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Multiword Expressions and LMF

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PARSEME Workshop

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Overview

- MWEs
- Lexical Representation of MWEs
- DuELME
- DuELME and LMF
- Extensions
- Summary

Overview

- **MWEs**
- Lexical Representation of MWEs
- DuELME
- DuELME and LMF
- Extensions
- Summary

What is an MWE?

- MWE = Multiword Expression
- Focus is on MWEs in an NLP context

What is an MWE?

- sequence of words
- that has linguistic (lexical, orthographic, phonological, morphological, syntactic, semantic, pragmatic) or translational properties
- not predictable from the individual componentwords and the normal rules for combining them

What is an MWE?

- *sequence of*
  - Not necessarily contiguous in a concrete utterance
    - ...omdat hij **de plaat** wilde **poetsen**
    - …because he **the plate** wanted **polish**
    - ‘…because he bolted’
  - Not necessarily always in the same order in each utterance
    - Hij **poetste** gisteren **de plaat**
    - He **polished** yesterday **the plate**
    - ‘he bolted yesterday’

What is an MWE?

- *words*
  - Ambiguity between type and token (intentional)
  - Inflected word form v. lemma (both are needed)
  - Ambiguity between
    - Character sequences separated from other character sequences by spaces and other separators (Narrow interpretation)
      - *Bibliotheekzaal* v. *library hall*
      - compounds in Dutch, German, Norwegian, Swedish are NOT included
      - Compounds in English are included (parts separated by space)
    - Abstract lexical units of the grammar (Broad interpretation)
      - Dutch, German compounds ARE included if they meet the other criteria

What is an MWE?

- *that has linguistic* (lexical, orthographic, phonological, morphological, syntactic, semantic, pragmatic) *or* translational *properties not predictable from the individual components and the normal rules for combining them*

What is an MWE?

- *the normal rules for combining them*
  - Assumptions about this must be made explicit
    - In some cases they are not known
  - For each concrete NLP-system: the rules of that NLP-system

What is an MWE?

- Whether a word sequence is an MWE is an empirical hypothesis (or, in NLP, a proposed engineering solution)
- Intuitions about the status of expressions as MWEs have limited validity
- MWE-status must be argued for (or against)
  - Using the definition as a guide

Types of MWEs (I)

- Fixed
- Semi-flexible
- Flexible

Fixed MWEs

- Fixed MWEs
  - Words of the MWE in a fixed order
  - No variation in lexical item choice
  - Always contiguous (no other elements in between)
  - No inflectional processes except at the edges

Fixed MWEs

- Fixed MWEs
  - *ad hoc, stante pede, ter plaatse*
  - *Hong Kong, Kuala Lumpur, New York, San Francisco*
  - *credit card, travel agency, real estate agency*
- *NOT*
  - *in plaats van (cf. in plaats **daar**van) (‘instead of’)*
  - *carta telefonica (cf. cart**e** telefonic**he**)*
  - *de plaat poetsen (‘polish the plate’, ‘bolt’)*

Semi-Flexible MWEs

- Semi-Flexible MWEs
  - MWEs with fixed order of elements
  - That are impenetrable for other words
  - Parts can be inflected

Semi-Flexible MWEs

- Examples:
  - Chambre des représentants
    - House of representatives
  - Patatas fritas
    - French fries
  - Mise au point automatique
    - Autofocus
  - Calculateur analogique
    - Analogue computer

Semi-Flexible MWEs

- Examples:
  - Cité plus haut
    - Above-stated
  - Résistant aux acides
    - Acid-proof
  - Malade en altitude
    - Airsick

Flexible MWEs

- Flexible MWEs
  - Allow or require inflection in multiple parts, and
  - Allow permutations of subphrases, or
  - Allow intrusion by other phrases, or
  - Have controlled variation (bound pronouns)

Flexible MWEs

- *de plaat poetsen ('bolt')*
  - *Hij heeft gisteren **de plaat gepoetst***
  - *…omdat hij **de plaat** wilde **poetsen***
  - *Hij **poetste** gisteren **de plaat***
- But of course not just anything:
  - **Hij gepoetst plaat de heeft*
  - **..omdat wilde poetsen hij de plaat*
- *to lose one's temper*
  - *He lost **his** temper*
  - *She lost **her** temper*

Types of MWEs (II)

- Idioms
- Semi-idioms
- Support-verb constructions

Types of MWEs(II)

- Idioms
  - Meaning not predictable from the components
  - The components have no or an unpredictable meaning
  - Fixed (or very limited) lexical item selection

Types of MWEs (II)

- Idioms
  - Non-transparant
    - *de plaat poetsen*, *kick the bucket*, *casser sa pipe*
    - Many restrictions on syntactic behavior (see handout example (4)

Types of MWEs(II)

- Idioms
  - Semi-transparant
    - *een bok schieten*
      - Bok (male goat) = blunder (but only with *schieten*)
      - Schieten (shoot) = make (but only with *bok)*
    - *dat varkentje wassen*
      - Varkentje (little pig) = problem (only with *wassen*)
      - Wassen (wash) = address, take care of (only with *varkentje)*
  - Little restrictions on syntactic behaviour. See handout example (5)

Types of MWEs(II)

- Semi-idioms (collocations)
  - One element occurs in its normal meaning
  - The lexical selection of the other element is fixed or very limited
  - The other element has a special meaning
  - Very little restrictions on syntactic behaviour. See handout example (6)

Types of MWEs(II)

- Semi-idioms (collocations)
  - Examples
    - Zware / * sterke tabak (heavy / *strong tobacco) `strong tobacco'
    - Scherpe kritiek (sharp criticism) `severe criticism'
    - Heavy / *strong smoker

Types of MWEs(II)

- Support verb constructions
  - Type I
    - Direct object + verb
    - Verb idiosyncratically determined by the direct object head noun
    - Arguments of the noun often realized outside the NP in the VP. See handout (8), (9)

Types of MWEs(II)

- Support verb constructions
  - Type I Examples
    - *Een poging wagen* 'dare an attempt'
    - *Een lezing houden / geven* 'hold / give a lecture'
    - With *hebben* 'have': see handout (7)
    - *To pay attention to* (aandacht schenken aan)
    - *To take advantage of*

Types of MWEs (II)

- Type II
  - Predicative complement (AP, PP)
    - often itself idiomatic
    - expressing a state or property
  - Combination with intransitive or transitive verb is idiosyncratic

Types of MWEs (II)

pred	Literal	intransitive	meaning
In de war	In the tangle	Zijn / raken / * gaan / *komen / *zitten	Confused (of humans)
In de war	In the tangle	*zijn / * raken / *gaan / komen / zitten	Entangled, mixed-up
In zijn nopjes	In his studs-DIM	Zijn / raken / *gaan / *komen / *zitten	Delighted,
De pijp uit	The pipe out	Zijn / *raken / gaan / *komen / * zitten	dead
		Be / get / go / come / sit	

Overview

- MWEs
- ➢ **Lexical Representation of MWEs**
- DuELME
- DuELME and LMF
- Extensions
- Summary

Lexical representation

- Focus on flexible MWEs
- Lexical representation for (grammar-based) NLP systems;
- NLP:
  - A sequence of words that is an MWE must be parsed / generated
  - A sequence of words that is an MWE must be recognized as an MWE
  - And mapped to the appropriate semantics / translation

Lexical representation

- Flexibility
  - Can be accounted for by assuming a syntactic structure for an MWE
  - Is usually identical to the syntactic structure of the literal expression
  - ➔ no problem to parse or generate sequences of strings that are MWEs.
  - Syntactic structure canNOT be determined automatically by an NLP system (ambiguities)

Lexical representation

- Flexibility (cont.)
  - Restrictions on flexibility must follow from general principles or additional MWE-specific properties
  - But: the syntactic structure is of course highly framework/ theory / implementation-dependent

Lexical representation

- Examples of syntactic structures in
  - Lexical Functional Grammar (LFG): (1)
  - Tree Adjoining Grammar (TAG): (2)
  - M-Grammar : (3)

Lexical representation

- Syntactic structure contains references to lexical items from the lexicon used in the NLP-system
  - Otherwise it cannot be parsed / generated correctly
  - And the lexical properties must be correct!
    - Inflection
    - Syntactic and semantic selection
  - Extremely framework / grammar / implementation-dependent!

Lexical representation

- Summary: MWE lexical representation
  - Syntactic structure compatible with NLP-system
  - Correct references to lexical items in the NLP-system's lexicon corresponding to the MWE components
  - Maximally framework / theory / implementation- independent

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DuELME

- Dutch Electronic Lexicon of Multiword Expressions
- App. 5000 entries
- MWEs of different types:
  - Mostly flexible idioms
  - Collocations (semi-idioms)
  - Mostly verbal
- Focus on syntax

DuELME

- Maximally theory-neutral:
  - (parameterized) Equivalence Class Method (ECM):
    - Method to lexically represent MWEs
    - Procedure to incorporate MWEs thus represented into a concrete NLP system
- See
  - Odijk 2004a, 2004b, 2013a, 2013b
  - Grégoire 2010

DuELME Lexical Representation

- Lexical Entries
  - MWEs with the same syntactic structure
    - by means of an MWE pattern id
  - Components: sequence of their lemmas
    - Any order but the same order within one pattern
  - Example sentence
    - Identical syntactic structure for each example in one equivalence class

DuELME Lexical Representation

- MWE Pattern descriptions
  - Mwe pattern id
  - Description (free text)

DuELME Lexical Representation

- DuELME is a *proto*-lexicon
  - Lexical resource from which a lexicon can be derived automatically or semi-automatically
  - By a well-defined procedure
- Link to DuELME description
- Search GUI, User Documentation
- Metadata
- Product and license

Incorporation Procedure

- Incorporation in some NLP system
- Assumes the NLP system contains a parser
- For each MWE pattern P do
  - Bootstrap part
    - Contains some manual actions
  - Repeat part (for each MWE of pattern P)
    - Fully automatic
- Procedure and example (no parameters)

Further properties

- DuELME does contain models for syntactic structures
  - Based on *de facto* standard for Dutch
  - Used in Alpino, LASSY, CGN treebanks
- DuELME assumes the parameterized ECM
- Encodes several lexical properties
  - auxiliary used for perfect tenses (conjugation)
  - Negative and positive polarity (polarity)
  - Gender of nouns in an MWE
  - …

