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

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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 xsl:import-schema 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'.

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.

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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 (=>)

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_20240815-170237.xml.