

XML Schema for WSML Logical Expressions

Table of Contents

- [Schema Document Properties](#)
- [Global Schema Components](#)
 - [Element: **constraint**](#)
 - [Element: **impliedByLP**](#)
 - [Complex Type: **logicalExpressionType**](#)
 - [Element: **and**](#)
 - [Element: **or**](#)
 - [Element: **neg**](#)
 - [Element: **naf**](#)
 - [Element: **implies**](#)
 - [Element: **impliedBy**](#)
 - [Element: **equivalent**](#)
 - [Element: **forall**](#)
 - [Element: **exists**](#)
 - [Complex Type: **quantifiedComplexExpressionType**](#)
 - [Complex Type: **complexExpressionType**](#)
 - [Complex Type: **binaryComplexExpressionType**](#)
 - [Element: **atom**](#)
 - [Complex Type: **termType**](#)
 - [Element: **molecule**](#)

[top](#)

Schema Document Properties

Target Namespace	http://www.wsmo.org/wsml/wsml-syntax#
Element and Attribute Namespaces	<ul style="list-style-type: none">• Global element and attribute declarations belong to this schema's target namespace.• By default, local element declarations belong to this schema's target namespace.• By default, local attribute declarations have no namespace.
Schema Composition	<ul style="list-style-type: none">• This schema includes components from the following schema document(s):<ul style="list-style-type: none">◦ http://www.wsmo.org/TR/d16/d16.1/v0.21/xml-syntax/wsml-identifiers.xsd
Documentation	version: \$Revision: 1.31 \$ date: \$Date: 2005/09/20 13:58:02 \$ author: Jos de Bruijn, Reto Krummenacher this schema is a module, which belongs to the WSML/XML schema specification. This schema provides WSML/XML syntax for logical expressions. This syntax for logical expressions is inspired by the RuleML FOL (First-Order Logic) variant. Necessary additions for WSML-Full were the introduction of negation-as-failure, LP implication and constraints

Declared Namespaces

Prefix	Namespace
Default namespace	http://www.wsmo.org/wsml/wsml-syntax#
xml	http://www.w3.org/XML/1998/namespace
xs	http://www.w3.org/2001/XMLSchema

Schema Component Representation

```
<xs:schema targetNamespace="http://www.wsmo.org/wsml/wsml-syntax#"
  elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:include
    schemaLocation="http://www.wsmo.org/TR/d16/d16.1/v0.21/xml-syntax/wsml-identifiers:
    ...
  </xs:schema>
```

[top](#)

Global Schema Components

Element: **constraint**

Name	constraint
Type	complexExpressionType
Nilable	no
Abstract	no
Documentation	Database-style constraint. Corresponds with the '!' symbol in the human readable syntax.

XML Instance Representation

```
<constraint>
  Start Choice [1]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</constraint>
```

Schema Component Representation

```
<xs:element name="constraint" type=" complexExpressionType "/>
```

[top](#)

Element: **impliedByLP**

Name	impliedByLP
Type	binaryComplexExpressionType
Nilable	no
Abstract	no
Documentation	Logic Programming rule. This rule has a head and a body. This XML element corresponds with the ':' symbol in the human-readable syntax.

XML Instance Representation

```
<impliedByLP>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</impliedByLP>
```

Schema Component Representation

```
<xs:element name="impliedByLP" type=" binaryComplexExpressionType "/>
```

[top](#)

Complex Type: **logicalExpressionType**

Super-types: None

Sub-types: None

Name	logicalExpressionType
Abstract	no
Documentation	A WSML logical expression is either a constraint, an LP rule or a formula. The formula corresponds to an LP rule with an empty body.

XML Instance Representation

```
<...>
  Start Choice [1..*]
  <constraint> ... </constraint> [1..*]
  <impliedByLP> ... </impliedByLP> [1..*]
  <atom> ... </atom> [1..*]
  <molecule> ... </molecule> [1..*]
  <and> ... </and> [1..*]
  <or> ... </or> [1..*]
  <neg> ... </neg> [1..*]
  <naf> ... </naf> [1..*]
  <implies> ... </implies> [1..*]
  <impliedBy> ... </impliedBy> [1..*]
  <equivalent> ... </equivalent> [1..*]
  <forall> ... </forall> [1..*]
  <exists> ... </exists> [1..*]
  End Choice
</...>
```

