# Multilingual Text processing & Multilingual Lexical Databases

## Structure, encoding, issues...

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# 1 Introduction

# Foreword

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It means that you will have to participate!

Ask question whenever you want! Don't hesitate to interrupt me!
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# Who Am I?

Working on multilingual lexical database management since 1990.

PhD thesis on pivot approach to MLDB and generic MLDB system in 1994

Active in Electronic Lexicography, Multilingual Information Retrieval, Multilingual Computing

# Part I

# Multilingual Lexical Resources, a First Approach

2. Dictionaries and Other Lexical Data
   - Monolingual Lexical Data
   - Bilingual Lexical Data
   - Multilingual Lexical Data

3. Computational Problems posed by ALL Lexical Data
   - Denoting languages of the world
   - Writing Systems
   - Naming a language
   - String Encoding Problems
     - Presentation of the problem
     - What do we code?
     - UNICODE
   - Searching and Sorting
   - RDF and Linked Data

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# Monolingual Lexical Data

# Dictionary

## A First Definition

A dictionary is a book of alphabetically listed words in a specific language, with definitions, etymologies, pronunciations, and other information; or a book of alphabetically listed words in one language with their equivalents in another, also known as a lexicon.[a]

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1. a collection of words,
2. each word comes with a set of information that describes it,
3. there is an implicit access method to each word.

# Examples of monolingual dictionary

**com•pose** |kəmˈpōz|

verb [ trans. ]

**1** write or create (a work of art, esp. music or poetry) *: he composed the First Violin Sonata four years earlier.*

- write or phrase (a letter or piece of writing) with care and thought *: the first sentence is so hard to compose.*
- form (a whole) by ordering or arranging the parts, esp. in an artistic way *: compose and draw a still life.*
- order or arrange (parts) to form a whole, esp. in an artistic way *: make an attempt to compose your images.*

**2** (usu. **be composed**) (of elements) constitute or make up (a whole) *: the system is* ***composed of*** *a group of machines.*

- be (a specified number or amount) of a whole *: Christians compose 40 percent of the state's population.*

**3** calm or settle (oneself or one's features or thoughts) *: she tried to* ***compose herself.***

- archaic settle (a dispute) *: the king, with some difficulty, composed this difference.*

**4** prepare (a text) for printing by manually, mechanically, or electronically setting up the letters and other characters in the order to be printed.

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**compose** *v.* composed ◊ composing ◊ composes <k&m'pOz> 1. To write music; "Beethoven composed nine symphonies"; 2. To write prose; "Many students compose their paper at the computer keyboard"; 3. To put together out of existing material; 4. To form the substance of; "Greed and ambition composed his personality." 5. To calm (someone, esp. oneself); make quiet; "She had to compose herself before she could reply to this terrible insult."

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1. a collection of words,
2. there is no definition or description of any word (this is left to the dictionary),
3. a thesaurus may be seen as a network of word senses.

# An example of monolingual thesaurus

## compose

verb

**1** *a poem composed by Shelley* WRITE, formulate, devise, make up, think up, produce, invent, concoct; pen, author, draft; score, orchestrate, choreograph.

**2** *compose a still life* ORGANIZE, arrange, set out.

**3** *the subcommittee is composed of ten senators* MAKE UP, constitute, form.

PHRASES

**compose oneself** *you have to compose yourself before you take the stand* CALM DOWN, control oneself, regain one's composure, pull oneself together, collect oneself, steady oneself, keep one's head, relax; informal get a grip, keep one's cool, cool one's jets, decompress.

# A first set of problems

## What is a word ?

- *Composed* and *Compose*: one or two words ?
- *Compose* and *Composition*: one or two words ?

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# A first set of problems

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- *Compose* and *Composition*: one or two words ?

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## How do different lexical data interoperate ?

- Can I merge information from the dictionary and from the thesaurus ?
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## Can I extract data from a dictionary ?

- How is the dictionary structured ?
- How is this structure represented ?
- Are definitions consistent ?

# Some basic vocabulary

There is no such things as a word...