Further properties

- MWEs have been extracted from corpora
  - After automatic parsing with Alpino
  - Using a variety of statistical and (morpho-)syntactic measures
- Corpora statistics have been included in DuELME
  - E.g., for *een rol spelen* ‘play a role’, tuple= rol spelen, freq=1612
    - Number of ‘rol’: mor1: "sg 1563,pl 49,"
    - Dim form of ‘rol’: dim1: "nodim 1612,"
    - Det with ‘rol’: Det1: "een 918,de 311,die 98,zijn 48,NO 44,deze 38,geen 36,hun 31,welk 20,haar 19,"
- Ten example sentences from these corpora have been included for each MWE

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DUELME and LMF

- LMF
  - Abstract metamodel for computational lexicons
  - Represented through UML class diagrams
  - Multiple serialisation options
- DuELME-LMF
  - UML class model created for DuELME
  - Serialized in XML

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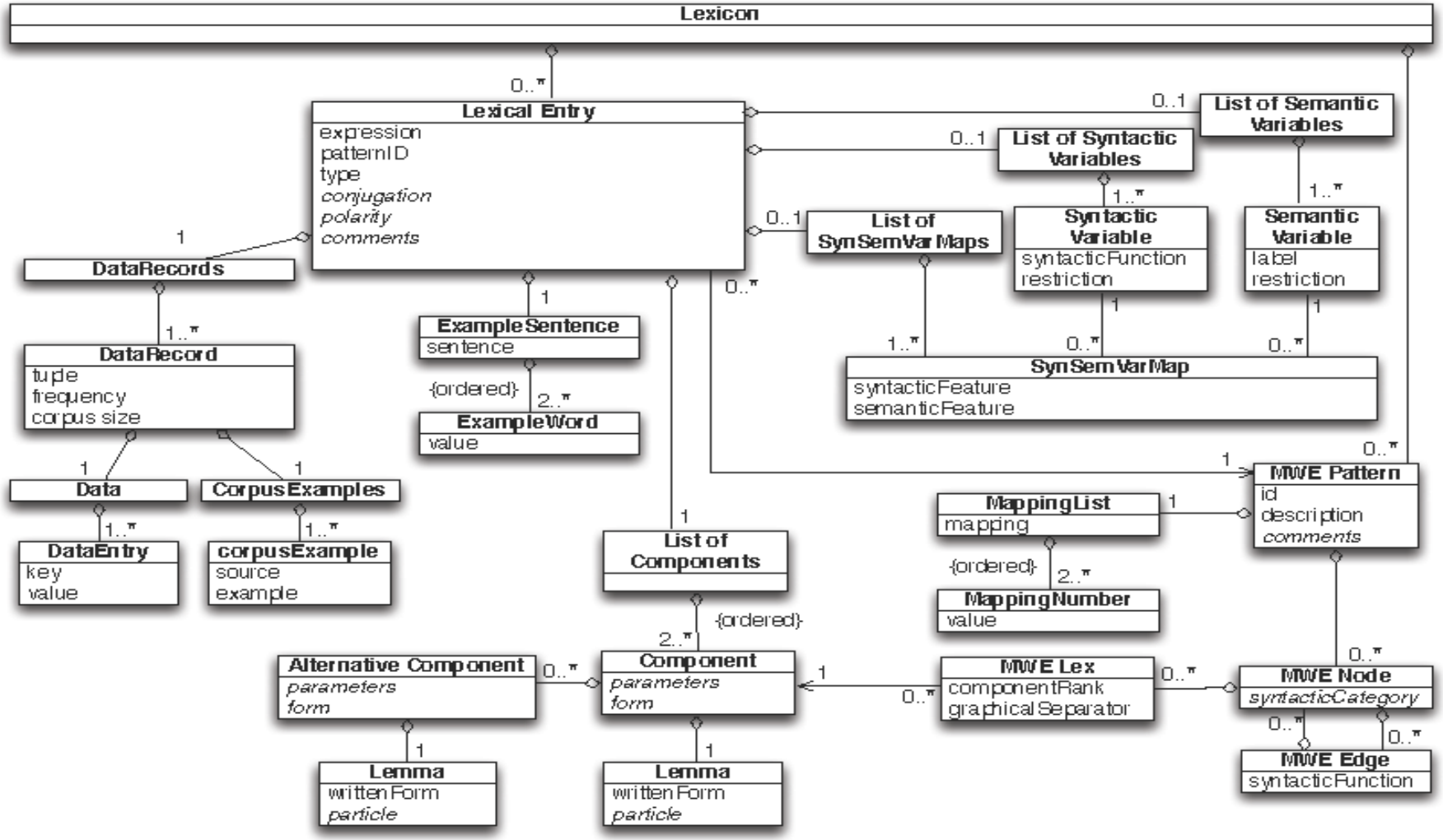
DuELME Class Model



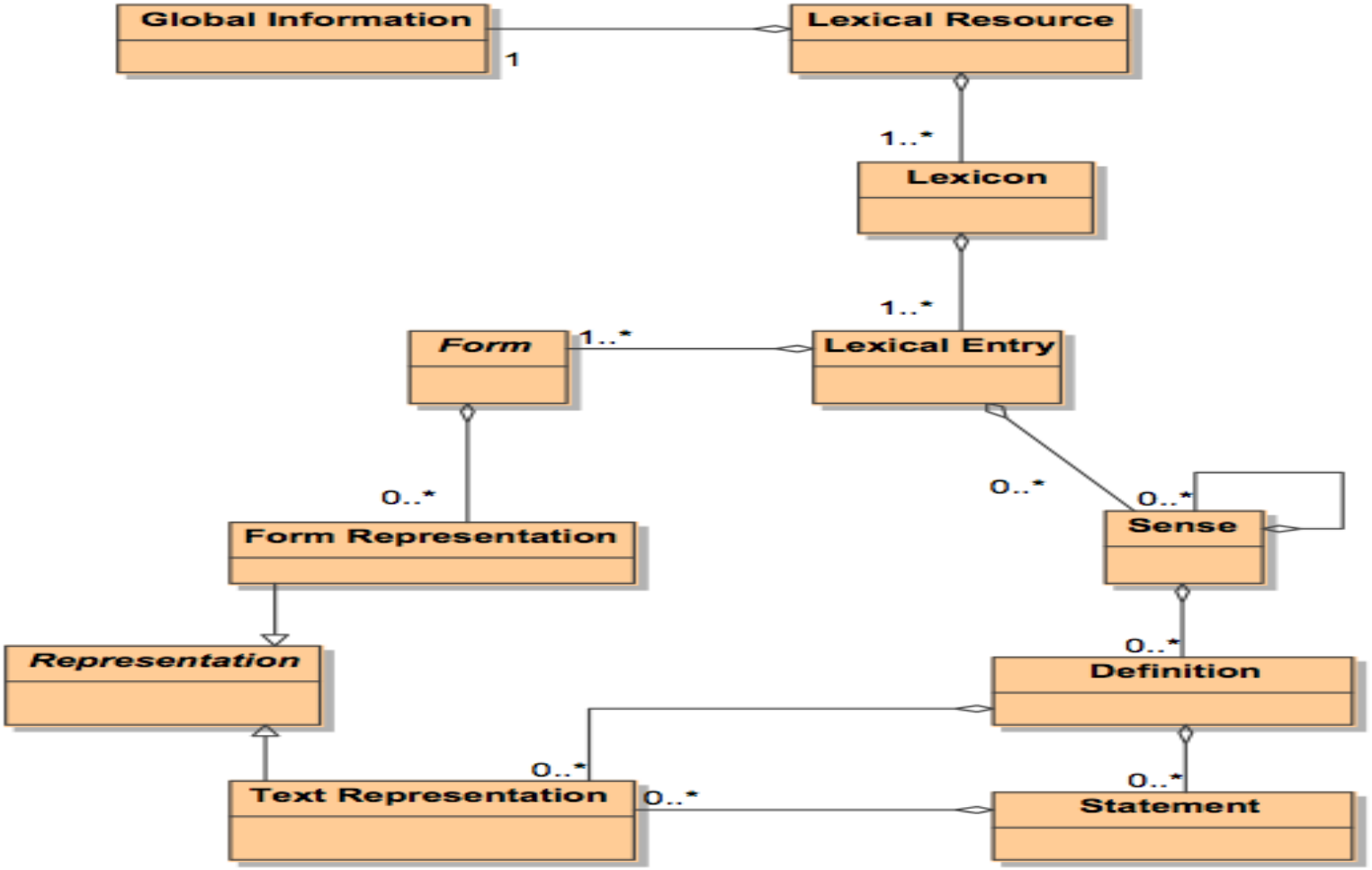
DuELME Lexicon

- Lexicon
  - **Lexical Entry** 0..*
  - **MWE Pattern** 0..*
- MWE Pattern
  - **MWE Pattern attributes**
  - MappingList
  - MWE Node
- (see the example MWE and pattern in the handout)

