BS ISO/IEC 19788-7:2019

BSI Standards Publication

Information technology — Learning, education and training — Metadata for learning resources

Part 7: Bindings

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National foreword

This British Standard is the UK implementation of ISO/IEC 19788-7:2019.

The UK participation in its preparation was entrusted to Technical Committee IST/43, Information technology for learning, education and training.

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Part 7: Bindings

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training.*

A list of all parts in the ISO/IEC 19788 series can be found on the ISO website.

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Introduction

The primary purpose of the ISO/IEC 19788 series is to facilitate: (1) the description of a learning resource by providing a standards-based approach to the identification and specification of the metadata elements required to describe a learning resource, e.g. as a metadata learning resource (MLR) record; and (2) the search, discovery, acquisition, evaluation, and use of learning resources, for instance by learners, instructors or automated software processes.

The ISO/IEC 19788 series is modularly structured with all subsequent parts corresponding to a specified set of user requirements for the identification and specification of metadata elements having a particular focus and intended use in the description of a learning resource. This includes categories of metadata elements focused on technical perspectives, pedagogical aspects, availability and intellectual property aspects, bindings, etc.

This document maps the different ISO/IEC 19788-1 constructs to machine readable/understandable entities. This document also proposes global (non-linguistic) identifiers for MLR entities and localized (linguistic) identifiers for the same MLR entities.

The primary purpose of the ISO/IEC 19788 series is to specify elements and their attributes for the description of learning resources. This includes the rules governing the identification of data elements and the specification of their attributes.

The ISO/IEC 19788 series provides data elements for the description of learning resources and resources directly related to learning resources.

The ISO/IEC 19788 series provides principles, rules and structures for the specification of the description of a learning resource; it identifies and specifies the attributes of a data element as well as the rules governing their use. The key principles stated in ISO/IEC 19788-1 are informed by a user requirements-driven context with the aim of supporting multilingual and cultural adaptability requirements from a global perspective.

ISO/IEC 19788-1 is information technology neutral and defines a set of common approaches, i.e. methodologies and constructs, which apply to the development of the subsequent parts of the ISO/IEC 19788 series.

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1 Scope

This document provides RDF mappings of the different MLR entities introduced in the MLR framework (ISO/IEC 19788-1 and its amendment): data element specifications (DESs), resource classes (RCs), data elements (DEs), application profiles (APs), MLR records and data element group specifications (DEGSs).

This document associates HTTP IRIs (linguistically neutral and linguistic) to **conceptual** MLR entities denoted by MLR identifiers. This is needed for the management of MLR entities and their versions.

Moreover, this document provides excerpts of an OWL 2 DL ontology for the resource classes and data element specifications (properties) introduced in the ISO/IEC 19788 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 639-2, *Codes for the representation of names of languages — Part 2: Alpha-3 code*

ISO 639-3,[1)] *Codes for the representation of names of languages — Part 3: Alpha-3 code for comprehensive coverage of languages*

ISO 3166-1,[2)] *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO 15924,[3)] *Information and documentation — Codes for the representation of names of scripts*

ISO/IEC 11404, [4)], *Information technology — General-Purpose Datatypes (GPD)*

ISO/IEC 19788-1:2011,[5)] *Information technology — Learning, education and training — Metadata for learning resources — Part 1: Framework*

ISO/IEC 19788-1:2011/Amd 1:2014, *Information technology — Learning, education and training — Metadata for learning resources — Part 1: Framework/Amendment 1*

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1) The name and contact information of the Registration Authority for this ISO 639-3 can be found at http://www.iso.org/mara.

2) Alpha-2 codes available at http://www.iso.org/iso/country_codes/iso_3166_code_lists/country_names_and_code_elements.htm.

3) Codes available at http://www.unicode.org/iso15924/codelists.html.

4) Freely available at http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html.

5) Freely available at http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html.

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ISO/IEC 19788-2, *Information technology — Learning, education and training — Metadata for learning resources — Part 2: Dublin Core elements*

ISO/IEC 19788-2:2011/Amd 1:2016, *Information technology — Learning, education and training — Metadata for learning resources — Part 2: Dublin Core elements/Amendment 1: Non-literal content value data elements*

ISO/IEC 19788-5:2012, *Information technology — Learning, education and training — Metadata for learning resources — Part 5: Educational elements*

ISO/IEC 19788-8:2015, *Information technology — Learning, education and training — Metadata for learning resources — Part 8: Data elements for MLR records*

IETF BCP 47: 2009,[6] Tags for Identifying Languages

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19788-1 and ISO/IEC 19788-1:2011/Amd 1:2014 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
conceptual
<MLR entity> the qualified entity captures the "essence" of an MLR entity defined in an ISO/IEC 19788 part and further versioned in later parts of ISO/IEC 19788 (e.g. in later editions, amendments or corrigenda)

EXAMPLE 1 Conceptual DES.

EXAMPLE 2 Conceptual RC.

EXAMPLE 3 Conceptual vocabulary.

EXAMPLE 4 Conceptual vocabulary term.

Note 1 to entry: MLR entities are identified with MLR identifiers, and conceptual MLR entities are identified with canonical MLR identifiers.

3.2
blank node
<rdf> element from a *blank node set* (3.3)

Note 1 to entry: In an *RDF graph* (3.14) a blank node indicates the existence of a thing, without using an *IRI* (3.8) or a *literal* (3.10) to denote it. A blank node may be thought of as referring to an anonymous resource.

Note 2 to entry: In concrete RDF syntaxes, when identified, blank node identifiers are locally scoped to their container and are NOT persistent.

Note 3 to entry: The MLR standard does not use blank nodes. Each blank node is replaced by a globally unique IRI (a Skolem IRI).

Note 4 to entry: In Turtle, a concrete syntax for RDF, blank nodes in triples are expressed as _: followed by a blank node label (e.g. `_:alice`, `_:0-34-abc`).

6) See http://tools.ietf.org/html/bcp47.

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3.3
blank node set
<rdf> infinite set disjoint from the set of all *IRI*s (3.8) and the set of all *literal*s (3.10)

Note 1 to entry: Any blank node set, the set of all IRIs and the set of all literals are pairwise disjoint.

Note 2 to entry: No other conditions are imposed on a blank node set than being disjoint from IRIs and literals.

3.4
content negotiation
<web architecture> practice of providing multiple *representation*s (3.20) available via the same URI

Note 1 to entry: Which representation is served depends on negotiation between the requesting agent and the agent serving the representations.

[SOURCE: Architecture of the World Wide Web, Volume One. W3C Recommendation. Available from: http://www.w3.org/TR/2004/REC-webarch-20041215/]

3.5
graph store
<rdf> mutable container of *RDF graph*s (3.14) managed by a single service

Note 1 to entry: Graph stores are similar to *RDF datasets* (3.12), but unlike an RDF dataset, named graphs can be added to or deleted from a graph store.

Note 2 to entry: A graph store can be viewed as a mutable RDF dataset.

[SOURCE: SPARQL 1.1 Update — W3C Recommendation 21 March 2013, Section 2. Available from: http://www.w3.org/TR/2013/REC-sparql11-update-20130321/]

3.6
information resource
<web architecture> resource which has the property that all of its essential characteristics can be conveyed in a message

EXAMPLE The information content of the book "Turtle, Termites, and Traffic Jams" by Mitchel Resnick (ISBN 0-262-18162-2) is an information resource. However, the physical object "Turtle, Termites, and Traffic Jams" book owned by Gilles Gauthier is not an information resource.

[SOURCE: Architecture of the World Wide Web, Volume One. W3C Recommendation. Available from: http://www.w3.org/TR/2004/REC-webarch-20041215/]

3.7
Internationalized Resource Identifier
IRI
<general> sequence of characters that conforms to the syntax defined in RFC 3987

Note 1 to entry: IRIs may be written on paper, read aloud, stored or transmitted digitally. The same IRI may be represented in many different ways.

3.8
Internationalized Resource Identifier
IRI
<rdf> Unicode/ISO/IEC 10646 string that conforms to the syntax defined in RFC 3987

Note 1 to entry: IRIs in the RDF abstract syntax MUST be absolute and MAY contain a fragment identifier.

Note 2 to entry: When IRIs are used in operations that are only defined for URIs, they must first be converted according to the mapping defined in section 3.1 of RFC 3987. A notable example is retrieval over the HTTP protocol. The mapping involves UTF-8 encoding of non-ASCII characters, %-encoding of octets not allowed in URIs, and Punycode-encoding of domain names.

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[SOURCE: RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 3.2. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.9
language-tagged string
<rdf> *literal* (3.10) for which the third component is present

Note 1 to entry: Most concrete RDF syntaxes represent language-tagged strings without the datatype IRI because it always equals `http://www.w3.org/1999/02/22-rdf-syntax-ns#langString`.

3.10
literal
<rdf> entity comprising two or three elements:

— a **lexical form**, being a Unicode string, which should be in Normal Form C,

— a **datatype IRI**, being an *IRI* (3.8) identifying a datatype that determines how the lexical form maps to a literal value, and

— if and only if the datatype IRI is `http://www.w3.org/1999/02/22-rdf-syntax-ns#langString`, a non-empty language tag as defined by BCP 47. The language tag MUST be well-formed according to section 2.2.9 of BCP 47

[SOURCE: RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 3.3. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.11
media type
metadata for a *representation* (3.20), as per IETF RFC 6838, that provides format specification and preferred interpretation for the representation

EXAMPLE image/jpeg, image/svg+xml, text/plain, text/html, text/turtle, video/H264, application/xhtml+xml, application/trig, application/ld+json, application/json, application/rdf_xml.

