

Kyoto-LMF

WordNet representation format

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Knowledge-Yielding Ontologies for Transition-Based Organization

KYOTO (project nr. 211423)

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1 Introduction¹

The format described in the following pages is the current proposal for representing wordnets inside the Kyoto project (henceforth, “Kyoto-LMF wordnet format”).

The reference model is Lexical Markup Framework (LMF), version 16, probably one of the most widely recognized standards for the representation of NLP lexicons. LMF is a model providing a common standardized framework for the description and representation of NLP lexicons. The goals of LMF are to provide a common model for the creation and use of such lexical resources, to manage the exchange of data between and among them, and to enable the merging of a large number of individual resources to form extensive global electronic resources².

LMF was specifically designed to accommodate as many models of lexical representations as possible. Purposefully, it is designed as a *meta-model*, i.e. a high-level specification for lexical resources defining the structural constraints of a lexicon.

It is organised around two main components:

- The *core package*, i.e. a structural skeleton to represent the basic hierarchy of information in a lexicon, under the form of core classes of objects and relations.
- A set of modular *extensions* to the core package, i.e. additional classes and relations required for the description of specific types of lexical resources. Available extensions include morphology, syntax, semantics, multilingual notations, paradigm classes, multi-word expression patterns and constraint expressions.

While not yet issued as an official ISO standard³, LMF is in a very mature stage, having passed a range of officially needed stages and having been extensively discussed and commented in a wide community comprising both academia and industry. LMF is thus mature enough to be taken as “the” choice when coming to selecting a standardized format for the representation and encoding of computational lexicons.

KYOTO-LMF is an LMF dialect tailored to encoding of lexical resources adhering to the WordNet⁴ model of lexical knowledge representation. LMF specifications

¹ Part of the content of this introduction is taken from [5].

² We leave the interested reader the opportunity to get a complete description of LMF by looking at [1], [2], [3].

³ Currently (October 2008), LMF is in FDIS status (Final Draft For International Standard). The ISO code number for LMF is ISO-24613.

⁴ We use *wordnet* as a generic term and leave *WordNet* (a registered name) for referring to Princeton WordNet.

are fully compatible with the structural organization of lexical knowledge encoded in wordnet-like lexical resources; actually, WordNet has been one among the pivot models that have informed the design of LMF since its very beginning. However, no real attempt has been made so far in order to fully apply LMF to wordnet-like lexicons.

The KYOTO-LMF format builds on the representational devices made available by LMF and tailors them to the specific content requirements of the WordNet model.

Starting from the meta-model provided by LMF, version 16, the additional packages used in KYOTO-LMF are the semantics and the multilingual extension packages.

On the basis of a review of the wordnets available in the KYOTO consortium, it turned out that the main conceptual components of WordNet-like lexicons that need to be represented in LMF are the following:

- Synsets, variants and synset relations;
- Domain attribution, linking to ontologies, administrative information;
- Interlingual information, i.e. mapping of synsets in a given language to Interlingual Index (ILI).

The LMF semantic package naturally lends itself to the representation of wordnet-like resources, since it already contains lexical objects devised for the representation of synsets, their associated gloss and examples, variants, and synset relations.

Most wordnets also contain one or more of the following information: mapping among different versions of the same resource; reference to external information, such as mapping onto entries of another lexical database and or referencing additional sources. All these kinds of information can be dealt with by the *MonolingualExternalRef* object, which, according to LMF specifications, is an object representing a relationship between a synset instance and an external system, be it a knowledge organisation system or a terminological repository.

Interlingual information in wordnets can be represented via the LMF Multilingual Notation Extension (see [4], p. 49). This package provides a means to encode multilingual information and it is designed as an independent package, in order not to overload the representation of monolingual lexicons. The model is based on the notion of “Axes” that link synsets pertaining to different languages. For the purposes of creating a grid of WordNets linked via Interlingual Index, the most appropriate device is the *SenseAxis* object, since it is specifically designed to implement approaches based on an interlingual pivot. Any *SenseAxis* element groups together monolingual synsets that correspond one to another by means of a particular type of relation, for instance a *synonymy* or *near_synonymy* relation.

KYOTO-LMF fully complies with standard LMF as for its major lexical objects and general framework. Expression of WordNet-related types of information (such

as names of synset relations, name and values of external sources linked to wordnets) fall into the realm of LMF Data Categories, which are by definition either selectable from pre-defined standard registries or custom-defined. The KYOTO-LMF format, accordingly, has defined a number of specific information, or Data Categories, necessary to fully represent the various wordnets to be integrated in KYOTO⁵. Examples of custom Data Categories are values for describing synset relations, inter-lingual relations, for identifying external resources and their associated nodes, etc.

KYOTO-LMF wordnet format deviates from standard LMF only regarding the way data categories are instantiated: in LMF, these are represented by means of attribute-value pairs that, in an informative annex to LMF specifications, are instantiated as separate XML elements. In KYOTO-LMF wordnet format we decided to represent the same information by means of XML attributes and values instead of nested elements. This decision was motivated on the basis of better parsing efficiency. By explicitly naming the attributes, we also make a stronger claim about the features and properties of the structure of a wordnet. This will enforce better compatibility and interoperability across the many wordnets for different languages that are available.

In this respect, the KYOTO-LMF DTD or XML Schema implementation has to be seen as a *dialectal variant* of the LMF DTD, which, according to the specifications, is only one possible translation of the LMF model into a mark-up language ([4], p. 82).

