# Modeling full form lexica for Arabic

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# Objectives

- Presentation of the current standardization activity in the domain of lexical data modeling
- Validation of the proposed standard on Arabic
- Contribution to the establishment of a reference resource for Arabic

# Overview

- Background
  - Why do we need full form lexica ?
- Standards
  - Lexical resources & dictionaries
- Instanciation
  - Specificities of an Arabic full form lexicon
- Overall goal
  - making current work interoperable

# Two views on lexical data

- Extensional representation
  - exhaustive list of observables
    - set of inflected word forms
    - set of syntactic constructions
- Intensional representation
  - factorization of regular behaviour ("grammar")
    - lemma + inflection rules
    - deep syntactic representation + transformation rules

# Full form lexica : advantages

- Local linguistic information
  - local inflectional variants (courbattu vs. courbaturé)
  - defective paradigms (*nous pleuvons)
  - phonological variants (les − [le]/[lez])
- Testimony of inflected forms
  - token frequency wrt a reference corpus
- Exchange of lexical resources
  - no consensus on encoding format for grammar rules
  - pivot format for merging and comparing lexicons

- Extensional data for data recognition purposes

# Standards for NLP lexica

- Forefathers
  - a wide range of international projects
    - MULTEXT, EAGLES, ISLE/MILE, Parole...
- XML encoding of print dictionaries
  - "Print dictionary" chapter of the TEI
    - http://www.tei-c.org
- Terminology
  - Sense-to-word oriented
    - Terminology Markup Framework (ISO 16642)

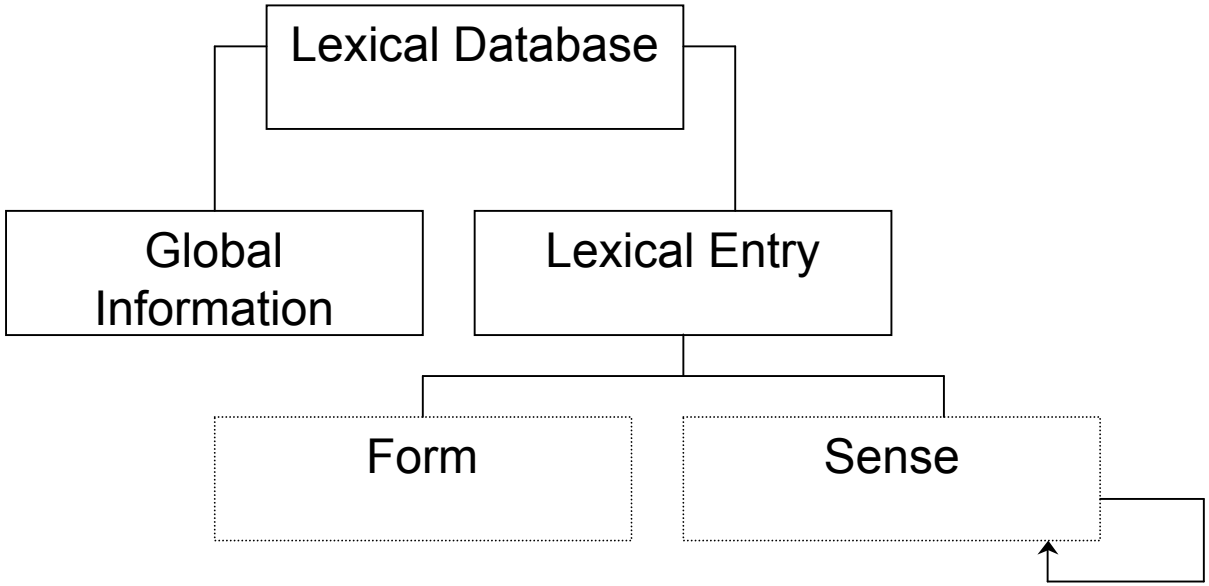
# Lexical Markup Framework

- Future ISO standard 24613
- ISO technical committee TC 37/SC 4
  - Language Resource Management
    - http://www.tc37sc4.org
    - http://lirics.loria.fr
- Project leaders
  - Monte George (USA) & Gil Francopoulo (FR)
- First applications
  - *Morphalou* (Salmon-Alt et alii, 2004)

# LMF: Basic principles

- An open platform for specifying lexical data
  - implemented prototypes : Lexus, Syntax
- Main modeling principles
  - metamodel
    - basic building blocks and basic structural constraints
    - e.g. "A lexical database is made of lexical entries."
  - data categories
    - basic linguistic descriptors
    - e.g. "grammatical gender", "synonymOf", ...
    - stored in a shared data category registry

