

## Appendix A: OIL Syntax in XML

This appendix provides an XML-based syntax definition of OIL. First we define a DTD for OIL. Then we use XML schemas to define the syntax of OIL. Finally we provide the example of Section 3 in XML syntax.

### Appendix A.1 A DTD for OIL

The XML syntax of OIL ontologies is defined by the following DTD.

```
<!-- DTD for Ontology Integration Language OIL -->

<!ELEMENT ontology (ontology-container, ontology-definitions)>

<!-- Ontology container -->
<!ELEMENT ontology-container(rdf:RDF)>
<!-- This part contains meta-data about the ontology.
It is formatted according [Miller et al., 1999] -->
<!ELEMENT rdf:RDF (rdf:Description)>
<!ATTLIST rdf:RDF
  xmlns:rdf CDATA #FIXED "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc CDATA #FIXED "http://purl.oclc.org/dc#"
  xmlns:dcq CDATA #FIXED "http://purl.org/dc/qualifiers/1.0/"
  >
<!ELEMENT rdf:Description ((dc:Title+, dc:Creator+, dc:Subject*, dc:Description+,
  dc:Publisher*, dc:Contributor*, dc:Date*, dc:Type+,
  dc:Format*, dc:Identifier+, dc:Source*,
  dc:Language+, dc:Relation*, dc:Rights*) |
  (dcq:descriptionType, rdf:value) |
  (dcq:relationType, rdf:value) )>
<!ATTLIST rdf:Description about CDATA #IMPLIED >
<!ELEMENT dc:Title (#PCDATA)>
<!ELEMENT dc:Creator (#PCDATA)>
<!ELEMENT dc:Subject (#PCDATA)>
<!ELEMENT dc:Description (#PCDATA | rdf:Description)*>
<!ELEMENT dc:Publisher (#PCDATA)>
<!ELEMENT dc:Contributor (#PCDATA)>
<!ELEMENT dc:Date (#PCDATA)>
<!ELEMENT dc:Type (#PCDATA)>
<!ELEMENT dc:Format (#PCDATA)>
<!ELEMENT dc:Identifier (#PCDATA)>
<!ELEMENT dc:Source (#PCDATA)>
<!ELEMENT dc:Language (#PCDATA)>
<!ELEMENT dc:Relation (#PCDATA | rdf:Description)*>
<!ELEMENT dc:Rights (#PCDATA)>
<!ELEMENT dcq:descriptionType (#PCDATA)>
<!ELEMENT dcq:relationType (#PCDATA)>
<!ELEMENT rdf:value (#PCDATA)>

<!-- Ontology-definitions -->
<!ELEMENT ontology-definitions (imports?, rule-base?,
  (class-def | slot-def)* )>
<!-- Import-section with URI's to other ontology-files -->
<!ELEMENT imports(URI)+>
```

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```
<!ELEMENT URI (#PCDATA)>
<!-- Rules with URL to definition -->
<!ELEMENT rule-base (#PCDATA)>
<!ATTLIST rule-base type CDATA #REQUIRED>

<!-- Class-expressions -->
<!ENTITY % class-expr "( class | slot-constraint | AND | OR | NOT)">
  <!ELEMENT AND ((%class-expr;), (%class-expr;)+)>
  <!ELEMENT OR ((%class-expr;), (%class-expr;)+)>
  <!ELEMENT NOT (%class-expr;)>

<!-- Class-definition -->
<!ELEMENT class-def (class, documentation?,
  subclass-of?, slot-constraint*)>
  <!ATTLIST class-def type ( primitive | defined ) "primitive">
  <!-- Class-name -->
  <!ELEMENT class EMPTY>
  <!ATTLIST classname CDATA #REQUIRED>
  <!ELEMENT documentation (#PCDATA)>
  <!ELEMENT subclass-of(%class-expr;)+>

<!-- Slot-definition -->
<!ELEMENT slot-def (slot, documentation?, subslot-of?,
  domain?, range?, inverse?, properties?)>
  <!-- Slot-name -->
  <!ELEMENT slot EMPTY>
  <!ATTLIST slot name CDATA #REQUIRED>
  <!ELEMENT subslot-of (slot)+>
  <!ELEMENT domain (%class-expr;)+>
  <!ELEMENT range (%class-expr;)+>
  <!ELEMENT inverse (slot)>
  <!-- Slot-properties -->
  <!ELEMENT properties( transitive | symmetric | other )*>
    <!ELEMENT transitive EMPTY>
    <!ELEMENT symmetric EMPTY>
    <!ELEMENT other (#PCDATA)>

