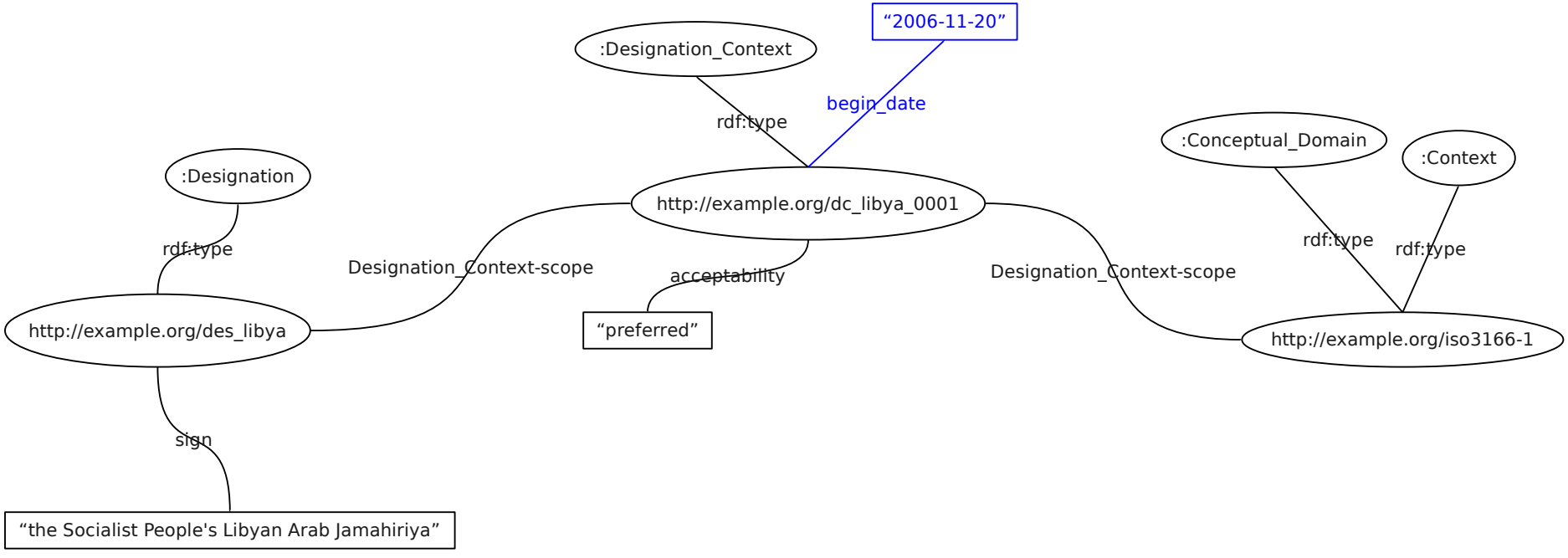


ISO/IEC 11179-3 Metamodel OWL Ontology

- begin_date and end_date extension for Designation_Context

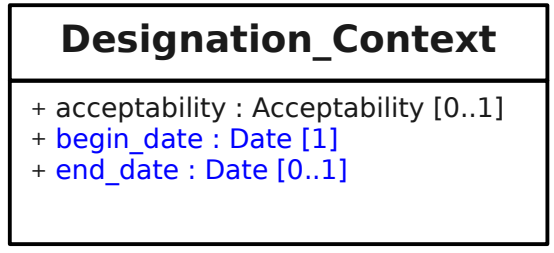