Note 1 to entry: Media types, also called Internet media types, were previously called MIME types when used essentially for email sent through the SMTP protocol.

Note 2 to entry: Registry of Internet media type is available online at http://www.iana.org/assignments/media-types.

3.12
RDF dataset
collection of RDF graphs comprising of

— exactly one **default graph**, being an *RDF graph* (3.14), and

— zero or more **named graphs**

Note 1 to entry: The default graph does not have a name and MAY be empty.

Note 2 to entry: Each named graph is a pair consisting of an *IRI* (3.8) or a *blank node* (3.2) (the ***graph name***), and an RDF graph. Graph names are unique within an RDF dataset.

Note 3 to entry: Blank nodes can be shared between graphs in an RDF dataset.

Note 4 to entry: RDF datasets are non-mutable (immutable): adding or removing RDF triples or RDF graphs from an RDF dataset yields a different RDF dataset.

Note 5 to entry: Despite the use of the word “name” in “named graph”, the graph name is not required to denote the graph. It is merely syntactically paired with the graph. RDF does not place any formal restrictions on what resource the graph name may denote, nor on the relationship between that resource and the graph.

[SOURCE: Adapted from RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 4. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

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3.13
RDF document
<rdf> document that encodes an *RDF graph* (3.14) or *RDF dataset* (3.12) in a concrete RDF syntax, such as Turtle, RDFa, JSON-LD or TriG

Note 1 to entry: RDF documents enable the exchange of RDF graphs and RDF datasets between systems.

[SOURCE: RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 1.8. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.14
RDF graph
set of *RDF triples* (3.18)

Note 1 to entry: RDF graphs are non-mutable (immutable): adding or removing RDF triples from an RDF graph yields a different RDF graph.

3.15
RDF node set
set of subjects and objects from all the *RDF triples* (3.18) of an *RDF graph* (3.14)

3.16
RDF source
persistent and mutable source or container for *RDF graphs* (3.14)

Note 1 to entry: An RDF source is a resource whose state can change over time.

Note 2 to entry: Examples of RDF sources are files containing a serialization of an RDF graph using a concrete RDF syntax and *triple stores* (3.22).

[SOURCE: Adapted from RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 1.5. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.17
RDF term
IRI (3.8), *literal* (3.10) or *blank node* (3.2)

Note 1 to entry: IRIs, literals and blank nodes are distinct and distinguishable. For example, `http://example.org/` as a string literal is neither equal to `http://example.org/` as an IRI, nor to a blank node with the blank identifier `http://example.org/`.

[SOURCE: RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 3.1. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.18
RDF triple
entity consisting of three ordered components, namely

— the **subject**, which is an *IRI* (3.8) or a *blank node* (3.2),

— the **predicate**, which is an IRI, and

— the **object**, which is an IRI, a *literal* (3.10) or a blank node

Note 1 to entry: Any IRI denotes an entity in the world (the "universe of discourse").

Note 2 to entry: Triples are written in the order subject, predicate, object.

[SOURCE: Adapted from RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 3.1. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

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3.19
RDF vocabulary
collection of *IRI*s (3.8) intended for use in *RDF graph*s (3.14)

[SOURCE: RDF 1.1 Concepts and Abstract Syntax — W3C Recommendation 25 February 2014, Section 1.4. Available from: http://www.w3.org/TR/2014/REC-rdf11-concepts-20140225/]

3.20
representation
<web architecture> data that encode information about resource state

Note 1 to entry: A resource may have more than one representation: The information resource "Turtle, Termites, and Traffic Jams" by Mitchel Resnick (ISBN 0-262-18162-2) could have textual representations (plain text, HTML, epub, portable document format (PDF), Microsoft Word, Braille, etc.), representations in various languages (English, French, etc.), audio representations, etc.

Note 2 to entry: Metadata such as character encoding (e.g. UTF-8, UTF-16, US-ASCII, ISO-8859-1) or content encoding (e.g. XML, HTML, JPEG video, JSON file) may be provided.

[SOURCE: Adapted from Architecture of the World Wide Web, Volume One. W3C Recommendation, 2004. Available from: http://www.w3.org/TR/2004/REC-webarch-20041215/]

3.21
simple literal
<rdf> *literal* (3.10) for which the datatype *IRI* (3.8) is `http://www.w3.org/2001/XMLSchema#string`

Note 1 to entry: Most concrete syntaxes represent simple literals without the datatype IRI because it always equals `http://www.w3.org/2001/XMLSchema#string`.

3.22
triple store
<rdf> specialized database for the storage and retrieval of *RDF triple*s (3.18)

Note 1 to entry: A triple store is an *RDF source* (3.16).

3.23
Web resource
information resource (3.6) that "lives on the World Wide Web"

Note 1 to entry: A Web resource can be denoted by an HTTP IRI and under normal conditions (server not down), a representation of the resource (the exact representation retrieved might depend on content negotiation) can be retrieved using that IRI and the HTTP protocol.

4 Symbols and abbreviated terms

AP Application Profile

DEGS Data Element Group Specification

DES Data Element Specification

FOAF Friend of a Friend

HTTP Hypertext Transfer Protocol

IRI Internationalized Resource Identifier

JSON JavaScript Object Notation

JSON-LD JavaScript Object Notation for Linking Data

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MLR	Metadata for Learning Resource
OWL	Web Ontology Language
PRS	Predefined Rule Set
PURL	Persistent Uniform Resource Locator
RC	Resource Class
RDF	Resource Description Framework
SKOS	Simple Knowledge Organization System
TriG	RDF Dataset Language
Turtle	Terse RDF Triple Language
URI	Uniform Resource Identifier
VOC	Vocabulary
W3C	World Wide Web Consortium
XML	Extensible Markup Language

5 IRIs/URIs for ISO/IEC 19788 entities

5.1 MLR identifiers

The ISO/IEC 19788 series makes available **data element specification**s (DESs), **resource class**es (RCs), **data element group specification**s (DEGSs) and **application profile**s (APs). The ISO/IEC 19788 series assigns globally unique, persistent identifiers for those objects, as specified in the production rules (see ISO/IEC 19788-1:2011, B.2).

Examples of MLR identifier[7]:

1) **Data element specification** (DES) from ISO/IEC 19788-2 (Dublin Core elements) —
ISO/IEC 19788-2:2011, 5.1:
ISO_IEC_19788-2:2011::DES0100 (title)

2) **Data element specification** (DES) from ISO/IEC 19788-2 (Dublin Core elements) —
ISO/IEC 19788-2:2011/Amd 1:2016, 5.16:
ISO_IEC_19788-2:2011:AMD.1:2015::DES1600 (creator)

3) **Resource class** (RC) from ISO/IEC 19788-1 (Framework) —
ISO/IEC 19788-1:2011, 8.4.2:
ISO_IEC_19788-1:2011::RC0002 (Learning Resource)

4) **Predefined rule set** (PRS) from ISO/IEC 19788-1 (Framework) —
ISO/IEC 19788-1:2011, 9.4:
ISO_IEC_19788-1:2011::PRS0003 (Date & Time)

5) **Data element group specification** (DEGS) from ISO/IEC 19788-3 (Basic application profile) —
ISO/IEC 19788-3:2011, 6.1:
ISO_IEC_19788-3:2011::DEGS0001 (MLR Basic data element group specification)

7) Terms between parentheses, e.g. (title), at the end of MLR identifiers are not part of the identifiers; they are only provided to ease the reading of the present document.

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6) **Application profile** (AP) from ISO/IEC 19788-3 (Basic application profile) —
ISO/IEC 19788-3:2011, Clause 5:
ISO_IEC_19788-3:2011::AP0001 (MRL Basic Application Profile)

7) **Vocabulary** (V) from ISO/IEC 19788-5 (Educational elements) —
ISO/IEC 19788-5:2012, A.1:
ISO_IEC_19788-5:2012::V0100 (Agent role)

NOTE See B.7, Footnote 25.

8) **Vocabulary term** (T) from ISO/IEC 19788-5 (Educational elements) —
ISO/IEC 19788-5:2012, A.1:
ISO_IEC_19788-5:2012::V0100:T020 (validator)

5.2 RFC 5141-based identifier for ISO/IEC 19788 standard identifiers

In the context of the World Wide Web and the Semantic Web, there is a need to have global identifiers based on URIs for MLR identifiers. Fortunately, the ISO Central Secretariat has already published the specification of a syntax for URNs that identifies documents developed (as per the ISO/IEC Directives) by the International Organization for Standardization (ISO): RFC 5141 — A Uniform Resource Name (URN) for the International Organization for Standardization (ISO)[8].

RFC 5141 identifiers are globally unique, persistent and location-independent, and allow for the identification of any clause from an ISO standard.

The ISO/IEC 19788 identifiers make use of only a subset of the RFC 5141: the part needed to identify the ISO/IEC 19788 documents or resources extracted from such documents (for any of its parts, in any of its editions, versions, amendments, corrigenda, etc.).

