

# Kyoto-LMF

## WordNet representation format

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Knowledge-Yielding Ontologies for Transition-Based Organization

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# 1 Introduction<sup>1</sup>

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 resources<sup>2</sup>.

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 standard<sup>3</sup>, 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 WordNet<sup>4</sup> model of lexical knowledge representation. LMF specifications 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.

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<sup>1</sup> Part of the content of this introduction is taken from [5].

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

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

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

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 KYOTO<sup>5</sup>. 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).

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

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"/>
    <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

```

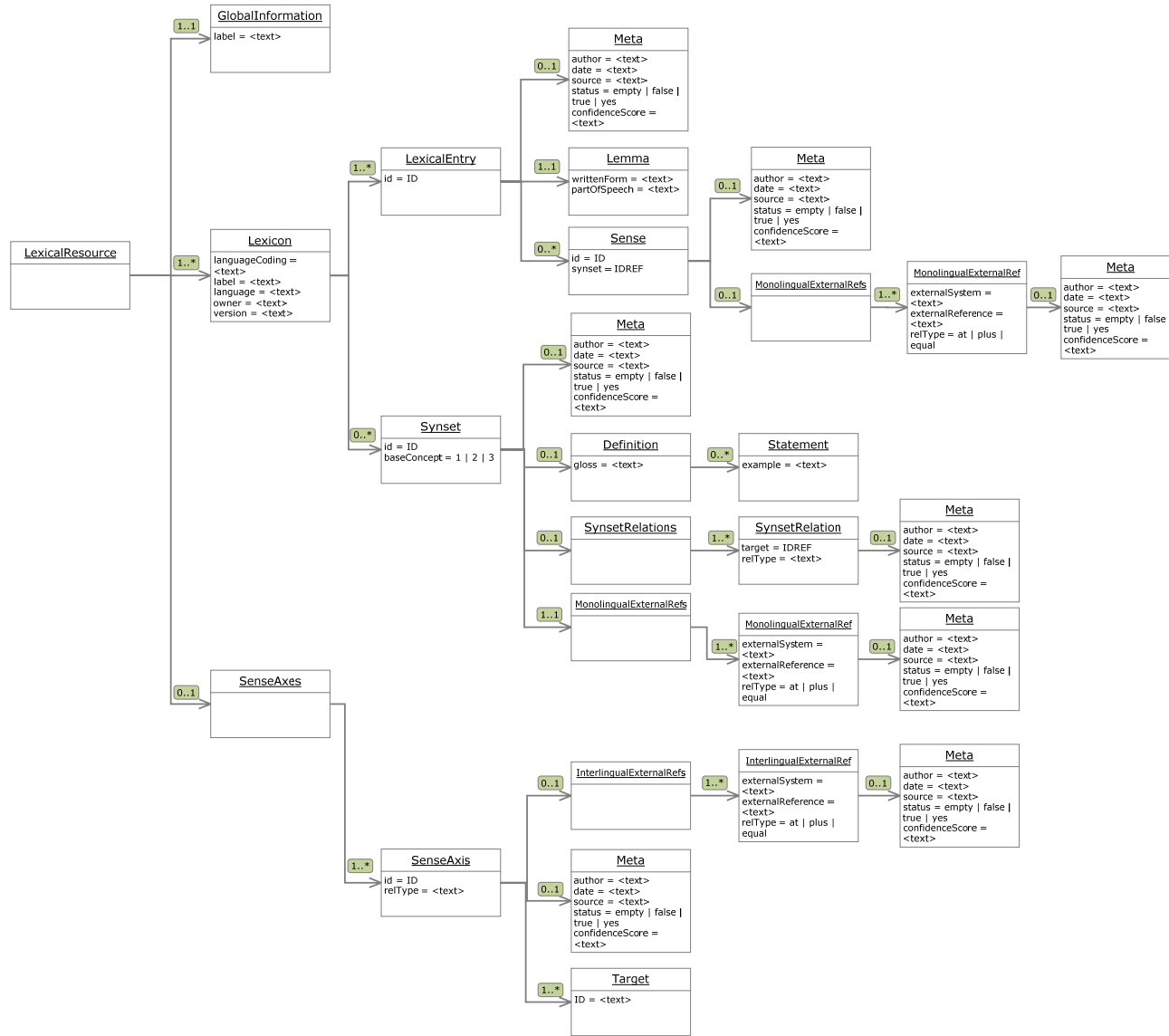
<Synset id="eng-30-06645039-n" baseConcept="1">
<Definition gloss="mark of a foot or shoe on a surface">
<Statement example="the police made casts of the footprints in the soft earth outside the
window" />
</Definition>
<SynsetRelations>
<SynsetRelation target="eng-30-06798750-n" relType="has_hyperonym" >
<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 *dialect*

# Kyoto-LMF UML Diagram



## 2 Description of KYOTO-LMF representation format

### *LexicalResource*

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

- one *GlobalInformation* element
- one ore 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* and *MonolingualExternalRef***

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

*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 resource<sup>6</sup>.

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 system<sup>7</sup>.

Attributes are:

- *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"/>
```