# LMF core metamodel



# Data categories

- Independent from the hierarchical structure of the data model
  - /partOfSpeech/, /grammaticalNumber/, /grammaticalCase/
- Characteristics
  - complex vs. simple
    - /grammaticalNumber/ => /singular/, /plural/
  - relational data categories
    - /synonymOf/, /toInflectionalParadigm/
  - generic vs. language specific
    - /grammaticalNumber/ => {/singular/, /plural/, /dual/}

# Documention and localization

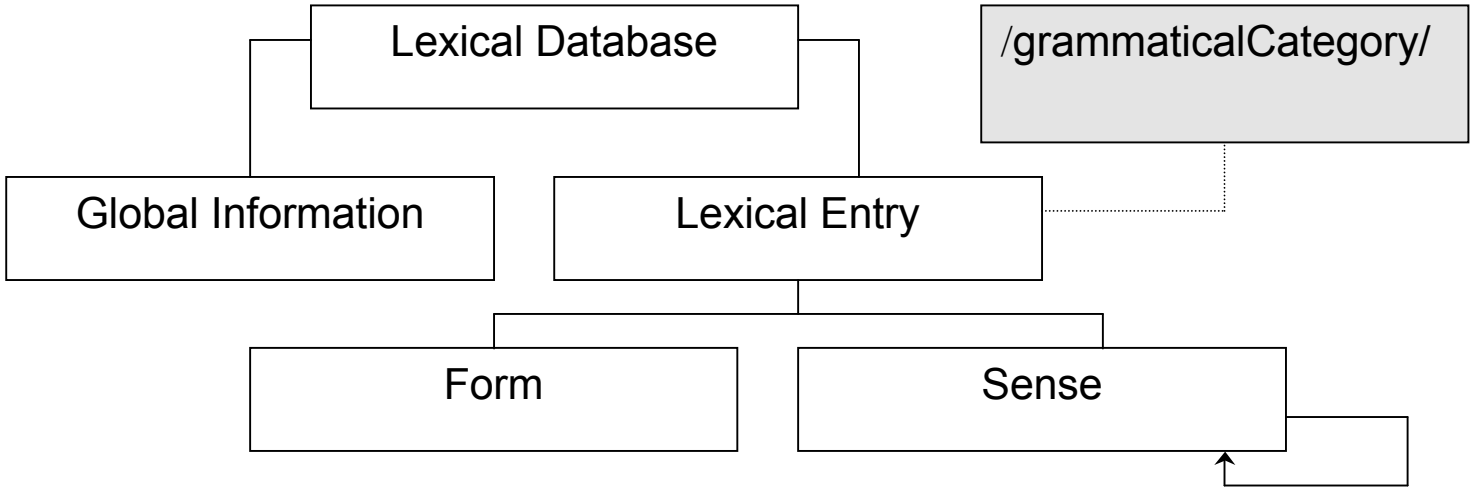
| | |
|---|---|
| Entry Identifier : | /grammaticalGender/ |
| Profile : | Morpho-syntax |
| Definition : | Grammatical genders are classes of nouns reflected in the behavior of associated words |
| Explanation: | Grammatical gender is distinguished from natural gender by the fact that grammatical gender requires *agreement* between nouns and the forms of modifiers ... |
| Source : | Charles F. Hockett, *A Course in Modern Linguistics*, Macmillan, 1958. |
| Range : | {/masculine/, /feminine/, /neuter/, /common/} |

| | |
|---|---|
| Object Language : | fr |
| Name : | genre |
| Range : | {/masculine/, /feminine/} |

| | |
|---|---|
| Object Language : | en |
| Name : | gender, grammatical gender |
| Range : | {} |

| | |
|---|---|
| Object Language : | de |
| Name : | Genus, Geschlecht |
| Range : | {/masculine/, /feminine/, /neuter/} |

# Lexicon specification



# GMT (Generic Mapping Tool)

```
<struct type="lexicalDatabase">
        <struct type="globalInformation">...</struct>
        <struct type="lexicalEntry">
                <feat type="grammaticalCategory">...</feat>
                <struct type="form">...</struct>
                <struct type="sense">...</struct>
                <struct type="sense">...</struct>
                ...
        </struct>
        <struct type="lexicalEntry">...</struct>
        ...
</struct>
```

# User specific XML format

```
<lexicalDatabase>
        <globalInformation>...</globalInformation >
        <lexicalEntry POS="...">
                <form>...</form>
                <sense>...</sense>
        </lexicalEntry>
        <lexicalEntry POS="...">
                <form>...</form>
                <sense>...</sense>
        </lexicalEntry>
        ...
</lexicalDatabase >
```

