

A Study on the Ontology Languages and Application Systems for the Semantic Web

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1.	4.
2.	5.
3.	•

, W3C
OWL (Web Ontology Language)
Thesaurus)

가

RDF
AAT (Art and Architecture

*
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· : 2003 9 9
· : 2003 9 20

ABSTRACT

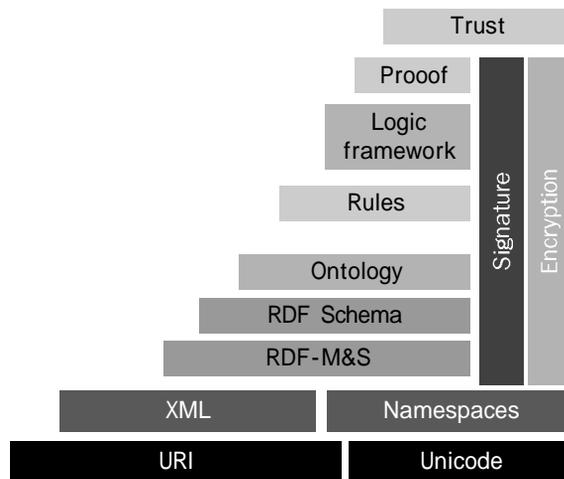
Continual attempts to accumulate and apply information eventually gave birth to the concept of the "Semantic Web". Thus, the "Semantic Web" can be defined as a product of mankind's desire to standardize information. At the same time, the term provides "a method that standardizes mankind's concept of linguistic expression", and can be noted as an effort to combine such methods into a standard web environment that may materialize to form a catalogue. This study introduced RDF schema, ontology languages for the semantic web, and ontology-based systems. The purpose of the study was to construct a system based on the semantic web environment's ontology by utilizing the ontology schema derived from the facet-type Art and Architecture Thesaurus(AAT). The aforementioned ontology schema is based on the Web Ontology Language(OWL), which is being widely considered the standard ontology language for the W3C-centered semantic web environment.

KEYWORDS

Semantic Web, Ontology, RDF, RDF Schema, XML Schema, Metadata

1. (World Wide Web)
(Tim Berners-Lee)
(, W3C)
(Semantic Web)
Resource Description Framework(,
RDF)
가
, W3C
Web Ontology Language(, OWL)

1> Art and Architecture Thesaurus(URI가 , AAT) 가 Extensible Markup Language(, XML) Namespace(), RDF(S), (Berners-Lee, Hendler, and Lassila 2001). 가 Logic 가 Proof Trust (2003). 가 XML RDF(S),



< 1> - 가

2.1 RDF(S)

2.1.1

RDF (Hjelm 2001).

가

2.1.2 RDF(S)

가

RDF

가

RDFS

RDF

가

XML(S) RDF(S)
W3C

“가”
XML
(semantic) ” RDF(S)

가 1)

(human-readable), 가
(machine-processable)

2)

, 3)

가

RDF(S) (1998). RDF

(2002).

XML

RDF 가

가

RDF

RDF

. RDF

XML

RDF

가 , XML

가 RDF

()	http://www.w3.org/Home/Lassila
()	Creator
(,)	Ora Lassila



< 2> 3- RDF

URI (Namespace) (Brickley, and Guha 2000). (Berners-Lee, Hendler, and Lassila 2001).
 XML RDF XML 가 (object)- (attribute)- (value)

URI (Namespace) (Brickley, and Guha 2000). (Berners-Lee, Hendler, and Lassila 2001).
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 XML RDF XML 가 (object)- (attribute)- (value)

< 1> RDF

RDFS

· rdfs:Resource	RDF	rdfs:Resource	()
· rdf:Property	RDF		
· rdfs:Class	RDF		

()

RDFS

· rdfs:type	rdfs:Class	rdf:type
· rdfs:subClassOf		
· rdfs:subPropertyOf		
· rdfs:seeAlso	가	
· rdfs:isDefinedBy	rdfs:seeAlso	

RDFS

· rdfs:ConstraintResource	rdfs:Resource
· rdfs:ConstraintProperty	rdf:Property ,
· rdfs:range	rdfs:ConstraintProperty () , .
· rdfs:domain	가 rdfs:ConstraintProperty

2.2 Axioms

2.2.1

ontos[being:
] logos[word:]

· ,
·

(taxonomy)

(2002).