<!-- Slot-constraint -->
<!ELEMENT slot-constraint (slot, (has-value | value-type | cardinality |
  max-cardinality | min-cardinality )+ )>
  <!ELEMENT has-value (%class-expr;)+>
  <!ELEMENT value-type (%class-expr;)+>
  <!ELEMENT cardinality (number, %class-expr;)+>
  <!ELEMENT max-cardinality (number, %class-expr;)+>
  <!ELEMENT min-cardinality(number, %class-expr;)+>
  <!ELEMENT number (#PCDATA)>
```

According to <http://www.w3.org/DesignIssues/Syntax> and <http://www-db.stanford.edu/~melnik/rdf/syntax.html> a more comprehensible RDF serialization in XML will be coming. Our oil-container would become much more simple and intuitive:

```
<?xml version="1.0" encoding="UTF-8"?>
<ontology>
  <ontology-container rdf:for="http://www.cs.vu.nl/~dieter/oil/"
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
```

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```
  xmlns:dc="http://purl.oclc.org/dc#"
  xmlns:dcq="http://purl.org/dc/qualifiers/1.0/">
<dc:Title>African animals</dc:Title>
<dc:Creator>Ian Horrocks</dc:Creator>
<dc:Subject>animal, food, vegetarians</dc:Subject>
<dc:Description>A didactic example ontology describing African animals</dc:Description>
<dc:Description dcq:descriptionType="Release">1.01</dc:Description>
<dc:Publisher>I. Horrocks</dc:Publisher>
<dc>Type>ontology</dc>Type>
<dc:Format>pdf</dc:Format>
<dc:Identifier>http://www.cs.vu.nl/~dieter/oil/TR/oil.pdf</dc:Identifier>
<dc:Source>http://www.africa.com/nature/animals.html</dc:Source>
<dc:Language>OIL</dc:Language>
<dc:Language>en-uk</dc:Language>
<dc:Relation dcq:relationType="hasPart">
  http://www.ontosRus.com/animals/jungle.onto
</dc:Relation>
</ontology-container>
</ontology>
```

## Appendix A.2 An XML schema definition of OIL

This section provides the OIL-syntax defined by an XML-Schema definition. It is equivalent to the DTD definition of OIL.

```
<!DOCTYPE schema PUBLIC "-//W3C//DTD XMLSCHEMA 19991216//EN"
  "WD-xmlschema-1-19991217/structures.dtd" [
  <!ATTLIST schema xmlns:x CDATA #IMPLIED> <!-- keep this schema XML1.0 valid -->
]>
<schema targetNamespace="oil.dtd">
  <type name="ontology" content="elementOnly">
    <group order="seq">
      <element name="ontology-container"/>
      <element name="ontology-definitions"/>
    </group>
  </type>
  <type name="ontology-container" content="elementOnly">
    <element name="rdf:RDF"/>
  </type>
  <type name="rdf:RDF" content="elementOnly">
    <element name="rdf:Description"/>
    <attribute name="xmlns:dcq" type="string" minOccurs="1" fixed="http://purl.org/dc/qualifiers/1.0/">
    <attribute name="xmlns:rdf" type="string" minOccurs="1"
      fixed="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
    <attribute name="xmlns:dc" type="string" minOccurs="1" fixed="http://purl.oclc.org/dc#">
  </type>
  <type name="rdf:Description" content="elementOnly">
    <group order="choice">
      <group order="seq">
        <group maxOccurs="*">
          <element name="dc:Title"/>
        </group>
        <group maxOccurs="*">
          <element name="dc:Creator"/>
        </group>
        <group maxOccurs="*" minOccurs="0">
          <element name="dc:Subject"/>
        </group>
      </group>
    </type>
```