The RFC 5141 URN identifiers used in this document are constructed using the following production rules (using the syntax of IETF RFC 5141):

```
RFC5141_URN_Identifier[9] = "urn:iso:std:iso-iec:19788" [":" partnumber]
                            [[":" status] ":" edition][":" docversion]
                            *supplement [addition[10]]
```

Table 1 provides examples of RFC 5141 URN for ISO/IEC 19788-related standards given in the first column.

8) RFC 5141: http://tools.ietf.org/html/rfc5141.

9) The *type*, *language* and *docelement* constructs of RFC 5141 are not used in this document.

10) This document uses the following RFC 5141 production rules:

```
addition     = techdefined | isodefined

techdefined = ":tech" *techelement

techelement = <unspecified>
```

with the following exception: The part ":tech" of the "techdefined" construct is not used as no ambiguities are introduced doing so and the resultings MLR identifiers are then more "natural". This may be reviewed if necessary.

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Table 1 — RFC 5141 URN identifier of standard examples

Standard	RFC5141_URN_Identifier
ISO_IEC_19788-2:2011	urn:iso:std:iso-iec:19788:-2:ed-1
ISO_IEC_19788-2:2011(E)	urn:iso:std:iso-iec:19788:-2:ed-1
ISO_IEC_19788-2:2011(F)	urn:iso:std:iso-iec:19788:-2:ed-1
ISO/IEC 19788-1:2011/Amd 1:2014	urn:iso:std:iso-iec:19788:-1:ed-1:amd:1
Document comprising the first edition of the standard (ISO/IEC 19788-1:2011) and incorporating its first amendment (ISO/IEC 19788-1:2011/Amd 1:2014).	urn:iso:std:iso-iec:19788:-1:ed-1:v1-amd1.v1

The RFC 5141 URN schema has been developed with the intent that a URN identifying an ISO document item can be transformed to a valid HTTP URI by replacing the URN namespace prefix ("iso") and the "std:" prefix with the domain name "standards.iso.org", replacing all occurrences of ":" within the identifier with "/", and converting characters to lower case.

Table 2 provides the RFC 5141 URI identifiers version of the previous table.

Table 2 — RFC 5141 URI identifiers for the standards of Table 1

Standard	RFC5141 URI Identifier
ISO_IEC_19788-2:2011	http://standards.iso.org/iso-iec/19788/-2/ed-1
ISO_IEC_19788-2:2011(E)	http://standards.iso.org/iso-iec/19788/-2/ed-1
ISO_IEC_19788-2:2011(F)	http://standards.iso.org/iso-iec/19788/-2/ed-1
ISO/IEC 19788-1:2011/Amd 1:2014	http://standards.iso.org/iso-iec/19788/-1/ed-1/amd/1
Document comprising the first edition of the standard (ISO/IEC 19788-1:2011) and incorporating its first amendment (ISO/IEC 19788-1:2011/Amd 1:2014).	http://standards.iso.org/iso-iec/19788/-1/ed-1/v1-amd1.v1

5.3 HTTP URIs for MLR entities

Given an MLR identifier (see B.1)

```
MLR_Identifier ::= Standard_ID "::" MLR_ID
MLR_ID ::= DES_ID | RC_ID | PRS_ID | DEGS_ID | AP_ID |
           Vocabulary_ID | Vocabulary_Term_ID
```

for an MLR entity (either data element specification, resource class, predefined rule set, data element group specification, application profile, vocabulary, or vocabulary term), an HTTP URI denoting (identifying) the entity is given by

<Entity Standard URI> / <MLR_ID>

where <Entity Standard URI> is the RFC 5141 URI identifier version of the "Standard_ID" part of the identifier of the MLR entity, and <MLR_ID> is the MLR_ID part of the identifier of the MLR entity (in which any ":" is replaced by a "#"[11)] and upper case letters changed to their lower case equivalent).

Examples of HTTP URI for MLR entities (using the examples provided in 5.1) are provided in Table 3.

11) This case only concerns identifier of vocabulary terms.

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Table 3 — Examples of HTTP URI for MLR entities

MLR entity	HTTP URI denoting the MLR entity
ISO_IEC_19788-2:2011::DES0100 (title)	`http://standards.iso.org/iso-iec/19788/-2/ed-1/des0100`[a]
ISO_IEC_19788-2:2011:AMD.1:2015::DES1600 (creator)	`http://standards.iso.org/iso-iec/19788/-2/ed-1/amd/1/des1600`
ISO_IEC_19788-1:2011::RC0002 (Learning Resource)	`http://standards.iso.org/iso-iec/19788/-1/ed-1/rc0002`
ISO_IEC_19788-1:2011::PRS0003 (Date & Time)	`http://standards.iso.org/iso-iec/19788/-1/ed-1/prs0003`
ISO_IEC_19788-3:2011::DEGS0001 (MLR Basic data element group specification)	`http://standards.iso.org/iso-iec/19788/-3/ed-1/degs0001`
ISO_IEC_19788-3:2011::AP0001 (MRL Basic Application Profile)	`http://standards.iso.org/iso-iec/19788/-3/ed-1/ap0001`
ISO_IEC_19788-5:2012::V0100 (Agent role)	`http://standards.iso.org/iso-iec/19788/-5/ed-1/v0100`
ISO_IEC_19788-5:2012::V0100:T020 (validator)	`http://standards.iso.org/iso-iec/19788/-5/ed-1/v0100#t020`

[a] To be fully conformant to RFC 5141, this should be `http://standards.iso.org/iso-iec/19788/-2/ed-1/tech/des0100`. See the note attached to the "addition" construct in 5.2. The same applies to all MLR entities identifiers. We do not use "`tech`" in this document.

5.4 Non-linguistic persistent canonical HTTP URIs for MLR entities

5.4.1 MLR entities other than vocabulary terms

Consider an MLR identifier (see B.1) for an MLR entity that is either a data element specification, a resource class, a predefined rule set, a data element group specification, an application profile or a vocabulary).

```
MLR_Identifier ::= Standard_ID "::" MLR_ID
MLR_ID ::= DES_ID | RC_ID | PRS_ID | DEGS_ID | AP_ID | Vocabulary_ID
```

The non-linguistic persistent canonical HTTP URI denoting the MLR entity is composed of two parts (separated by "/"): the first part concerning the identification of the standard involved and the second part concerning the local identifier of the entity (in the context of the standard).

The first part is the HTTP form (see 5.3) of the RFC 5141 URI identifier of the canonical version (see Annex B) of the "Standard_ID" part of the identifier of the MLR entity in which the string "`standards.iso.org`" has been replaced by "`purl.iso.org`", and the second part is the MLR_ID part of the identifier of the MLR entity in which upper case letters have been changed to their lower case equivalent.

Table 4 presents examples of non-linguistic persistent canonical HTTP URI for MLR entities (using the examples provided in 5.1).

Table 4 — Examples of non-linguistic persistent canonical HTTP URI for MLR entities

MLR entity	Persistent canonical HTTP URI denoting the associated conceptual MLR entity
ISO_IEC_19788-2:2011::DES0100 (title)	`http://purl.iso.org/iso-iec/19788/-2/des0100`
ISO_IEC_19788-2:2011:AMD.1:2015::DES1600 (creator)	`http://purl.iso.org/iso-iec/19788/-2/des1600`
ISO_IEC_19788-1:2011::RC0002 (Learning Resource)	`http://purl.iso.org/iso-iec/19788/-1/rc0002`

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Table 4 *(continued)*

MLR entity	Persistent canonical HTTP URI denoting the associated conceptual MLR entity
ISO_IEC_19788-1:2011::PRS0003 (Date & Time)	`http://purl.iso.org/iso-iec/19788/-1/prs0003`
ISO_IEC_19788-3:2011::DEGS0001 (MLR Basic data element group specification)	`http://purl.iso.org/iso-iec/19788/-3/degs0001`
ISO_IEC_19788-3:2011::AP0001 (MRL Basic Application Profile)	`http://purl.iso.org/iso-iec/19788/-3/ap0001`
ISO_IEC_19788-5:2012::V0100 (Agent role)	`http://purl.iso.org/iso-iec/19788/-5/v0100`

5.4.2 MLR vocabulary terms

For an MLR vocabulary term, a non-linguistic persistent canonical HTTP URI is constructed by adding a fragment part (and so creating a new URI) to the non-linguistic persistent canonical HTTP URI of the containing vocabulary. The fragment string is the `Term_ID` (see B.8) of the vocabulary term in which the upper case "T" has been replaced by its lower case version.

Examples of a non-linguistic persistent canonical HTTP URI for a vocabulary term (MLR-5 "validator") are as follows.

MLR entity	Persistent canonical HTTP URI denoting the associated conceptual MLR entity
ISO_IEC_19788-5:2012::V0100 (Agent role)	`http://purl.iso.org/iso-iec/19788/-5/v0100`
ISO_IEC_19788-5:2012::V0100:T020 (validator)	`http://purl.iso.org/iso-iec/19788/-5/v0100#t020`

5.4.3 Prefixes for MLR entities non-linguistic persistent canonical HTTP URIs

Table 5 provides prefixes for MLR entities non-linguistic persistent canonical HTTP URIs.

— Those prefixes are only suggestions.

— As prefixes are only placeholders for namespaces names, applications should use the namespace names directly, not the prefixes, when the triples scope extends beyond the containing document.