Schema Component Representation

```
<xs:complexType name="logicalExpressionType">
  <xs:choice maxOccurs="unbounded">
    <xs:element ref=" constraint " maxOccurs="unbounded"/>
    <xs:element ref=" impliedByLP " maxOccurs="unbounded"/>
    <xs:element ref=" atom " maxOccurs="unbounded"/>
    <xs:element ref=" molecule " maxOccurs="unbounded"/>
    <xs:element ref=" and " maxOccurs="unbounded"/>
    <xs:element ref=" or " maxOccurs="unbounded"/>
    <xs:element ref=" neg " maxOccurs="unbounded"/>
    <xs:element ref=" naf " maxOccurs="unbounded"/>
    <xs:element ref=" implies " maxOccurs="unbounded"/>
    <xs:element ref=" impliedBy " maxOccurs="unbounded"/>
    <xs:element ref=" equivalent " maxOccurs="unbounded"/>
    <xs:element ref=" forall " maxOccurs="unbounded"/>
    <xs:element ref=" exists " maxOccurs="unbounded"/>
  </xs:choice>
</xs:complexType>
```

[top](#)

Element: **and**

Name	and
Type	binaryComplexExpressionType
Nilable	no
Abstract	no
Documentation	Conjunction

XML Instance Representation

```

<and>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</and>

```

Schema Component Representation

```

<xs:element name="and" type=" binaryComplexExpressionType "/>

```

[top](#)

Element: or

Name	or
Type	binaryComplexExpressionType
Nilable	no
Abstract	no
Documentation	Disjunction

XML Instance Representation

```

<or>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</or>

```

Schema Component Representation

```

<xs:element name="or" type=" binaryComplexExpressionType "/>

```

[top](#)

Element: neg

Name	neg
Type	complexExpressionType
Nilable	no
Abstract	no
Documentation	Classical negation

XML Instance Representation

```

<neg>
  Start Choice [1]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</neg>

```

Schema Component Representation

```

<xs:element name="neg" type=" complexExpressionType "/>

```

[top](#)

Element: naf

Name	naf
Type	complexExpressionType
Nilable	no
Abstract	no
Documentation	Negation-as-failure

XML Instance Representation

```

<naf>
  Start Choice [1]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</naf>

```

Schema Component Representation

```

<xs:element name="naf" type=" complexExpressionType "/>

```

[top](#)

Element: implies

Name	implies
Type	binaryComplexExpressionType
Nilable	no
Abstract	no
Documentation	Right implication (corresponds with necessary conditions). The first formula nested inside the 'implies' element, implies the second formula. For an implication, exactly two formulas must be nested inside the implication element.

XML Instance Representation

```

<implies>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</implies>

```

Schema Component Representation

```
<xs:element name="implies" type="binaryComplexExpressionType" />
```

[top](#)

Element: **impliedBy**

Name	impliedBy
Type	binaryComplexExpressionType
Nilable	no
Abstract	no
Documentation	Left implication (corresponds with sufficient conditions). The first formula nested inside the 'implies' element, is implied by the second formula. For an implication, exactly two formulas must be nested inside the implication element.

XML Instance Representation

```

<impliedBy>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</impliedBy>

```

Schema Component Representation

```
<xs:element name="impliedBy" type="binaryComplexExpressionType" />
```

Element: **equivalent**

Name	equivalent
Type	binaryComplexExpressionType
<u>Nillable</u>	no
<u>Abstract</u>	no
Documentation	Dual implication (corresponds with necessary and sufficient conditions). The first formula nested inside the 'implies' element, is implied by the second formula. For an implication, exactly two formulas must be nested inside the implication element.

XML Instance Representation

```

<equivalent>
  Start Choice [2..2]
    <atom> ... </atom> [1]
    <molecule> ... </molecule> [1]
    <and> ... </and> [1]
    <or> ... </or> [1]
    <neg> ... </neg> [1]
    <naf> ... </naf> [1]
    <implies> ... </implies> [1]
    <impliedBy> ... </impliedBy> [1]
    <equivalent> ... </equivalent> [1]
    <forall> ... </forall> [1]
    <exists> ... </exists> [1]
  End Choice
</equivalent>

```

Schema Component Representation

```
<xs:element name="equivalent" type=" binaryComplexExpressionType "/>
```

Element: **forall**

Name	forall
Type	quantifiedComplexExpressionType
<u>Nillable</u>	no
<u>Abstract</u>	no
Documentation	Universal quantification.