Designation_Context

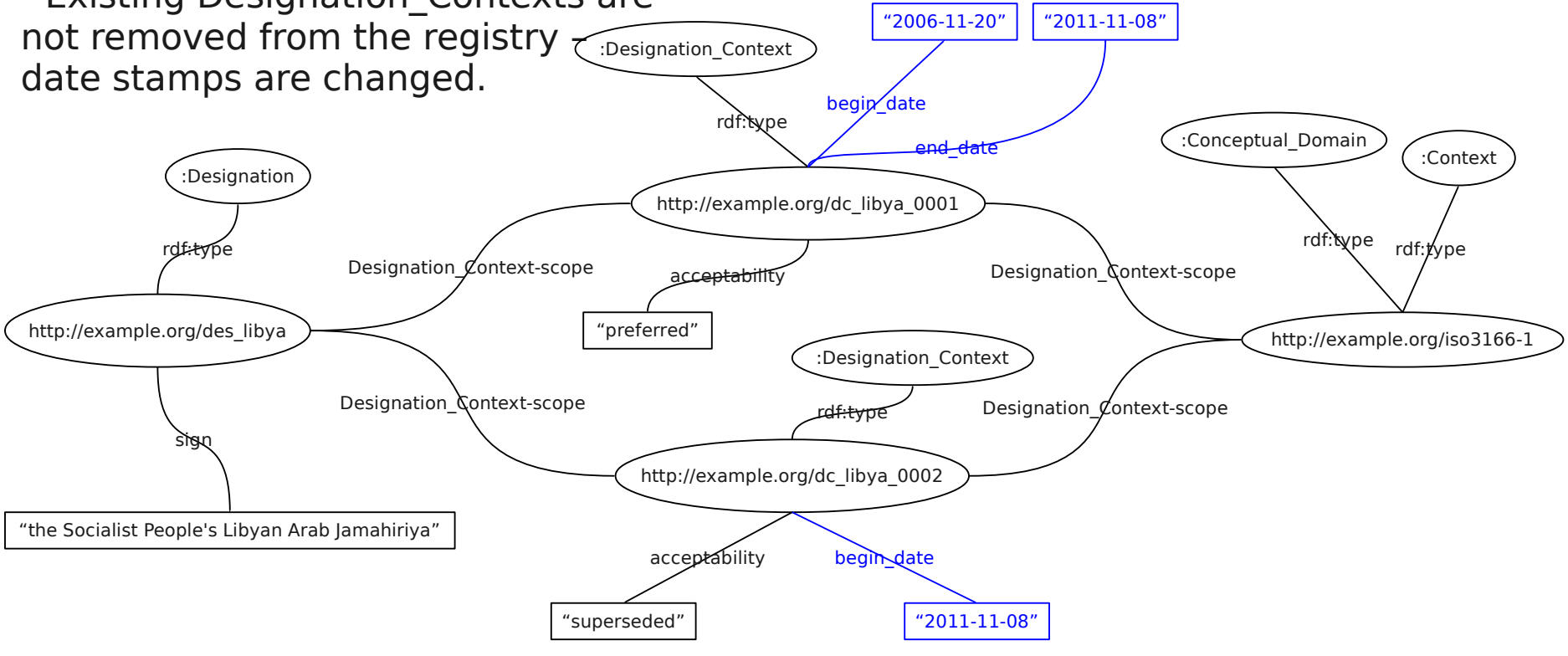
+ acceptability : Acceptability [0..1]
+ begin_date : Date [1]
+ end_date : Date [0..1]