Table 5 — Prefixes for MLR entities non-linguistic persistent canonical HTTP URIs

Prefix	Namespace URI	Name of vocabulary
`mlr1`	`http://purl.iso.org/iso-iec/19788/-1/`	—
`mlr2`	`http://purl.iso.org/iso-iec/19788/-2/`	—
`mlr3`	`http://purl.iso.org/iso-iec/19788/-3/`	—
`mlr4`	`http://purl.iso.org/iso-iec/19788/-4/`	—
`mlr5`	`http://purl.iso.org/iso-iec/19788/-5/`	—
`mlr8`	`http://purl.iso.org/iso-iec/19788/-8/`	—
`mlr9`	`http://purl.iso.org/iso-iec/19788/-9/`	—
`typv`	`http://purl.iso.org/iso-iec/19788/-3/v0200#`	Type
`agrv`	`http://purl.iso.org/iso-iec/19788/-5/v0100#`	Agent role
`aurv`	`http://purl.iso.org/iso-iec/19788/-5/v0200#`	Audience role
`inav`	`http://purl.iso.org/iso-iec/19788/-5/v0300#`	Induced activity

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Table 5 *(continued)*

Prefix	Namespace URI	Name of vocabulary
lemv	http://purl.iso.org/iso-iec/19788/-5/v0400#	Learning method
antv	http://purl.iso.org/iso-iec/19788/-5/v0500#	Annotation type
phtv	http://purl.iso.org/iso-iec/19788/-9/v0210#	Phone type

5.5 Linguistic persistent canonical HTTP URIs for MLR entities

5.5.1 General

When working in the context of a given natural language (English, French, Russian, Chinese, etc.), it is possible (and more human and culturally friendly) to work with linguistic versions of the non-linguistic persistent canonical HTTP URI introduced in 5.4. When containers for RDF triples (such as graph stores, RDF documents and RDF sources) are intended to be used globally, the persistent, non-linguistic and location-independent HTTP identifiers for MLR entities introduced in 5.4 **should** be used.

This subclause introduces **persistent, linguistic and location-independent IRIs** for MLR entities (data element specification, resource class, predefined rule set, data element group specification, application profile, vocabulary, or vocabulary term).

Canonical HTTP URI denoting a conceptual MLR entity is composed of two parts (separated by "/"): the first part concerning the identification of the standard involved and the second part concerning a global linguistic identifier of the entity (in the context of a given language).

For a given language, the linguistic versions of canonical HTTP URI of MLR entities all follow the following format:

```
"http://purl.iso.org/iso-iec/19788/" <Language> "/" <Linguistic_ID>
```

Where <Language> is an IETF BCP 47 language tag for the language (constructed using codes in accordance with ISO 639-2, ISO 639-3, ISO 3166-1 and ISO 15924) and the <Linguistic _ID> part is function of the type of the MLR entity under consideration (DES, RC, PRS, DEGS, AP, vocabulary or vocabulary term).

Table 6 provides suggested prefixes for MLR entities linguistic persistent canonical HTTP URIs (for the English, French and Russian languages).

Table 6 — Prefixes for MLR entities linguistic persistent canonical HTTP URIs

Prefix	Namespace URI
mlr	http://purl.iso.org/iso-iec/19788/en/
mra	http://purl.iso.org/iso-iec/19788/fr/
мор	http://purl.iso.org/iso-iec/19788/ru/

In the following subclauses, we will first introduce the linguistic HTTP IRIs for data element specifications (DESs), resource classes (RCs), vocabularies and vocabulary terms as those are the most important to users.

For information concerning the dereferencing of IRI identifiers, see D.3.

5.5.2 Linguistic identifier for DESs

For a given language, the linguistic identifier of a data element specification is constructed as follows:

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```
<Linguistic_ID> ::= <Domain> "·"[12] <Codomain> "·" <XML_Name>
```

if the codomain is a resource class, or

```
<Linguistic_ID> ::= <Domain> "·" <XML_Name>
```

if the codomain is "literal"

where

`<Domain>`: name of the RC that is the value of the "Domain attribute" of the DES in the stated language;

`<Codomain>`: when the "Codomain attribute" value of the DES is an RC, name of this RC in the stated language (this production rule in not used otherwise);

`<XML_Name>`: a version of the "property name" of the DES that is a valid name as per the production rule for `Name` in the XML W3C Recommendation, in the stated language. Those values are provided by the MLR standard, in the part that contains the DESs.

EXAMPLE

```
Contribution·Person·contributedBy        (language: English)
Contribution·Personne·fourni_par         (language: French)
Natural_Person·givenName             (language: English)
Personne_Naturelle·prénom            (language: French)
```

As its localized version, national bodies could replace the MIDDLE DOT by another character (for example, KATS could mandate the use of 및, 와 or 과).

5.5.2.1 Example extracted from the ISO/IEC 19788-2 (first edition and first amendment)

Figure 1 is an extract of the Data Element Specification (DES) diagram of ISO/IEC 19788-2.

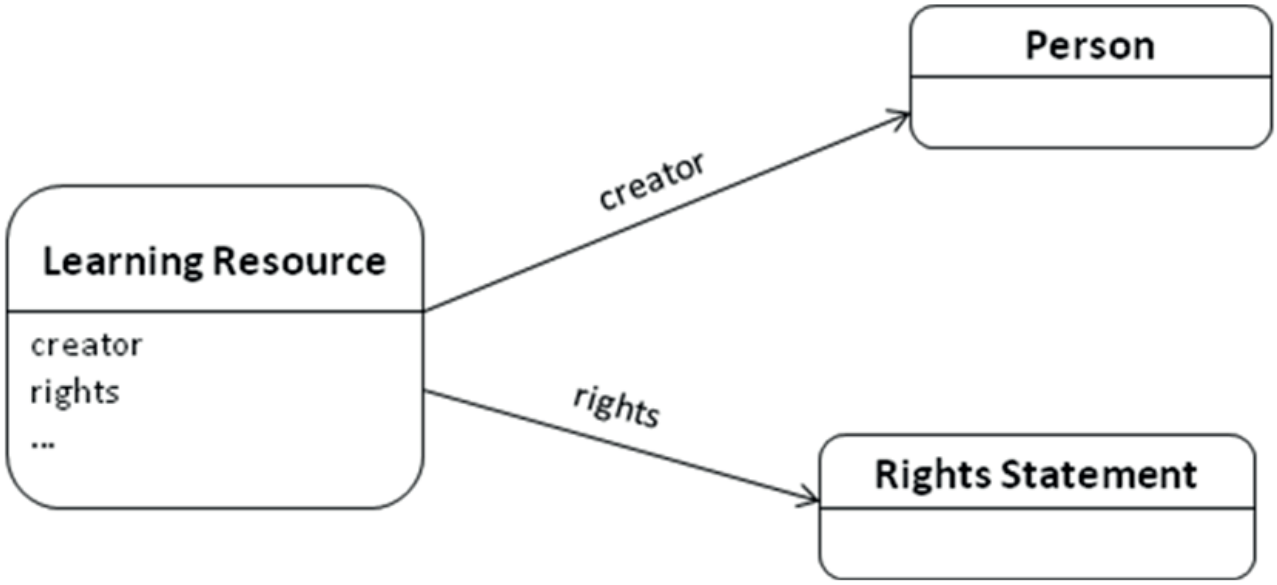

Figure 1 — Partial ISO/IEC 19788-2 DES diagram

12) The character · is the unreserved (iunreserved, RFC3987) unicode character U+00B7 MIDDLE DOT.

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The data element specifications (partial)

Data element specification	
Identifier	ISO_IEC_19788-2:2011::DES0200
Data element specification attributes	
Property name	creator
Definition	entity primarily responsible for making the learning resource
Linguistic indicator	linguistic
Domain	*Learning Resource* (ISO_IEC_19788-1:2011::RC0002)
Codomain	*literal*
Content value rules	MLR String (ISO_IEC_19788-1:2011::PRS0001)

Data element specification	
Identifier	ISO_IEC_19788-2:2011::DES1500
Data element specification attributes	
Property name	rights
Definition	information about rights held in and over the learning resource
Linguistic indicator	linguistic
Domain	*Learning Resource* (ISO_IEC_19788-1:2011::RC0002)
Codomain	*literal*
Content value rules	MLR String (ISO_IEC_19788-1:2011::PRS0001)

Data element specification	
Identifier	ISO_IEC_19788-2:2011:AMD.1:2016::DES1600
Data element specification attributes	
Property name	creator
Definition	entity primarily responsible for making the learning resource
Linguistic indicator	non-linguistic
Domain	*Learning Resource* (ISO_IEC_19788-1:2011::RC0002)
Codomain	*Person* (ISO_IEC_19788-1:2011::RC0003)
Content value rules	N/A

Data element specification	
Identifier	ISO_IEC_19788-2:2011:AMD.1:2016::DES2300
Data element specification attributes	
Property name	rights
Definition	information about rights held in and over the learning resource
Linguistic indicator	non-linguistic

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Domain	*Learning Resource* (ISO_IEC_19788-1:2011::RC0002)
Codomain	*Rights Statement* (ISO_IEC_19788-2:2011:AMD.1:2016::RC0002)
Content value rules	N/A

Resource classes

Identifier	ISO_IEC_19788-1:2011::RC002
Name	*Learning Resource*
Definition	Set of all resources that can be used for learning, education and training
SubclassOf	ISO_IEC_19788-1:2011::RC0001 (*Resource*)
Note	—

Identifier	ISO_IEC_19788-1:2011::RC0003
Name	*Person*
Definition	Any entity which is a natural or legal person
SubclassOf	ISO_IEC_19788-1:2011::RC0001 (*Resource*)
Note	—

Identifier	ISO_IEC_19788-2:2011:AMD.1:2016::RC0001
Name	*Rights Statement*
Definition	A statement about the intellectual property rights held in or over a resource
SubclassOf	ISO_IEC_19788-1:2011::RC0001 (*Resource*)
Note	—

HTTP IRIs

1) The following HTTP IRIs (and URIs) denote the same conceptual data element specification (DES).