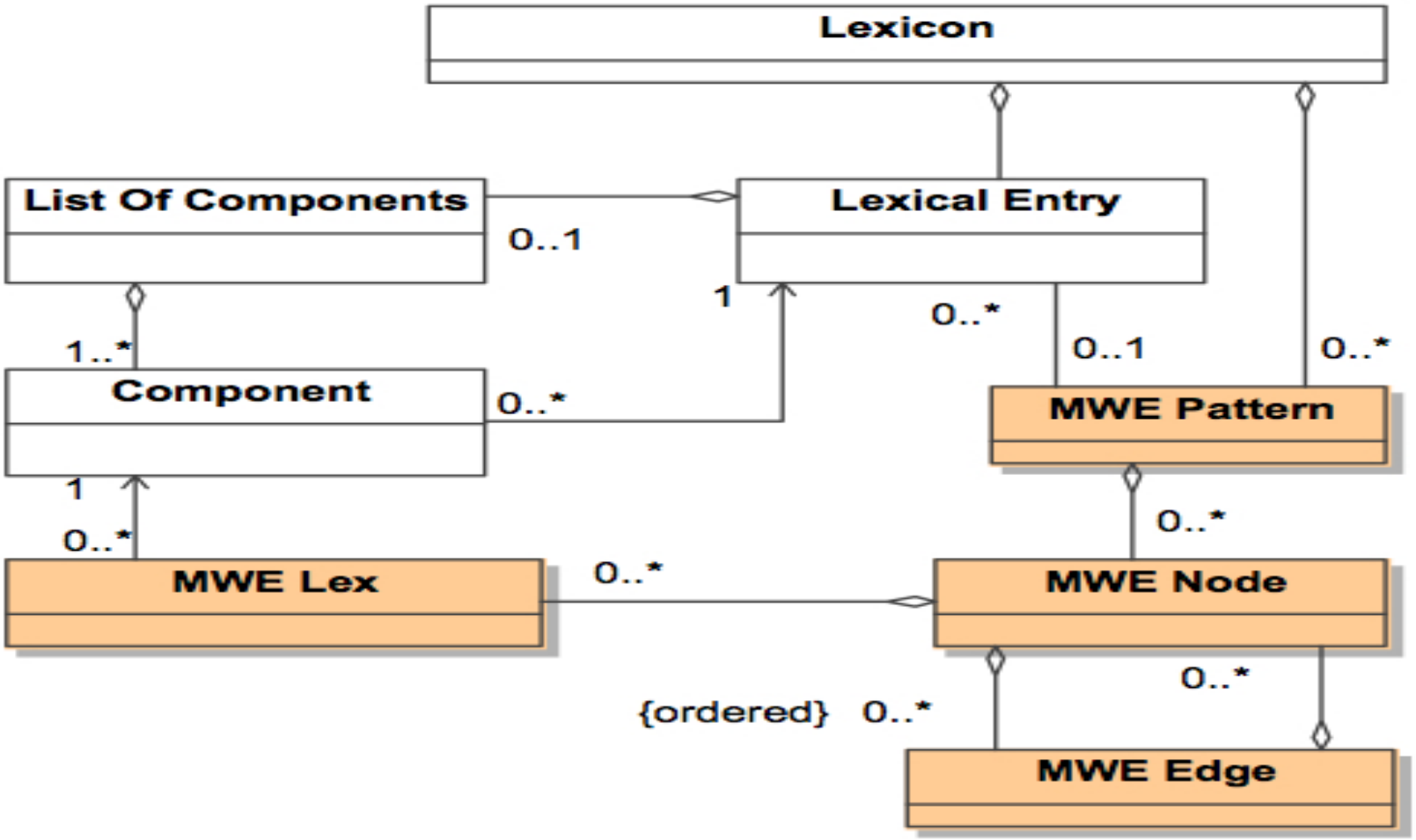
DuELME and LMF

- DuELME-LMF v. LMF
  - Compare DuELME Class Model with LMF Core Package
  - Compare DuELME Class Model with LMF NLP MWE patterns extension (normative)

LMF Core Package



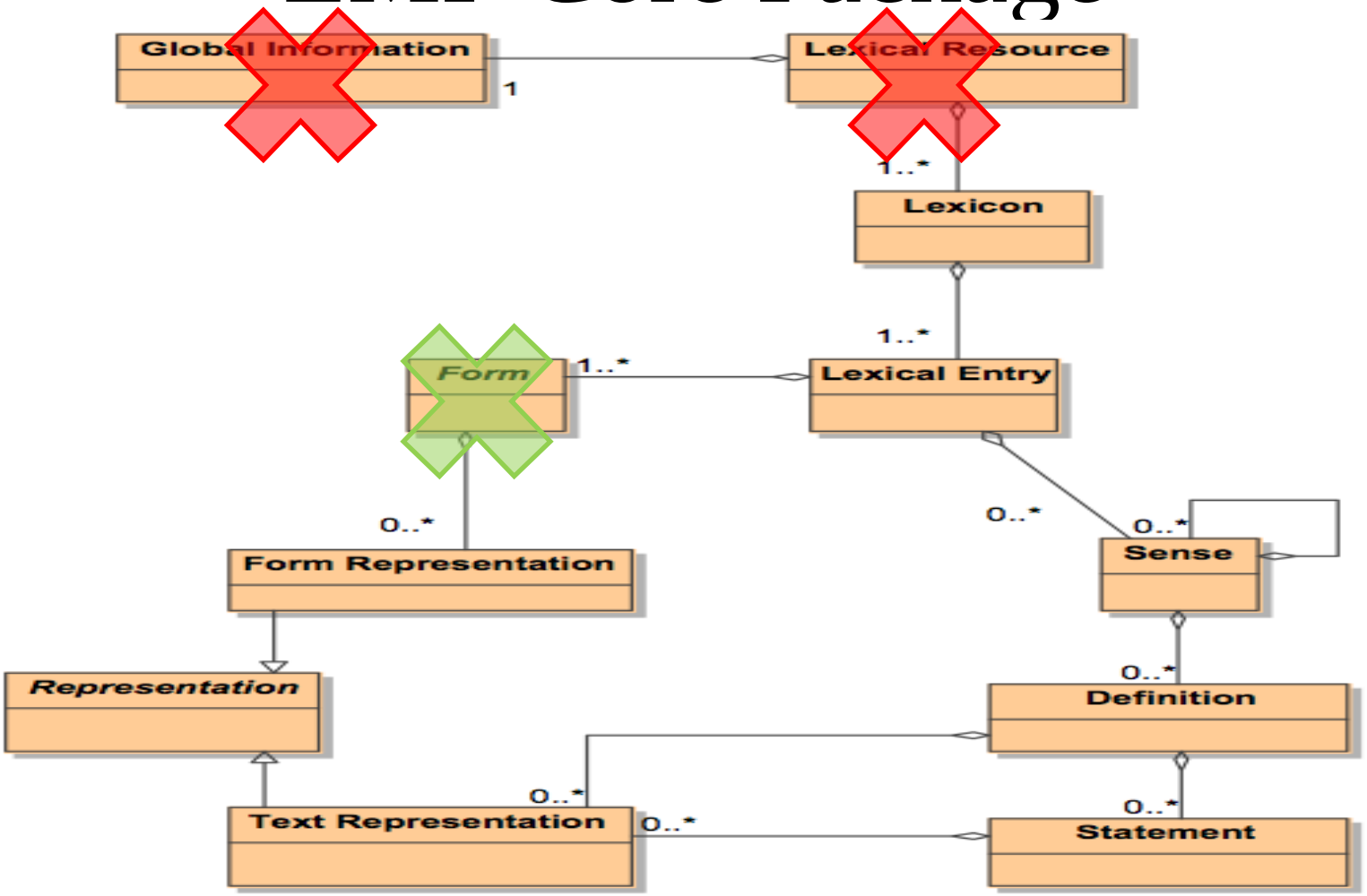
LMF NLP MWE extension



DuELME and LMF

- DuELME Class Model v. LMF Core Package
  - no **Lexical Resource** and **Global Information**
    - This is an error
  - Lexical Entry: no **Form Class** (but LMF requires one)
    - Not needed for MWEs
    - Not desirable for components of MWEs since DuELME is a *proto-lexicon*

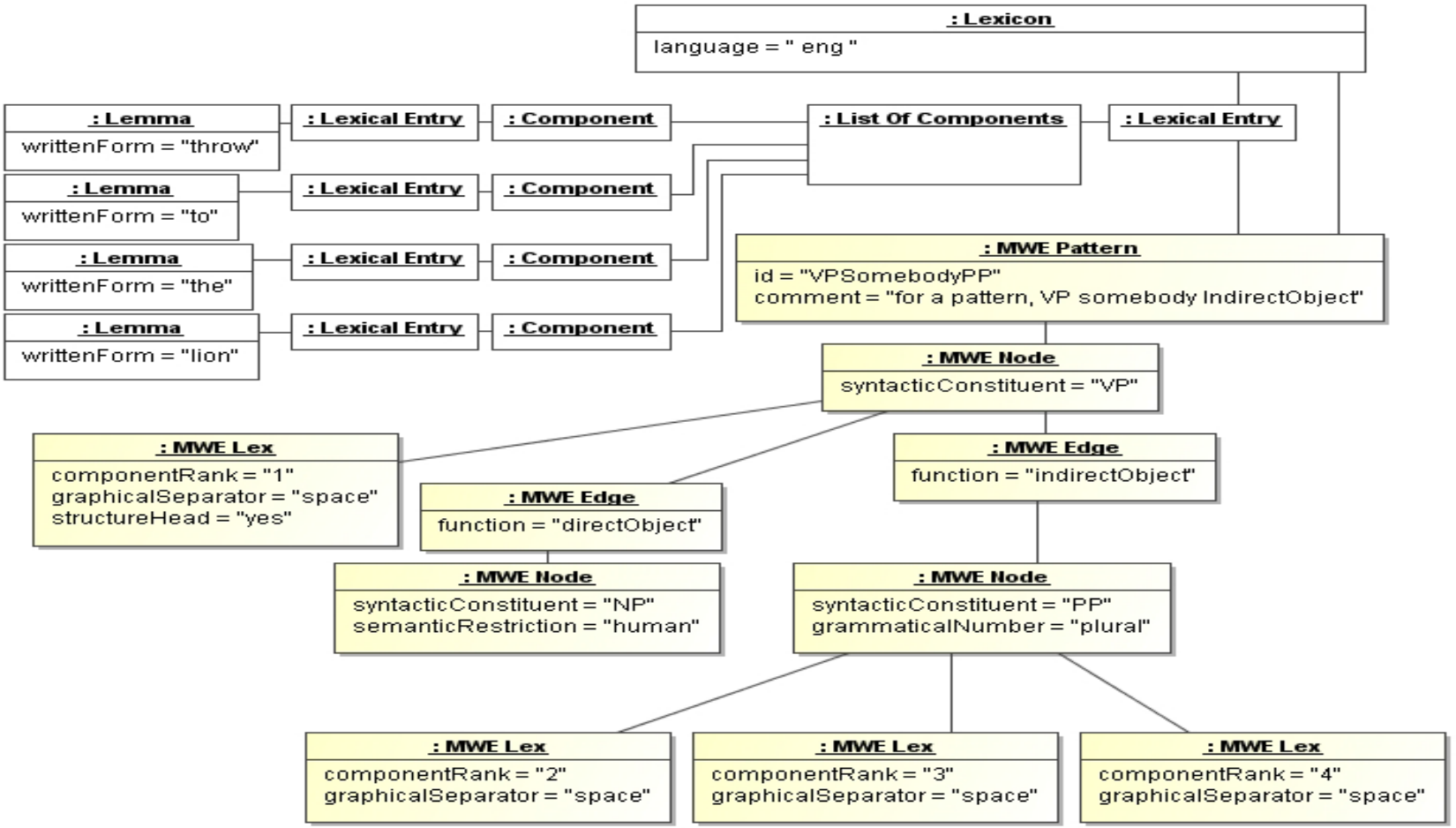
LMF Core Package



DuELME and LMF

- DuELME Class Model v. LMF NLP MWE Extension
  - Richer but compatible:
    - DataRecords: corpus-derived information
    - ExampleSentence
    - Alternative Components in ComponentList
    - MWE Pattern