## Textual Analysis View (usual in GETALP translation systems)

**Occurrences** a "word" as it appears in a text (e.g. am, are, lists, listed...).

**Lemmas** a set of occurrences (e.g. to be = {am, are, ...}, to list = {lists, list, listed...})

**Lexical Unit** a set of morpho-semantically related lemmas (e.g. {to build, building, builder, ...}

## Lexicological View (definitions may vary among $\neq$ dictionaries)

**Inflected form** a "word" as it appears in a text (e.g. am, are, lists, listed...).

**Vocable** a set of lexical entries (e.g. bleu = {bleu$_n$, bleu$_{adj}$})

**Lexical Entry** a set of word senses with a common etymology and an unique Part Of Speech (e.g. {to build, building, builder, ...}

**Word Sense/Acception** a set of morpho-semantically related lemmas (e.g. {to build, building, builder, ...}

# Some basic vocabulary

## Polysemy vs Homonymy

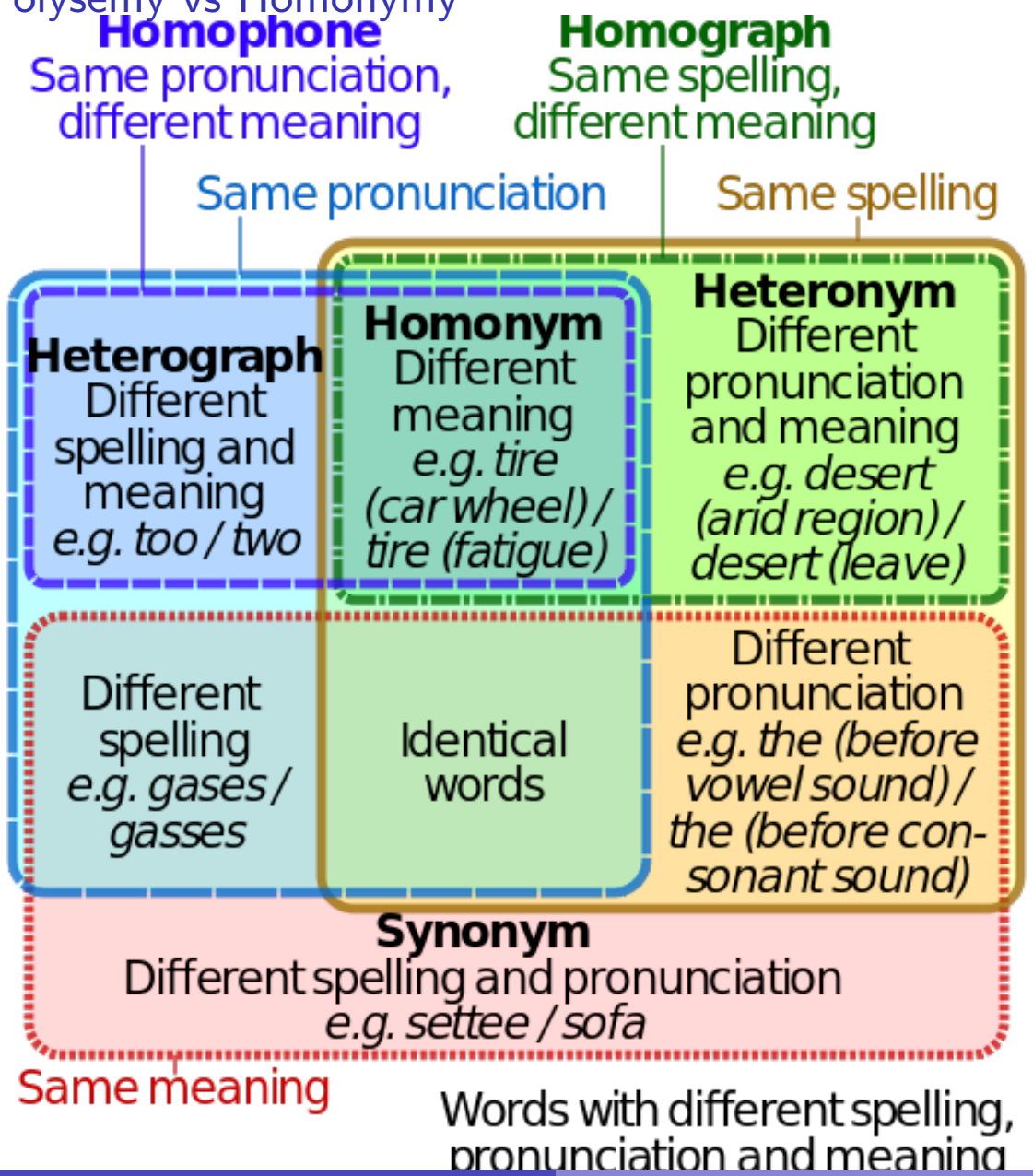
### Spelling, pronunciation and meaning

**Polysemy** a Lexical Entry is polysemic if it has different word senses. e.g. river$_n$: a. a stream of water; b. flow of liquid; c. (poker) last card in a deal;