```
http://purl.iso.org/iso-iec/19788/-2/des0200
http://purl.iso.org/iso-iec/19788/en/Learning_Resource·creator
http://purl.iso.org/iso-iec/19788/fr/Ressource_d_apprentissage·créateur
http://purl.iso.org/iso-iec/19788/fr-FR/Ressource_pédagogique·créateur
http://purl.iso.org/iso-iec/19788/fr-CA/Ressource_d_apprentissage·créateur
http://purl.iso.org/iso-iec/19788/ru/Обучение_ресурсов·автор
http://purl.iso.org/iso-iec/19788/zh/学习资源·创建者
```

2) The following HTTP IRIs (and URIs) denote the same conceptual data element specification (DES).

```
http://purl.iso.org/iso-iec/19788/-2/des1600
http://purl.iso.org/iso-iec/19788/en/Learning_Resource·Person·creator
http://purl.iso.org/iso-iec/19788/fr/Ressource_d_apprentissage·Personne·créateur
http://purl.iso.org/iso-iec/19788/fr-FR/Ressource_pédagogique·Personne·créateur
http://purl.iso.org/iso-iec/19788/fr-CA/Ressource_d_apprentissage·Personne·créateur
http://purl.iso.org/iso-iec/19788/ru/Обучение_ресурсов·Человек·автор
http://purl.iso.org/iso-iec/19788/zh/学习资源·人·创建者
```

3) The following HTTP IRIs (and URIs) denote the same conceptual data element specification (DES).

```
http://purl.iso.org/iso-iec/19788/-2/des1500
http://purl.iso.org/iso-iec/19788/en/Learning_Resource·rights
http://purl.iso.org/iso-iec/19788/fr/Ressource_d_apprentissage·droits
http://purl.iso.org/iso-iec/19788/fr-FR/Ressource_pédagogique·droits
http://purl.iso.org/iso-iec/19788/fr-CA/Ressource_d_apprentissage·droits
```

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```
http://purl.iso.org/iso-iec/19788/ru/Обучение_ресурсов·правовая_информация
http://purl.iso.org/iso-iec/19788/zh/学习资源·权利
```

4) The following HTTP IRIs (and URIs) denote the same conceptual data element specification (DES).

```
http://purl.iso.org/iso-iec/19788/-2/des2300
http://purl.iso.org/iso-iec/19788/en/Learning_Resource·RightsStatement·rights
http://purl.iso.org/iso-iec/19788/fr/Ressource_d_apprentissage·Déclaration_de_
droits·droits
http://purl.iso.org/iso-iec/19788/fr-FR/Ressource_pédagogique·Déclaration_de_droits·droits
http://purl.iso.org/iso-iec/19788/fr-CA/Ressource_d_apprentissage·Déclaration_de_
droits·droits
http://purl.iso.org/iso-iec/19788/ru/Обучение_ресурсов·О_себе_права·правовая_информация
http://purl.iso.org/iso-iec/19788/zh/学习资源·权利声明·权利
```

5.5.3 Linguistic identifier for RCs

For a given language, the linguistic identifier of a resource class is constructed as follows:

```
<Linguistic_ID> ::= <Resource_Class_Name>
```

where

`<Resource_Class_Name>`: name (see ISO/IEC 19788-1:2011, 8.2) of the resource class in the stated language.

EXAMPLE HTTP IRIs for the resources classes from the example in 5.5.2.1.

1) The following HTTP IRIs (and URIs) denote the same conceptual resource class.

```
http://purl.iso.org/iso-iec/19788/-1/rc0002
http://purl.iso.org/iso-iec/19788/en/Learning_Resource
http://purl.iso.org/iso-iec/19788/fr/Ressource_d_apprentissage
http://purl.iso.org/iso-iec/19788/fr-FR/Ressource_pédagogique
http://purl.iso.org/iso-iec/19788/fr-CA/Ressource_d_apprentissage
http://purl.iso.org/iso-iec/19788/ru/Образовательный _ресурс
http://purl.iso.org/iso-iec/19788/zh/学习资源
```

2) The following HTTP IRIs (and URIs) denote the same conceptual resource class.

```
http://purl.iso.org/iso-iec/19788/-1/rc0003
http://purl.iso.org/iso-iec/19788/en/Person
http://purl.iso.org/iso-iec/19788/fr/Personne
http://purl.iso.org/iso-iec/19788/fr-FR/Personne
http://purl.iso.org/iso-iec/19788/fr-CA/Personne
http://purl.iso.org/iso-iec/19788/ru/Человек
http://purl.iso.org/iso-iec/19788/zh/人
```

3) The following HTTP IRIs (and URIs) denote the same conceptual resource class.

```
http://purl.iso.org/iso-iec/19788/-2/rc0001
http://purl.iso.org/iso-iec/19788/en/RightsStatement
http://purl.iso.org/iso-iec/19788/fr/Déclaration_de_droits
http://purl.iso.org/iso-iec/19788/fr-FR/Déclaration_de_droits
http://purl.iso.org/iso-iec/19788/fr-CA/Déclaration_de_droits
http://purl.iso.org/iso-iec/19788/ru/О_себе_права
http://purl.iso.org/iso-iec/19788/zh/权利声明
```

5.5.4 Linguistic identifier for vocabularies

For a given language, the linguistic identifier of a vocabulary is constructed as follows:

```
<Linguistic_ID> ::= <Vocabulary_Name>
```


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where

`<Vocabulary_Name>`: XML name of the vocabulary in the stated language.

EXAMPLE

Consider the MLR vocabulary ISO_IEC_19788-5:2012::V0100 (Agent role) from ISO/IEC 19788-5:2012, A.1.

The following HTTP IRIs (and URIs) denote the same conceptual vocabulary.

```
http://purl.iso.org/iso-iec/19788/-5/v0100
http://purl.iso.org/iso-iec/19788/en/AgentRole
http://purl.iso.org/iso-iec/19788/fr/Rôle_d_agent
http://purl.iso.org/iso-iec/19788/ru/Роль_агента
http://purl.iso.org/iso-iec/19788/zh/代理角色
```

5.5.5 Linguistic identifier for vocabulary terms

For a given language, the linguistic identifier of a vocabulary term is constructed as follows:

```
<Linguistic_ID> ::= <Vocabulary_Name> "#" <Term_Name>
```

where

`<Vocabulary_Name>`: XML name of the vocabulary, from which the term is taken, in the stated language;

`<Term_Name>`: XML name of the term in the stated language.

EXAMPLE

Consider the term with MLR identifier ISO_IEC_19788-5:2012::V0100:T020 (validator) from ISO/IEC 19788-5:2012, A.1.

The following HTTP IRIs (and URIs) denote the same conceptual vocabulary term.

```
http://purl.iso.org/iso-iec/19788/-5/v0100#t020
http://purl.iso.org/iso-iec/19788/en/AgentRole#validator
http://purl.iso.org/iso-iec/19788/fr/Rôle_d_agent#attestateur
http://purl.iso.org/iso-iec/19788/ru/Роль_агента#валидатор
http://purl.iso.org/iso-iec/19788/zh/代理角色#验证
```

5.5.6 Linguistic identifier for PRSs

For a given language, the linguistic identifier of a predefined rule set is constructed as follows:

```
<Linguistic_ID> ::= <PRS_Name>
```

where

`<PRS_Name>`: name (see ISO/IEC 19788-1:2011, Clause 9) of the predefined rule set in the stated language.

EXAMPLE

Consider the predefined rule set with identifier ISO_IEC_19788-1:2011::PRS0002 (DATE)

The following HTTP IRIs (and URIs) denote the same conceptual predefined rule set.

```
http://purl.iso.org/iso-iec/19788/-1/prs0002
http://purl.iso.org/iso-iec/19788/en/DATE
http://purl.iso.org/iso-iec/19788/fr/DATE
```

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5.5.7 Linguistic identifier for DEGSs

For a given language, the linguistic identifier of a data element group specification is constructed as follows:

```
<Linguistic_ID> ::= <DEGS_Name>
```

where

`<DEGS_Name>`: name (see ISO/IEC 19788-1:2011, 11.4) of the data element group specification in the stated language.

EXAMPLE

Consider the data element groups specification with identifier ISO_IEC_19788-3:2011::DEGS0001 (MLR Basic data element group specification)

The following HTTP IRIs (and URIs) denote the same conceptual data element group specification.

```
http://purl.iso.org/iso-iec/19788/-3/degs0001
http://purl.iso.org/iso-iec/19788/en/MLR_Basic_data_element_group_specification
```

5.5.8 Linguistic identifier for APs

For a given language, the linguistic identifier of an application profile is constructed as follows:

```
<Linguistic_ID> ::= <AP_Name>
```

where

`<AP_Name>`: name (see ISO/IEC 19788-1:2011, 12.2) of the application profile in the stated language.