LMF MWE Pattern Example



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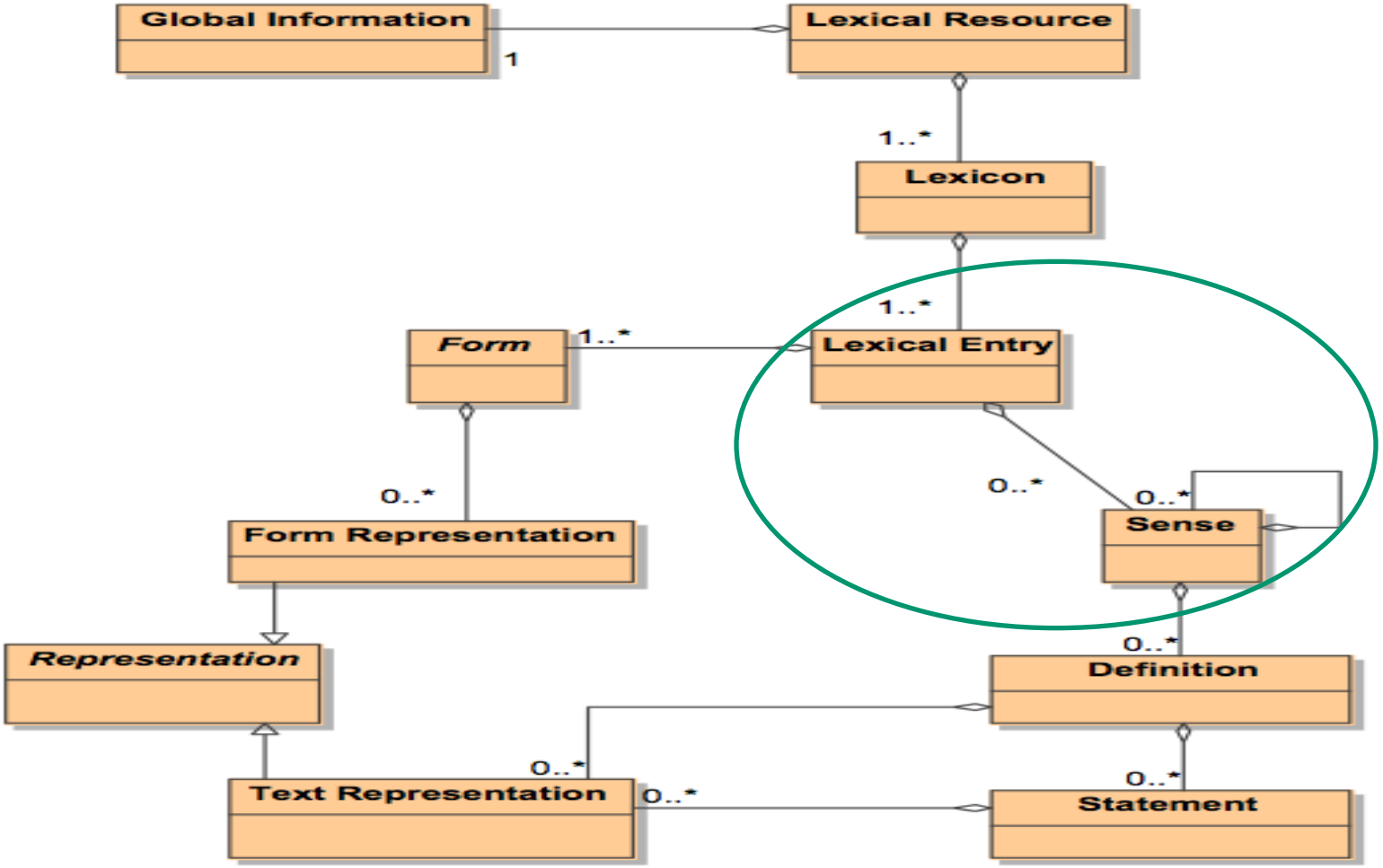
NOT in DuELME

- Meaning
- Semantic selection restrictions
- Translation

Meaning

- MWEs are described as a special kind of Lexical Entry
- Sense class, and all its dependents, can be used as with single word lexical entries

LMF Core Package



Meaning

- For collocations and semi-transparent idioms the meaning of each part?
  - Zware shag (lit. heavy tobacco, ‘strong tobacco’) -> zwaar-a-3 shag-n-1
  - Varkentje wassen (lit. pig-DIM wash)-> **varkentje-n-1**, **wassen-v-7**
  - Flater slaan (lit. blunder hit)-> flater-n-1 **slaan-v-10**

(Sense IDs from Cornetto **or should be added to Cornetto)**

Meaning

- And how they are combined(?)
  - Or maybe this follows from their syntactic manner of combination?
- LMF makes no specific provisions for this
- Perhaps by adding a MWE in the other languages' lexicons ('address problem')

Semantic selection restrictions

- DuELME already specifies
  - Syntactic variables, and syntactic selection restrictions
  - Semantic variables, and semantic selection restrictions
  - Their mutual relation
- But not linked to Sense
  - This should be adapted

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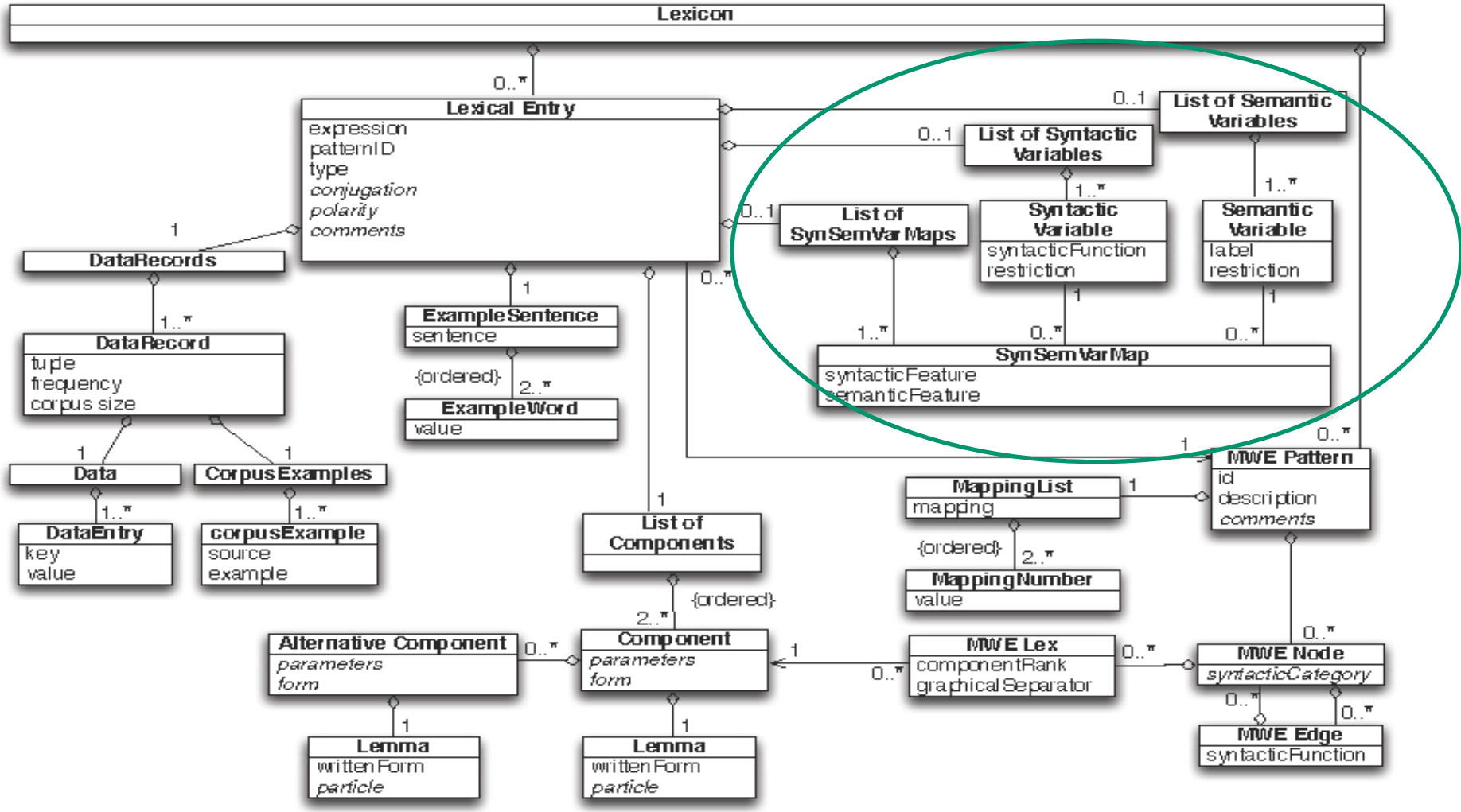
DuELME Class Model



Translation

- Elements for Translation in the Multilingual Notations Model ([ISO 08] Annex I, J, p. 48ff)
- Supports semantics based translation, possibly interlingual, and transfer
- Relations between entries from lexicons of different languages
- Can be adopted straightforwardly for MWEs in DuELME