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```
</group>
<group maxOccurs="*">
  <element name="dc:Description"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Publisher"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Contributor"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc>Date"/>
</group>
<group maxOccurs="*">
  <element name="dc:Type"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Format"/>
</group>
<group maxOccurs="*">
  <element name="dc:Identifier"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Source"/>
</group>
<group maxOccurs="*">
  <element name="dc:Language"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Relation"/>
</group>
<group maxOccurs="*" minOccurs="0">
  <element name="dc:Rights"/>
</group>
</group>
<group order="seq">
  <element name="dcq:descriptionType"/>
  <element name="rdf:value"/>
</group>
<group order="seq">
  <element name="dcq:relationType"/>
  <element name="rdf:value"/>
</group>
</group>
<attribute name="about" type="string" minOccurs="0"/>
</type>
<type name="dc:Title" content="textOnly"/>
<type name="dc:Creator" content="textOnly"/>
<type name="dc:Subject" content="textOnly"/>
<type name="dc:Description" content="mixed">
  <group maxOccurs="*" minOccurs="0">
    <group order="choice">
      <element name="rdf:Description"/>
    </group>
  </group>
</type>
<type name="dc:Publisher" content="textOnly"/>
<type name="dc:Contributor" content="textOnly"/>
<type name="dc>Date" content="textOnly"/>
<type name="dc:Type" content="textOnly"/>
<type name="dc:Format" content="textOnly"/>
```

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```
<type name="dc:Identifier" content="textOnly"/>
<type name="dc:Source" content="textOnly"/>
<type name="dc:Language" content="textOnly"/>
<type name="dc:Relation" content="mixed">
  <group maxOccurs="*" minOccurs="0">
    <group order="choice">
      <element name="rdf:Description"/>
    </group>
  </group>
</type>
<type name="dc:Rights" content="textOnly"/>
<type name="dcq:descriptionType" content="textOnly"/>
<type name="dcq:relationType" content="textOnly"/>
<type name="rdf:value" content="textOnly"/>
<type name="ontology-definitions" content="elementOnly">
  <group order="seq">
    <group minOccurs="0" maxOccurs="1">
      <element name="imports"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="rule-base"/>
    </group>
    <group maxOccurs="*" minOccurs="0">
      <group order="choice">
        <element name="class-def"/>
        <element name="slot-def"/>
      </group>
    </group>
  </group>
</type>
<type name="imports" content="elementOnly">
  <group maxOccurs="*">
    <element name="URI"/>
  </group>
</type>
<type name="URI" content="textOnly"/>
<type name="rule-base" content="textOnly">
  <attribute name="type" type="string" minOccurs="1"/>
</type>
<type name="AND" content="elementOnly">
  <group order="seq">
    <group order="choice">
      <element name="class"/>
      <element name="slot-constraint"/>
      <element name="AND"/>
      <element name="OR"/>
      <element name="NOT"/>
    </group>
    <group maxOccurs="*">
      <group order="choice">
        <element name="class"/>
        <element name="slot-constraint"/>
        <element name="AND"/>
        <element name="OR"/>
        <element name="NOT"/>
      </group>
    </group>
  </group>
</type>
<type name="OR" content="elementOnly">
  <group order="seq">
```