EXAMPLE

Consider the application profile with identifier ISO_IEC_19788-3:2011::AP0001 (MLR Basic Application Profile).

The following HTTP IRIs (and URIs) denote the same conceptual application profile.

```
http://purl.iso.org/iso-iec/19788/-3/ap0001
http://purl.iso.org/iso-iec/19788/en/MLR_Basic_Application_Profile
```

6 Data elements: From MLR to RDF[13)]

6.1 General

6.1.1 Data elements

A data element, as introduced in ISO/IEC 19788-1:2011, 7.1 (MLR-1), comprises three (3) or four (4) components as illustrated in the following two examples of MLR data elements related to the description of the following learning resource (that will be used in many of the examples). See Annex C for a more complete description of this resource.

13) The version of RDF used in this document is RDF 1.1 (see http://www.w3.org/TR/rdf11-concepts/).

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Title: Turtles, Termites, and Traffic Jams
Author: Mitchel Resnick
Language: English
Publisher: The MIT Press
Publication date: July 1, 1994
Copyright: @1994 Massachusetts Institute of Technology
ISBN-10: 0-262-18162-2

This resource has a Spanish translation:
Title: Tortugas, Termitas y Atascos de Trafico: Exploraciones Sobre Micromundos Masivamente Paralelos
Publisher: Gedisa Editorial
ISBN-10: 84-7432-834-9

Data element specification ID	ISO_IEC_19788-2:2011::DES0100 (title)
Subject	ISBN-10: 0-262-18162-2
Content value	Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds
Language code	eng

Data element specification ID	ISO_IEC_19788-2:2011::DES0700 (date)
Subject	ISBN-10: 0-262-18162-2
Content value	1994-07

The value of the component:

— "Data element specification ID" of the data element is the identifier of a **data element specification** (DES);

— "Subject" of the data element is a global **identifier** for the resource being described;

— "Content Value" of a data element is the value for the stated "Subject" of the property defined by the "Data element specification". It can be either a literal or a resource (entity). For the two examples presented, the content values are literals;

— "Language Code" of the data element is a code, from ISO 639-3, for the name of the language used in the content value component if that content is linguistically significant.

Clause 6 provides mappings (by way of examples) from MLR data elements (illustrated in Figure 2) to RDF triples. MLR data elements come in two flavours:

— data element with a literal as content value:

  — linguistic data element;

  — non-linguistic data element;

— data element with a non-literal content value (a resource which is denoted by an IRI).

See also ISO/IEC 19788-1:2011, Clause 7.

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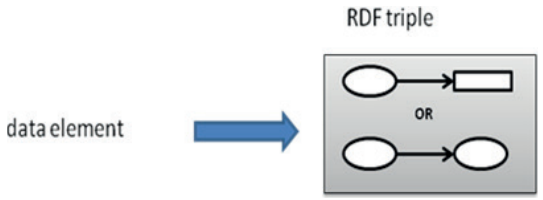

Figure 2 — Mapping a data element to an RDF triple

6.1.2 From MLR to RDF: At a glance

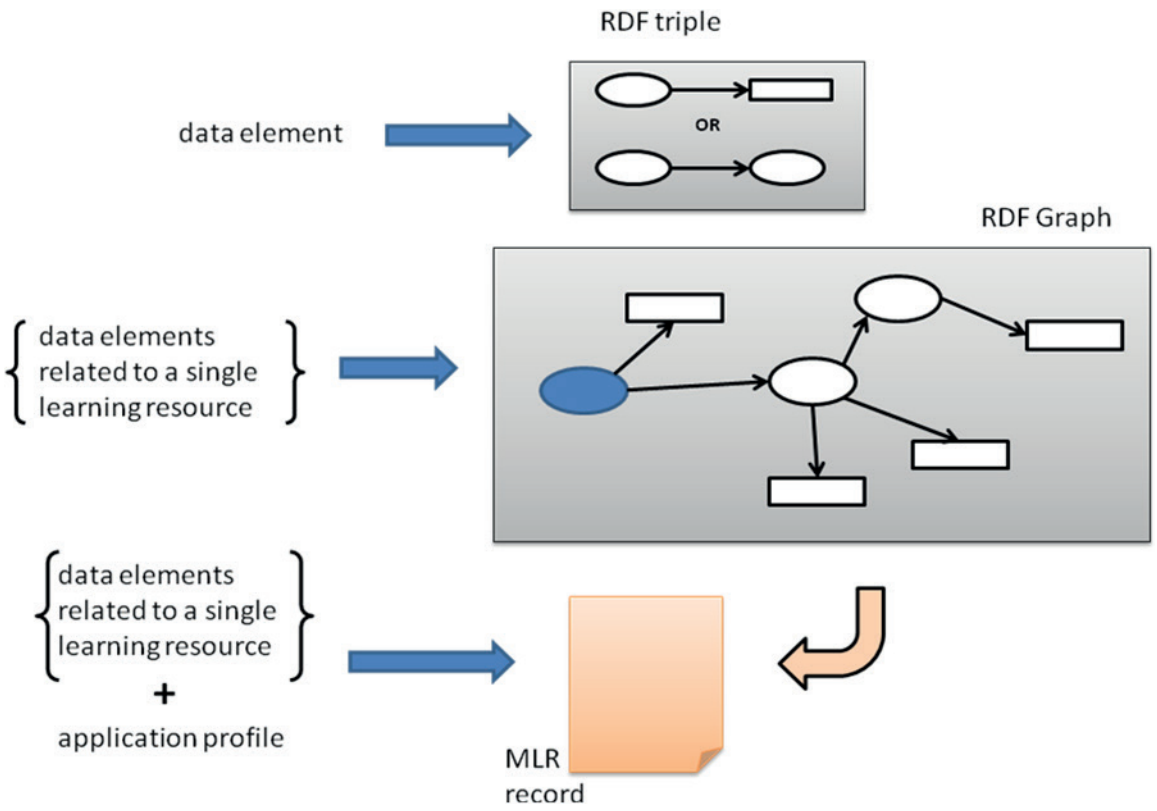

Figure 3 — Mapping MLR data elements to RDF

In Figure 3, the rectangles stand for literal and ovals stand for non-literal entities (resources denoted by IRI).

6.1.3 Mapping of MLR literal content

Consider a data element for which the attribute "Codomain" of its associated DES takes the value "literal".

— If the "Linguistic indicator" attribute of the DES has value "linguistic" and the "Content value rules" attribute of the DES has as its value the predefined rule set "ISO_IEC_19788-1:2011::PRS0001" (MLR STRING), then the data element maps to an RDF triple with, as object, a *language-tagged string*.

— If the "Linguistic indicator" attribute of the DES has value "non-linguistic" and the rule set that is the value of the "Content value rules" attribute of the DES has a rule set *extension* (see ISO/IEC 19788-1:2011, 3.18) of the form "lexical space of a given datatype denoted by an IRI *x*", then the data element maps to an RDF triple with, as object, a *literal* with datatype IRI, the IRI *x*, else either use

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xsd:string or a datatype D that contains the *codomain* (see ISO/IEC 19788-1:2011/Amd 1:2014, 3.28) of the associated DES (illustrated in Figure 4). (One should use the best fit available).

That datatype could either be user defined or come from such places as the W3C XML Schema Definition Language (XSD) 1.1 Part 2: Datatypes (Section 3.3) or the ISO/IEC 11404[14)] standard.

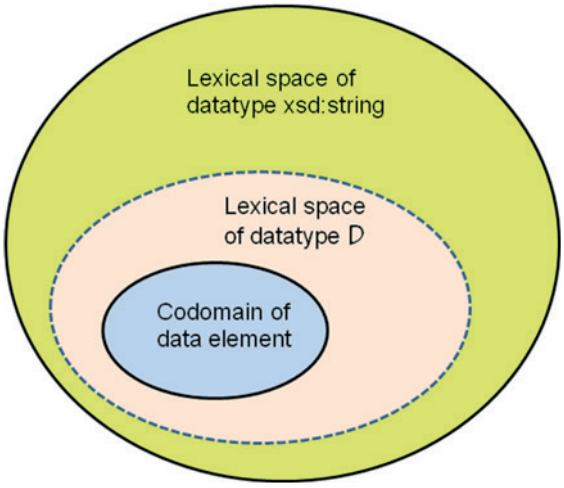

Figure 4 — Best fit for codomain

The lexical space[15)] of a datatype is the set of literals used to denote values of the datatype.

6.1.4 Prefixes

Examples in this document make use of Table 7 prefixes and their associated namespaces and of those introduced in 5.4.3 and 5.5.1.

Table 7 — Prefixes used in this document

Prefix	Namespace URI
rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
dc	http://purl.org/dc/elements/1.1/
dcterms	http://purl.org/dc/terms/
xsd	http://www.w3.org/2001/XMLSchema#
foaf	http://xmlns.com/foaf/0.1/
rdfs	http://www.w3.org/2000/01/rdf-schema#
owl	http://www.w3.org/2002/07/owl#
skos	http://www.w3.org/2004/02/skos/core#

6.2 Data element with literal content

6.2.1 Literal content data elements

An MLR data element has literal content value if the “Codomain” attribute of its associated DES has value “literal”.

As stated in 6.1.1, these data elements may be linguistic or non-linguistic.

14) http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html.

