Kyoto-LMF

WordNet representation format
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Knowledge-Yielding Ontologies for Transition-Based Organization
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# 1 Introduction

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.

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, 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 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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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.
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. 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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3 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}:

```xml
<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"/>
    <Meta author="AH" date="2008-07-01" source="Wordnet3.0" status="yes" confidenceScore="1.0"/>
  </SynsetRelation>
  <SynsetRelation targets="eng-30-06645266-n">
    <feat att="relType" val="has_hyponym"/>
    <Meta author="AH2" date="2008-07-01" source="eng-Wordnet3.0" status="yes" confidenceScore="1.0"/>
  </SynsetRelation>
</Synset>
```

standard LMF

```xml
<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>
  <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>
</Synset>
```
KYOTO-LMF dialect
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; interlingual 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:

```xml
<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:

```xml
<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:

```xml
<LexicalEntry id="footmark">
    <Lemma writtenForm="footmark" partOfSpeech="n"/>
</LexicalEntry>
```
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:

```xml
<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>
```

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:

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

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%1:10:00::"/>
    </MonolingualExternalRefs>
</Sense>
```

**MonolingualExternalRefs and MonolingualExternalRef**

*MonolingualExternalRef* 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. 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.

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"/>
</MonolingualExternalRefs>
```

---

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.
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

```xml
<Sense id="footprint_1" synset="eng-30-06645039-n">
  <MonolingualExternalRefs>
    <MonolingualExternalRef externalSystem="Wordnet3.0" externalReference="footprint%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.

```xml
<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 MonolingualExternalRef 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:

```xml
<Synset id="eng-30-05129054-n" baseConcept="1">
```
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:

```xml
<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>

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:

```xml
<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="spa-30-09686541-n"/>
<Target ID="eng-30-13480848-n"/>
</SenseAxis>
...
<SenseAxis id="sa_zho30-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:

```xml
<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:**

```xml
<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:**

```xml
<SenseAxes>
    <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>
</SenseAxes>
```

**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:

```xml
<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>
  </InterlingualExternalRefs>
</SenseAxis>
```
References


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

eq_synonym
eq_near_synonym
eq_has_hypernym
eq_has_hypernym
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, footprint_2}, {footprint_3}, {footmark_1}, {footmark_2}, {footmark_3}
<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>
</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>
</Synset>
Appendix D – Example representation of Dutch wordnet synsets

<?xml version="1.0" encoding="UTF-8"?>
<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="hiet 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"/>
</Sense>
</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_a-508353">
<Definition gloss="enkele reis"/>
<Statement example="Doe mij maar een enkel naar Amsterdam"/>
</Sense>
</LexicalResource>
<LexicalEntry>
  <Lemma writtenForm="enkeltje" partOfSpeech="n"/>
</LexicalEntry>

<Sense id="nld-00-r_n-12442" synset="nld-00-n_n-508353">
  <Definition gloss="treinkaartje voor reis in één richting"/>
</Sense>

<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"/>
    <SynsetRelation target="nld-00-d_n-33017" relType="has_mero_part"/>
  </SynsetRelations>
  <MonolingualExternalRefs>
    <MonolingualExternalRef externalSystem="SUMO" externalReference="Ankle" relType="plus"/>
    <MonolingualExternalRef externalSystem="Domain" externalReference="anatomy" relType="plus"/>
  </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"/>
    <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="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" relType="plus"/>
    <MonolingualExternalRef externalSystem="Domain" externalReference="factotum" relType="plus"/>
    <MonolingualExternalRef externalSystem="Domain" externalReference="metrology quality" relType="plus"/>
    <MonolingualExternalRef externalSystem="Domain" externalReference="psychology" relType="plus"/>
    <MonolingualExternalRef externalSystem="Domain" externalReference="psychology zoology" relType="plus"/>
  </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_hyponym">
<Meta author="Laura" date="19971222" source="d_n-16661" status="yes" confidenceScore="0.0"/>
</SynsetRelation>
<SynsetRelation target="nld-00-d_n-17790" relType="has_hyponym">
<Meta author="Laura" date="19980112" source="d_n-16661" status="yes" confidenceScore="0.0"/>
</SynsetRelation>
</SynsetRelations>
<MonolingualExternalRefs>
<MonoLingualExternalRef externalSystem="SUMO" externalReference="Sock" relType="part"/>
</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"/>
</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>
</MonolingualExternalRefs>
</Synset>
<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-20-01971486-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-20-02080883-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>
<Meta author="Paul" date="19970903" source="Irion Wordnet Aligner 1.0" confidenceScore="500.0"/>
<Target ID="nld-00-n_a-536020"/>
<Target ID="eng-20-02171493-a"/>
</SenseAxis>
<SenseAxis id="sa_nl00-en20_040" 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-20-02173715-a"/>
</SenseAxis>
<SenseAxis id="sa_nl00-en20_041" 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-20-02286364-a"/>
</SenseAxis>
<SenseAxis id="sa_nl00-en20_042" relType="eq_has_hypernym">
<Meta source="Irion Wordnet Aligner 1.0" confidenceScore=""/>
<Target ID="nld-00-n_n-508353"/>
<Target ID="eng-20-06116265-n"/>
</SenseAxis>
</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?, Definition?, SynsetRelations, 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>
refType (at|plus|equal) #IMPLIED>
<ELEMENT SenseAxes (SenseAxis+)>
<ELEMENT SenseAxis (Meta?, Target+, InterlingualExternalRefs?)>
<ATTLIST SenseAxis id ID #REQUIRED
refType CDATA #REQUIRED>
<ELEMENT Target EMPTY>
<ATTLIST Target id ID CDATA #REQUIRED>
<ELEMENT InterlingualExternalRefs (InterlingualExternalRef+)>
<ELEMENT InterlingualExternalRef (Meta?)>
<ATTLIST InterlingualExternalRef externalSystem CDATA #REQUIRED
externalReference CDATA #REQUIRED
refType (at|plus|equal) #IMPLIED>