Abstract

This document presents the specification for a primitive datatype representing internationalized text that is used in both the RIF and OWL languages.

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Set of Documents

This document is being published as one of a set of 11 documents:

1. Structural Specification and Functional-Style Syntax
First Public Working Draft

This datatype was developed jointly by the Rule Interchange Format (RIF) Working Group and OWL Working Group, in order to simplify working formally with the RDF language-tagged string literals.

Please Comment By 23 January 2009

The OWL Working Group and Rule Interchange Format (RIF) Working Group seek public feedback on this First Public Working Draft. Please send your comments to public-owl-comments@w3.org (public archive). If possible, please offer specific changes to the text that would address your concern. You may also wish to check the Wiki Version of this document for internal-review comments and changes being drafted which may address your concerns.

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- 1 Introduction
1 Introduction

Internationalized text — that is, text that additionally conveys information in terms of a language tag — is used in several existing W3C specifications, such as RDF, XML, OWL, and RIF. This specification defines a datatype called rdf:text in order to allow specifications such as RDF, OWL, and RIF to refer to internationalized text literals in an interoperable way. Parallel efforts have been made to support internationalized strings by several W3C working groups, including the OWL WG and the RIF WG. Collaboration between the two working groups on the choice of language constructs for internationalized strings has lead to the present specification [1][2].

Parts of this document are based on the current work on rif:text [3] (RIF WG) and owl:internationalizedString [4] (OWL WG), for more details see a summary.

2 Preliminaries

A character is an atomic unit of communication. The structure of characters is not further specified in this document, other than to note that each character has a Universal Character Set (UCS) code point [ISO/IEC 10646] (or, equivalently, a Unicode code point [UNICODE]). The set of available characters is assumed to be infinite, and it is thus independent from the current version of UCS and Unicode.

A string is a finite sequence of characters. The length of a string is the number of characters in it. Strings are written in this specification by enclosing them in quotes. Two strings are identical if they contain exactly the same sequence of characters.
Example:

To understand the rationale behind the assumption on the infinite number of characters, consider the following OWL 2 ontology:

```
ClassAssertion( a:i MinCardinality( n a:some-property
DatatypeRestriction( xs:string xs:length 1 ) ) )
```

Intuitively, this OWL 2 axiom states that the individual a:i is connected to at least n different strings of length 1. If one assumes that there are exactly m UCS characters, then this ontology is satisfiable if and only if \( n \leq m \). This has several undesirable consequences:

- OWL 2 reasoners need to know exactly how many UCS characters there are.
- Changing the number of UCS characters might change satisfiability of an ontology.

In order to avoid such problems, this specification assumes that the number of UCS characters is infinite; that is, \( m = \infty \). Despite this assumption, at any given point in time, UCS provides means of addressing only a finite subset of this set.

Thus, the example ontology is satisfiable regardless of with respect to which version of UCS it is interpreted.

A language tag is a string of the form as specified in BCP 47 [BCP 47].

This specification uses Uniform Resource Identifiers (URIs) for naming datatypes and their components, which are defined in RFC 3986 [RFC 3986]. For readability, URIs are often abbreviated according to the convention of XML Namespaces [XML Namespaces]. The following namespace prefixes are used throughout this document:

- the xs: prefix stands for the XML Schema namespace URI
  http://www.w3.org/2001/XMLSchema#
- the rdf: prefix stands for http://www.w3.org/1999/02/22-rdf-syntax-ns#

Datatypes are defined in this document along the lines of XML Schema Datatypes [XML Schema Datatypes]. Each datatype is identified by a URI and is described by the following components:

- The value space is a set determining the set of values of the datatype. Elements of the value space are called data values.
- The lexical space is a set of strings that can be used to refer to data values. Each member of the lexical space is called a lexical value, and it is mapped to a particular data value.
The facet space is a set of pairs of the form \( \langle F, v \rangle \), where \( F \) is a URI called a constraining facet, and \( v \) is an arbitrary object called a value. Each such pair is mapped to a subset of the value space of the datatype.

The italicized keywords must, must not, should, should not, and may specify certain aspects of the normative behavior of tools implementing this specification, and are interpreted as specified in RFC 2119 [RFC 2119].