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```
<group order="choice">
  <element name="class"/>
  <element name="slot-constraint"/>
  <element name="AND"/>
  <element name="OR"/>
  <element name="NOT"/>
</group>
<group maxOccurs="*">
  <group order="choice">
    <element name="class"/>
    <element name="slot-constraint"/>
    <element name="AND"/>
    <element name="OR"/>
    <element name="NOT"/>
  </group>
</group>
</group>
</type>
<type name="NOT" content="elementOnly">
  <group order="choice">
    <element name="class"/>
    <element name="slot-constraint"/>
    <element name="AND"/>
    <element name="OR"/>
    <element name="NOT"/>
  </group>
</type>
<type name="class-def" content="elementOnly">
  <group order="seq">
    <element name="class"/>
    <group minOccurs="0" maxOccurs="1">
      <element name="documentation"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="subclass-of"/>
    </group>
    <group maxOccurs="*" minOccurs="0">
      <element name="slot-constraint"/>
    </group>
  </group>
  <attribute name="type" type="NMTOKEN" minOccurs="0" default="primitive">
    <datatype source="string">
      <enumeration value="primitive|defined"/>
    </datatype>
  </attribute>
</type>
<type name="class" content="empty">
  <attribute name="name" type="string" minOccurs="1"/>
</type>
<type name="documentation" content="textOnly"/>
<type name="subclass-of" content="elementOnly">
  <group maxOccurs="*">
    <group order="choice">
      <element name="class"/>
      <element name="slot-constraint"/>
      <element name="AND"/>
      <element name="OR"/>
      <element name="NOT"/>
    </group>
  </group>
</type>
```

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```
<type name="slot-def" content="elementOnly">
  <group order="seq">
    <element name="slot"/>
    <group minOccurs="0" maxOccurs="1">
      <element name="documentation"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="subslot-of"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="domain"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="range"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="inverse"/>
    </group>
    <group minOccurs="0" maxOccurs="1">
      <element name="properties"/>
    </group>
  </group>
</type>
<type name="slot" content="empty">
  <attribute name="name" type="string" minOccurs="1"/>
</type>
<type name="subslot-of" content="elementOnly">
  <group maxOccurs="*">
    <element name="slot"/>
  </group>
</type>
<type name="domain" content="elementOnly">
  <group maxOccurs="*">
    <group order="choice">
      <element name="class"/>
      <element name="slot-constraint"/>
      <element name="AND"/>
      <element name="OR"/>
      <element name="NOT"/>
    </group>
  </group>
</type>
<type name="range" content="elementOnly">
  <group maxOccurs="*">
    <group order="choice">
      <element name="class"/>
      <element name="slot-constraint"/>
      <element name="AND"/>
      <element name="OR"/>
      <element name="NOT"/>
    </group>
  </group>
</type>
<type name="inverse" content="elementOnly">
  <element name="slot"/>
</type>
<type name="properties" content="elementOnly">
  <group maxOccurs="*" minOccurs="0">
    <group order="choice">
      <element name="transitive"/>
      <element name="symmetric"/>
    </group>
  </group>
</type>
```

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```
        <element name="other"/>
    </group>
</group>
</type>
<type name="transitive" content="empty"/>
<type name="symmetric" content="empty"/>
<type name="other" content="textOnly"/>
<type name="slot-constraint" content="elementOnly">
    <group order="seq">
        <element name="slot"/>
        <group maxOccurs="*">
            <group order="choice">
                <element name="has-value"/>
                <element name="value-type"/>
                <element name="cardinality"/>
                <element name="max-cardinality"/>
                <element name="min-cardinality"/>
            </group>
        </group>
    </group>
</type>
<type name="-has-value" content="elementOnly">
    <group maxOccurs="*">
        <group order="choice">
            <element name="class"/>
            <element name="slot-constraint"/>
            <element name="AND"/>
            <element name="OR"/>
            <element name="NOT"/>
        </group>
    </group>
</type>
<type name="value-type" content="elementOnly">
    <group maxOccurs="*">
        <group order="choice">
            <element name="class"/>
            <element name="slot-constraint"/>
            <element name="AND"/>
            <element name="OR"/>
            <element name="NOT"/>
        </group>
    </group>
</type>
<type name="cardinality" content="elementOnly">
    <group maxOccurs="*">
        <group order="seq">
            <element name="number"/>
            <group order="choice">
                <element name="class"/>
                <element name="slot-constraint"/>
                <element name="AND"/>
                <element name="OR"/>
                <element name="NOT"/>
            </group>
        </group>
    </group>
</type>
<type name="max-cardinality" content="elementOnly">
    <group maxOccurs="*">
        <group order="seq">
            <element name="number"/>
```

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```

    <group order="choice">
      <element name="class"/>
      <element name="slot-constraint"/>
      <element name="AND"/>
      <element name="OR"/>
      <element name="NOT"/>
    </group>
  </group>
</type>
<type name="min-cardinality" content="elementOnly">
  <group maxOccurs="*">
    <group order="seq">
      <element name="number"/>
      <group order="choice">
        <element name="class"/>
        <element name="slot-constraint"/>
        <element name="AND"/>
        <element name="OR"/>
        <element name="NOT"/>
      </group>
    </group>
  </group>
</type>
<type name="number" content="textOnly"/>
</schema>
<?xml version="1.0" encoding="UTF-8"?>
```