For the purposes of comparison, we illustrate below an LMF and a KYOTO-LMF representation of the same Princeton WordNet 3.0 synset {footprint_1}:

```
<Synset id="eng-30-06645039-n">
  <feat att="baseConcept" val="1"/>
  <Definition>
    <feat att="gloss" val="mark of a foot or shoe on a surface"/>
    <Statement>
      <feat att="example" val="the police made casts of the footprints in the soft earth outside
the window"/>
    </Statement>
  </Definition>
  <SynsetRelation targets="eng-30-06798750-n">
    <feat att="relType" val="has_hyperonym"/>
    <feat att="author" val="AH"/>
    <feat att="date" val="2008-07-01"/>
    <feat att="source" val="Wordnet3.0"/>
    <feat att="status" val="yes"/>
    <feat att="confidenceScore" val="1.0"/>
  </SynsetRelation>
  <SynsetRelation targets="eng-30-06645266-n">
    <feat att="relType" val="has_hyponym"/>
    <feat att="author" val="AH"/>
    <feat att="date" val="2008-07-01"/>
    <feat att="source" val="Wordnet3.0"/>
    <feat att="status" val="yes"/>
  </SynsetRelation>
</Synset>
```

⁵ While the set of skeletal objects is fully determined, the definition of the custom data categories is still in progress.

```

        <feat att="confidenceScore" val="1.0"/>
    </SynsetRelation>
    <MonolingualExternalRef>
        <feat att="externalSystem" val="Wordnet1.6"/>
        <feat att="externalReference" val="eng-16-01234567-n"/>
    <MonolingualExternalRef>
    <MonolingualExternalRef>
        <feat att="externalSystem" val="SUMO"/>
        <feat att="externalReference" val="superficialPart"/>
        <feat att="relType" val="at"/>
    </MonolingualExternalRef>
</Synset>

```

standard LMF

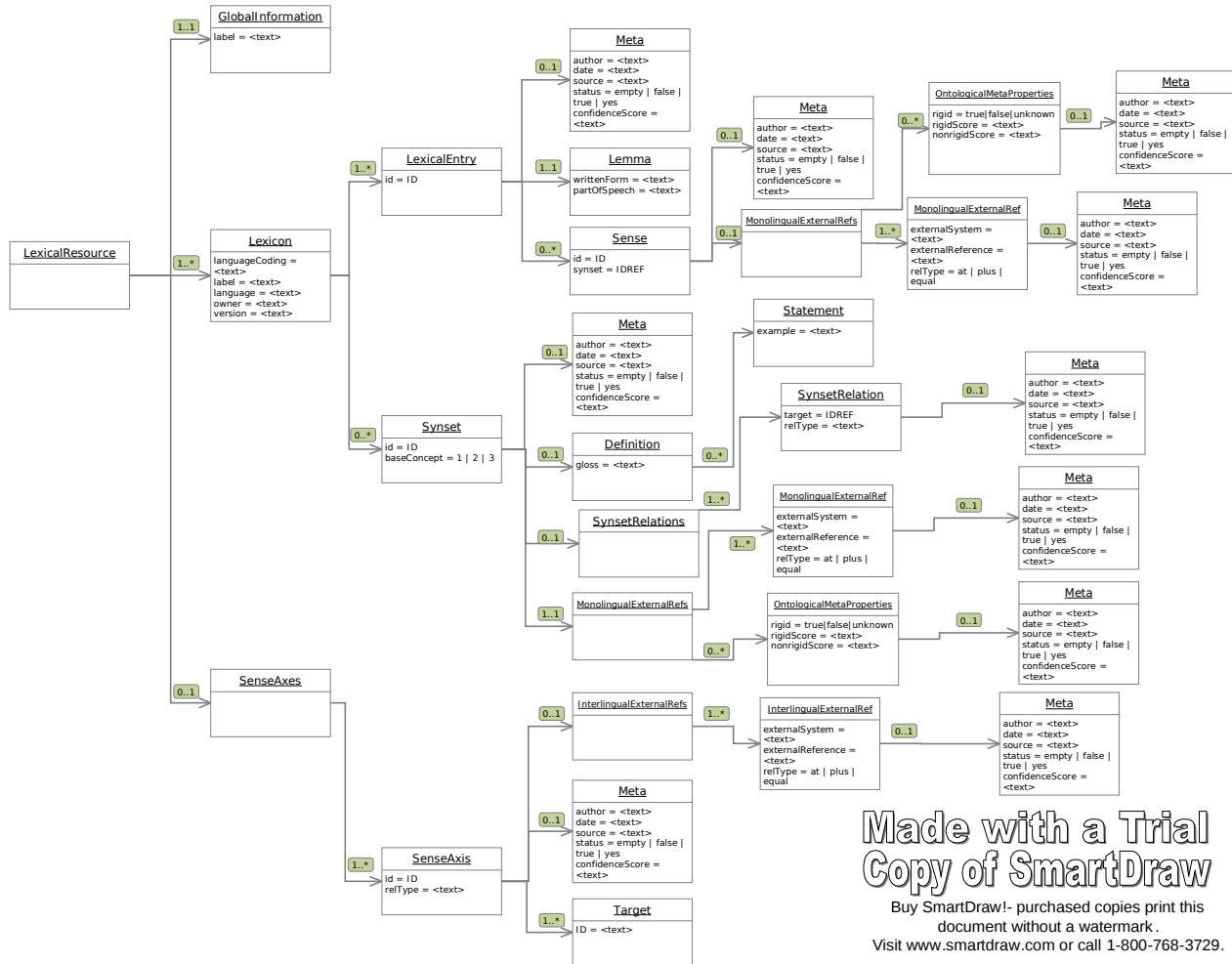
```

<Synset id="eng-30-06645039-n" baseConcept="1">
<Definition gloss="mark of a foot or shoe on a surface">
<Statement example="the police made casts of the footprints in the soft earth outside the
window" />
</Definition>
<SynsetRelations>
<SynsetRelation target="eng-30-06798750-n" relType="has_hyperonym" >
<Meta author="AH" date="2008-07-01" source="Wordnet3.0" status="yes"
confidenceScore="1.0" />
</SynsetRelation>
<SynsetRelation target="eng-30-06645266-n" relType="has_hyponym" >
<Meta author="AH2" date="2008-07-01" source="eng-Wordnet3.0" status="yes"
confidenceScore="1.0" />
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-
01234567-n" />
<MonolingualExternalRef externalSystem="SUMO" externalReference="superficialPart"
relType="at"/>
</MonolingualExternalRefs>
</Synset>