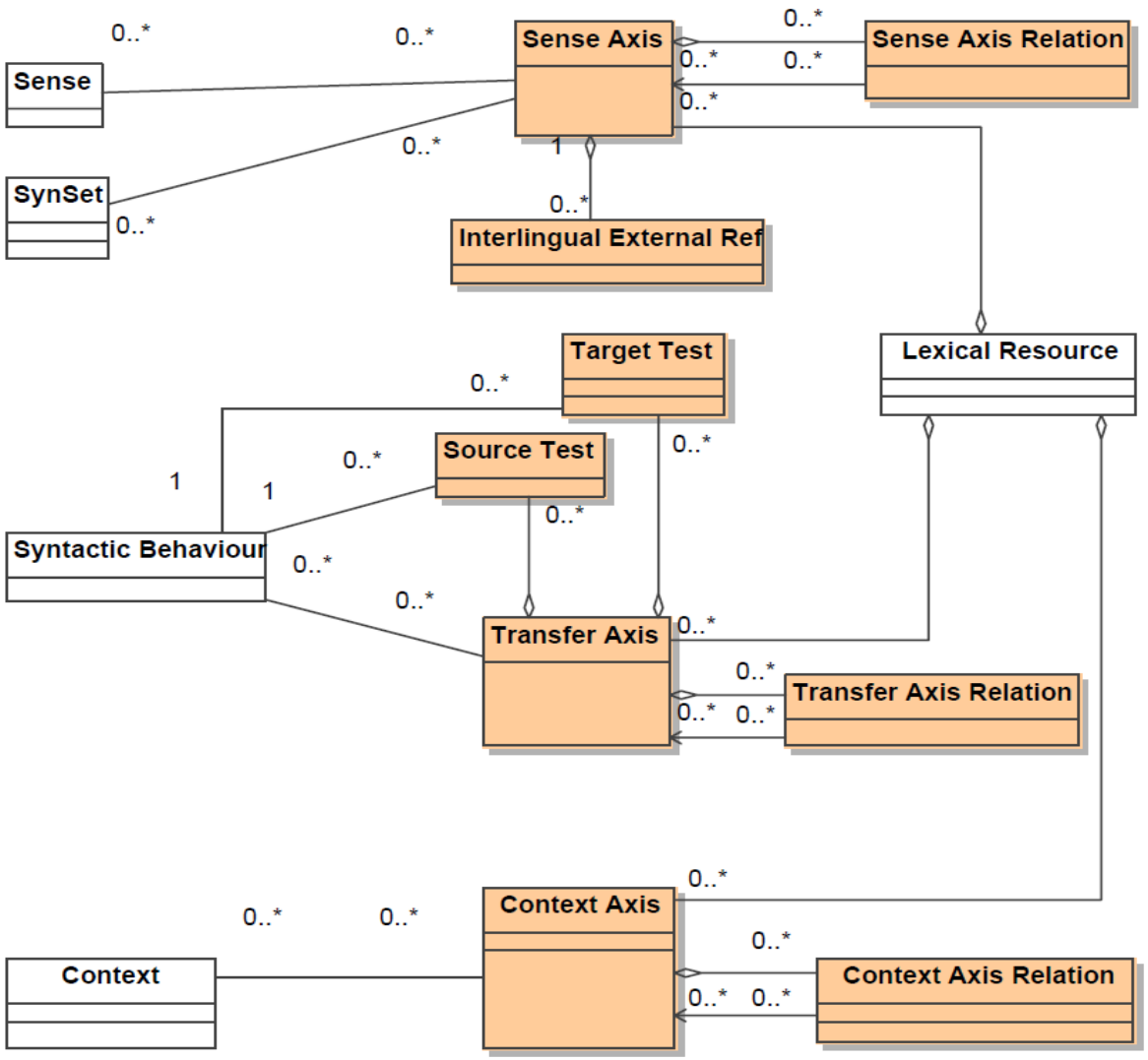


Figure I.1 – Multilingual notations model

Overview

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Summary

- DuELME
  - Lexical entries for MWEs
  - With focus on syntax
    - Almost no semantics
    - No translational equivalence
  - Still very incomplete
    - Lacks many syntactic restrictions (e.g. passivisation)
    - Semantic restrictions mostly not specified

Summary

- DuELME
  - Encoded in LMF
    - But some improvements are needed
    - Proposes some deviations
  - Explicit Semantics:
    - only partly (ISOCAT, CLARIN Concept Registry)
    - not formally encoded in the schema yet

Summary

- DuELME
  - highly theory-neutral but
    - Specifically aimed at NLP systems with an explicit grammar
    - Some parts are highly Dutch-specific

THANKS FOR YOUR ATTENTION

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DO NOT ENTER HERE

DuELME Lexicon

- Lexical Entry (see also the example)
  - Lexical Entry attributes
  - **List of Components**
  - DataRecords
  - **Example Sentence**
  - List of SyntacticVariables
  - List of SemanticVariables
  - List of SynSemVar Maps

DuELME Lexicon

- **List of Components**
  - {Component}
  - Component attributes to express the parameters
  - Lemma with attributes for the writtenform and the (separable) particle

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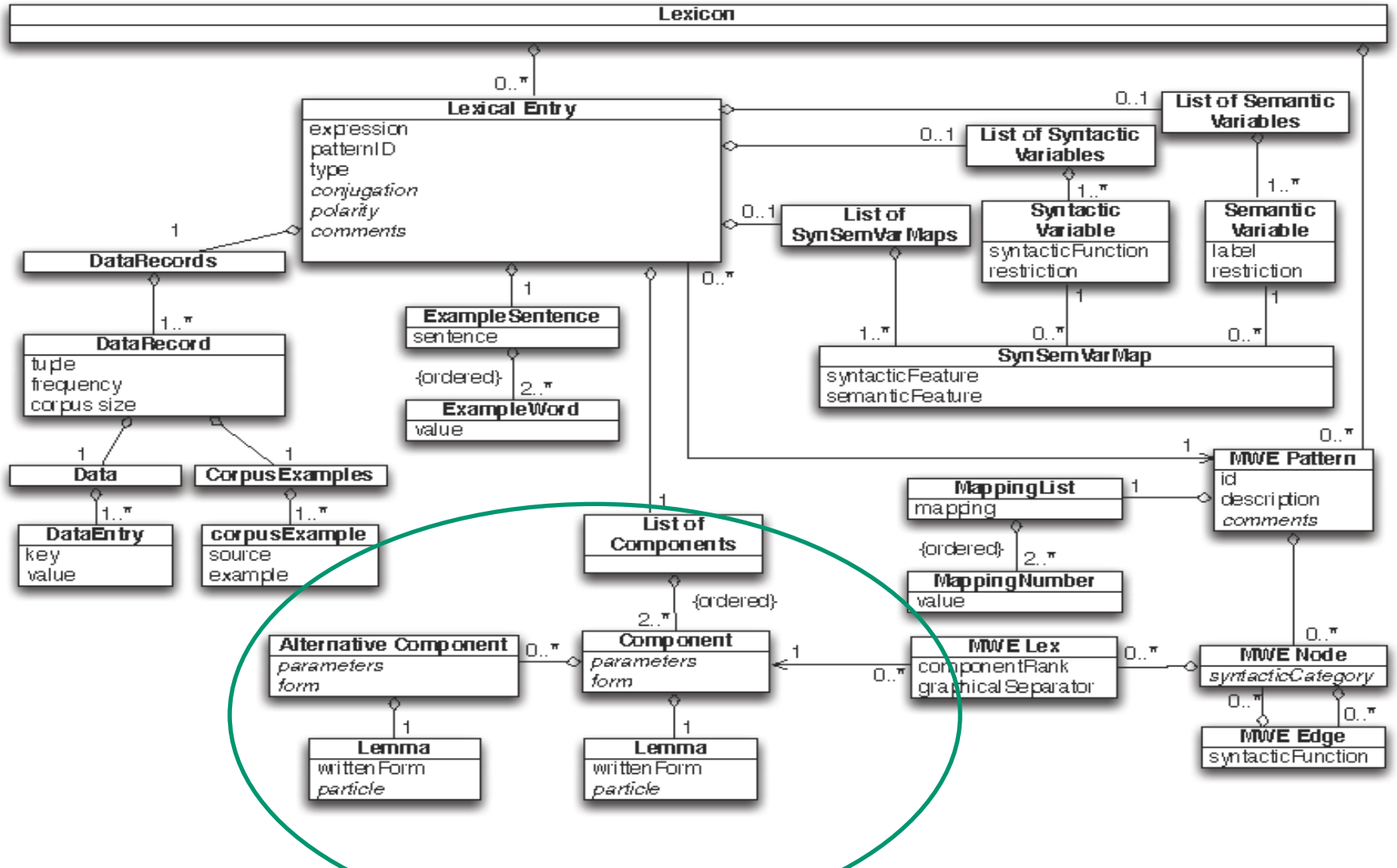
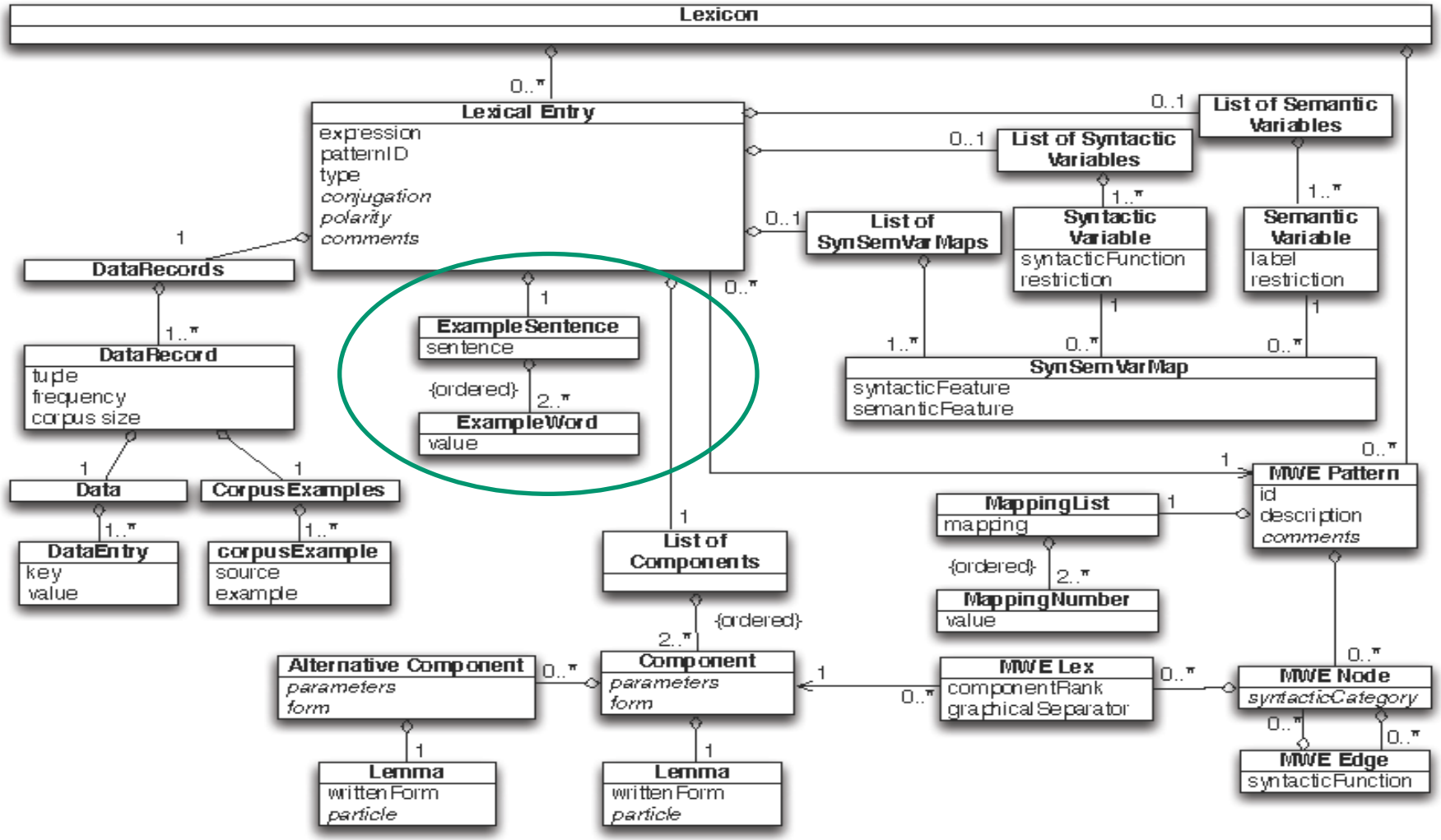
DuELME Class Model



