**Apache Xalan-J’s, XSLT 3.0 specification implementation status**

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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.

1. Basic XSLT processor Supported

XSLT 3.0 instructions, whose implementations are

available is mentioned in section (1.1) below.

1. Schema-aware XSLT processor Not supported

There is support for, minor use cases of XSLT instruction

xsl:import-schema. There are few working examples for

this, available within tests folder ‘xsl\_import\_schema’.

1. Serialization feature Supported

Xalan-J’s implementation for this, is exactly same as Xalan’s

XSLT 1.0 processor, with support for following output

methods : xml, html, text.

1. Streaming feature Not supported
2. Dynamic evaluation feature Not supported

This requires an XSLT processor, to implement an XSL

instruction xsl:evaluate.

1. XPath 3.1 feature, for arrays Supported
2. 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 is modified, to handle few XSLT 3.0 requirements.
5. xsl:function instruction
6. xsl:sequence instruction
7. xsl:attribute element can now have "select" attribute as well in addition to mutually exclusive

child content as well, as specified by XSLT 3.0 spec.

1. xsl:import-schema instruction

Currently, the XML Schema simple types imported via xsl:import-schema instruction within an

XSLT stylesheet, can be used with “as” attribute of XSLT xsl:variable elements to enforce schema

type constraints on xsl:variable data contents.

1. xsl:variable instruction evaluation to node set instead of result tree fragment (RTF). This is a XSLT

spec change first introduced within XSLT 2.0 language, as compared to XSLT 1.0.

10) The sequence type expression "as" attribute on XSLT elements xsl:variable, xsl:template,

xs:function, xsl:param, xsl:with-param.

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11) Function implementations

a) New function implementations : fn:current-grouping-key, fn:current-group, fn:regex-group

b) Function implementation enhancements : fn:system-property

**(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

For e.g, XPath expressions like (1, 2, 3) etc.

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 within 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.

Currently, following XML Schema built-in data types are supported (depicted with XML Schema data type and subtype hierarchy as specified by “W3C XML Schema” data types specification), for this work :

xs:anyType

xs:anySimpleType

xs:anyAtomicType

xs:anyURI

xs:boolean

xs:date

xs:dateTime

xs:decimal

xs:integer

xs:long

xs:int

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 expressions

17) Map expressions

18) Array expressions

19) Cast expression

20) Castable expression

21) Arrow operator (=>)

**(1.3) XPath 3.1 functions**

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

Implementation of built-in functions namespace uri : http://www.w3.org/2005/xpath-functions

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

1) String functions that use regular expressions

fn:matches

fn:replace

fn:tokenize

fn:analyze-string

2) Functions on numeric values

fn:abs

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

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) Context functions

fn:current-dateTime

fn:current-date

fn:current-time

fn:implicit-timezone

fn:default-collation

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) Mathematical 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)

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: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)

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 implementations described 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_20240622-124238.xml>.

Apache Xalan-J site

https://xalan.apache.org/xalan-j/

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