```

KYOTO-LMF *dia*

Kyoto-LMF UML Diagram



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2 Description of KYOTO-LMF representation format

LexicalResource

As in LMF, *LexicalResource* is the root element. It has three children:

- one *GlobalInformation* element
- one or more *Lexicon* elements
- zero or one *SenseAxes* element

This means that the object *LexicalResource* is a container for possibly more than one lexicon; inter-lingual correspondences are grouped in a section (*SenseAxes*) that is separated from the lexical resources proper and contains only inter-lexicon correspondences.

GlobalInformation

This element is used to record general information about the lexical resource. The optional attribute "label" is a free text field.

Example:

```
<GlobalInformation label="Proposal for Kyoto-internal WordNet representation"/>
```

Lexicon

Each element *Lexicon* contains a monolingual resource, instantiated as a set of *LexicalEntry* instances followed by a set of *Synset* elements.

The following attributes are specified:

- *languageCoding* (fixed): it has "ISO 639-3" as a fixed value.
- *language* (required): for specifying the language represented by the lexical resource. Use of the standardized 3-letter language coding (e.g. eng, nld) is recommended.
- *owner* (required): the copyright holder
- *version* (required): the resource version
- *label* (optional): for recording any additional information that may be needed.

Example:

```
<Lexicon languageCoding="ISO 639-3" label="English Wordnet 3.0" language="eng" owner="Princeton" version="3.0">
```

LexicalEntry

This element is a container for representing a lexeme in a lexicon. A *LexicalEntry* element can contain one lemma and zero to many different senses. It has one optional attribute 'id' (a unique identifier).

Example:

```
<LexicalEntry id="footmark">
  <Lemma writtenForm="footmark" partOfSpeech="n"/>
  <Sense id="footmark_1" synset="eng-30-06645039-n">
    <MonolingualExternalRefs>
      <MonolingualExternalRef externalSystem="Wordnet3.0" externalReference="" />
    </MonolingualExternalRefs>
  </Sense>
</LexicalEntry>
```

Meta

The element *Meta* is used to encode administrative information. Attributes are (all optional):

- author: the author of the insertion or modification
- date: the date of the insertion or modification
- source: it expresses the originating database/system. It is typically associated with *SynsetRelation* elements.
- status: a key expressing editing status of the parent element. Possible values are "empty" (i.e. not confirmed), "false" (wrong to be deleted), "true" (confirmed as ok) and sometimes "yes".
- confidenceScore: a numeric value indicating the degree of certainty about a given element. Typically, it is specified for *SynsetRelation* and *MonolingualExternalRef* elements.

Example:

```
<SynsetRelation target="eng-30-06798750-n" relType="has_hyperonym" >
  <Meta author="AH" date="2008-07-01" source="Wordnet3.0" status="yes"
  confidenceScore="1.0"/>
</SynsetRelation>
```

Lemma

This element represents a word form chosen by convention to designate the lexical entry. Attributes are:

- partOfSpeech (required) is attributed to *Lemma*, in conformance with LMF, and takes as its value the part-of-speech value that according to WordNet conventions is usually specified for a synset.
- writtenForm (optional): added in case the id of *LexicalEntry* is numerical and it takes Unicode strings as values.

Example:


```
<Lemma writtenForm="footmark" partOfSpeech="n"/>
```

Sense

This element represents one meaning of a lexical entry. For wordnet representation, it represents the variant (or literal) of a synset. The element *Sense* can contain zero to one *Meta* elements and zero to one *MonolingualExternalRefs* elements.

Required attributes are:

- *id*: it must be specified according to the convention used in wordnet, i.e. *word_sense#nr*.
- *synset*: it takes as its value the ID of the synset to which the particular sense of the variant belongs.

Example:

```
<Sense id="footmark_1" synset="eng-30-06645039-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footprint&#37;1:10:00:." />
</MonolingualExternalRefs>
</Sense>
```

MonolingualExternalRefs, *MonolingualExternalRef*

MonolingualExternalRefs is a bracketing element for grouping together all *MonolingualExternalRef* and *OntologicalMetaProperties* elements. It must contain at least one *MonolingualExternalRef* element and optional *OntologicalMetaProperties*.

MonolingualExternalRef elements must be used to represent linking between a *Sense* or *Synset* and another resource, be it an ontology, a database, or another lexical resource.

Its use is defined by slightly different conventions according to the particular parent element in which it appears. For instance, when occurring as a child of the *Sense* element, it can be used to express mapping between a sense and its correspondent in another lexical resource⁶.

When occurring inside the representation of the *Synset* element, then *MonolingualExternalRef* allows to encode reference to the domain and/or one or more links to an ontological system⁷.

Attributes are:

⁶ For example, see the Dutch instantiation, where linking to Cornetto database is encoded in this way.

⁷ See again the Dutch and English instantiations, where linking to SUMO ontology is specified.

- externalSystem (required): the name of the external resource. Possible values are, for instance, “domain”, “SuperSense”, “SUMO”, “TCO” (= Top Concept Ontology), and “WordNet3.0” (for recording SenseKey values).
- externalReference (required): the particular identifier or node
- relType (optional): the type of relations with SUMO ontology nodes. Possible values are “at”, “plus”, “equal”.