ISO/IEC 11179-3 Metamodel OWL Ontology

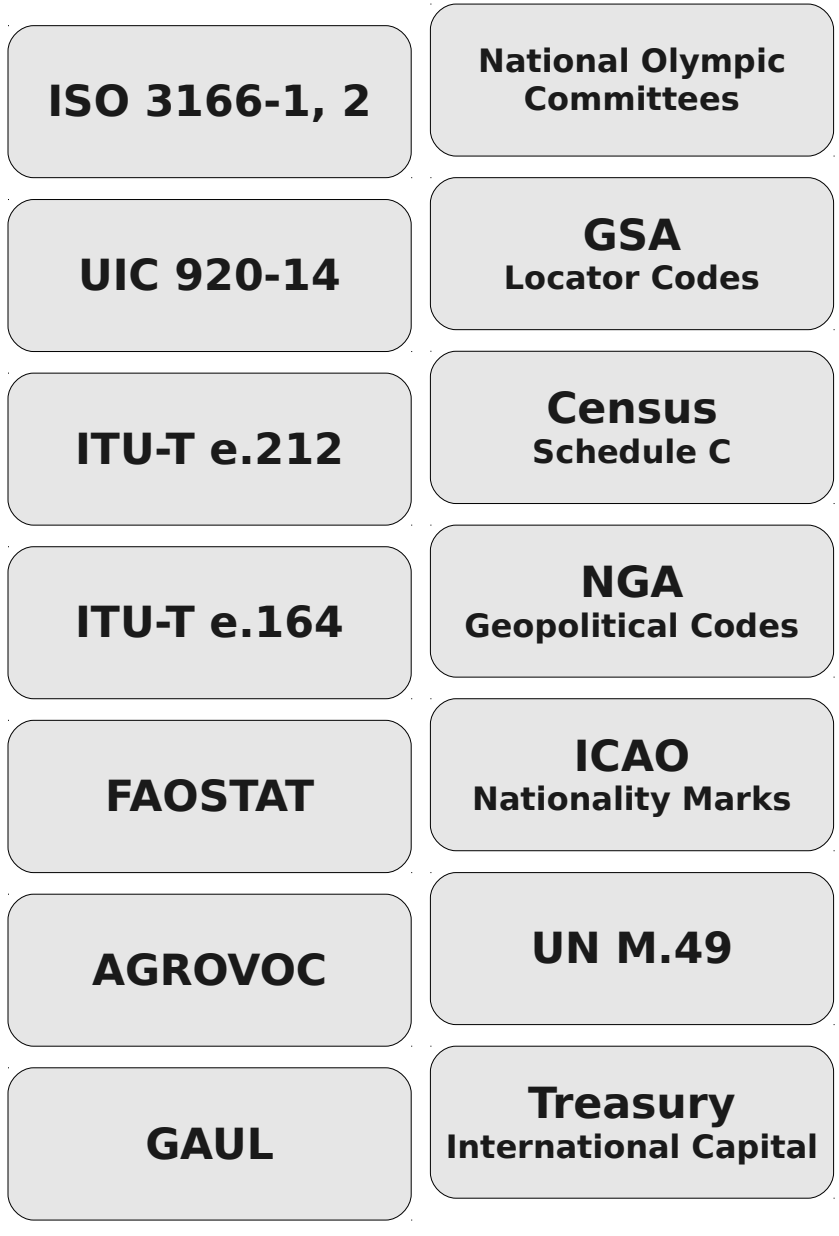
- Updating the Designation_Context is a strictly additive process.
- Conceptual_Domain as the Context for Designations
- Existing Designation_Contexts are not removed from the registry – date stamps are changed.