XML Instance Representation

```

<forall>
  <variable> wsmVariable </variable> [1..*]
  Start Choice [1]
    <atom> ... </atom> [1]
    <molecule> ... </molecule> [1]
    <and> ... </and> [1]
    <or> ... </or> [1]
    <neg> ... </neg> [1]
    <naf> ... </naf> [1]
    <implies> ... </implies> [1]
    <impliedBy> ... </impliedBy> [1]
    <equivalent> ... </equivalent> [1]
    <forall> ... </forall> [1]
    <exists> ... </exists> [1]
  End Choice
</forall>

```

Schema Component Representation

```
<xs:element name="forall" type=" quantifiedComplexExpressionType "/>
```

[top](#)

Element: **exists**

Name	exists
Type	quantifiedComplexExpressionType
Niltable	no
Abstract	no
Documentation	Existential quantification

XML Instance Representation

```
<exists>  
  <variable> wsmVariable </variable> [1..*]  
  Start Choice [1]  
    <atom> ... </atom> [1]  
    <molecule> ... </molecule> [1]  
    <and> ... </and> [1]  
    <or> ... </or> [1]  
    <neq> ... </neq> [1]  
    <naf> ... </naf> [1]  
    <implies> ... </implies> [1]  
    <impliedBy> ... </impliedBy> [1]  
    <equivalent> ... </equivalent> [1]  
    <forall> ... </forall> [1]  
    <exists> ... </exists> [1]  
  End Choice  
</exists>
```

Schema Component Representation

```
<xs:element name="exists" type=" quantifiedComplexExpressionType "/>
```

[top](#)

Complex Type: **quantifiedComplexExpressionType**

<i>Super-types:</i>	None
<i>Sub-types:</i>	None

Name	quantifiedComplexExpressionType
Abstract	no
Documentation	For now the complexExpressionType is repeated after the 'var' element, because I don't know how to include it *after* 'var'.

XML Instance Representation

```
<...>  
  <variable> wsmVariable </variable> [1..*]  
  Start Choice [1]  
    <atom> ... </atom> [1]  
    <molecule> ... </molecule> [1]  
    <and> ... </and> [1]  
    <or> ... </or> [1]  
    <neq> ... </neq> [1]  
    <naf> ... </naf> [1]  
    <implies> ... </implies> [1]  
    <impliedBy> ... </impliedBy> [1]
```



```

    <equivalent> ... </equivalent> [1]
    <forall> ... </forall> [1]
    <exists> ... </exists> [1]
  End Choice
</...>

```

Schema Component Representation

```

<xs:complexType name="quantifiedComplexExpressionType">
  <xs:sequence>
    <xs:element name="variable" type=" wsmlVariable "
      maxOccurs="unbounded"/>
    <xs:choice>
      <xs:element ref=" atom "/>
      <xs:element ref=" molecule "/>
      <xs:element ref=" and "/>
      <xs:element ref=" or "/>
      <xs:element ref=" neg "/>
      <xs:element ref=" naf "/>
      <xs:element ref=" implies "/>
      <xs:element ref=" impliedBy "/>
      <xs:element ref=" equivalent "/>
      <xs:element ref=" forall "/>
      <xs:element ref=" exists "/>
    </xs:choice>
  </xs:sequence>
</xs:complexType>

```

[top](#)

Complex Type: **complexExpressionType**

Super-types:	None
Sub-types:	None

Name	complexExpressionType
Abstract	no
Documentation	The basic type for WSML-Full expressions, allowing exactly one expression

XML Instance Representation

```

<...>
  Start Choice [1]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</...>

```

Schema Component Representation

```

<xs:complexType name="complexExpressionType">
  <xs:choice>
    <xs:element ref=" atom "/>
    <xs:element ref=" molecule "/>
    <xs:element ref=" and "/>
    <xs:element ref=" or "/>
    <xs:element ref=" neg "/>
    <xs:element ref=" naf "/>
  </xs:choice>
</xs:complexType>

```

```

    <xs:element ref=" implies "/>
    <xs:element ref=" impliedBy "/>
    <xs:element ref=" equivalent "/>
    <xs:element ref=" forall "/>
    <xs:element ref=" exists "/>
  </xs:choice>
</xs:complexType>

```

[top](#)

Complex Type: **binaryComplexExpressionType**

Super-types: None

Sub-types: None

Name	binaryComplexExpressionType
Abstract	no
Documentation	The basic type for WSML-Full expressions, allowing exactly two expressions to each side of the operator

XML Instance Representation

```

<...>
  Start Choice [2..2]
  <atom> ... </atom> [1]
  <molecule> ... </molecule> [1]
  <and> ... </and> [1]
  <or> ... </or> [1]
  <neg> ... </neg> [1]
  <naf> ... </naf> [1]
  <implies> ... </implies> [1]
  <impliedBy> ... </impliedBy> [1]
  <equivalent> ... </equivalent> [1]
  <forall> ... </forall> [1]
  <exists> ... </exists> [1]
  End Choice
</...>