(Fensel 2001)

· (Domain ontology) -

· (Metadata ontology) -

· (Generic or common sense ontology) -

(, ,)

· (Representational ontology) -

· , 가

(method ontology or task ontology) - , (inverseOf), (union), (intersection)

가 (Smith, Welty, and McGuinness 2003).

- , - XML XOL(Ontology Exchange Language) OML(Ontology Markup Language), SHOE(Simple HTML Ontology Extensions)가 W3C RDF RDFS OIL DAML+OIL, OWL .

(Iwazume, Takeda, and Nishida 1996).

가

2.2.3 OIL Ontology Inference Layer(, OIL) On-To-Knowledge IST(Information Society Technologies) . OIL

(가 가 , . OIL XML , RDF 가 OWL (McGuinness, and van Harmelen 2002).

가 가

axiom , 가 , (Ontology Language)가 가 CycL, KIF, Ontolingua .

RDF OIL

(Fensel 2001). (meta layer) :

가 (meta-meta layer) :

XML

RDF

가

, OIL

가 OWL (http://www.w3c.org/2002/07/owl)

(Fensel et al. 2000). (object layer) :

OIL

RDF

OIL RDF

) OWL

```

<Ontology rdf:about="">
  <versionInfo>March 18. 2003, GS</versionInfo>
  <imports rdf:resource="http://www.w3.org/2000/01/rdf-schema" />
  <dc:title>Classes and properties for the Web Ontology Language OWL</dc:title>
  <dc:creator>W3C Web Ontology (WebOnt) Working Group</dc:creator>
  <dc:subject>OWL; Web Ontology Language; Semantic Web</dc:subject>
  <dc:description>This file specifies in RDF Schema format the built-in classes and properties...
    People that do import this file should expect their ontology to be an OWL Full
    ontology.</dc:description>
  <dc:publisher>W3C</dc:publisher>
  <dc:date>2003-02-10</dc:date>
  <dc:format>text/xml</dc:format>
  <dc:language>en</dc:language>
  <dc:identifier>http://www.w3.org/2002/07/owl</dc:identifier>
</Ontology>

```

RDF OIL , DAML-OIL
 , ONT OIL
 OIL DAML+OIL
 RDF (Cost et al. 2002).
 OIL DAML+OIL (Class
 (DAML+OIL, OWL) Constructors) axiom
 . OWL .
 < 2> OIL
 RDFS 2.2.5 OWL
 (Broekstra et al. DAML+OIL
 2001). , ,
 2.2.4 DAML+OIL ,
 DARPA Agent Markup Language(,
 DAML) RDF · SHOE · OIL 가 . OWL
 DARPA . DAML+OIL
 OWL
 < 2> RDFS OIL

OIL Primitive	RDFS OIL	Type
class-of	rdfs:Class	class
subclass-of	rdfs:subclassof	property
class-expression	oil:ClassExpression(placeholder only)	class
and	oil:And(subclass of BooleanExpression)	class
or	oil:Or(subclass of BooleanExpression)	class
not	oil:Not(subclass of BooleanExpression)	class
slot-constraint	oil:PropertyRestriction(placeholder Only) oil:hasPropertyRestriction (rdfs:type of rdfs:ConstraintProperty) oil:CardinalityRestriction(placeholder Only) (subclass of oil:PropertyRestriction)	class property class
has-value	oil:HasValue(subclass of oil:PropertyRestriction)	class
value-type	oil:ValueType(subclass of oil:PropertyRestriction)	class
max-cardinality	oil:MaxCardinality (subclass of oil:CardinalityRestriction)	class
min-cardinality	oil:MinCardinality (subclass of oil:CardinalityRestriction)	class
cardinality	oil:Cardinality (subclass of oil:CardinalityRestriction)	class

OWL Lite OWL DAML Lite OWL DL, OWL Full ,
 +OIL OWL Lite
 , OWL DL(Description Logic)
 RDFS 가 Lite
 (McGuinness, and van Harmelen 2003). 가 OWL Full
 OWL OWL RDF