Example:

```
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO"
externalReference="SubjectiveAssessmentAttribute" relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="ObjectiveNorm"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="NormativeAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="and"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Word"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Number"
relType="equal"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="TraitAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="SocialInteraction"
relType="bracket"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Organism"
relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="quality"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="factotum"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="metrology
quality"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology
zoology"/>
</MonolingualExternalRefs>
```

Note: In the particular case of the representation of English Princeton WordNet, the MonolingualExternalRef element can serve as a representational device to express the following information:

1) as a child of the element *Sense*, it can be used to express the SenseKey

```
<Sense id="footprint_1" synset="eng-30-06645039-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footprint&#37;1:10:00:"/>
</MonolingualExternalRefs>
</Sense>
```

2) as a child of the element *Synset*, it can be used to express i) synset mappings between different versions of WordNet and ii) linking to concepts from a given ontology.

```
<Synset id="eng-30-06645039-n" baseConcept="1">
...
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-
01234567-n" />
<MonolingualExternalRef externalSystem="SUMO" externalReference="superficialPart"
relType="at"/>
</MonolingualExternalRefs>
</Synset>
```

OntologicalMetaProperty

Ontological MetaProperty is an optional element of MonolingualExternalRefs, that is used to represent information about the rigidity of the concepts.

Attributes are:

- *rigid*, representing one out of three possible judgements on rigidity: true, false, unknown.

- *rigidScore* and *nonrigidScore*, representing the score of rigidity and non rigidity; these are optional since human annotators may not provide values for these. The value is implementation dependent and thus CDATA. Tools using the rigidity information will only have to use the derived value in the *rigid* attribute.

Here are three examples (without embedded meta element):

1. /teacher/ (a role, non-rigid)

```
<OntologicalMetaProperty rigidity="false" rigid_score="0.00"
non_rigid_score="0.23"/>
```

"The tool says 0.00 for rigidity, 0.23 for non-rigidity and tags rigid=no"

2. /mountain gorilla/ (a species name, rigid)

```
<OntologicalMetaProperty rigidity="true" rigid_score="0.72"
non_rigid_score="?"/>
```

"The tool says 0.72 for rigidity, no idea about non-rigidity and tags rigid=yes"

3. /wine/ (if it turns into vinegar, is it still the same entity?)

```
<OntologicalMetaProperty rigidity="unknown" rigid_score="0.05"
non_rigid_score="0.10"/>
```

"The tool says 0.05 for rigidity, 0.10 for non-rigidity and because both values are fairly low it decides not to take a decision: rigid=unknown"

Synset

This element encodes information about a wordnet synset. A *Synset* element can link senses of different *LexicalEntry* instances within the same part of speech.

Synset elements can contain zero to one *Meta*, zero to one *Definition*, one *SynsetRelations* and one *MonolingualExternalRefs* bracketing elements.

Required attributes for this element are the following:

- id: a unique identifier. The agreed syntax is "language code-version-id-pos tag"
- baseConcept: values for the baseConcept attribute will be numerical (1, 2, 3), which correspond to the BaseConcept sets

Examples:

Representation of synset {footprint_3}, from English Princeton WordNet:

```
<Synset id="eng-30-05129054-n" baseConcept="1">
<Definition gloss="the area taken up by some object">
<Statement example="the computer had a desktop footprint of 10 by 16 inches" />
</Definition>
<SynsetRelations>
<!-- {area, expanse, surface_area}: -->
<SynsetRelation target="eng-30-05128519-n" relType="has_hyperonym" />
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-23456789-n"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="AreaMeasure" relType="at"/>
</MonolingualExternalRefs>
</Synset>
```

Representation of synset {enkel, enkeltje} from Dutch wordnet:

```
<Synset id="nld-00-n_n-508353" baseConcept="1">
<Definition gloss="enkele reis"/>
<SynsetRelations>
<SynsetRelation target="nld-00-d_n-20153" relType="has_hyperonym">
<Meta author="Paul" date="19961206" source="n_n-508353" confidenceScore="0.0"/>
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Ticket" relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="transport"/>
</MonolingualExternalRefs>
</Synset>
```

Definition and Statement

The element *Definition* allows to represent the gloss associated with each synset. It has an obligatory attribute “gloss” and in turn contains an empty element *Statement* whose purpose is to represent examples of use associated with the synset by means of the required attribute “example”.

Example:

```
<Definition gloss="a trace suggesting that something was once present or felt or otherwise important">
  <Statement example="the footprints of an earlier civilization" />
</Definition>
```

SynsetRelations and SynsetRelation

SynsetRelations is a bracketing element for grouping together all *SynsetRelation* elements. It must contain at least one of them.

Relations between synsets are codified by means of *SynsetRelation* elements, one per relation.

Required attributes are:

- target: contains the ID value of the synset that is target of the relation.
- relType: the particular relation type (ex., has_hyperonym, has_holo_member, has_hyponym, etc.). A list of possible values is enclosed in the Appendix.

Example:

```
<SynsetRelations>
  <!-- {mark, print}: -->
  <SynsetRelation target="eng-30-06798750-n" relType="has_hyperonym" >
  <Meta author="AH" date="2008-07-01" source="Wordnet3.0" status="yes"
  confidenceScore="1.0"/>
  </SynsetRelation>
  <!-- {footprint_evidence}: -->
  <SynsetRelation target="eng-30-06645266-n" relType="has_hyponym">
  <Meta author="AH2" date="2008-07-01" source="eng-Wordnet3.0" status="yes"
  confidenceScore="1.0"/>
  </SynsetRelation>
</SynsetRelations>
```

SenseAxes and SenseAxis

SenseAxes is a bracketing element that groups together elements (*SenseAxis*) used for interlingual correspondences. It has no attributes and must contain at least one *SenseAxis* element.

