

# XML Schema for WSML Logical Expressions

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## Schema Document Properties

<b>Target Namespace</b>	<a href="http://www.wsmo.org/wsml/wsml-syntax#">http://www.wsmo.org/wsml/wsml-syntax#</a>
<b>Element and Attribute Namespaces</b>	<ul style="list-style-type: none"><li>• Global element and attribute declarations belong to this schema's target namespace.</li><li>• By default, local element declarations belong to this schema's target namespace.</li><li>• By default, local attribute declarations have no namespace.</li></ul>
<b>Schema Composition</b>	<ul style="list-style-type: none"><li>• This schema includes components from the following schema document(s):<ul style="list-style-type: none"><li>◦ <a href="http://www.wsmo.org/TR/d16/d16.1/v0.21/xml-syntax/wsml-identifiers.xsd">http://www.wsmo.org/TR/d16/d16.1/v0.21/xml-syntax/wsml-identifiers.xsd</a></li></ul></li></ul>
<b>Documentation</b>	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	<a href="http://www.wsmo.org/wsml/wsml-syntax#">http://www.wsmo.org/wsml/wsml-syntax#</a>
xml	<a href="http://www.w3.org/XML/1998/namespace">http://www.w3.org/XML/1998/namespace</a>
xs	<a href="http://www.w3.org/2001/XMLSchema">http://www.w3.org/2001/XMLSchema</a>

## 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>
```

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# Global Schema Components

## Element: **constraint**

<b>Name</b>	constraint
<b>Type</b>	<a href="#">complexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>
```

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## Element: **impliedByLP**

<b>Name</b>	impliedByLP
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>
```

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## Complex Type: **logicalExpressionType**

Super-types: None

Sub-types: None

<b>Name</b>	logicalExpressionType
<b>Abstract</b>	no
<b>Documentation</b>	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>
```

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## Element: **and**

<b>Name</b>	and
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>

```

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## Element: or

<b>Name</b>	or
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>

```

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## Element: neg

<b>Name</b>	neg
<b>Type</b>	<a href="#">complexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>

```

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## Element: naf

<b>Name</b>	naf
<b>Type</b>	<a href="#">complexExpressionType</a>
<b>Nilable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>

```

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## Element: implies

<b>Name</b>	implies
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b>Niltable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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" />
```

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## Element: **impliedBy**

<b>Name</b>	impliedBy
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b>Niltable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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**

<b>Name</b>	equivalent
<b>Type</b>	<a href="#">binaryComplexExpressionType</a>
<b><u>Nilable</u></b>	no
<b><u>Abstract</u></b>	no
<b>Documentation</b>	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**

<b>Name</b>	forall
<b>Type</b>	<a href="#">quantifiedComplexExpressionType</a>
<b><u>Nilable</u></b>	no
<b><u>Abstract</u></b>	no
<b>Documentation</b>	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 "/>
```

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## Element: **exists**

<b>Name</b>	exists
<b>Type</b>	<a href="#">quantifiedComplexExpressionType</a>
<b>Niltable</b>	no
<b>Abstract</b>	no
<b>Documentation</b>	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 "/>
```

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## Complex Type: **quantifiedComplexExpressionType**

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

<b>Name</b>	quantifiedComplexExpressionType
<b>Abstract</b>	no
<b>Documentation</b>	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]  
  End Choice  
</...>
```

```

    <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>

```

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## Complex Type: **complexExpressionType**

Super-types: None

Sub-types: None

<b>Name</b>	complexExpressionType
<b>Abstract</b>	no
<b>Documentation</b>	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>

```

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## Complex Type: **binaryComplexExpressionType**

Super-types: None

Sub-types: None

<b>Name</b>	binaryComplexExpressionType
<b>Abstract</b>	no
<b>Documentation</b>	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>

```

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## Element: **atom**

<b>Name</b>	atom
<b>Type</b>	Locally-defined complex type
<b><u>Nilable</u></b>	no
<b><u>Abstract</u></b>	no
<b>Documentation</b>	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>
```

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## Complex Type: **termType**

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

<b>Name</b>	termType
<b><u>Abstract</u></b>	no
<b>Documentation</b>	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>
```

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## Element: **molecule**

<b>Name</b>	molecule
<b>Type</b>	Locally-defined complex type
<b>Nilable</b>	no
<b>Abstract</b>	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>
```

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