# Applying LMF to Arabic

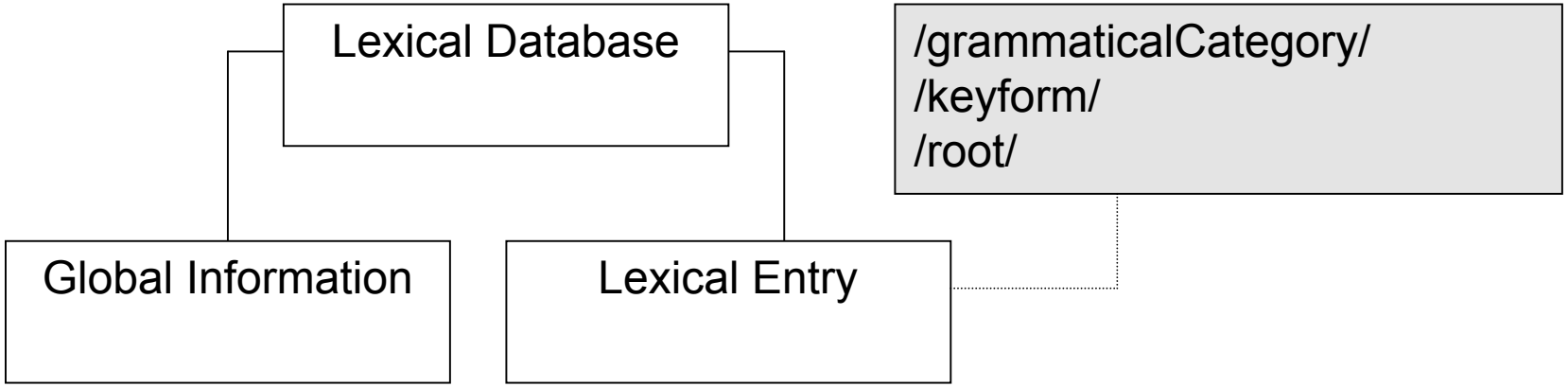
- Little representation of Arabic speaking countries in ISO/TC 37/SC 4
- NLP of Arabic morphology
  - Beesley K., 2001; Buckwalter, 2002; Cavalli-Sforza et alii, 2000; Maamouri & Bies, 2004; Tahir et alii, 2004…
- Yet, no widely, freely accessible and cumulative lexicon can be used to boost research on Arabic language
  - strategy : combining efforts through standardization

# FR vs. Arabic full form lexica

- French lexicography
  - semasiological + alphabetical perspective
- (Traditional) Arabic perspective
  - mixed + root based
    - grouping of all derivates from consonantic pattern
      - ktb (notion of writing) => kâtaba (to write), kattaba (cause to write), maktabun (desk), maktabatun (library), kitâbun (book)
    - therefore
      - distinction between human readability and machine processing
      - essential to keep reference to the root

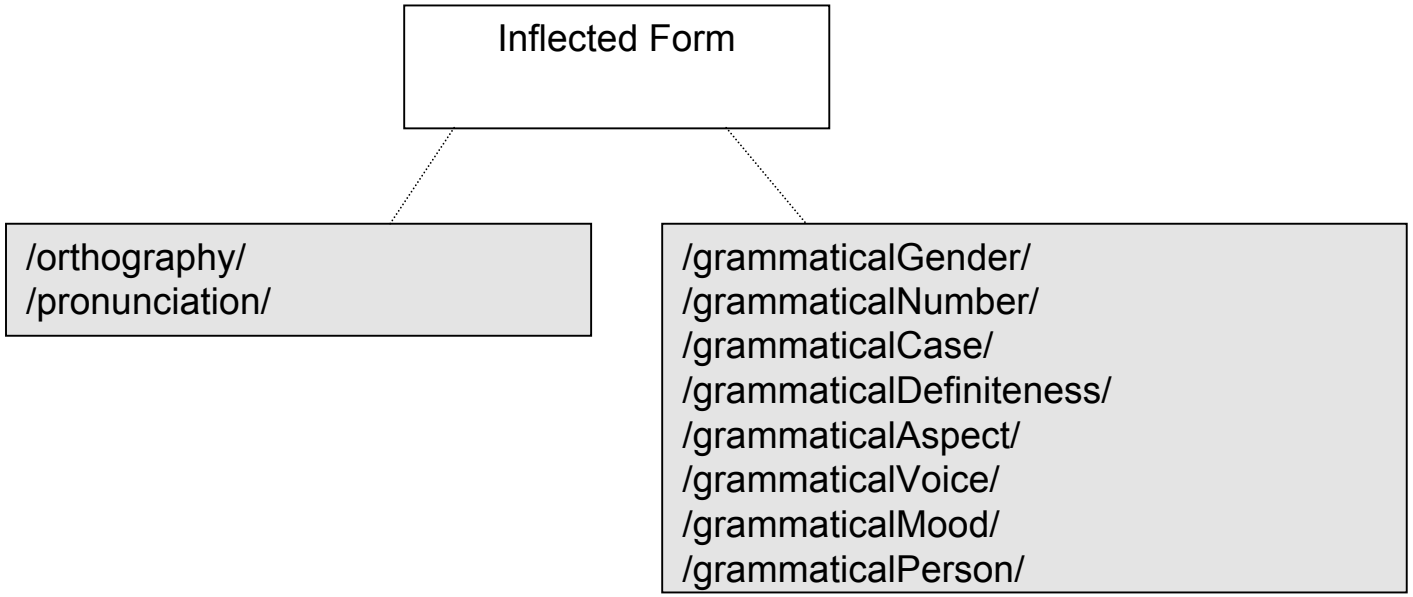
# Adapting LMF to Arabic (I)