3 Definition of the rdf:text Datatype

The datatype identified by the URI http://www.w3.org/1999/02/22-rdf-syntax-ns#text (abbreviated rdf:text) allows for the representation of internationalized text strings. In addition to the RIF and OWL specifications, this datatype is expected to supersede RDF’s plain literals with language tags, cf. [5], which is why this datatype has been added into the rdf: namespace.

Value Space. The value space of rdf:text is the set of all pairs of the form \(("text", "lang")\), where "text" is a string and "lang" is either the empty string "" or a lowercase language tag.

Lexical Space. A lexical value of rdf:text is a string "val" that contains at least one @ character (U+40) and that satisfies the following condition:

\[
\text{Let } i \text{ be the position of the last } @ \text{ (U+40) character in } "\text{val}", \text{ and let } "abc" \text{ and } "tag" \text{ be the substrings of } "\text{val}" \text{ containing the characters up to and after position } i \text{ (noninclusive), respectively. Then, } "tag" \text{ must be either empty or a valid language tag.}
\]

Each such lexical value is assigned a data value \(("abc", "lc-tag")\), where "lc-tag" is the string "tag" converted to lowercase.

**Editor's Note: Open Issues**: The definition of the set of characters, particularly the fact that it is infinite, as well as the compatibility with XML strings - whether the string part of the lex & val space should be the same as xs:string - are still under discussion.

**Example:**

Lexical value "Family Guy@en" is mapped to the data value \(("Family Guy", "en")\), and "Family Guy@" is mapped to \(("Family Guy", """)\). Furthermore, "Family Guy" is not a valid lexical value of rdf:text because it does not contain the @ (U+40) character.

Facet Space. The facet space of the rdf:text datatype is shown in Table 1.
### Table 1. The Facet Space of the rdf:text Datatype

<table>
<thead>
<tr>
<th>A pair of the form...</th>
<th>...is mapped to the subset of the value space of rdf:text containing all pairs of the form (&quot;text&quot;, &quot;lang&quot;) such that...</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \langle \text{xs:minLength } v \rangle ) where ( v ) is a nonnegative integer</td>
<td>the length of &quot;text&quot; is at least ( v )</td>
</tr>
<tr>
<td>( \langle \text{xs:maxLength } v \rangle ) where ( v ) is a nonnegative integer</td>
<td>the length of &quot;text&quot; is at most ( v )</td>
</tr>
<tr>
<td>( \langle \text{xs:length } v \rangle ) where ( v ) is a nonnegative integer</td>
<td>the length of &quot;text&quot; is exactly ( v )</td>
</tr>
<tr>
<td>( \langle \text{xs:pattern } v \rangle ) where ( v ) is a string specifying a regular expression with the syntax as in Section F of XML Schema Datatypes [XML Schema Datatypes]</td>
<td>&quot;text&quot; matches the regular expression ( v )</td>
</tr>
<tr>
<td>( \langle \text{rdf:langPattern } v \rangle ) where ( v ) is a string specifying a regular expression with the syntax as in Section F of XML Schema Datatypes [XML Schema Datatypes]</td>
<td>&quot;lang&quot; matches the regular expression ( v )</td>
</tr>
</tbody>
</table>

**Editor's Note:** TODO: an example of pattern and langPattern, e.g., a language pattern that matches all English dialects including en-US and en-UK

### 3.1 xs:string as a restriction of rdf:text

The xs:string datatype is a datatype defined in XML Schema Datatypes [XML Schema Datatypes] as having the value space equal to the set of all strings. Thus, the value space of xs:string is not a subset of the value space of rdf:text, which may cause problems for certain applications of this specification. A similar problem arises with XML Schema datatypes that are derived from xs:string.

To overcome this difficulty, specifications that use rdf:text may choose to interpret the datatypes from the following list in a slightly different way. The resulting datatypes have value spaces that are isomorphic with the value spaces from XML Schema Datatypes [XML Schema Datatypes], but that are subsets of the value space of rdf:text.