---

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

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

```

<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>

```

## 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

1. Francopoulo G., George M., Calzolari N., Monachini M., Bel N., Pet M., Soria C. 2006 Lexical Markup Framework (LMF). LREC, Genoa.
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3. Francopoulo G., George M., Calzolari N., Monachini M., Bel N., Pet M., Soria C. 2006. Lexical Markup Framework (LMF). In Proceedings of LREC 2006. Genoa, Italy, 24-25-26 May 2006. Proceedings, Paris, The European Language Resources Association (ELRA). CD-ROM, 233-236.
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## 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>
</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="Irlion Technologies" date="20070622" source="Irlion 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="Irlion 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="Irlion 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="Irlion 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="Irlion 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="Irlion 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="Irlion 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="Irlion 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="Irlion 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">  
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</SenseAxis>  
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<Meta author="Paul" date="19970903" source="Irrion Wordnet Aligner 1.0" confidenceScore="500.0"/>  
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<Target ID="eng-20-01971486-a" />  
</SenseAxis>  
<SenseAxis id="sa\_nl00-en20\_031" relType="eq\_near\_synonym">  
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<SenseAxis id="sa\_nl00-en20\_032" relType="eq\_near\_synonym">  
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<Target ID="eng-20-02081054-a" />  
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<Target ID="eng-20-02138301-a" />  
</SenseAxis>  
<SenseAxis id="sa\_nl00-en20\_035" relType="eq\_near\_synonym">  
<Meta author="Paul" date="19970903" source="Irrion Wordnet Aligner 1.0" confidenceScore="500.0"/>  
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<Target ID="eng-20-02139858-a" />  
</SenseAxis>  
<SenseAxis id="sa\_nl00-en20\_036" relType="eq\_near\_synonym">  
<Meta author="Paul" date="19970903" source="Irrion Wordnet Aligner 1.0" confidenceScore="500.0"/>  
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<Target ID="eng-20-02139343-a" />  
</SenseAxis>  
<SenseAxis id="sa\_nl00-en20\_037" relType="eq\_near\_synonym">  
<Meta author="Paul" date="19970903" source="Irrion Wordnet Aligner 1.0" confidenceScore="500.0"/>  
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<Target ID="eng-20-02170048-a" />  
</SenseAxis>  
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<Meta author="Paul" date="19970903" source="Irrion Wordnet Aligner 1.0" confidenceScore="500.0"/>  
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<Target ID="eng-20-02170678-a" />  
</SenseAxis>  
<SenseAxis id="sa\_nl00-en20\_039" relType="eq\_near\_synonym">

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<Meta author="Paul" date="19970903" source="Iriion Wordnet Aligner 1.0"
confidenceScore="500.0"/>
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<Target ID="eng-20-02171493-a" />
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confidenceScore="500.0"/>
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<SenseAxis id="sa_nl00-en20_041" relType="eq_near_synonym">
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confidenceScore="500.0"/>
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<Target ID="eng-20-02286364-a" />
</SenseAxis>
<SenseAxis id="sa_nl00-en20_042" relType="eq_has_hyponym">
<Meta source="Iriion Wordnet Aligner 1.0" confidenceScore="" />
<Target ID="nld-00-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 #IMPLIED
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 IDREF #REQUIRED
relType CDATA #REQUIRED>
<!ELEMENT MonolingualExternalRefs (MonolingualExternalRef+)>
<!ELEMENT MonolingualExternalRef (Meta?)>
<!ATTLIST MonolingualExternalRef
externalSystem CDATA #REQUIRED
externalReference CDATA #REQUIRED
```

relType (at | plus | equal) #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 (at | plus | equal) #IMPLIED>