```

Schema Component Representation

```

<xs:complexType name="binaryComplexExpressionType">
  <xs:choice minOccurs="2" maxOccurs="2">
    <xs:element ref=" atom "/>
    <xs:element ref=" molecule "/>
    <xs:element ref=" and "/>
    <xs:element ref=" or "/>
    <xs:element ref=" neg "/>
    <xs:element ref=" naf "/>
    <xs:element ref=" implies "/>
    <xs:element ref=" impliedBy "/>
    <xs:element ref=" equivalent "/>
    <xs:element ref=" forall "/>
    <xs:element ref=" exists "/>
  </xs:choice>
</xs:complexType>

```

[top](#)

Element: **atom**

Name	atom
Type	Locally-defined complex type
<u>Nilable</u>	no
<u>Abstract</u>	no
Documentation	An atom denotes a relation with an n-ary domain, where n is the arity of the predicate

XML Instance Representation

```
<atom
  name="anySimpleType [1]">
  <arg> termType </arg> [0..*]
</atom>
```

Schema Component Representation

```
<xs:element name="atom">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="arg" type=" termType " minOccurs="0"
        maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="name" use="required"/>
  </xs:complexType>
</xs:element>
```

[top](#)

Complex Type: **termType**

Super-types: None
Sub-types: None

Name	termType
<u>Abstract</u>	no
Documentation	A term can be a IRI or a variable, or a constructed term (corresponding to a function symbol), where the arguments are terms themselves. In the latter case, the name may not be a variable. It is possible to use regular content instead of arguments for the first argument; the content is either an IRI or a variables; in case the type of information is apparent from the name of the term (i.e. either <code>wsml#string</code> , <code>wsml#integer</code> , or <code>wsml#decimal</code>), the content is of this type.

XML Instance Representation

```
<...
  name=" xs:string [1]">
  <!-- Mixed content -->
  <arg> termType </arg> [0..*]
</...>
```

Schema Component Representation

```
<xs:complexType name="termType" mixed="true">
  <xs:sequence>
    <xs:element name="arg" type=" termType " minOccurs="0"
      maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="name" type=" xs:string " use="required"/>
</xs:complexType>
```

[top](#)

Element: **molecule**

Name	molecule
Type	Locally-defined complex type
Nilable	no
Abstract	no

XML Instance Representation

```
<molecule>
  <term> termType </term> [1]
  Start Choice [1..*]
    <attributeDefinition
      type=" xs:string (value comes from list:
        {'inferring'|'constraining'}) [0..1]"> [0..*]
      <name> termType </name> [1]
      <type> termType </type> [1..*]
    </attributeDefinition>
    <attributeValue> [0..*]
      <name> termType </name> [1]
      <value> termType </value> [1..*]
    </attributeValue>
    <isa
      type=" xs:string (value comes from list: {'memberOf'|'subConceptOf'})
        [0..1]"> [0..1]
      <term> termType </term> [1..*]
    </isa>
  End Choice
</molecule>
```

Schema Component Representation

```
<xs:element name="molecule">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="term" type=" termType "/>
      <xs:choice maxOccurs="unbounded">
        <xs:element name="attributeDefinition" minOccurs="0"
          maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="name" type=" termType "/>
              <xs:element name="type" type=" termType "
                maxOccurs="unbounded"/>
            </xs:sequence>
            <xs:attribute name="type" default="constraining">
              <xs:simpleType>
                <xs:restriction base=" xs:string ">
                  <xs:enumeration value="inferring"/>
                  <xs:enumeration value="constraining"/>
                </xs:restriction>
              </xs:simpleType>
            </xs:attribute>
          </xs:complexType>
        </xs:element>
        <xs:element name="attributeValue" minOccurs="0"
          maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="name" type=" termType "/>
              <xs:element name="value" type=" termType "
                maxOccurs="unbounded"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:choice>
      <xs:element name="isa" minOccurs="0">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="term" type=" termType "
              maxOccurs="unbounded"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

```
<xs:attribute name="type">
  <xs:simpleType>
    <xs:restriction base=" xs:string ">
      <xs:enumeration value="memberOf"/>
      <xs:enumeration value="subConceptOf"/>
    </xs:restriction>
  </xs:simpleType>
</xs:attribute>
</xs:complexType>
</xs:element>
</xs:choice>
</xs:sequence>
</xs:complexType>
</xs:element>
```

[top](#)

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