### Appendix A.3 The Example in XML syntax

The following is an example of an OIL ontology that conforms to the above DTD. It is the same ontology that was presented in Section 3.2.

```

<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE ontology SYSTEM "oil.dtd">
<ontology>
  <ontology-container>
    <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
      xmlns:dc="http://purl.oclc.org/dc#"
      xmlns:dcq="http://purl.org/dc/qualifiers/1.0/">
      <rdf:Description about="">
        <dc:Title>African animals</dc:Title>
        <dc:Creator>Ian Horrocks</dc:Creator>
        <dc:Subject>animal, food, vegetarians</dc:Subject>
        <dc:Description>A didactic example ontology describing African animals</dc:Description>
        <dc:Description>
          <rdf:Description>
            <dcq:descriptionType>Release</dcq:descriptionType>
            <rdf:value>1.01</rdf:value>
          </rdf:Description>
        </dc:Description>
        <dc:Publisher>I. Horrocks</dc:Publisher>
        <dc:Type>ontology</dc:Type>
        <dc:Format>pdf</dc:Format>
        <dc:Identifier>http://www.cs.vu.nl/~dieter/oil/TR/oil.pdf</dc:Identifier>
```

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```
<dc:Source>http://www.africa.com/nature/animals.html</dc:Source>
<dc:Language>OIL</dc:Language>
<dc:Language>en-uk</dc:Language>
<dc:Relation>
  <rdf:Description>
    <dcq:descriptionType>hasPart</dcq:descriptionType>
    <rdf:value>http://www.ontosRus.com/animals/jungle.onto</rdf:value>
  </rdf:Description>
</dc:Relation>
</rdf:Description>
</rdf:RDF>
</ontology-container>
<ontology-definitions>
  <imports>
    <URI>http://www.ontosRus.com/animals/jungle.onto</URI>
  </imports>
  <slot-def>
    <slot name="eats"/>
    <inverse>
      <slot name="is-eaten-by"/>
    </inverse>
  </slot-def>
  <slot-def>
    <slot name="has-part"/>
    <inverse>
      <slot name="is-part-of"/>
    </inverse>
    <properties>
      <transitive/>
    </properties>
  </slot-def>
  <class-def>
    <class name="animal"/>
  </class-def>
  <class-def>
    <class name="plant"/>
    <subclass-of>
      <NOT>
        <class name="animal"/>
      </NOT>
    </subclass-of>
  </class-def>
  <class-def>
    <class name="tree"/>
    <subclass-of>
      <class name="plant"/>
    </subclass-of>
  </class-def>
  <class-def>
    <class name="branch"/>
    <slot-constraint>
```

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```
<slot name="is-part-of"/>
  <has-value>
    <class name="tree"/>
  </has-value>
</slot-constraint>
</class-def>
<class-def>
<class name="leaf"/>
<slot-constraint>
  <slot name="is-part-of"/>
  <has-value>
    <class name="branch"/>
  </has-value>
</slot-constraint>
</class-def>
<class-def type="defined">
  <class name="carnivore"/>
  <subclass-of>
    <class name="animal"/>
  </subclass-of>
  <slot-constraint>
    <slot name="eats"/>
    <value-type>
      <class name="animal"/>
    </value-type>
  </slot-constraint>
</class-def>
<class-def type="defined">
  <class name="herbivore"/>
  <subclass-of>
    <class name="animal"/>
  <NOT>
    <class name="carnivore"/>
  </NOT>
</subclass-of>
  <slot-constraint>
    <slot name="eats"/>
    <value-type>
      <OR>
        <class name="plant"/>
        <slot-constraint>
          <slot name="is-part-of"/>
          <has-value>
            <class name="plant"/>
          </has-value>
        </slot-constraint>
      </OR>
    </value-type>
  </slot-constraint>
</class-def>
<class-def>
```

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```
<class name="giraffe"/>
  <subclass-of>
    <class name="animal"/>
  </subclass-of>
  <slot-constraint>
    <slot name="eats"/>
    <value-type>
      <class name="leaf"/>
    </value-type>
  </slot-constraint>
</class-def>
<class-def>
  <class name="lion"/>
  <subclass-of>
    <class name="animal"/>
  </subclass-of>
  <slot-constraint>
    <slot name="eats"/>
    <value-type>
      <class name="herbivore"/>
    </value-type>
  </slot-constraint>
</class-def>
<class-def>
  <class name="tasty-plant"/>
  <subclass-of>
    <class name="plant"/>
  </subclass-of>
  <slot-constraint>
    <slot name="eaten-by"/>
    <has-value>
      <class name="herbivore"/>
      <class name="carnivore"/>
    </has-value>
  </slot-constraint>
</class-def>
</definitions>
</ontology>
```