< 3> OWL Vocabulary Terms

Vocabulary Term	Abstract OWL Lite Syntax	Abstract OWL DL Syntax	Mapping to Triples	RDFS-Compatible Semantics
owl:AllDifferent				
owl:allValuesFrom				
owl:backwardCompatibleWith				
owl:cardinality				
owl:Class				
owl:complementOf				
owl:DatatypeProperty				
owl:DeprecatedClass				
owl:DeprecatedProperty				
owl:differentFrom				
owl:disjointWith				
owl:distinctMembers				
owl:FunctionalProperty				
owl:hasValue				
owl:imports				
owl:incompatibleWith				
owl:intersectionOf				
owl:InverseFunctionalProperty				
owl:inverseOf				
owl:maxCardinality				
owl:minCardinality				
owl:Nothing				
owl:ObjectProperty				
owl:oneOf				

()

Vocabulary Term	Abstract OWL Lite Syntax	Abstract OWL DL Syntax	Mapping to Triples	RDFS-Compatible Semantics
owl:onProperty				
owl:Ontology				
owl:priorVersion				
owl:Property				
owl:Restriction				
owl:sameAs				
owl:sameClassAs				
owl:sameIndividualAs				
owl:samePropertyAs				
owl:someValuesFrom				
owl:SymmetricProperty				
owl:Thing				
owl:TransitiveProperty				
owl:unionOf				
rdf:List				
rdf:nil				
rdf:type				
rdfs:comment				
rdfs:Datatype				
rdfs:domain				
rdfs:label				
rdfs:Literal				
rdfs:range				
rdfs:subClassOf				
rdfs:subPropertyOf				

OWL Full DL Lite

가

OWL Lite

OWL Lite DL axiom

Triple

가

RDFS

가

(van Harmelen et al. 2003).

(Smith, Welty, and McGuinness

OWL

2003).

(constraints)

< 3> RDF(S) OWL

(Smith,

Welty, and McGuinness 2003).

- SymmetricProperty 가 ,
- 가 RDF(S)
- (daml: do-main, daml:range)
- () , DAML disjointWith 가 가 (

DAML

axiom RDF(S)

DAML

가

. OWL

DAML

가 OWL

< 4> OWL Lite

(<http://www.w3c.org/2002/07/owl>)

axiom

DAML

, OWL

axiom

OWL

< 4> OWL Lite

RDF Schema Features

• Class	
• rdf:Property) hasChild, hasRelative, hasSibling, and hasAge
• rdfs:subClassOf	
• rdfs:subPropertyOf) hasSibling hasRelative subproperty X Y가 hasSibling , X Y hasRelative
• rdfs:domain	
• rdfs:range) hasChild Mammal , Louise hasChild Deborah , “Deborah is the child of Louise, then Deborah is a Mammal ” 가
• Individual	()

) OWL “ # x ” , subclassOf
 A A T . X가 Y Y
 가 Z , X Z
 <owl:Class rdf:ID=“ Associated Concepts ”> (transitive)†
 <owl:Class rdf:ID= “ Physical Attributes”> .
 ...) equivalentClass
 <owl:Class rdf:ID=“ Materials”> Food Wine Wine
 <owl:Class rdf:ID=“ Objects”> (vin) Wine
 ... ,
 <owl:Class rdf:ID=“ Finishings”> .
 <rdfs:subClassOf rdf:resource=“ # Objects”>
 </owl:Class> <owl:Class rdf:ID= “ Wine”>
 <owl:equivalentClass rdf:resource= “ & vin; Wine”>
 ‘ rdf:ID = ’ ‘ rdf:resource = </owl:Class>

Equality and Inequality

: Ontology Mapping()

· equivalentClass	가
· equivalentProperty	
· sameIndividualAs) Deborah sameIndividualAs DeborahMcGuinness
· differentFrom	, sameIndividualAs
· allDifferent	

Property Characteristics

· inverseOf	, P1(x,y) P2(y,x)
· TransitiveProperty	, P(x,y) and P(y,z) P(x,z)
· SymmetricProperty	, P(x,y) P(y,x)
· FunctionalProperty	, P(x,y) and P(x,z) y = z
· InverseFunctional Property	, P(y,x) and P(z,x) y = z

```

) TransitiveProperty
locatedIn TransitiveProperty
, SantaCruzMountainsRegion
locatedIn CaliforniaRegion and California-
Region locatedIn USRegion
(transitive property)
SantaCruzMountainsRegion locatedIn
USRegion

```

```

<rdfs:range rdf:resource=" # Region"/>
</owl:ObjectProperty>

<Region rdf:ID=" SantaCruzMountains-
Region">
<locatedIn rdf:resource=" # California-
Region"/>
</Region>

<Region rdf:ID=" CaliforniaRegion">
<locatedIn rdf:resource=" # USRegion"/>
</Region>

