

Apache Xalan-J's, XSLT 3.0 specification implementation status

Document modified : 2024-08-19

Document author : Apache Xalan-J team

(1) XSLT 3.0 & XPath 3.1

The XSLT 3.0 specification defines various conformance features as follows, and the level to which Xalan-J implements them.

- | | |
|-----------------------------------|--|
| a) Basic XSLT processor | Supported |
| | XSLT 3.0 instructions and XPath language features, whose implementations are available are described in subsequent sections of this document, below. |
| b) Schema aware XSLT processor | Supported |
| | An XML Schema document can be imported into an XSL stylesheet using <code>xsl:import-schema</code> instruction, and schema's global type definitions and element & attribute declarations can be used within the stylesheet. |
| | Schema aware feature where XML input document, resulting in node tree having detailed type annotations on all possible nodes is not supported. i.e, XPath processor is natively not schema aware. |
| c) Serialization feature | Supported |
| d) Streaming feature | Not supported |
| e) Dynamic evaluation feature | Supported |
| f) XPath 3.1 feature, for arrays | Supported |
| g) Higher-order functions feature | Supported |

Following are details of Xalan-J, XSL 3.0 family of language features, whose working implementation is available on Xalan-J XSL 3.0 dev repos branch 'xalan-j_xslt3.0'.

1.1) XSLT 3.0 features

XSLT 3.0 language specification : <https://www.w3.org/TR/xslt-30/>

- 1) `xsl:for-each-group` instruction

- 2) `xsl:analyze-string` instruction
- 3) `xsl:iterate` instruction
- 4) `xsl:for-each` instruction implementation improvements, for new XSLT 3.0 requirements. Particularly, `xsl:for-each` instruction being able to iterate XPath atomic values.
- 5) `xsl:evaluate` instruction
- 6) `xsl:function` instruction
- 7) `xsl:sequence` instruction
- 8) `xsl:element` instruction's attributes 'type' and 'validation'. Literal result element's attributes `xsl:type` and `xsl:validation`. `xsl:attribute` instruction's attributes 'type' and 'validation'. `xsl:copy-of` instruction's attributes 'type' and 'validation'.
- 9) `xsl:attribute` element can now have both, "select" attribute and child sequence constructor. But only one of these is allowed to be present on `xsl:attribute` instruction as specified by XSLT 3.0 specification.
- 10) `xsl:import-schema` instruction
- 11) `xsl:variable` instruction evaluation to node set instead of result tree fragment (RTF). This XSLT specification change was first introduced in XSLT 2.0. With XSLT 1.0, if RTF has to be used as node set, then it has to be converted to node set using node-set extension function.
- 12) The sequence type expression "as" attribute on XSLT elements `xsl:variable`, `xsl:template`, `xs:function`, `xsl:param`, `xsl:with-param`, `xsl:evaluate`.
- 13) Function implementations
 - a) New function implementations : `fn:current-grouping-key`, `fn:current-group`, `fn:regex-group`
 - b) Function implementation enhancements : `fn:system-property`

Support for following new Xalan-J XSL transformation properties :

<http://apache.org/xalan/validation> (used to enable XML input document validation when `xsl:import-schema` instruction is used within an XSL stylesheet, with default value false)

<http://apache.org/xalan/xslevaluate> (used to enable XSL stylesheet instruction `xsl:evaluate`, with default value false)

These new XSL transformation properties can be set, using Xalan-J's class `TransformerImpl` when XSL transformation is invoked via API, or via Xalan-J command line.

1.2) XPath 3.1 expression language features

XPath 3.1 language specification : <https://www.w3.org/TR/xpath-31/>

- 1) Range "to" expression
- 2) Value comparison operators eq, ne, lt, le, gt, ge
- 3) Function item "inline function expression"
- 4) Dynamic function calls
- 5) "if" expression
- 6) "for" expression
- 7) Quantified expressions 'some', 'every'
- 8) "let" expression
- 9) Sequence constructor expression, using comma operator
- 10) String concatenation operator "||"
- 11) Node comparison operators "is", "<<", ">>"
- 12) Simple map operator '!'
- 13) Instance Of expression
- 14) Implementation of various new XML Schema built-in data types for use in XSLT 3.0 stylesheets and XPath 3.1 expressions. Implementation of, XPath constructor function calls (for e.g, `xs:string('hello')`, `xs:date('2005-10-07')` etc) for these supported XML Schema data types.

Following XML Schema built-in types are supported (depicted with XML Schema data type and subtype hierarchy as specified by W3C XML Schema data types specification) :

```
xs:anyType
  xs:anySimpleType
    xs:anyAtomicType
      xs:anyURI
      xs:boolean
      xs:date
      xs:dateTime
      xs:decimal
      xs:integer
      xs:long
      xs:int
```

- xs:short
- xs:byte
- xs:nonNegativeInteger
- xs:positiveInteger
- xs:unsignedLong
- xs:unsignedInt
- xs:unsignedShort
- xs:unsignedByte
- xs:nonPositiveInteger
- xs:negativeInteger
- xs:double
- xs:duration
 - xs:dayTimeDuration
 - xs:yearMonthDuration
- xs:float
- xs:QName
- xs:string
 - xs:normalizedString
 - xs:token
 - xs:Name
 - xs:NCName
- xs:time

In addition to above mentioned XML Schema built-in data types, an XML Schema type `xs:untyped` specified by XPath 3.1 specification has also been implemented.

15) Collation support

Within the context of XSL languages, a collation is a method by which text information is compared and sorted.