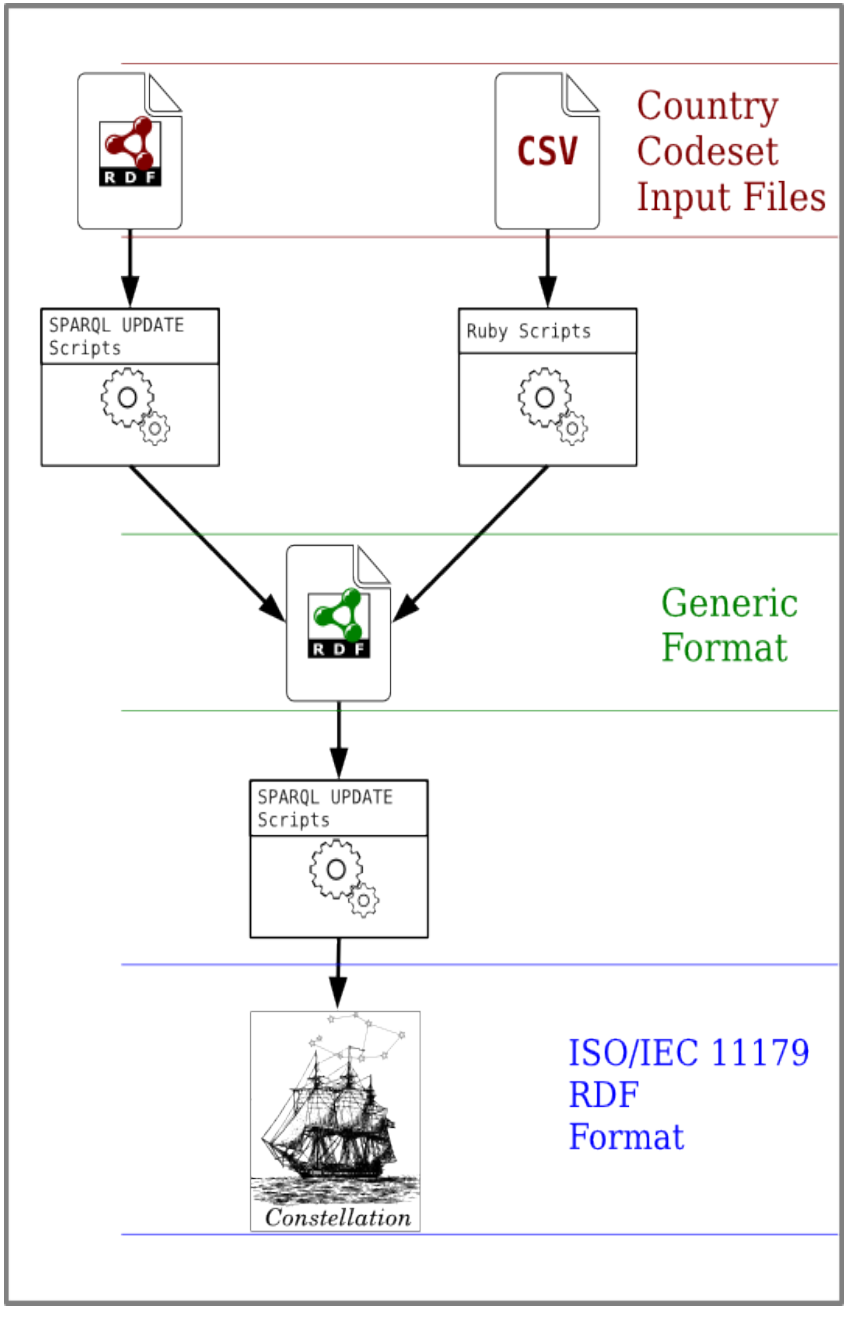
Country Code Sets as Conceptual_Domains and Value_Domains

- Need a methodology that can be generalized to multiple code sets.
- Concept_Systems for first order or second order geopolitical entities
- Working with ≈12 code sets, designations in 8 languages fully covering one or more code sets