- Specifying the notion of "lexical entry"
  - alphabetically ordered
  - characterized by
    - POS
    - keyform
    - reference to the root



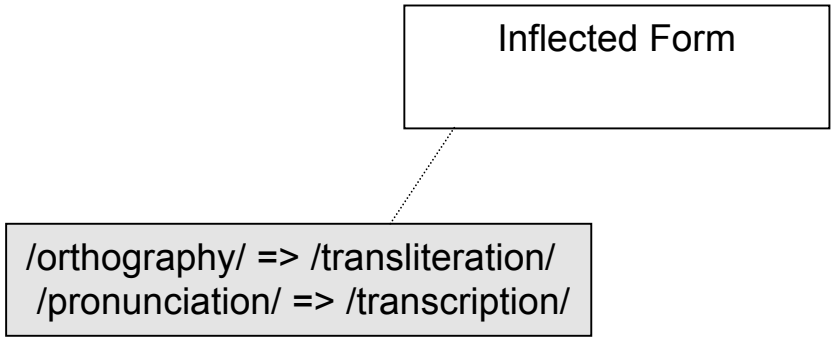
# Adapting LMF to Arabic (II)

- Specifying the notion of "inflected form"
  - a word form and inflectional features
    - form related & inflection related data categories



# Adapting LMF to Arabic (III)

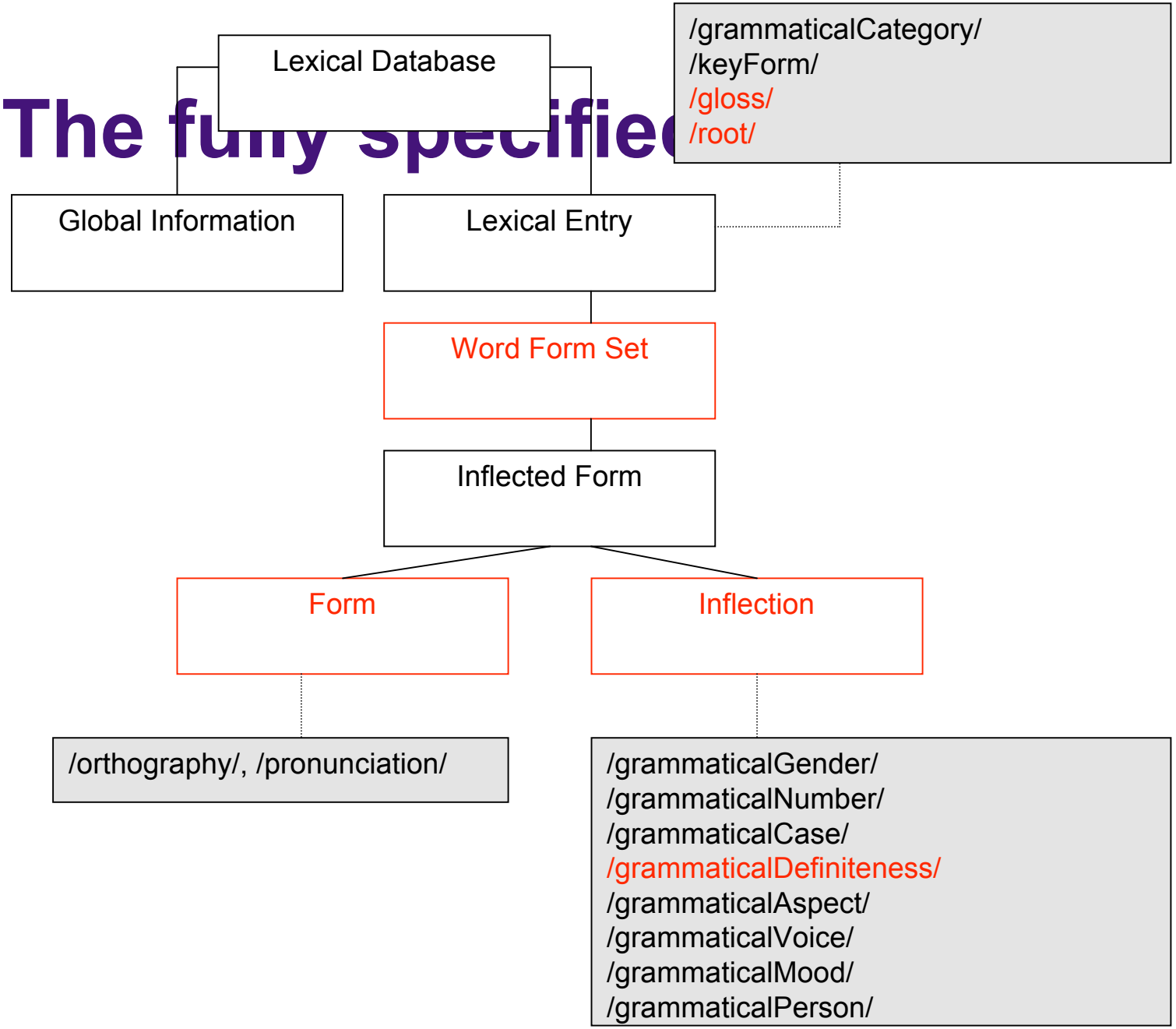
- Form related data categories
  - orthography and pronunciation
  - both are subject to refinements ("local metadata")
    - transliteration : fully reversible one-to-one mapping to original orthography
      - Buckwalter transliteration
    - transcription : devised to render (morpho)phonology
      - IPA



# Adapting LMF to Arabic (IV)

- Some questions on inflection related data categories
  - Nouns
    - /grammaticalGender/ => /masculine/, /feminine/
      - no lexicalized (because of gender change in plural forms)
      - choice of no "underspecified" gender
    - /grammaticalNumber/ => /singular/, /plural/, /dual/
      - (enter) and/or pick up /dual/ from the DCR
    - /grammaticalCase/ => /nominative/, /accusative/, /prepositional/
      - terminology (prepositional, indirect, possessive or genitive) ?
    - /definiteness/ => /definite/, /indefinite/
      - one or two categories of definiteness (def. alkitâbu, pos. kitâbî) ?
    - inflection vs composition (e.g. prepositional affixes) ?

# The fully specified



# XML example

```
<lexicalEntry keyform="kataba" grammaticalCategory="verb" root="ktb" gloss="écrire">