The *SenseAxis* element is a means for grouping together synsets belonging to different monolingual wordnets and sharing the same equivalence relation to a

pivot synset, which by convention is an English one. This is a compact way of encoding correspondences among wordnets, avoiding to have several languageX-to English single correspondences. Any *SenseAxis* element thus groups together monolingual synsets that correspond one to another by means of a particular type of relation.

Required attributes are:

- id: a unique identifier
- relType: specifies the particular type of correspondence among synsets belonging to different resources (e.g., eq_synonym, eq_near_synonym, etc.). The set of inter-WordNet relations is given in the Appendix.

For instance, suppose you have the following situation (Synset IDs are made up):

Italian synset ita-16-1251-n, Spanish synset spa-30-09686541-n and Chinese synset zho-30-05231501-n all map onto English WordNet eng-30-13480848-n by means of an eq_synonym relation.

This situation could be represented with several *SenseAxis* instances for each language pair:

```
<SenseAxis id="sa_ita16-eng30_001" relType="eq_synonym">  
<Target ID="ita-16-1251-n" />  
<Target ID="eng-30-13480848-n"/>  
</SenseAxis>
```

...

```
<SenseAxis id="sa_spa16-eng30_001" relType="eq_synonym">  
<Target ID="spa-30-09686541-n"/>  
<Target ID="eng-30-13480848-n"/>  
</SenseAxis>
```

...

```
<SenseAxis id="sa_spa16-eng30_001" relType="eq_synonym">  
<Target ID="zho-30-05231501-n"/>  
<Target ID="eng-30-13480848-n"/>  
</SenseAxis>
```

The representation proposed, instead, is the following one:

```
<SenseAxis id="sa_ita16-spa30-zho30-eng30_001" relType="eq_synonym">  
<Target ID="ita-16-1251-n"/>  
<Target ID="spa-30-09686541-n"/>  
<Target ID="zho-30-05231501-n"/>  
<Target ID="eng-30-13480848-n"/>  
</SenseAxis>
```

Note: since the *SenseAxis* element is used for expressing interlingual correspondences, it will not apply to representation of English WordNet. Mapping between different English WordNet versions are to be represented by means of the *MonolingualExternalRef* element.

Example :

```
<SenseAxes>
  <SenseAxis id="sa_nl00-en20_001" relType="eq_near_synonym">
    <Meta author="Irion Technologies" date="20070622" source="Irion Wordnet Aligner 1.0"
confidenceScore="1.0"/>
    <Target ID="nld-00-d_n-11043"/>
    <Target ID="eng-20-05259279-n"/>
  </SenseAxis>
  <SenseAxis id="sa_nl00-en20_002" relType="eq_near_synonym">
    <Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1351.0"/>
    <Target ID="nld-00-n_a-508343"/>
    <Target ID="eng-20-00022022-a"/>
  </SenseAxis>
  <SenseAxis id="sa_nl00-en20_003" relType="eq_near_synonym">
    <Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1373.0"/>
    <Target ID="nld-00-n_a-508343"/>
    <Target ID="eng-20-00914828-a"/>
  </SenseAxis>
</SenseAxes>
```

Target

The element *Target* is an empty element that references the monolingual synset ID that is referenced by each *SenseAxis*. It has a required attribute ID.

Example :

```
<SenseAxis id="sa_nl00-en20_004" relType="eq_near_synonym">
  <Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="516.0"/>
  <Target ID="nld-00-n_a-508343"/>
  <Target ID="eng-20-00916947-a"/>
</SenseAxis>
```

InterlingualExternalRefs and *InterlingualExternalRef*

InterlingualExternalRefs is a bracketing element for grouping together all *InterlingualExternalRef* elements. It must contain at least one of them.

InterlingualExternalRef is used in KYOTO-LMF to express a linking between a *SenseAxis* instance and an external system such as an ontology, and represents the means to anchor a multilingual group of synsets to an ontological node. In principle, however, the same element can hold a link to any system referenced by a homogeneous group of synsets.

Its intended use, thus, is to provide a representational device to link a group of synsets from different wordnets to the same ontological concept.

Attributes are:

- `externalSystem` (required): the name of the external resource (for instance SUMO, DOLCE, WordNet Top Ontology, etc.)

- externalReference (required): the particular identifier or node
- relType (optional): the type of relations with SUMO ontology nodes. Possible values are “at”, “plus”, “equal”.

Note: The *InterlingualExternalRefs* and *InterlingualExternalRef* package should not be used to link a monolingual synset to an ontology. To this end the element *MonolingualExternalRef* should be used instead.

The following example illustrates the case of Italian, Spanish, Chinese and English synsets for “fire”, all related by an “equal_synonym” relation and pointing to the same ontological node “Combustion”.

Example :

```
<SenseAxis id="sa_001" relType="eq_synonym">
  <Target ID="ita-16-0001251-n"/>
  <Target ID="spa-16-09686541-n"/>
  <Target ID="zho-14-05231501-Na"/>
  <Target ID="eng-30-13480848-n"/>
  <InterlingualExternalRefs>
  <InterlingualExternalRef externalSystem="SUMO" externalReference="Combustion"
  relType="at"/>
  <InterlingualExternalRefs>
</SenseAxis>
```


References

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4. ISO 24613 Language Resource Management – Lexical Markup Framework, ISO Geneva, 2008.
5. Soria C., Monachini M., Vossen P. in press. "KYOTO-LMF: fleshing out a standardized format for wordnet interoperability". Accepted for publication at IWIC2009, Stanford, Palo Alto, CA.