DuELME Lexicon

- **Example Sentence**
  - Full sentence and a tokenized version

DuELME Class Model



DuELME Lexicon

- DataRecords
  - For tuples identified as candidate MWEs
  - Contains statistics on occurring arguments, modifiers, determiners, morphosyntactic properties, etc
  - Formally structured but not in the class model hence not in XML
  - Tuple =/= MWE

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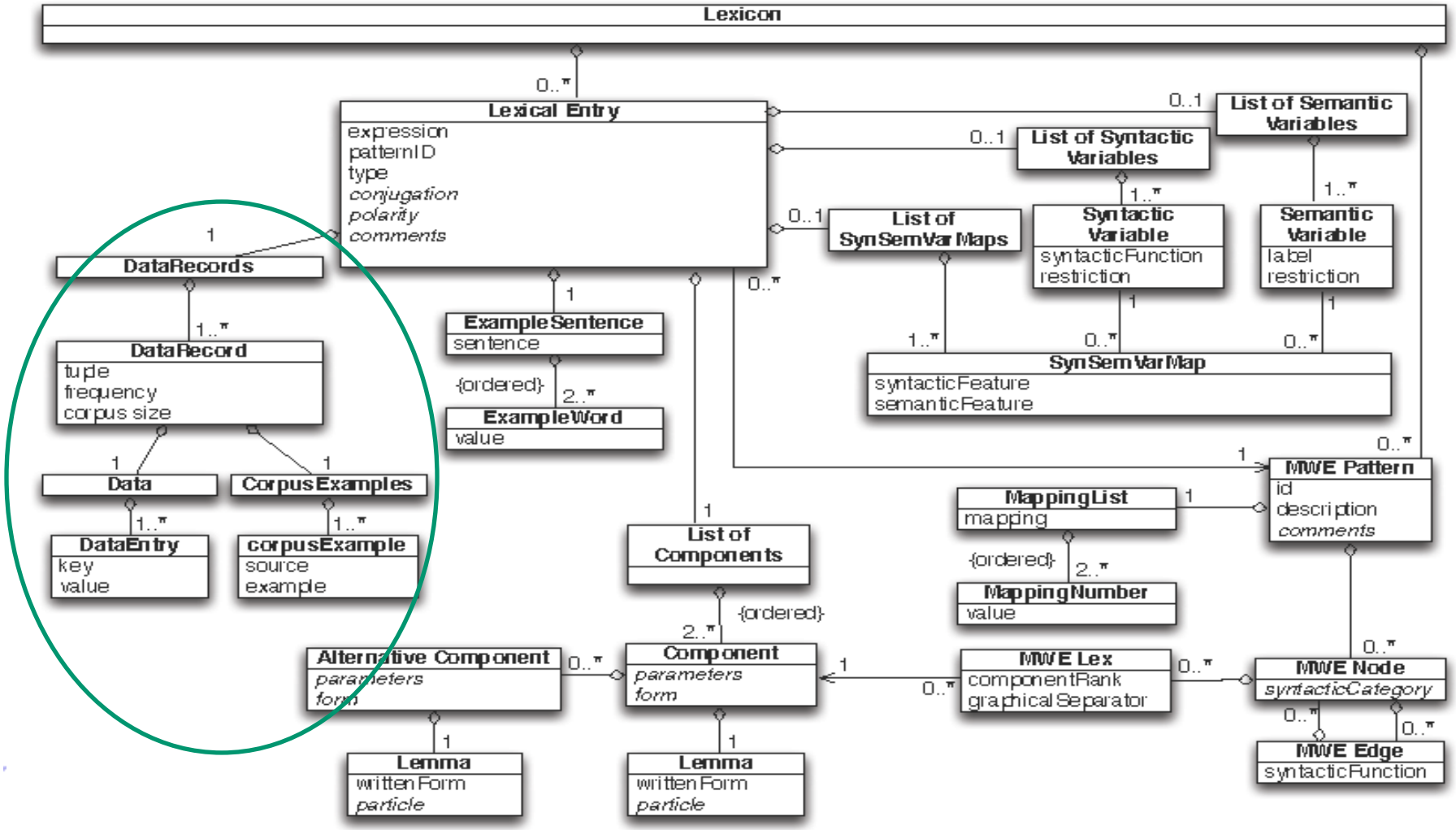
DuELME Class Model



DuELME Lexicon

- List of SyntacticVariables
  - syntactic open slots and restrictions
  - Restrictions: syntactic selection
  - E.g. HETVP, VP, NOHETSSUB, …
- List of SemanticVariables
  - semantic open slots and restrictions
  - Restrictions: limited number semantic selection restrictions
  - E.g. ANIM, NONANIM, FEM PL, …

DuELME Lexicon

- List of SynSemVar Maps
  - relates syntactic and semantic open slots
- Analogous to the NLP syntax and NLP Semantics extensions [ISO 08, pp 32, 38]

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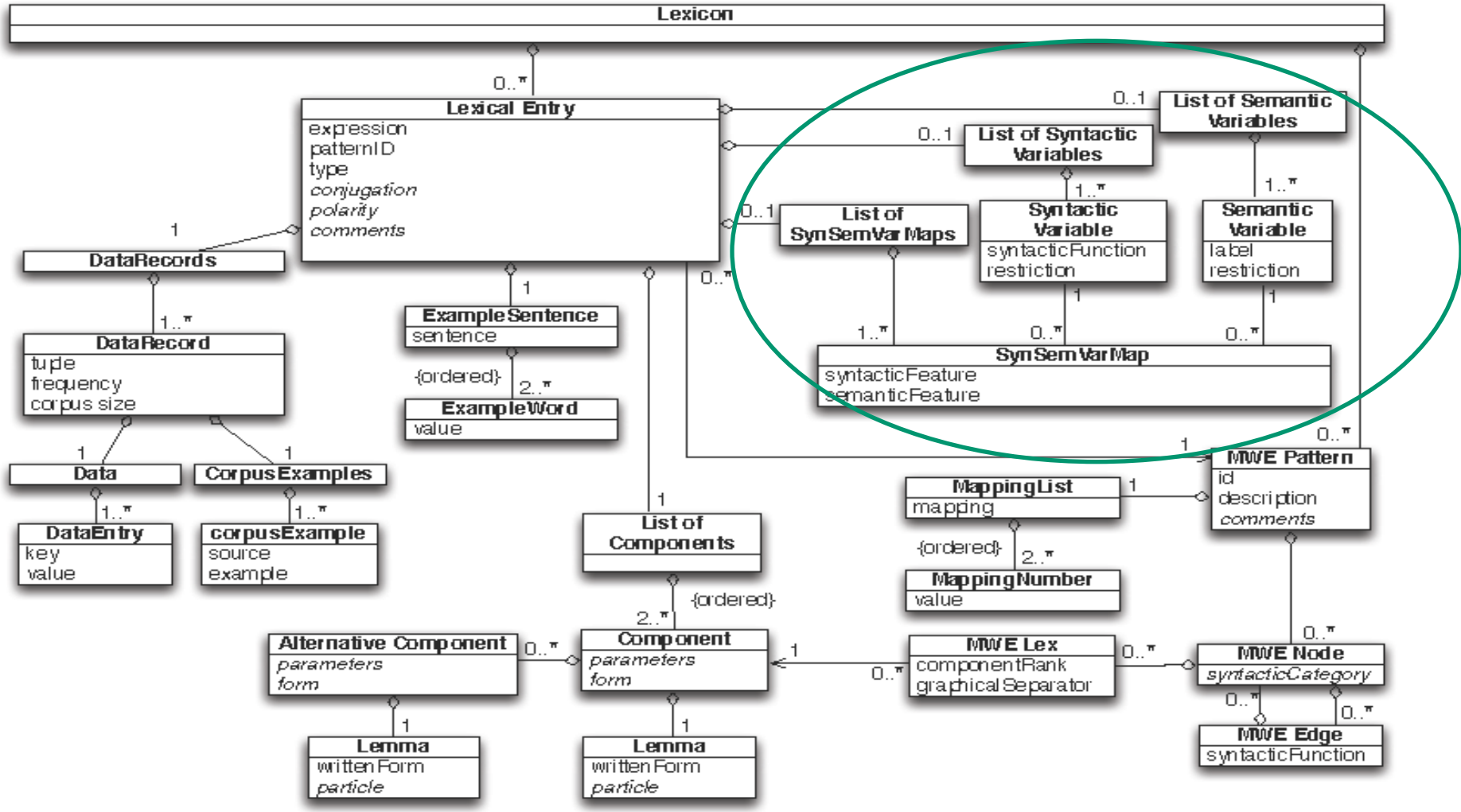
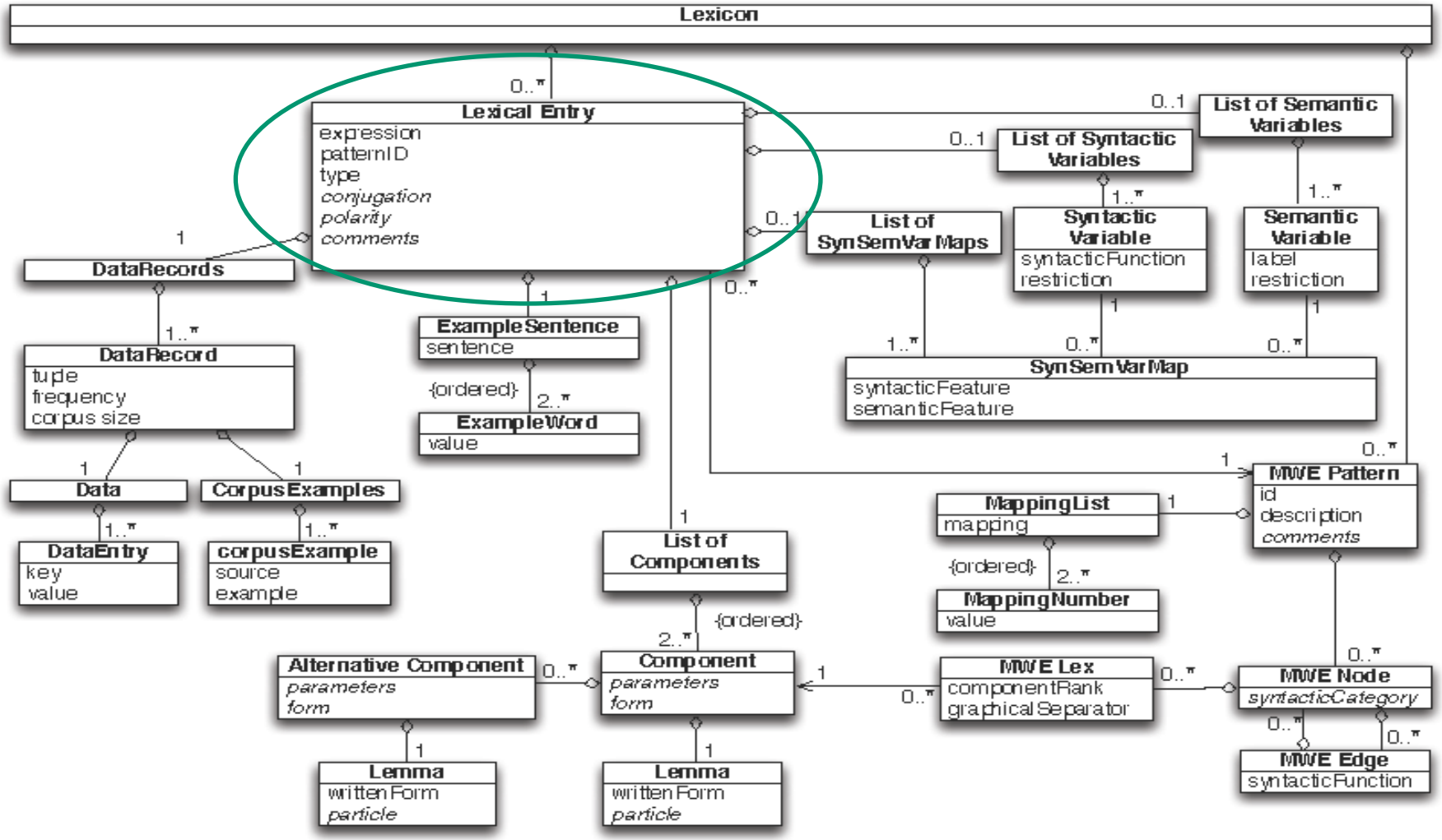
DuELME Class Model