```

```

<owl:ObjectProperty rdf:ID=" locatedIn">
<rdf:type rdf:resource=" & owl;Transi-
tiveProperty" />
<rdfs:domain rdf:resource=" & owl;
Thing"/>

```

Property Type Restriction

· allValuesFrom)
· someValuesFrom)

Restricted Cardinality

· minCardinality	OWL Lite	Cardinality	0	1		
· maxCardinality)		min	max	1	1
· cardinality						

Class Intersection

(unionOf, complementOf OWL DL)

· intersectionOf)
------------------	---

Header Information

· imports	include
· versionInfo	
· priorVersion	
· Dublin Core Metadata	

2.3 Axiom

(
) ()
 OWL ()
)
 가
 , axiom

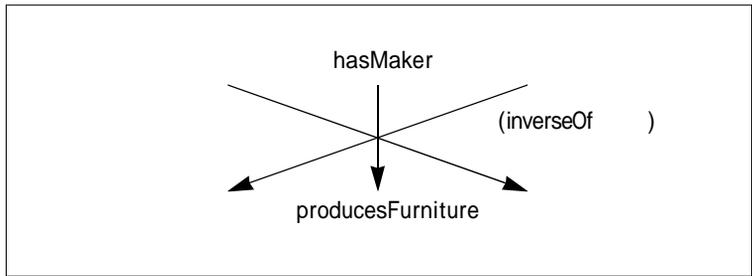
2.3.2 inverseOf

2.3.1 disjoint(OWL DL)

가 (chair) 가 (bench,
 sofa, wagon seat) disjoint , RDF

```

<owl:Class rdf:ID="chairs">
  <rdfs:subClassOf rdf:resource=" # seating furniture" />
  <owl:disjointWith rdf:resource=" # benches" />
  <owl:disjointWith rdf:resource=" # sofas" />
  <owl:disjointWith rdf:resource=" # wagon seats" />
</owl:Class>
  가 disjoint 가
  axiom (Smith, Welty, and McGuinness 2003). (가 )
  (< 3> ).
  <owl:ObjectProperty rdf:ID="hasMaker">
    <rdfs:type rdf:resource=" &owl;FunctionalProperty" />
  </owl:ObjectProperty>
  <owl:ObjectProperty rdf:ID="producesFurniture">
  
```



< 3> inverseOf

```
<owl:inverseOf rdf:resource="#hasMaker" />
```

(2003). MusicBrainz

hasMaker producesFurniture inverse-Of 가 , URI
 가 RDF . URI

hasMaker 가 ,
 hasMaker producesFurniture 가 ,
 가 RDF

3.

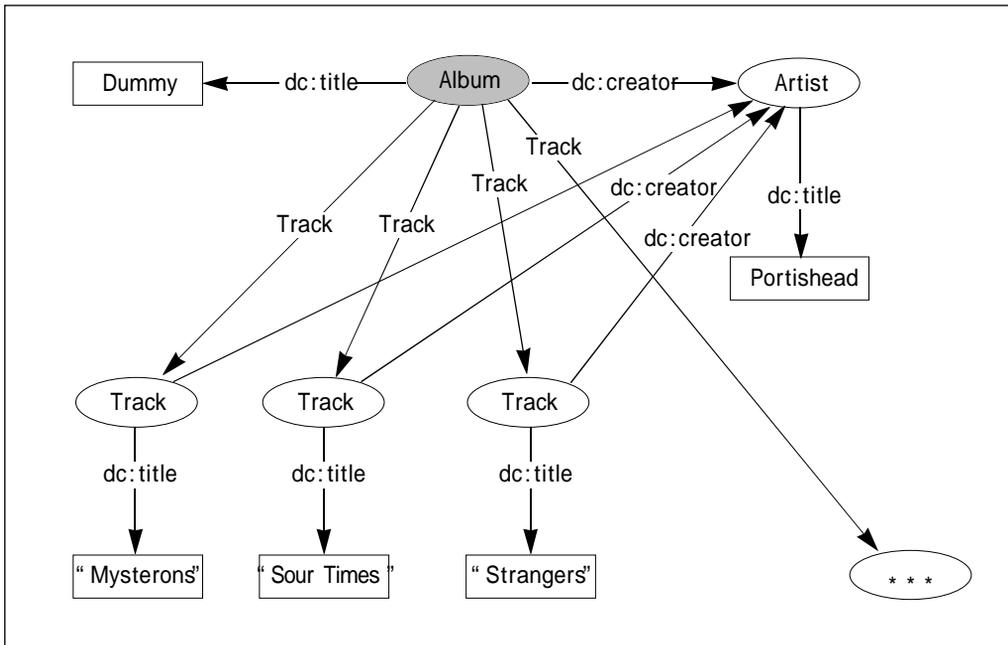
3.1 :
 MusicBrainz (< 4>).