Appendix A – List of values of attribute ‘relType’ for SynsetRelation elements

antonym
antonym_comp
be_in_state
category
category_term
causes
co_agent_instrument
co_agent_patient
co_agent_result
co_instrument_agent
co_instrument_patient
co_instrument_result
co_patient_agent
co_patient_instrument
co_patient_result
co_result_agent
co_result_instrument
co_result_patient
co_role
for_purpose_of
fuzzynym
gloss
has_derived
has_holo_location
has_holo_madeof
has_holo_member
has_holo_part
has_holo_portion
has_holonym
has_hyperonym
has_hyponym
has_mero_location
has_mero_madeof
has_mero_member
has_mero_part
has_mero_portion
has_meronym
has_pertainym
has_subevent
has_xpos_hyperonym
has_xpos_hyponym
in_manner

instance
involved
involved_agent
involved_direction
involved_instrument
involved_location
involved_patient
involved_result
involved_source_direction
involved_target_direction
is_a_value_of
is_caused_by
is_derived_from
is_subevent_of
manner_of
near_antonym
near_synonym
nearest
pertains_to
region
region_term
related
related_to
results_in
rgloss
role
role_agent
role_direction
role_instrument
role_location
role_manner
role_patient
role_result
role_source_direction
role_target_direction
see_also_wn15
state_of
usage
usage_term
verb_group
xpos_fuzzynym
xpos_near_antonym
xpos_near_synonym

Appendix B – List of values of attribute ‘relType’ for SenseAxis elements

eq_synonym
eq_near_synonym
eq_has_hypernym
eq_has_hyponym
eq_involved
eq_role
eq_is_caused_by
eq_causes
eq_has_holonym
eq_has_meronym
eq_has_subevent
eq_is_subevent_of
eq_be_in_state
eq_is_state_of
eq_co_role
eq_generalization
eq_metonym
eq_diathesis
eq_in_manner
eq_has_instance
eq_belongs_to_class
eq_antonym

Appendix C – Example representation of English Princeton WordNet 3.0 synsets {footprint_1, footmark_1}, {footprint_2}, {footprint_3}

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE LexicalResource SYSTEM "kyoto_wn.dtd">
<LexicalResource>
<GlobalInformation label="example encoding of Wordnet entries using Kyoto-LMF by
BBAW"/>
<Lexicon languageCoding="ISO 639-3" label="English Wordnet 3.0" language="eng"
owner="Princeton" version="3.0">
<LexicalEntry id="footprint">
<Lemma writtenForm="footprint" partOfSpeech="n"/>
<Sense id="footprint_1" synset="eng-30-06645039-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footprint&#37;1:10:00::"/>
</MonolingualExternalRefs>
</Sense>
<Sense id="footprint_2" synset="eng-30-06646854-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footprint&#37;1:10:01::"/>
</MonolingualExternalRefs>
</Sense>
<Sense id="footprint_3" synset="eng-30-05129054-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footprint&#37;1:07:00::"/>
</MonolingualExternalRefs>
</Sense>
</LexicalEntry>
<LexicalEntry id="footmark">
<Lemma writtenForm="footmark" partOfSpeech="n"/>
<Sense id="footmark_1" synset="eng-30-06645039-n">
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet3.0"
externalReference="footmark&#37;1:10:00::"/>
</MonolingualExternalRefs>
</Sense>
</LexicalEntry>
<Synset id="eng-30-06645039-n" baseConcept="1">
<Definition gloss="mark of a foot or shoe on a surface">
<Statement example="the police made casts of the footprints in the soft earth outside the
window"/>
</Definition>
<SynsetRelations>
<SynsetRelation target="eng-30-06798750-n" relType="has_hyperonym">
<Meta author="AH" date="2008-07-01" source="Wordnet3.0" status="yes"
confidenceScore="1.0"/>
</SynsetRelation>
<SynsetRelation target="eng-30-06645266-n" relType="has_hyponym">
```