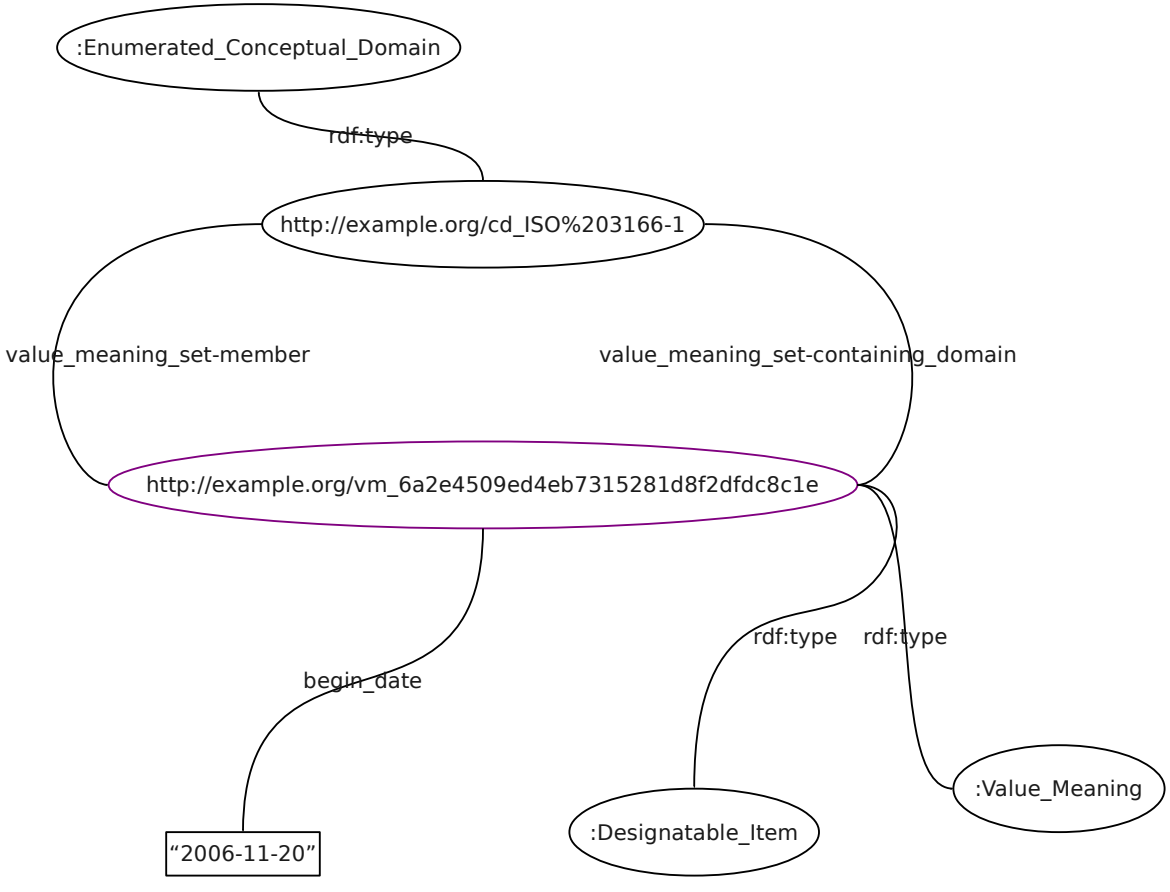
Implementation

- Able to ingest any code sets in RDF format or CSV format with established columns
- Intermediate/generic RDF format
  - Makes it easier to have one workflow to transform data to 11179 format
  - Puts the data in a uniform state for easy comparison
- Store processed code sets in 11179-formatted metadata in RDF Triple Store



ISO 3166-1:2006 Implementation

- One Conceptual_Domain, three Value_Domains
  - alphabetic2
  - alphabetic3
  - numeric3
- Value_Meanings are also typed as Designatable_Items