3.2 :
 UNSPSC ()
 MusicBrainz 2003 2 3 가 5 , 65 가

(Swartz 2003).

가

UNSPSC



< 4> Portishead MusicBrainz RDF

. UNSPSC

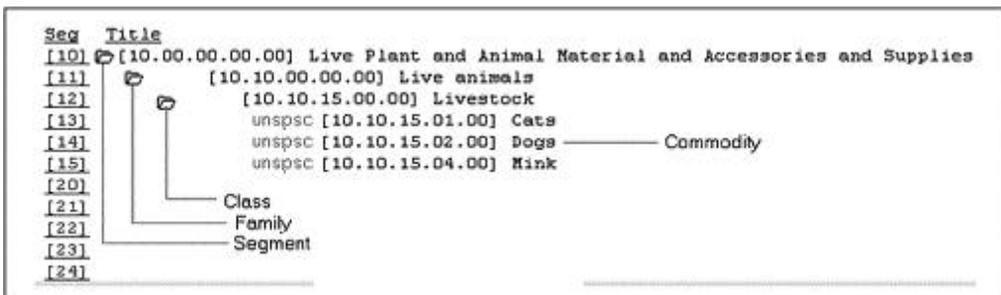
Golden-

Bullet UNSPSC

, UNSPSC 가

(UNSPSC website 2003)

(< 5>).



< 5> UNSPSC (<http://eccma.org/unspsc>)

3.3 ITTALKS

ITTALKS

ITTALKS IT

6>

가

가

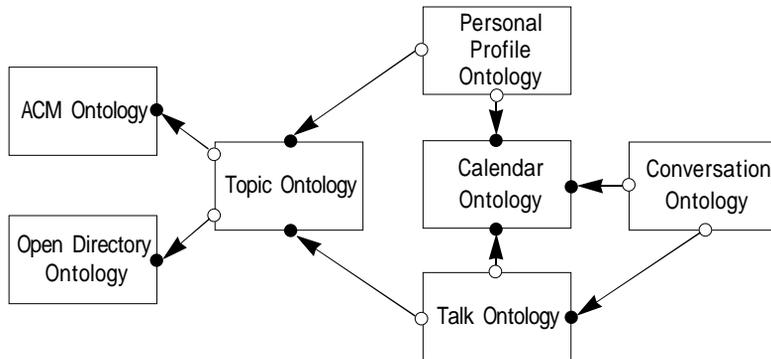
DAML

(Cost et al. 2002) (<

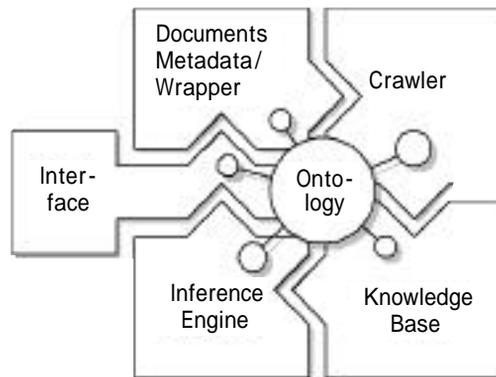
가

6>).

(2003).



< 6> ITTALKS



< 7> Ontobroker

< 5>

EU

On-To-Knowledge (<http://www.onto-knowledge.org>) Karlsruhe

AIFB

Ontobroker (http://ontobroker.aifb.uni-karlsruhe.de/index_ob.html)

(< 7>),

(, 2003)

4.