DuELME Lexicon

- Lexical Entry attributes
  - Expression (text)
  - **PatternId** (text)
  - Type: collocation or unspecified
  - [Conjugation]: H (*have*), Z (*be*) or B (*both*)
  - [Comments] (text)
  - [Polarity]: NPI or PPI

DuELME Class Model



DuELME Lexicon

- MWE Pattern attributes
  - **ID**
  - **Description**
  - [comments]
- **MappingList**
  - Needed to relate actual example to tree model
- MWE Node
  - Used to define the syntactic tree model

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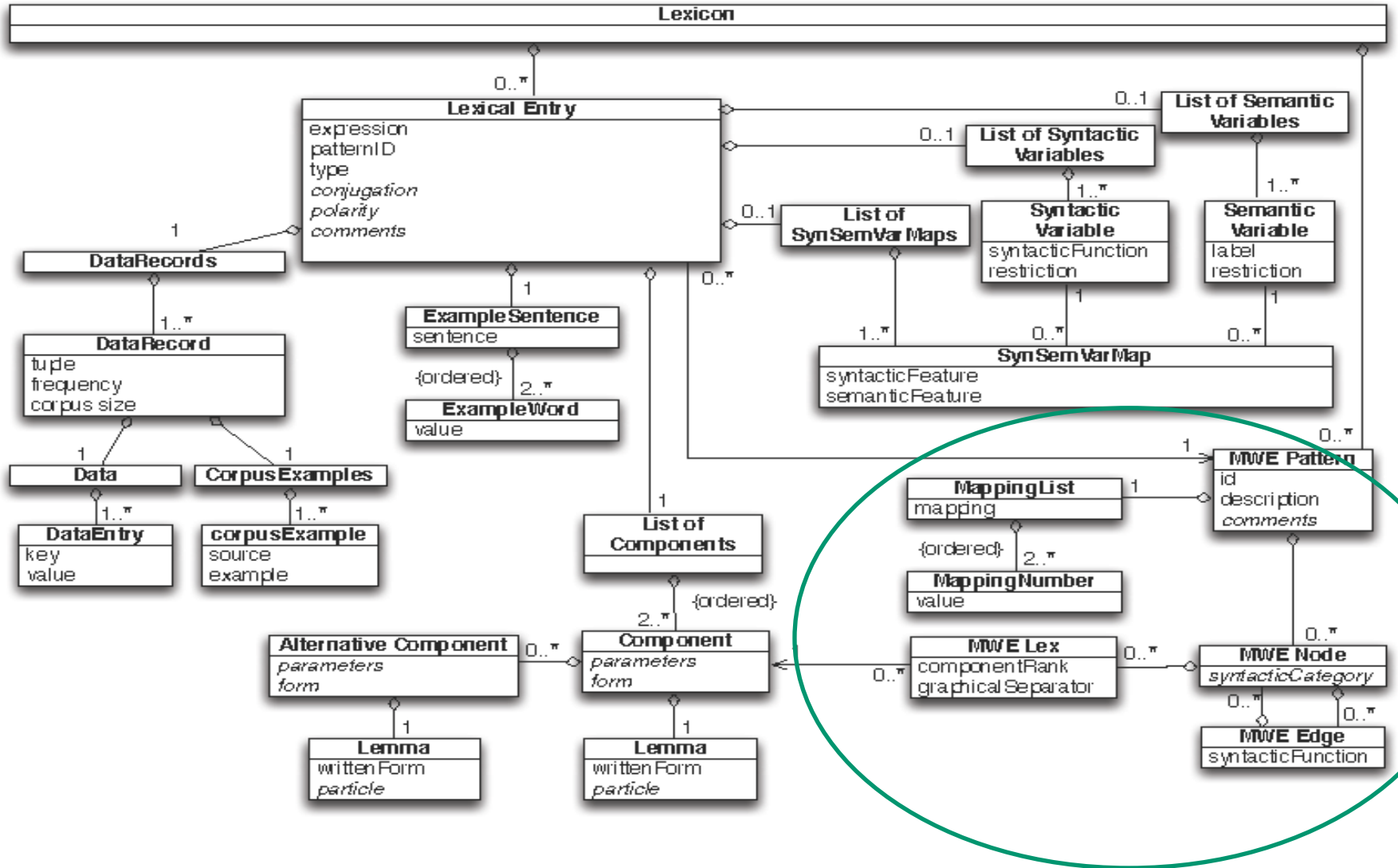
DuELME Class Model



Lexical

- Lexical
  - De **plaat poetsen** ‘the plate polish’
- NOT any synonym**:**
  - **Poetsen:** afnemen-v-4, doen-v-8, kuisen-v-2 reinigen-v-1, schoonmaken-v-1
  - **Plaat:** afbeelding-n-1, plaatje-n-4, plaatje-n-6, draaischijf-n-1, grammofoonplaat-n-1, bank-n-3, schol-n-3
  - Een poging **wagen** / **doen** / ***maken**
  - ***dare / *do / make** an attempt
  - Perdre la tête/ la boule / *la cervelle
  - Se creuser la tête / * la boule / la cervelle

Orthographic

- Orthographic
  - viz. , Bijv., i.v.m., http://www.uilots.nl
  - Yahoo! , Groen!
  - Aujourd'hui (v. l'homme)
  - 's (avonds/morgens/middags)
    - D-gen evening-gen / morning-gen / afternoon-gen
    - In the evenings / mornings / afternoons
- Is dependent on the tokenization rules (cf. *the normal rules of combining them*)

Phonological

- Optional Intervocalic /d/ deletion obligatory in some MWEs [Zonneveld 1978]

expression	literal	meaning
Over de rooie / *rode (gaan/zijn/raken)	Over the red / red (go/be/get)	Lose one's cool
Om de dooie / *dode donder niet	For the dead / dead thunder not	Absolutely not
Je niet in de kouwe / *koude kleren gaan zitten	You not in the cold cloths go sit	Affect you seriously
Een gouwe /* gouden ouwe / *oude	A gold old	A classical music hit

Morphological

Phenomenon	Example	Literal	Meaning
Obl. diminutive	Het lood*(je) leggen	The lead-DIM lay	‘die’
Obl. diminutive	Dat varken*(tje) wassen	That pig-DIM wash	‘address that problem’
Obl. plural	De *raap is / rapen zijn gaar	The turnip is / turnips are cooked	‘there is trouble’
Exceptional morphology	Van goede**n** huiz**e**	Of good-EN house-E	From good homes
Exceptional morphology	Zonder aanzien **des** persoon**s**	Without regard the-GEN person-GEN	Without respect of persons

Syntactic

Syntax	Example	Literal	Meaning
Obl. indefinite	(*de) rekening houden met	(*the) count keep with	‘take into account’
Oblig no –e suffix	Het bijvoeglijk(*e) naamwoord (v. het klein*(e) meisje	The adjectival nominal The little girl	‘the adjective’ ‘The little girl’
Exceptional government	Ten gevolg*(e) van v. Als gevolg(*e) van	To consequence of As consequence of	‘as a consequence of’

Semantic

Expression	Literal	Meaning
De plaat poetsen	Polish the plate	‘bolt’
Dat varkentje wassen	Wash that little pig	‘address that problem’
Een bok schieten	Shoot a goat	‘make a blunder’
Een flater slaan	Hit a blunder	‘make a blunder’

Pragmatic

- Pragmatic
  - Ladies and Gentlemen
  - Ik heb gezegd. (lit. I have said)
  - Eet smakelijk! (Bon appétit!, Enjoy!)
  - Sincerely yours