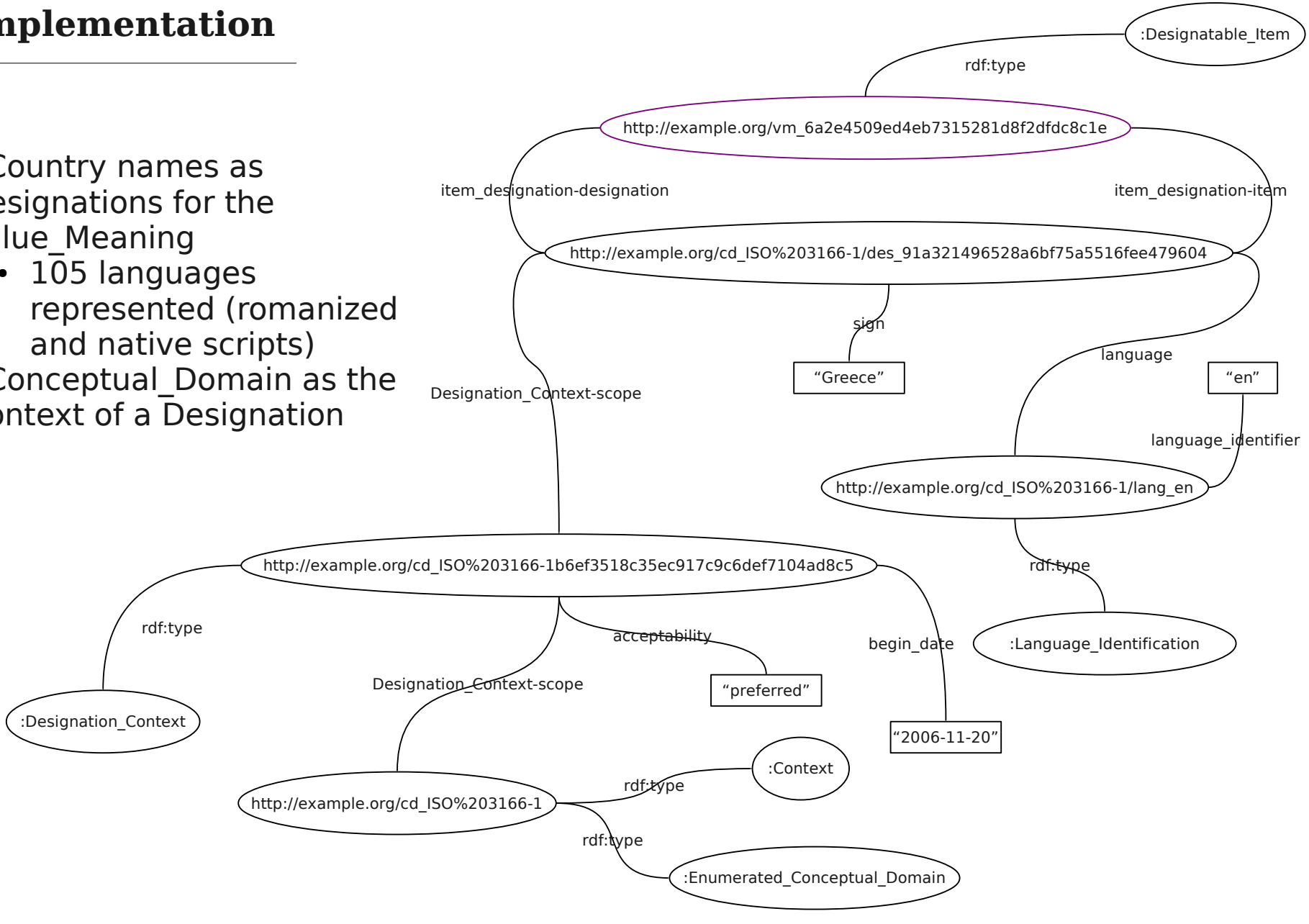


ISO 3166-1:2006 Implementation

- URIs for Permissible_Values are constructed using the path for the Value_Domain URI
- Decided to represent names of countries as Designations rather than Permissible_Values
- Used Permissible_Values for the country codes.

ISO 3166-1:2006 Implementation

- Country names as Designations for the Value_Meaning
  - 105 languages represented (romanized and native scripts)
- Conceptual_Domain as the Context of a Designation