As specified by XPath 3.1 F&O spec, implementations of following collations are available:

15.1) The Unicode Codepoint Collation

15.2) The Unicode Collation Algorithm

Support for following collation uri query parameters is available : 'fallback', 'lang', 'strength'

For the collation's query "lang" parameter, all languages as those supported by Java's 'java.util.Locale' class are available within Xalan-J's XSLT 3.0 implementation (ref, <https://docs.oracle.com/javase/8/docs/api/java/util/Locale.html>).

For the collation's query "strength" parameter, following values are supported : 'primary', 'secondary', 'tertiary', 'identical'.

15.3) The HTML ASCII Case-Insensitive Collation

16) Sequence type expression

- 17) Map expression
- 18) Array expression
- 19) Cast expression
- 20) Castable expression
- 21) Treat expression
- 22) Named function reference
- 23) Array and map lookup using function call syntax
- 24) Arrow operator (\Rightarrow)

1.3) XPath 3.1 functions

XPath 3.1 F&O specification : <https://www.w3.org/TR/xpath-functions-31/>

Implementation of XPath built-in default functions namespace : <http://www.w3.org/2005/xpath-functions>

Implementation of XPath built-in math functions namespace : <http://www.w3.org/2005/xpath-functions/math>

Implementation of XPath built-in map functions namespace : <http://www.w3.org/2005/xpath-functions/map>

Implementation of XPath built-in array functions namespace : <http://www.w3.org/2005/xpath-functions/array>

1) Functions on numeric values

fn:abs

fn:round (implementation of an optional second argument, that's used to specify 'precision')

2) Context functions

fn:current-dateTime

fn:current-date

fn:current-time

fn:implicit-timezone

fn:default-collation

3) Functions giving access to external information

fn:doc
fn:unparsed-text

4) Functions on strings

fn:string-join
fn:upper-case
fn:lower-case
fn:codepoints-to-string
fn:string-to-codepoints
fn:compare (with support for collation argument)
fn:codepoint-equal
fn:contains-token (with support for collation argument)

5) String functions that use regular expressions

fn:matches
fn:replace
fn:tokenize
fn:analyze-string

6) Functions that compare values in sequences

fn:distinct-values (with support for collation argument)
fn:index-of (with support for collation argument)
fn:deep-equal (with support for collation argument)

7) Maths trigonometric and exponential functions

math:pi
math:exp
math:exp10
math:log
math:log10
math:pow
math:sqrt
math:sin
math:cos
math:tan
math:asin
math:acos
math:atan
math:atan2

8) Component extraction functions on durations

fn:years-from-duration
fn:months-from-duration
fn:days-from-duration

fn:hours-from-duration
fn:minutes-from-duration
fn:seconds-from-duration

9) Constructing xs:dateTime value

fn:dateTime

10) Component extraction functions on dates and times

fn:year-from-dateTime
fn:month-from-dateTime
fn:day-from-dateTime
fn:hours-from-dateTime
fn:minutes-from-dateTime
fn:seconds-from-dateTime
fn:timezone-from-dateTime
fn:year-from-date
fn:month-from-date
fn:day-from-date
fn:timezone-from-date
fn:hours-from-time
fn:minutes-from-time
fn:seconds-from-time
fn:timezone-from-time

11) Built-in higher-order functions

fn:for-each
fn:filter
fn:fold-left
fn:fold-right
fn:for-each-pair
fn:sort (with support for collation argument)
fn:apply

12) Functions on sequences

12.1 General functions on sequences

fn:empty
fn:exists
fn:head
fn:tail
fn:insert-before
fn:remove
fn:reverse
fn:subsequence
fn:unordered

12.2 Aggregate functions

fn:avg

fn:max

fn:min

13) Parsing and serializing

fn:parse-xml

fn:parse-xml-fragment

14) Accessors

fn:node-name

fn:data

fn:base-uri

fn:document-uri

15) Functions related to QNames

fn:resolve-QName

fn:QName

16) Functions related to maps

map:merge

map:size

map:keys

map:contains

map:get

map:find

map:put

map:entry

map:remove

map:for-each

17) Functions related to arrays

array:size

array:get

array:put

array:append

array:subarray

array:remove

array:insert-before

array:head

array:tail

array:reverse

array:join

array:for-each

array:filter
array:fold-left
array:fold-right
array:for-each-pair
array:sort (with support for collation argument)
array:flatten

18) Functions on JSON data

fn:parse-json
fn:json-doc
fn:json-to-xml
fn:xml-to-json

Other than the above mentioned newly implemented XPath 3.1 functions, all the functions that are already available within XPath 1.0 (all of them are common with XPath 3.1 function library as well) are available within Xalan-J's XPath 3.1 implementation as well.

Please refer to the web link <https://www.w3.org/TR/1999/REC-xpath-19991116/> (section “4 Core Function Library”), for XPath 1.0 functions that shall work with Xalan-J's XSLT 3.0 implementation as well.

(2) Xalan-J XSLT 3.0 & XPath 3.1 test suite

For the Xalan-J XSLT 3.0 & XPath 3.1 specification features mentioned within this document, a working test suite is available at the location : https://github.com/apache/xalan-java/tree/xalan-j_xslt3.0/tests, and the results of these Xalan-J XSL tests are available at the location : https://xalan.apache.org/xalan-j/xsl3/tests/AllXsl3Tests_20240819-221050.xml.

Apache Xalan-J site
<https://xalan.apache.org/xalan-j/>

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