4.1

, AAT Furniture
가

. 가

(Dublin Core)

VRA (Visual Resources
Association Core Categories)

가

VRA		Dublin Core	AAT
Record Type		Type	
Type		Type	
Title	<ul style="list-style-type: none"> · Variant · Translation · Series · Larger Entity 	Title	
Measurements	<ul style="list-style-type: none"> · Dimensions · Format · Resolution 	Format	
Material	<ul style="list-style-type: none"> · Medium · Support 	Format	
Technique		Format	
Creator	<ul style="list-style-type: none"> · Role · Attribution · Personal name · Corporate name 	Creator, Contributor	
Date	<ul style="list-style-type: none"> · Creation · Design · Beginning · Completion · Alteration · Restoration 	Date, Coverage	
Location	<ul style="list-style-type: none"> · Current Site · Former Site · Creation Site · Discovery Site · Current Repository · Former Repository 	Contributor Coverage	
ID Number	<ul style="list-style-type: none"> · Current Repository · Former Repository · Current Accession · Former Accession 	Identifier	
Style/Period	<ul style="list-style-type: none"> · Style · Period · Group · School · Dynasty · Movement 	Coverage, Subject	
Culture		Coverage	
Subject		Subject	
Relation	<ul style="list-style-type: none"> · Identity · Type 	Relation	
Description		Description	
Source		Source	
Rights		Rights	

가 , Python PHP My-
 가 , (DBMS) SQL

4.2

AAT < 8>

< 5>

가

(Redhat Linux 9.0)

가

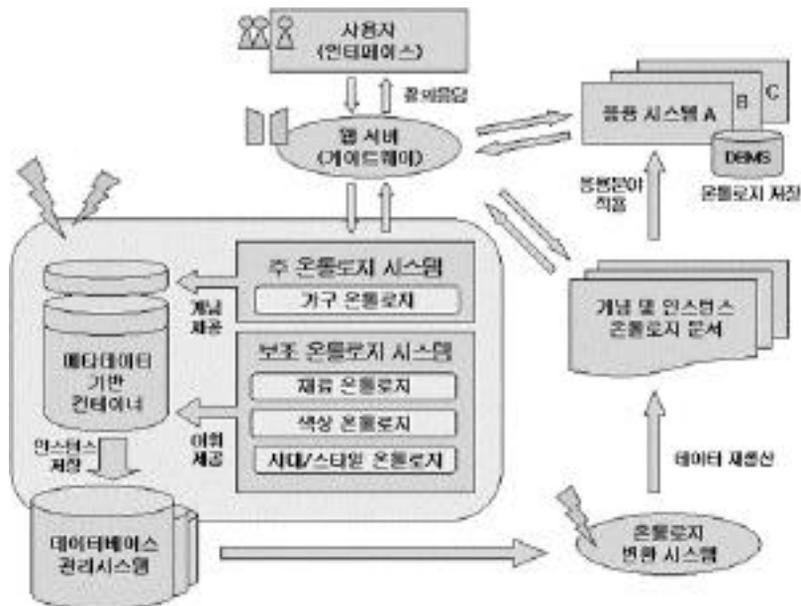
XML

expat Python

expat

API SAX

(,



< 8>

)
 .
 :
 RDF (, ,)(<
 10>).

4.3

(<http://lis.yonsei.ac.kr/~heon/ontology>)
 : 가
 , . .
 (< 9>).

.
 :
 .
 :
 RDF
 (< 11>).



< 9>



< 11> RDF



< 10>

.
 :
 . ()
 : RDF

<p>5. 가</p>	<p>가 가 가</p>
<p>가 가</p> <p>(infrastructure)</p> <p>W3C</p>	<p>. 2001. 『 RDF 』 . 1999. 『 . 2002. “ 』 19(4) : 297-319. . 2003. 『</p>
<p>SOAP(Simple Object Access Protocol)</p> <p>, XML, RDF(S),</p>	<p>』 』, 21</p>
<p>가</p> <p>, XML(S), RDF(S)</p> <p>OWL</p>	<p>. 2003. “ < > ”. 『 (3) : 3-50. Berners-Lee, T., J. Hendler, and O. Lassila. 2001. The Semantic Web. Scientific American.</p>
<p>AAT(Art and Architecture Thesaurus) Furniture 가</p> <p>가</p>	<p>Brickley, D., and R. V. Guha. 2000. “ Resource Description Framework (RDF) Schema Specification 1.0. W3C Candidate Recommendation 27 March 2000 ”. [online]. [cited : 2002. 10. 20]. <http://www.w3.org/TR/2000/CR-rdf-schema-20000327/>. Broekstra, J., M. Klein, S. Deckter, D. Fensel, F. van Harmelen, and I.</p>

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