- xs:string
- xs:normalizedString
- xs:token
- xs:language
- xs:Name
- xs:NCName
- xs:NMTOKEN
**Value Space.** For DT a datatype from the above list, the value space of DT is a set of pairs of the form ("text","") where "text" is a string matching the restrictions of DT as specified in XML Schema Datatypes [XML Schema Datatypes] and "" is the empty string.

**Lexical Space.** For DT a datatype from the above list, the lexical space of DT is a string "text" that matches the restrictions of DT as specified in XML Schema Datatypes [XML Schema Datatypes]. Each lexical value "text" is assigned a data value ("text","").

**Facet Space.** Each datatype DT from the above list supports the constraining facets xs:minLength, xs:maxLength, xs:length, and xs:pattern. The facet value of each pair for DT is the same as in Table 1, with the difference that the result is a subset of the value space of DT rather than of rdf:text.

### 3.2 Abbreviations of rdf:text and xs:string Literals

In syntaxes such as the RIF presentation syntax [6], the OWL 2 functional-style syntax [7], or the TURTLE syntax [8], literals are written using the form "rep"^^datatypeURI. This specification defines a convenient representation for rdf:text and xs:string literals. In particular, literals of the form "text@lang"^^rdf:text where "lang" is not empty can be abbreviated as "text"@lang; furthermore, literals of the form "text"^^xs:string can be abbreviated as "text". If an implementation supports abbreviation of literals, it should abbreviate the literals eagerly whenever possible.

The abbreviated literals can be written using the following grammar. A subset of the N-triples quoting mechanism is employed in order to allow strings to contain quotes.

```
quotedString := 'a finite sequence of characters in which " (U+22) and \ (U+5C) occur only in pairs of the form \" (U+22, U+5C) and \ (U+22, U+22), enclosed in a pair of " (U+22) characters'
languageTag := a nonempty (not quoted) string defined as specified in BCP-47 [BCP-47]
abbreviatedXSDStringLiteral := quotedString
abbreviatedRDFTextLiteral := quotedString '@' languageTag
abbreviatedLiteral := abbreviatedXSDStringLiteral | abbreviatedRDFTextLiteral
```

Text matching the abbreviatedXSDStringLiteral production should be mapped to an xs:string literal, and text matching the abbreviatedRDFTextLiteral production should be mapped to an rdf:text literal.
Example:

"Padre de familia" @ es is an abbreviation for the rdf:text literal "Padre
de familia"^^ rdf:text — a literal denoting a pair consisting of the
string "Padre de familia" and the language tag es denoting the Spanish
language. Furthermore, "Padre de familia" is an abbreviation for an
xs:string literal "Padre de familia"^^ xs:string, which is mapped to
the same data value as the rdf:text literal "Padre de
familia"^^ rdf:text.

4 Functions and Operators on rdf:text

This section defines constructor functions, operators, and functions on the
rdf:text datatype. The terminology used and structure to describe these
functions and operators is in accordance with the XQuery 1.0 and XPath 2.0
Functions and Operators [XPathFunc]. The error codes used in this section are
given in Appendix G of the XPath 2.0 specification [XPath20] and Appendix C of
XQuery and XPath function specification [XPathFunc].

Editor's Note: Reuse of the fn: namespace in the following functions is still
under discussion, cf. http://lists.w3.org/Archives/Public/public-rdf-text/
2008OctDec/0020.html

4.1 Functions for Assembling and Disassembling of rdf:text
Literals

4.1.1 fn:text-from-string-lang

fn:text-from-string-lang( $arg1 as xs:string, $arg2 as xs:string) as rdf:text

Summary: returns the data value ( $arg1, $arg2 ) of type rdf:text. The
arguments both have to be of type xs:string or one of its subtypes additionally,$arg2 has to be a valid language tag according to BCP-47 [BCP-47]; otherwise, this
function raises type error err:FORG0006.

4.1.2 fn:text-from-string

fn:text-from-string( $arg as xs:string) as rdf:text

Summary: returns the data value ($arg, "") of type rdf:text. The argument
has to be of type xs:string or one of its subtypes; otherwise, this function raises
type error err:FORG0006.
4.1.3 fn:string-from-text

fn:string-from-text( $arg as rdf:text) as xs:string

Summary: extracts the string part $s$ from the argument $\text{arg} = (\ s, \ l \ )$ of type rdf:text. The argument $\text{arg}$ has to be of type rdf:text; otherwise, this function raises type error err:FORG0006.