    <wordFormSet>
        <inflectedForm>
            <form>
                <orthography code=""Akrout_2005">katabtu</realization >
            </form>
            <inflection>
                <grammaticalAspect>perfect</grammaticalAspect>
                <grammaticalGender>masculine</grammaticalGender>
                <grammaticalPerson>firstPerson</grammaticalPerson>
                <grammaticalNumber>singular</grammaticalNumber>
                <grammaticalVoice>active</grammaticalVoice>
            </inflection>
        </inflectedForm>
        ...
        <inflectedForm>
            <form>
                <orthography code="Akrout_2005">taktubâ</realization >
            </form>
            <inflection>
                <grammaticalAspect>imperfect</grammaticalAspect>
                <grammaticalGender>masculine</grammaticalGender>
                <grammaticalPerson>secondPerson</grammaticalPerson>
                <grammaticalNumber>dual</grammaticalNumber>
                <grammaticalMood>subjunctive</grammaticalMood>
            </inflection>
        </inflectedForm>
        ...
    </wordFormSet>
</lexicalEntry>
```

# Towards a reference lexicon for Arabic: issues

- Interoperability
  - Comparison of proprietary specifications
- Coverage
  - Completion of specific advances (dialectal, terminological, phonology)
- Accessibility
  - Common query interface, wide (free ?) distribution
- Maintenance
  - Common rules to ensure editorial evenness
  - Documentation & user manuals

- A step towards an intensional representation…