```
<Meta author="AH2" date="2008-07-01" source="eng-Wordnet3.0" status="yes"
confidenceScore="1.0" />
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-
01234567-n"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="superficialPart"
relType="at"/>
</MonolingualExternalRefs>
</Synset>
<Synset id="eng-30-06646854-n" baseConcept="1">
<Definition gloss="a trace suggesting that something was once present or felt or otherwise
important">
<Statement example="the footprints of an earlier civilization"/>
</Definition>
<SynsetRelations>
<SynsetRelation target="eng-30-06646628-n" relType="has_hyperonym"/>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-
12345678-n"/>
<MonolingualExternalRef externalSystem="SUMO"
externalReference="SubjectiveAssessmentAttribute" relType="at"/>
</MonolingualExternalRefs>
</Synset>
<Synset id="eng-30-05129054-n" baseConcept="1">
<Definition gloss="the area taken up by some object">
<Statement example="the computer had a desktop footprint of 10 by 16 inches"/>
</Definition>
<SynsetRelations>
<SynsetRelation target="eng-30-05128519-n" relType="has_hyperonym"/>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="Wordnet1.6" externalReference="eng-16-
23456789-n"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="AreaMeasure"
relType="at"/>
</MonolingualExternalRefs>
</Synset>
</Lexicon>
</LexicalResource>
```

Appendix D – Example representation of Dutch wordnet synsets

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE LexicalResource SYSTEM "kyoto_wn.dtd">
<LexicalResource>
<GlobalInformation label="Cornetto translated to Kyoto-LMF."/>
Lexicon languageCoding="ISO 639-3" label="Cornetto" language="nld" owner="VUA"
version="">
<LexicalEntry>
<Lemma writtenForm="enkelgewricht" partOfSpeech="n"/>
<Sense id="nld-00-d_n-74258" synset="nld-00-d_n-11043"/>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="enkelvoudig" partOfSpeech="a"/>
<Sense id="nld-00-r_a-10587" synset="nld-00-n_a-508343">
<Definition gloss="in het enkelvoud"/>
</Sense>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="zuiver" partOfSpeech="a"/>
<Sense id="nld-00-r_a-16454" synset="nld-00-n_a-536020">
<Definition gloss="puur"/>
</Sense>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="bloot" partOfSpeech="a"/>
<Sense id="nld-00-d_a-33332" synset="nld-00-n_a-536020"/>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="sec" partOfSpeech="a"/>
<Sense id="nld-00-d_a-257412" synset="nld-00-n_a-536020"/>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="enkel" partOfSpeech="n"/>
<Sense id="nld-00-r_n-12437" synset="nld-00-d_n-11043">
<Definition gloss="gewricht tussen voet en onderbeen"/>
</Sense>
<Sense id="nld-00-r_a-10430" synset="nld-00-n_a-508343">
<Definition gloss="niet dubbel">
<Statement example="wil je een enkele of een dubbele boterham?"/>
</Definition>
</Sense>
<Sense id="nld-00-d_n-74244" synset="nld-00-d_n-16661">
<Definition gloss="deel van een kous enz. dat de enkel omsluit">
<Statement example="Hij heeft een gat in de enkel van zijn linkersok"/>
</Definition>
</Sense>
<Sense id="nld-00-d_a-74247" synset="nld-00-n_a-536020"/>
<Sense id="nld-00-d_n-74243" synset="nld-00-n_n-508353">
<Definition gloss="enkele reis">
<Statement example="Doe mij maar een enkel naar Amsterdam"/>
</Definition>
</Sense>
```

```
</Sense>
</LexicalEntry>
<LexicalEntry>
<Lemma writtenForm="enkeltje" partOfSpeech="n"/>
<Sense id="nld-00-r_n-12442" synset="nld-00-n_n-508353">
<Definition gloss="treinkaartje voor reis in Ã©Ã©n richting"/>
</Sense>
</LexicalEntry>
<Synset id="nld-00-d_n-11043" baseConcept="1">
<Definition gloss="gewricht tussen voet en onderbeen"/>
<SynsetRelations>
<SynsetRelation target="nld-00-d_n-16972" relType="has_hyperonym">
<Meta author="Laura" date="19970703" source="d_n-11043" status="yes"
confidenceScore="0.0"/>
</SynsetRelation>
<SynsetRelation target="nld-00-d_n-33017" relType="has_mero_part">
<Meta author="Laura" date="19970703" source="d_n-11043" status="yes"
confidenceScore="0.0"/>
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO" externalReference=",Ankle"
relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="anatomy"/>
</MonolingualExternalRefs>
</Synset>
<Synset id="nld-00-n_a-508343" baseConcept="1">
<Definition gloss="niet dubbel"/>
<SynsetRelations>
<SynsetRelation target="nld-00-n_a-507710" relType="near_antonym">
<Meta author="Paul" date="19961206" source="n_a-508343" confidenceScore="0.0"/>
</SynsetRelation>
<SynsetRelation target="nld-00-n_a-507976" relType="has_hyponym"/>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO"
externalReference="SubjectiveAssessmentAttribute" relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="ObjectiveNorm"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="NormativeAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="and"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Word"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Number"
relType="equal"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="equal"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="TraitAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="SocialInteraction"
relType="bracket"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Organism"
relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="quality"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="factotum"/>
```



```
<MonolingualExternalRef externalSystem="Domain" externalReference="metrology
quality"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology
zoology"/>
</MonolingualExternalRefs>
</Synset>
  <Synset id="nld-00-d_n-16661" baseConcept="1">
<Definition gloss="deel van een kous enz. dat de enkel omsluit"/>
<SynsetRelations>
<SynsetRelation target="nld-00-d_n-38865" relType="has_hyperonym">
<Meta author="Laura" date="19971222" source="d_n-16661" status="yes"
confidenceScore="0.0"/>
</SynsetRelation>
<SynsetRelation target="nld-00-d_n-17790" relType="has_holo_part">
<Meta author="Laura" date="19980112" source="d_n-16661" status="yes"
confidenceScore="0.0"/>
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Sock"
relType="part"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="fashion"/>
</MonolingualExternalRefs>
</Synset>
<Synset id="nld-00-n_a-536020" baseConcept="1">
<Definition gloss="puur"/>
<SynsetRelations>
<SynsetRelation target="nld-00-n_a-507617" relType="near_synonym"/>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO"
externalReference="SubjectiveAssessmentAttribute" relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="ObjectiveNorm"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="NormativeAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="and"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Word"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Number"
relType="equal"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="equal"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="TraitAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="SocialInteraction"
relType="bracket"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Organism"
relType="plus"/>
<MonolingualExternalRef externalSystem="SUMO" externalReference=",TasteAttribute"
relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="quality"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="factotum"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="metrology
quality"/>
```

```
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="psychology
zoology"/>
</MonolingualExternalRefs>
</Synset>
<Synset id="nld-00-n_n-508353" baseConcept="1">
<Definition gloss="enkele reis"/>
<SynsetRelations>
<SynsetRelation target="nld-00-d_n-20153" relType="has_hyperonym">
<Meta author="Paul" date="19961206" source="n_n-508353" confidenceScore="0.0"/>
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonolingualExternalRef externalSystem="SUMO" externalReference="Ticket"
relType="plus"/>
<MonolingualExternalRef externalSystem="Domain" externalReference="transport"/>
</MonolingualExternalRefs>
</Synset>
</Lexicon>
<SenseAxes>
<SenseAxis id="sa_nl00-en20_001" relType="eq_near_synonym">
<Meta author="Irion Technologies" date="20070622" source="Irion Wordnet Aligner 1.0"
confidenceScore="1.0"/>
<Target ID="nld-00-d_n-11043" />
<Target ID="eng-20-05259279-n" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_002" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1351.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-00022022-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_003" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1373.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-00914828-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_004" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="516.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-00916947-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_005" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="516.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-00914828-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_006" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="516.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-01322931-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_007" relType="eq_near_synonym">
```