4.1.4 fn:lang-from-text

fn:lang-from-text( $arg as rdf:text ) as xs:lang

Summary: extracts the language tag $l$ from the argument $\text{arg} = (\ s, \ l \ )$ of type rdf:text. The argument $\text{arg}$ has to be of type rdf:text; otherwise, this function raises type error err:FORG0006.

4.2 Comparison of rdf:text Values

The notion of collations used in this section is taken from Section 7.3.1 of XPath and XQuery function specification [XPathFunc].

4.2.1 fn:text-compare

fn:text-compare( $comparand1 as rdf:text?, $comparand2 as rdf:text? ) as xs:integer?

fn:text-compare( $comparand1 as rdf:text?, $comparand2 as rdf:text?, $collation as xs:string )  as xs:integer?

Summary: returns the empty sequence if one of the arguments is empty or if the language parts of $\text{comparand1}$ and $\text{comparand2}$ are unequal; otherwise, this function returns -1, 0, or 1 depending on whether the value of the string-part of $\text{comparand1}$ is respectively less than, equal to, or greater than the value of the string-part of $\text{comparand2}$. The collation used by the invocation of this function is determined according to the rules in Section 7.3.1 of the XPath and XQuery functions specification [XPathFunc].

This function, invoked with the first signature, backs up the "eq", "ne", "gt", "lt", "le" and "ge" operators on text values.

The two functions may be viewed as declared XQuery functions with the following definitions:

declare function fn:text-compare( $comparand1 as rdf:text?, $comparand2 as rdf:text? ) as xs:integer?
{
    return
        if ( fn:compare ( fn:lang-from-text( $comparand1 ), fn:lang-from-text( $comparand2 ) ) = 0 ) then
            0
        else if ( fn:lang-from-text( $comparand1 ) < fn:lang-from-text( $comparand2 ) ) then
            -1
        else if ( fn:lang-from-text( $comparand1 ) > fn:lang-from-text( $comparand2 ) ) then
            1
        end if;
}

declare function fn:text-compare( $comparand1 as rdf:text?, $comparand2 as rdf:text?, $collation as xs:string ) as xs:integer?
{
    return
        if ( fn:compare ( fn:lang-from-text( $comparand1, $collation ), fn:lang-from-text( $comparand2, $collation ) ) = 0 ) then
            0
        else if ( fn:lang-from-text( $comparand1, $collation ) < fn:lang-from-text( $comparand2, $collation ) ) then
            -1
        else
            1
        end if;
}
4.3 Other Functions on rdf:text Values

Editor's Note: Open Issues: The inclusion of text-length, as well as the definition of the function - whether the length of an rdf:text value should concern only the string part - are still under discussion.

4.3.1 fn:text-length

fn:text-length($arg as rdf:text) as xs:integer

Summary: returns the number of characters that constitute the string part of $arg.

This function may be viewed as a declared XQuery function with the following definition:

declare function fn:text-length($arg as rdf:text?) as xs:integer
{
  return fn:string-length ( fn:string-from-text( $arg ) )
}

4.3.2 fn:matches-language-range

fn:matches-language-range($input as rdf:text?, $range as xs:string) as xs:boolean

Summary: returns true if the language tag part of $input is a valid language tag according to BCP-47 [BCP-47], and if it matches the language-range expression supplied as $range as specified by the algorithm for "Matching of Language Tags" which is part of BCP-47 [BCP-47]; otherwise, it returns false.

An empty input sequence is treated as a rdf:text value consisting of the empty string and the empty language tag. Since the empty string is not a valid language tag according to BCP-47 [BCP-47], on such input this function returns false.
5 References

[RFC 3986]

[RFC 2119]

[UNICODE]
The Unicode Standard. The Unicode Consortium.

[ISO/IEC 10646]

[BCP 47]

[XML Namespaces]

[XML Schema Datatypes]

[XPath20]

[XPathFunc]

[IRC Log July 21, 2008]
Joint meeting of OWL, RIF and I18N WGs.