Metamodel Implementation Challenges

- Indirection and complex 11179 metamodel creates problems for
  - Query performance
  - Query maintainability
- For example
  - Relations and Links
  - Designatable_Items
  - Multi-page SPARQL queries to account for optional class associations and attributes.
- SKOS reimplementation as a 11179 Concept_System
- Link-centric vs. Role-centric
- Representation of Links and Relations has changed as ISO/IEC 11179-3 FDIS sneak peeks were released

```
                    cmdr:item_designation-item ?country;
                    rdf:type cmdr:Designation.
      ?country a cmdr:Value_Meaning;
                rdf:value ?vmValue;
                cmdr:permissible_value_meaning-represe
                cmdr:value_meaning_set-containing_dom
                cmdr:begin_date ?countryBeginDate .

OPTIONAL {
  ?country cmdr:concept_system_membership-includi
            a <http://constellation.jhuapl.edu/countryM
            rdf:value ?matchUUID
]
}

OPTIONAL {
 ?country2  cmdr:language [cmdr:language_identifier
}

filter(!BOUND(?lang2) || ?lang2 = "en")

BIND ( concat("results-frame.html?
queryName=DesignationQuery&showHeader=true&$
m=", ENCODE_FOR_URI(str(?country2)) ) as ?country2
}
     OPTIONAL { ?country cmdr:end_date ?countryEnd
                    cmdr:begin_date ?countryBeginDat
 }

#In order for hyperlinks to work with groups, we need
as a URL and not convert it using the linkformatter in
BIND ( concat("<a href='", "results-frame.html?
queryName=GenericQuery&showHeader=true&$Data
yURI=", ENCODE_FOR_URI(str(?faoURL)), "'>",?vmValu

BIND ( if(bound(?hyperLink), ?hyperLink, ?country) as

BIND ( concat("results-frame.html?
queryName=DesignationQuery&showHeader=true&$
m=", ENCODE_FOR_URI(str(?country)) ) as ?countryLi

BIND ( concat("results-frame.html?
```

Benefits of ISO/IEC 11179 Metamodel

• Representing countries using Value_Meanings belonging to Enumerated_Conceptual_Domains, and having Designations and Permissible_Values creates a common framework for promoting data understanding
• Representing code sets in 11179 OWL ontology further facilitates:
  - Uniform data representation
  - Querying across diverse data sources
  - Avoiding terminology conflicts
• Flexibility of the metamodel supports easily adding/modifying information (new code set elements, relationships, updating names or codes for countries)

Postprocessing - Country Matching System

- Semiautomated
- Based on normalized names and trigram similarity with manually-curated truth data
  - “Côte d'Ivoire” ⇄ “COTE D'IVOIRE”
  - “United States of America” ⇄ “United States”
  - “Republic of Korea” ⇄ “South Korea”
  - “Burma” ⇄ “Myanmar”
- Using skos:closeMatch implemented as a 11179 Relation to associate similar countries
- Each set of matched countries is a Concept_System. The elements in the Concept_System are Value_Meanings that are related to each other via skos:closeMatch.

SPARQL Query System

- SPARQL query templates
  - Provide multiple views of the data
    - Grouping by matched countries
    - Querying by code or name
    - Querying for names in multiple languages or acceptabilities
    - Querying by transnational grouping
  - Specific variables can be parameters for REST services (code, conceptual_domain, country_name)
- Data analysis
- SPARQL 1.1

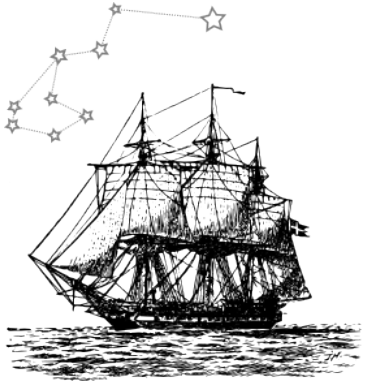
Modeling Challenges

• Difference of opinion between code sets on what geopolitical entities are 'first order' and which are 'second order'
  - U.S. Virgin Islands assigned different codes in ISO 3166-1 and ISO 3166-2
  - British Virgin Islands absent in 3166-2

• Semantics of identical terms can vary across code sets
  - 'unknown', 'undefined', 'reserved'
  - China (whether Hong Kong or Macao are assigned their own codes)

Future Direction

- Implement the Registry metamodel region
  - Research vs. Productization
- Update the ontology to edition 3 IS and use OWL 2 punning.
  - Investigate SPARQL query implementation and maintainability impact.
- Research the management of other types of metadata artifacts.



Constellation