15) http://www.w3.org/TR/xmlschema11-2/#datatype (Section 2.1).

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6.2.2 Linguistic MLR data element

An MLR data element is said to be linguistic if the linguistic indicator attribute of its associated DES has value “linguistic”.

6.2.2.1 MLR data element

Data element specification ID	ISO_IEC_19788-2::DES0100 (title)
Subject	ISBN-10: 0-262-18162-2
Content value	Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds
Language code	eng

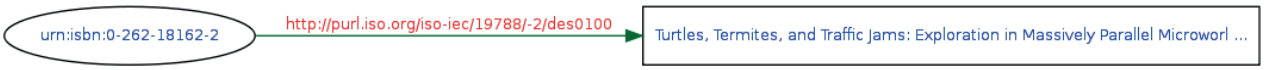
6.2.2.2 RDF 1.1 data model

Using the non-linguistic persistent canonical HTTP URI of the predicate (DES):

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	`urn:isbn:0-262-18162-2`[a]
predicate	IRI	—	`http://purl.iso.org/iso-iec/19788/-2/des0100`
object	literal	lexical form	`Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds`
		datatype IRI	`http://www.w3.org/1999/02/22-rdf-syntax-ns#langString`
		language tag	`en`[b]

[a] See http://tools.ietf.org/html/rfc3187.

[b] Tag as per BCP 47 *langtag* production rule.



Using the English linguistic version of the persistent canonical HTTP URI:

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	`urn:isbn:0-262-18162-2`
predicate	IRI	—	`http://purl.iso.org/iso-iec/19788/en/Learning_Resource·title`
object	literal	lexical form	`Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds`
		datatype IRI	`http://www.w3.org/1999/02/22-rdf-syntax-ns#langString`
		language tag	`en`

6.2.2.3 Serialization using Turtle 1.1 concrete syntax

We use here only the Turtle concrete syntax; for other serialization, see C.4.

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With non-linguistic persistent canonical HTTP URI

```
<urn:isbn:0-262-18162-2>
  <http://purl.iso.org/iso-iec/19788/-2/des0100>
    "Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds"@en .
```

and linguistic version of the persistent canonical HTTP URI

```
@base  <http://purl.iso.org/iso-iec/19788/en/> .

<urn:isbn:0-262-18162-2>
  <Learning_Resource·title>
    "Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds"@en .
```

```
@prefix mlr: <http://purl.iso.org/iso-iec/19788/en/> .

<urn:isbn:0-262-18162-2>
  mlr:Learning_Resource·title
    "Turtles, Termites, and Traffic Jams: Exploration in Massively Parallel Microworlds"@en .
```

6.2.3 Non-linguistic data element

A data element is said to be non-linguistic if the linguistic indicator attribute of its associated DES has value “non-linguistic”.

6.2.3.1 MLR data elements

Data element specification ID	ISO_IEC_19788-2:2011::DES1000 (identifier)
Subject	ISBN-10: 0-262-18162-2
Content value	ISBN-13: 978-0-262-18162-4

Data element specification ID	ISO_IEC_19788-2:2011::DES0700 (date)
Subject	ISBN-10: 0-262-18162-2
Content value	1994-07-01

Data element specification ID	ISO_IEC_19788-5::DES0800 (contributor role)
Subject	tag:example.com,2012-08-26:contribution-23[a]
Content value	ISO_IEC_19788-5:2012::V0100[b]:T020 (validator)

[a] See A.1.2.

[b] See B.7, Footnote 25.

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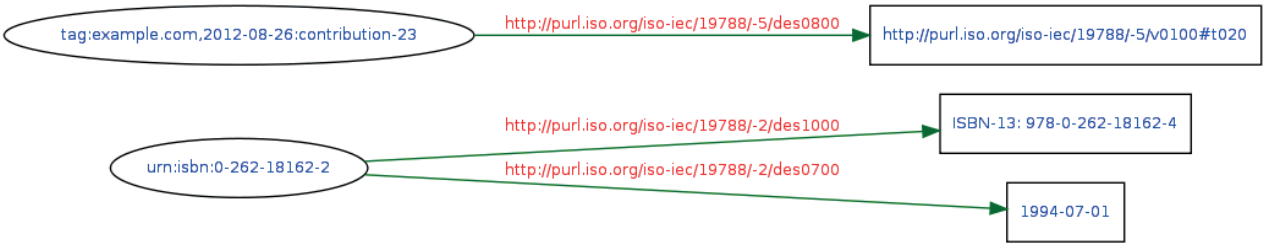
6.2.3.2 RDF 1.1 data model

Using the non-linguistic persistent canonical HTTP URIs of the predicates (DESs):

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	urn:isbn:0-262-18162-2
predicate	IRI	—	http://purl.iso.org/iso-iec/19788/-2/des1000
object	literal	lexical form	ISBN-13: 978-0-262-18162-4
		datatype IRI	http://www.w3.org/2001/XMLSchema#string

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	urn:isbn:0-262-18162-2
predicate	IRI	—	http://purl.iso.org/iso-iec/19788/-2/des0700
object	literal	lexical form	1994-07-01
		datatype IRI	http://www.w3.org/2001/XMLSchema#date

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	tag:example.com,2012-08-26:contribution-23
predicate	IRI	—	http://purl.iso.org/iso-iec/19788/-5/des0800
object	literal	lexical form	http://purl.iso.org/iso-iec/19788/-5/v0100#t020
		datatype IRI	http://www.w3.org/2001/XMLSchema#anyURI



Using the English linguistic version of the persistent canonical HTTP URIs:

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	urn:isbn:0-262-18162-2
predicate	IRI	—	http://purl.iso.org/iso-iec/19788/en/Learning_Resource·identifier
object	literal	lexical form	ISBN-13: 978-0-262-18162-4
		datatype IRI	http://www.w3.org/2001/XMLSchema#string

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	urn:isbn:0-262-18162-2
predicate	IRI	—	http://purl.iso.org/iso-iec/19788/en/Learning_Resource·date
object	literal	lexical form	1994-07-01
		datatype IRI	http://www.w3.org/2001/XMLSchema#date

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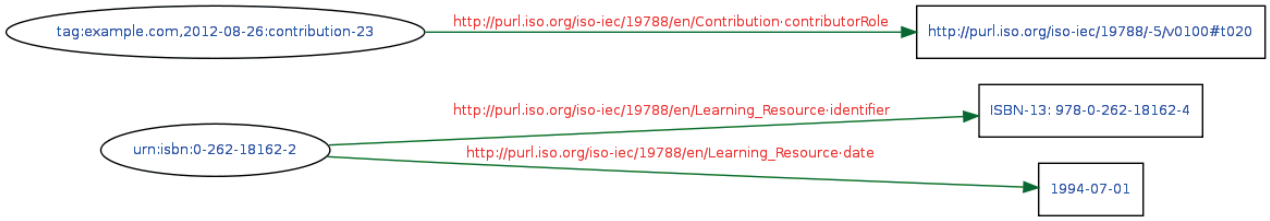
Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	`tag:example.com,2012-08-26:contribution-23`
predicate	IRI	—	`http://purl.iso.org/iso-iec/19788/en/Contribution·contributorRole`
object	literal	lexical form	`http://purl.iso.org/iso-iec/19788/en/AgentRole#validator`
		datatype IRI	`http://www.w3.org/2001/XMLSchema#anyURI`



6.2.3.3 Serialization using Turtle 1.1 concrete syntax

We use here only the Turtle concrete syntax; for other serialization, see C.4.

With non-linguistic persistent canonical HTTP URIs:

```
@prefix xsd: <http://www.w3.org/2001/XMLSchema-datatypes#> .

<urn:isbn:0-262-18162-2>
    <http://purl.iso.org/iso-iec/19788/-2/des1000>
        "ISBN-13: 978-0-262-18162-4" ;
    <http://purl.iso.org/iso-iec/19788/-2/des0700>
        "1994-07-01"^^xsd:date .

<tag:example.com,2014-03-06:contribution-23>
    <http://purl.iso.org/iso-iec/19788/-5/des0800>
        "http://purl.iso.org/iso-iec/19788/-5/v0100#t020"^^xsd:anyURI .
```

and linguistic version of the persistent canonical HTTP URIs:

```
@prefix mlr:  <http://purl.iso.org/iso-iec/19788/en/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema-datatypes#> .

<urn:isbn:0-262-18162-2>
    mlr:Learning_Resource·identifier "ISBN-13: 978-0-262-18162-4" ;
    mlr:Learning_Resource·date "1994-07-01"^^xsd:date .

<tag:example.com,2014-03-06:contribution-23>
    mlr:Contribution·contributorRole
        "http://purl.iso.org/iso-iec/19788/en/AgentRole#validator"^^anyURI .
```

6.3 Data element with non-literal content

6.3.1 Non-literal content data elements

An MLR data element has non-literal content if the “Codomain” attribute of its associated DES has a value different from “literal”.

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Non-literal MLR data elements are non-linguistic.