<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="916.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-01431773-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_008" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1217.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-01501916-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_009" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1416.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-01969773-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_010" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="516.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-01971486-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_011" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1265.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02080883-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_012" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1265.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02081054-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_013" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1741.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02101374-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_014" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="2314.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02138301-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_015" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1964.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02139858-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_016" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI" confidenceScore="1964.0"/>
<Target ID="nld-00-n_a-508343" />

<Target ID="eng-20-02139343-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_017" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1950.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02170048-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_018" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1950.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02170678-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_019" relType="eq_near_synonym">
<Meta author="Paul" date="19970908" source="HEURISTICS_BI"
confidenceScore="1421.0"/>
<Target ID="nld-00-n_a-508343" />
<Target ID="eng-20-02173715-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_020" relType="eq_near_synonym">
<Meta author="Irion Technologies" date="20070622" source="Irion Wordnet Aligner 1.0"
confidenceScore="1.0"/>
<Target ID="nld-00-d_n-11043" />
<Target ID="eng-20-05259279-n" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_021" relType="eq_has_holonym">
<Meta source="Irion Wordnet Aligner 1.0" confidenceScore="" />
<Target ID="nld-00-d_n-16661" />
<Target ID="eng-20-04091722-n" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_022" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-00022022-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_023" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-00914828-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_024" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-00916947-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_025" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-00914828-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_026" relType="eq_near_synonym">

<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-01322931-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_027" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-01431773-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_028" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-01501916-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_029" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-01969773-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_030" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-01971486-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_031" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-02080883-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_032" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-02081054-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_033" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-02101374-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_034" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />
<Target ID="eng-20-02138301-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_035" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020" />

<Target ID="eng-20-02139858-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_036" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02139343-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_037" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02170048-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_038" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02170678-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_039" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02171493-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_040" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02173715-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_041" relType="eq_near_synonym">
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
<Target ID="nI00-n_a-536020" />
<Target ID="eng-20-02286364-a" />
</SenseAxis>
<SenseAxis id="sa_nI00-en20_042" relType="eq_has_hypernym">
<Meta source="Irion Wordnet Aligner 1.0" confidenceScore="" />
<Target ID="nI00-n_n-508353" />
<Target ID="eng-20-06116265-n" />
</SenseAxis>
</SenseAxes>
</LexicalResource>

Appendix E – DTD of Kyoto-LMF wordnet format

```
<?xml version='1.0' encoding="UTF-8"?>
<!ELEMENT LexicalResource (GlobalInformation, Lexicon+, SenseAxes?)>
<!ELEMENT GlobalInformation EMPTY>
<!ATTLIST GlobalInformation
label CDATA #IMPLIED>
<!ELEMENT Lexicon (LexicalEntry+, Synset*)>
<!ATTLIST Lexicon
languageCoding CDATA #FIXED "ISO 639-3"
label CDATA #IMPLIED
language CDATA #REQUIRED
owner CDATA #REQUIRED
version CDATA #REQUIRED>
<!ELEMENT LexicalEntry (Meta?, Lemma, Sense*)>
<!ATTLIST LexicalEntry
id ID #IMPLIED>
<!ELEMENT Lemma EMPTY>
<!ATTLIST Lemma
writtenForm CDATA #REQUIRED
partOfSpeech CDATA #REQUIRED>
<!ELEMENT Sense (Meta?, MonolingualExternalRefs?)>
<!ATTLIST Sense
id ID #REQUIRED
synset IDREF #REQUIRED>
<!ELEMENT Meta EMPTY>
<!ATTLIST Meta
author CDATA #IMPLIED
date CDATA #IMPLIED
source CDATA #IMPLIED
status CDATA #IMPLIED
confidenceScore CDATA #IMPLIED>
<!ELEMENT Synset (Meta?, Definition?, SynsetRelations,
MonolingualExternalRefs)>
<!ATTLIST Synset
id ID #REQUIRED
baseConcept (1|2|3) #REQUIRED>
<!ELEMENT Definition (Statement*)>
<!ATTLIST Definition
gloss CDATA #REQUIRED>
<!ELEMENT Statement EMPTY>
<!ATTLIST Statement
example CDATA #REQUIRED>
<!ELEMENT SynsetRelations (SynsetRelation+)>
<!ELEMENT SynsetRelation (Meta*)>
<!ATTLIST SynsetRelation
```

```
target IDREFS #REQUIRED
relType CDATA #REQUIRED>
<!ELEMENT MonolingualExternalRefs (MonolingualExternalRef+,
OntologicalMetaProperty*)>
<!ELEMENT MonolingualExternalRef (Meta?)>
<!ATTLIST MonolingualExternalRef
externalSystem CDATA #REQUIRED
externalReference CDATA #REQUIRED
relType CDATA #IMPLIED>
<!ELEMENT OntologicalMetaProperty (Meta?)>
<!ATTLIST OntologicalMetaProperty
rigid (true|false|unknown) #REQUIRED
rigidScore CDATA #IMPLIED
nonRigidScore CDATA #IMPLIED>
<!ELEMENT SenseAxes (SenseAxis+)>
<!ELEMENT SenseAxis (Meta?, Target+, InterlingualExternalRefs?)>
<!ATTLIST SenseAxis
id ID #REQUIRED
relType CDATA #REQUIRED>
<!ELEMENT Target EMPTY>
<!ATTLIST Target
ID CDATA #REQUIRED>
<!ELEMENT InterlingualExternalRefs (InterlingualExternalRef+)>
<!ELEMENT InterlingualExternalRef (Meta?)>
<!ATTLIST InterlingualExternalRef
externalSystem CDATA #REQUIRED
externalReference CDATA #REQUIRED
relType CDATA #IMPLIED>
```