Translational

- Translational properties

Expression	Literal	Translation
Laten zien	Let see	E. show, F. montrer
Witte wijn	White wine	P. vinho verde
Nuclear power plant		D. atoomcentrale, G. Kernkraftwerk
Space probe		F. Sonde spatiale
Iemand iets laten weten	Someone something let know	E. inform someone of something

The normal rules

- Example: MWE?
  - *iemand een zoen geven*
  - *Someone a kiss give*
  - *Give someone a kiss*
- Productively related
  - *van iemand een zoen krijgen*
  - *From someone a kiss get*
  - *`be kissed by someone'*

The normal rules

- Instead of *zoen-n-1* one can also have other words meaning ‘body touch’
- *kus-n-1* and its hyponyms
  - *lik-n-4, smak-n-3, smok-n-1, afscheidskus-n-1, kushandje-n-1, french kiss-n-1, tongkus-n-1, tongzoen-n-1, doodskus-n-1, nachtkus-n-1, nachtzoen-n-1, klapzoen-n-1, smakker-n-1, voetkus-n-1, vredekus-n-1, vredeskus-n-1, handkus-n-1****, judaskus-n-1****, zuigzoen-n-1*
- *liefkozing-n-1*, ‘caress’
- *Words meaning ‘kick’, ‘slap’* and other forms of *‘body touching’*
- *schop-n-1, trap-n-2, fleer-n-1, haal-n-2, klap-n-2, muilpeer-n-1, opflikker-n-1, peer-n-4, klets-n-3, mep-n-1, pats-n-2, pets-n-1, tik-n-1, tikje-n-2, duw-n-1, zet-n-1, zetje-n-1, por-n-1, stoot-n-1, schouderduw-n-1,* ***kontje-n-2****, schop-n-1, trap-n-2, doodschop-n-1, hakje-n-1, kukkel-n-1 knietje*

The normal rules

- But not:
  - aanraking-n-2, contact-n-1, gefriemel-n-1, gefrunnik-n-1, gepriegel-n-1, aanslag-n-5, steek-n-1, touche-n-3, betasting-n-1, kneep-n-1, handtastelijkheid-n-2, aanraking-n-1, beroering-n-2, gewelddadigheid-n-1, geweldpleging-n-1, molest-n-1, molestatie-n-1, bal-n-7, *schot-n-2*,
  - *(*meaning ‘touch’, ‘contact’, etc.)
- And unclear:
  - lik-n-1, aai-n-1, streling-n-1
  - (‘lick’, ‘caress’, ‘caress’)

The normal rules

- describe such constructions by means of properties of the verbs *geven* and *krijgen?*
  - preferable given its productive nature
  - Only if we can characterize the relevant words by means of independently required properties
- NLP context
  - We might invent an ad-hoc feature
  - But are there resources with this feature? (not Dutch Wordnet (Cornetto))

Reflexive Verbs

- Example
  - *Hij schaamt *(zich)*
  - *He ashamed REFL*
  - *‘he is ashamed’*
- Analysis
  - *Schamen: reflexivity=true*
  - Rule that spells out right reflexive pronoun

Verb Particle Combinations

- Example
  - *Houden* = ‘keep’, transitive
  - *Op* + *houden* = ‘stop’, intransitive
- Analysis
  - Op + houden:
    - *houden*: particle = *op*, intransitive
    - Rule to introduce / check presence of the right particle
  - Houden: particle = _, transitive

Prepositional Complements

- Example
  - *Houden `keep' v.*
  - *Houden van (lit. keep of, 'love')*
- Analysis
  - *houden van*, intransitive, takes PCOMP
    - *houden* with property: complprep = *van*
    - Rule to introduce / check presence of *van*
  - *Houden:* complprep= _, transitive

Inflection

- *Plegen 1*, regular conjugation (pleegde) ‘commit’
- *Plegen 2*, irregular conjugation (placht) ‘do usually’
- Hij pleegde een moord => regular conjugation
- He committed a murder
- *Hij placht een moord

Selection

- Example 1
  - *Nemen* 1 subcat=[subj/NP, obj/NP] ‘take’
  - *Nemen* 2 subcat=[subj/NP, obj/NP, compl/PP] ‘accept as’
  - *Iets in acht nemen*
  - *something in attention take*, ‘obey’(of rules etc.)
  - Requires *nemen_2*

Selection

- Example 2
  - *Geven*`give' semantically takes 3 arguments
  - Syntactically: subj/NP, obj/NP, iobj/NP or PP
  - Indirect object optional
  - Absent indirect object still leads to an interpretation with 3 arguments
- But MWE *een gil geven* lit. a cry give, `give a shout' requires 2 syntactic arguments,
  Idem: de geest geven (the ghost give) 'die'

Selection

- Example 3
  - *Heten* `be called' 2 arguments
  - Syntactically: subj/NP, predc/NP
  - Ik heet Jan
  - I am-called Jan
  - But MWE *iemand welkom heten* lit. someone welcome be-called, `welcome someone' requires 3 syntactic arguments, subj, obj, predc

Selection

- Many such cases with support-verb constructions
  - Aandacht hebben voor, etc.
  - See handout (5)
  - These require special treatment

SEQCI

- Example:
  - Idiom Descriptions
    - Idp30;De pijp uit gaan;Hij is de pijp uit gegaan
    - Idp30;De boot in gaan;Hij is de boot in gegaan
    - Idp30:Het schip in gaan;Hij is het schip in gegaan
  - Idiom pattern definition
    - Idp30
    - Idiom headed by a verb taking a postpositional PP containing a definite singular NP and one free argument as subject

SEQCI

- Incorporation Method
  - Bootstrap part, once for each idiom pattern
  - Repeat Part, for each idiom description

SEQCI

- Bootstrap part (`*hij is de pijp uit gegaan*')
  1. Parse the example sentence of an idiom description with idiom pattern P, yielding the Reference Parse
  2. Define a transformation to turn the reference parse into the idiom structure (*Parse Transformation, PT*)
  3. Determine the list of unique IDs of the lexical items in the idiom structure for the system derived from the reference parse (*Idiom Component ID List*, *ICIL*)
  4. Define a transformation to relate ICL and ICIL (*Idiom Component Transformation*, *ICT*)
  5. Apply the ICT to the ICL, yielding the transformed ICL (TICL) and check that each item in it equals the base form of the corresponding element on the ICIL

SEQCI

Repeat part, for each idiom description I (`*hij is de boot in gegaan*')

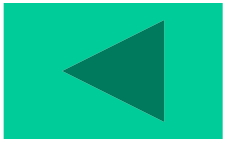
1. Parse example sentence (Syntactic Structure)
2. Apply IPT and check identity with idiom structure modulo the lexical items
3. Select the component IDs from the parse tree, in order to obtain the ICIL)
4. Apply ICT to the ICL of I, yielding the TICL
5. Check that <bf(c1),…bf(cn)>=TICL
   where ICIL = <c1, …cn> (TICL check)

SEQCI

- Advantages
  - Technically Simple
  - As theory/grammar/implementation-independent as possible
  - No need for prescribing syntactic structures
  - System-specific aspects are derived from the NLP-system itself

SEQCI: Reference Parse

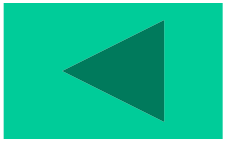
```
Rdecl[Rperf
        [Rsubst(j)
            [Rsent
               [Rsubst(i)
                  [RVP[$aV_00_ga,
                            RPPpost
                               [$s_prep1286700,
                                VAR_i
                                ]
                           ]
                     RNPdef [$aN_00_pijp]
                          ],
                     VAR_j
                        ],
                     RNP[$hij_PRON]
                      ]
                     ]
```



SEQCI: Idiom Structure

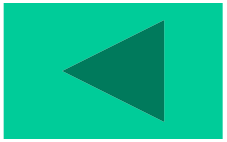
- IPT: IPT: Delete Rdecl, Rperf, Rsubj(j), RNP[$hij_Pron]
- D-tree for vpid30 (simplified):

```
Rsubst,i
   [RVP   [$aV_00_ga,
             RPPpost
                [$s_prep1286700,
                  VAR_i
                ]
           ],
    RNPdef [$aN_00_pijp]
   ]
```



ICIL

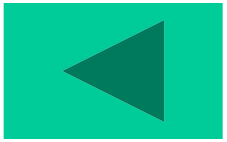
< $aV_00_ga, $prep1286700, $aN_00_pijp >



ICT

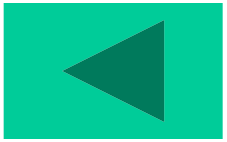
ICL: <de, pijp, uit, gaan>
Must be turned into: < gaan, uit, pijp>

ICT: 1 2 3 4 => 4 3 2



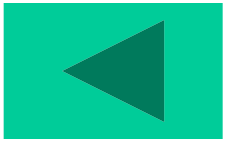
TICL

TICL = ICT(ICL) =
ICT(<de, pijp, uit, gaan>) =
<gaan, uit, pijp> =
< Bf($aV_00_ga), Bf($prep1286700),
Bf($aN_00_pijp)
>



Syntactic Structure

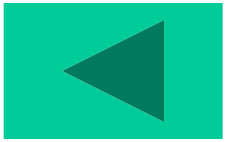
```
Rdecl[Rperf
        [Rsubst(j)
          [Rsent
            [Rsubst(i)
              [RVP[$aV_00_ga,
                    RPPpost
                      [$s_prep1286800,
                        VAR_i
                      ]
                   ],
               RNPdef [$aN_00_boot]
               ],
              VAR_j
               ],
              RNP[$hij_PRON]
               ]
              ]
```



Apply IPT

Rsubst,i

```
[RVP
    [$aV_00_ga,
     RPPpost
         [$s_prep1286800,
          VAR_i
         ]
    ],
 RNPdef [$aN_00_boot]
]
```



ICIL

ICIL=< $aV_00_ga , $s_prep1286800,
$aN_00_boot>)

TICL

ICT(ICL) =

ICT(<de, boot, in, gaan>)=

<gaan, in, boot>

TICL check

<bf($aV_00_ga), bf($s_prep1286800),
bf($aN_00_boot) > =
TICL =
<gaan, in, boot>

The normal rules

- Fixed combinations of open class word and closed class word
  - Reflexive verbs
  - Verb particle combinations
  - Prepositional complements
- Described by means of a property of the open class word + special rules

➔ no MWEs in these systems