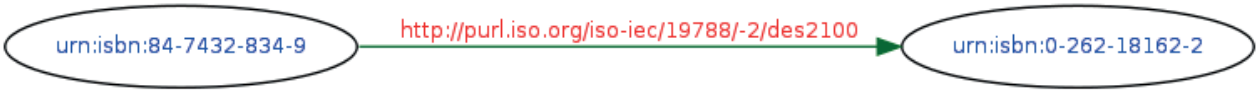
6.3.2 MLR data element

Data element specification ID	ISO_IEC_19788-2::DES2100 (source)
Subject	ISBN-10: 84-7432-834-9
Content value	Resource denoted by “ISBN-10: 0-262-18162-2”

6.3.3 RDF 1.1 data model

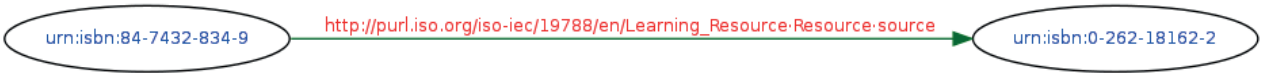
Using the canonical HTTP URI of the predicate (DES):

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	`urn:isbn:84-7432-834-9`
predicate	IRI	—	`http://purl.iso.org/iso-iec/19788/-2/des2100`
object	IRI	—	`urn:isbn:0-262-18162-2`



Using the English linguistic version of the persistent canonical HTTP URI:

Component	Type	Subcomponent, if of type literal	Value of component or subcomponent
subject	IRI	—	`urn:isbn:84-7432-834-9`
predicate	IRI	—	`http://purl.iso.org/iso-iec/19788/en/ Learning_ Resource·Resource·source`
object	IRI	—	`urn:isbn:0-262-18162-2`



6.3.4 Serialization using Turtle 1.1 concrete syntax

We use here only the Turtle concrete syntax; for other serialization, see C.4.

With non-linguistic persistent canonical HTTP URI:

```
<urn:isbn:84-7432-834-9>
    <http://purl.iso.org/iso-iec/19788/-2/des2100> <urn:isbn:0-262-18162-2> .
```

and linguistic version of the persistent canonical HTTP URI:

```
@base  <http://purl.iso.org/iso-iec/19788/en/> .


<urn:isbn:84-7432-834-9> <Learning_Resource·Resource·source> <urn:isbn:0-262-18162-2> .
```

```
@prefix  mlr:  <http://purl.iso.org/iso-iec/19788/en/> .


<urn:isbn:84-7432-834-9> mlr:Learning_Resource·Resource·source <urn:isbn:0-262-18162-2> .
```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7 OWL ontology for the ISO/IEC 19788 series

7.1 General

This clause introduces an OWL 2 DL ontology for the ISO/IEC 19788 series.

Persistent non-linguistic canonical HTTP URIs (see 5.4) and persistent, linguistic canonical HTTP IRIs (see 5.5) will be used to denote MLR-related classes and properties in the MLROnt ontology. The non-linguistic HTTP URIs should be used in the context of international interoperability and the linguistic versions are provided to support localization.

The MLROnt introduced in this subclause contains, in the form of OWL annotations, all the needed information to derive from its localized versions in English and French. When, and if, national bodies provide the needed information to support localization of the ontology for their languages, the MLROnt ontology will be updated to support the related localizations.

For the MLROnt ontology, an ISO/IEC 19788 resource class (RC) is mapped to an OWL class.

An ISO/IEC 19788 DES with an *MLR resource class* as the value of its Codomain (see ISO/IEC 19788-1:2011, 6.2) attribute is mapped to an OWL *Object property*. If a DES Codomain attribute takes the value *literal*, then it is mapped to an OWL *Datatype property*.

A DES with the value literal for its attribute Codomain takes for its attribute "Linguistic indicator" either the value linguistic or non-linguistic (see ISO/IEC 19788-1:2011, 6.2). If the value is linguistic, then the literal is a language-tagged string and the range of the related property is set to `rdf:PlainLiteral[langRange "*"]`.

If the value is *non-linguistic*, then: If the DES attribute "Content value rule" states that the values are from an MLR vocabulary (such as the ISO/IEC 19788-5 "Annotation type" vocabulary), then the range is then set to `xsd:anyURI`; otherwise, either the value is a string without a language tag and then the range is set to `xsd:string` (possibly restricting the value-space with the help of a facet) (in this case, we have a *simple literal*) or the range is set to a datatype IRI (such as xsd:date or xsd:integer).

The ontology for the MLR presented in this clause is based on the OWL 2 Web ontology language (information provided by http://www.w3.org/TR/owl2-primer). Figure 1 (in Section 2) of the OWL 2 Web Ontology Language Document Overview (http://www.w3.org/TR/owl2-overview/) is most useful to the understanding of OWL 2 in relation to its diverse descriptions, syntaxes and semantics.

7.2 OWL 2 DL ontology for the MLR: MLROnt

7.2.1 MLROnt ontology expressed using the Manchester syntax

The following listing is an excerpt of the MLROnt ontology expressed using the Manchester syntax.

```
Prefix: : <http://purl.iso.org/iso-iec/19788/>
Prefix: owl: <http://www.w3.org/2002/07/owl#>
Prefix: rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
Prefix: xml: <http://www.w3.org/XML/1998/namespace>
Prefix: xsd: <http://www.w3.org/2001/XMLSchema#>
Prefix: rdfs: <http://www.w3.org/2000/01/rdf-schema#>
Prefix: skos: <http://www.w3.org/2004/02/skos/core#>
Prefix: MLROnt: <http://purl.iso.org/iso-iec/19788/ontology/MLROnt#>

[…]

AnnotationProperty: MLROnt:xmlName
```

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```
    Annotations:
        rdfs:comment "XML compliant name for a property or resource class.
Those are provided as normative annexes in ISO/IEC Parts for the languages English, French and
Russian. For other languages, they are provided by the National Bodies."@en

    SubPropertyOf:
        skos:editorialNote
[…]

Datatype: xsd:duration
Datatype: xsd:positiveInteger
Datatype: xsd:dateTimeStamp
Datatype: xsd:date
Datatype: xsd:anyURI
Datatype: rdf:PlainLiteral
Datatype: xsd:string
Datatype: xsd:nonNegativeInteger
Datatype: xsd:token
[…]


ObjectProperty: <http://purl.iso.org/iso-iec/19788/-2/des1800>

    Annotations:
        MLROnt:name "description"@fr,
        MLROnt:xmlName "описание"@ru,
        MLROnt:xmlName "description"@fr,
        MLROnt:name "description"@en,
        MLROnt:name "описание"@ru,
        MLROnt:canonicalIdentifier "ISO_IEC_19788-2::DES1800"^^xsd:token,
        MLROnt:xmlName "description"@en

    Domain:
        <http://purl.iso.org/iso-iec/19788/-1/rc0002>

    Range:
        <http://purl.iso.org/iso-iec/19788/-1/rc0001>


ObjectProperty: <http://purl.iso.org/iso-iec/19788/-2/des2000>

    Annotations:
        MLROnt:name "contributor"@en,
        MLROnt:canonicalIdentifier "ISO_IEC_19788-2::DES2000"^^xsd:token,
        MLROnt:name "участник"@ru,
        MLROnt:xmlName "contributor"@en,
        MLROnt:xmlName "collaborateur"@fr,
        MLROnt:name "collaborateur"@fr,
        MLROnt:xmlName "участник"@ru

    Domain:
        <http://purl.iso.org/iso-iec/19788/-1/rc0002>

    Range:
        <http://purl.iso.org/iso-iec/19788/-1/rc0003>
[…]
ObjectProperty: <http://purl.iso.org/iso-iec/19788/-8/des0100>
```


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```
    Annotations:
        MLROnt:name "a pour enregistrement"@fr,
        MLROnt:xmlName "hasRecord"@en,
        MLROnt:canonicalIdentifier "ISO_IEC_19788-8::DES0100"^^xsd:token,
        MLROnt:name "has record"@en,
        MLROnt:xmlName "a_pour_enregistrement"@fr

    SubPropertyChain:
        <http://purl.iso.org/iso-iec/19788/-8/des0600> o
             <http://purl.iso.org/iso-iec/19788/-8/des1600>

    Domain:
        <http://purl.iso.org/iso-iec/19788/-1/rc0002>

    Range:
        <http://purl.iso.org/iso-iec/19788/-8/rc0001>
[…]

ObjectProperty: <http://purl.iso.org/iso-iec/19788/-9/des1100>

    Annotations:
        MLROnt:canonicalIdentifier "ISO_IEC_19788-9::DES1100"^^xsd:token,
        MLROnt:xmlName "géolocalisation"@fr,
        MLROnt:xmlName "geolocation"@en,
        MLROnt:name "géolocalisation"@fr,
        MLROnt:name "geolocation"@en

    Characteristics:
        Functional

    Domain:
        <http://purl.iso.org/iso-iec/19788/-9/rc0002>

    Range:
        <http://purl.iso.org/iso-iec/19788/-9/rc0003>


DataProperty: <http://purl.iso.org/iso-iec/19788/-5/des0300>

    Annotations:
        MLROnt:canonicalIdentifier "ISO_IEC_19788-5::DES0300"^^xsd:token,
        MLROnt:xmlName "annotationType"@en,
        MLROnt:name "type d'annotation"@fr,
        MLROnt:name "annotation type"@en,
        MLROnt:xmlName "type_d_annotation"@fr

    Domain:
        <http://purl.iso.org/iso-iec/19788/-5/rc0001>

    Range:
        xsd:anyURI


DataProperty: <http://purl.iso.org/iso-iec/19788/-9/des0200>

    Annotations:
        MLROnt:xmlName "name"@en,
        MLROnt:name "name"@en,
```

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