**Homonymy** Relation between words that are spelled the same but has a different meaning.

# Some basic vocabulary

## Polysemy vs Homonymy



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# Bilingual Lexical Data

# Bilingual Dictionary: an example

**compose:** English definition | in Italian | in Spanish
conjugator | in context | images

Écouter US - UK

**compose**:

**Principal Translations/Principales traductions**

| | | | |
|---|---|---|---|
| **compose** | (write) | vtr | écrire ⇒ |
| **compose** | (music, literature) | vtr | composer ⇒ (*musique, littérature*) |
| **compose** | (put together) | vtr | composer ⇒ |
| **compose** | (technical) | vtr | constituer ⇒ (*composer*) |

**Additional Translations:**

| | | | |
|---|---|---|---|
| **compose** | | vtr | rédiger ⇒ |

**compose** *v.* <k&m'pOz> 1. composer *v.* 2. rédiger *v.* 3. écrire *v.* p.p.: écrit (in writing)

# A second set of problems

## How do I translate in my context?

- What is my word sense?
- What is the resulting word sense ?

# A second set of problems

## How do I translate in my context?

- What is my word sense?
- What is the resulting word sense ?

## Can I use this info to translate the other way round?

- How much of the word sense is covered by the translation ?
- How marginal is the target word sense, compared to word senses of the target word ?

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# Multilingual Lexical Data

# An example of multilingual terminological database

| English | French | Spanish | Russian | Chinese | Arabic |
|---|---|---|---|---|---|
| child poverty | pauvreté touchant les enfants | pobreza infantil | детская нищета | 儿童贫穷 | فقر الأطفال |
| alien | étranger | extranjero | иностранец | 外侨 | أجنبي؛ غريب؛ دخيل |
| Judicial Support Division | Division de l'appui judiciaire | División de Apoyo Judicial | Отдел вспомогательного обслуживания судопроизводства | 司法支助司 | شعبة الدعم القضائي |
| Finance Assistant | assistant (finances) | Auxiliar de finanzas | помощник по финансовым вопросам | 财务助理 | مساعد مالي |
| service pack | - | - | пакет обновлений | 服务包 | حزمة خدمية |
| population pyramid | pyramide des âges | pirámide por edades; pirámide de la población por edades | возрастная структура населения | 人口金字塔 | هرم أعمار السكان |
| sighe marriage | - | - | - | - | نكاح (زواج) المتعة |
| Office of the Under-Secretary-General for Field Support | Bureau du Secrétaire général adjoint à l'appui aux missions | Oficina del Secretario General Adjunto de Apoyo a las Actividades sobre el Terreno | Канцелярия заместителя Генерального секретаря по полевой поддержке | 主管外勤支助事务副秘书长办公室 | مكتب وكيل الأمين العام للدعم الميداني |
| raster | - | - | 1. растр; 2. двумерный массив точек; 3. растровое изображение | 光栅 | نمط خطوط المسح |
| nuclear bomb; nuclear weapon | bombe nucléaire; arme nucléaire | bomba nuclear; arma nuclear | ядерное оружие | 核弹；核武器 | قنبلة نووية؛ سلاح نووي |

# An example of a multi-bilingual dictionary

**composer** /kon-po-ze-/

v.tr.

préparer ; make (up) ; menyediakan ; mengadun

Valérie a composé une salade avec tous les légumes du jardin ; Valérie took all the vegetables of the garden to make up a salad ; Valérie telah mengadun salad dgn sayur-sayuran yg diambil dari kebun

former ; form ; menubuhkan

sélectionner ; select ; memilih

disposer ; arrange ; menyusun

créer, écrire ; compose ; mencipta ; mengarang ; menyusun ; menggubah

faire un numéro ; dial ; memutar ; memusing ; mendail

v.intr. ; scol. ; take an exam ; mengambil peperiksaan ; menduduki peperiksaan

les élèves des classes terminales composeront lundi ; the pupils of form 6 will take their exam on monday ; pelajar tingkat 6 akan menduduki peperiksaan pada hari Isnin

transiger ; << ; <<

s'accomoder avec ; compromise ; bertolak ansur ; bersetujuse composer /sekon-po-ze-/

v.pr.

se composer de ; be made up of ; terdiri drpd

le spectacle se compose de deux parties avec un entracte ; the show is made up of two parts with an interlude ; pertunjukan itu terdiri drpd dua bhg dan ada waktu rehat di antaranya

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I mean: a dictionary for which you can use ANY language as a source and ANY language as a target...

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... because nobody knows how to layout/present such information on paper...
... except in very specific situations (i.e. terminology)

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But you may find such a database online.

Before we go further, let's see what are the technical difficulties that have to be handled...

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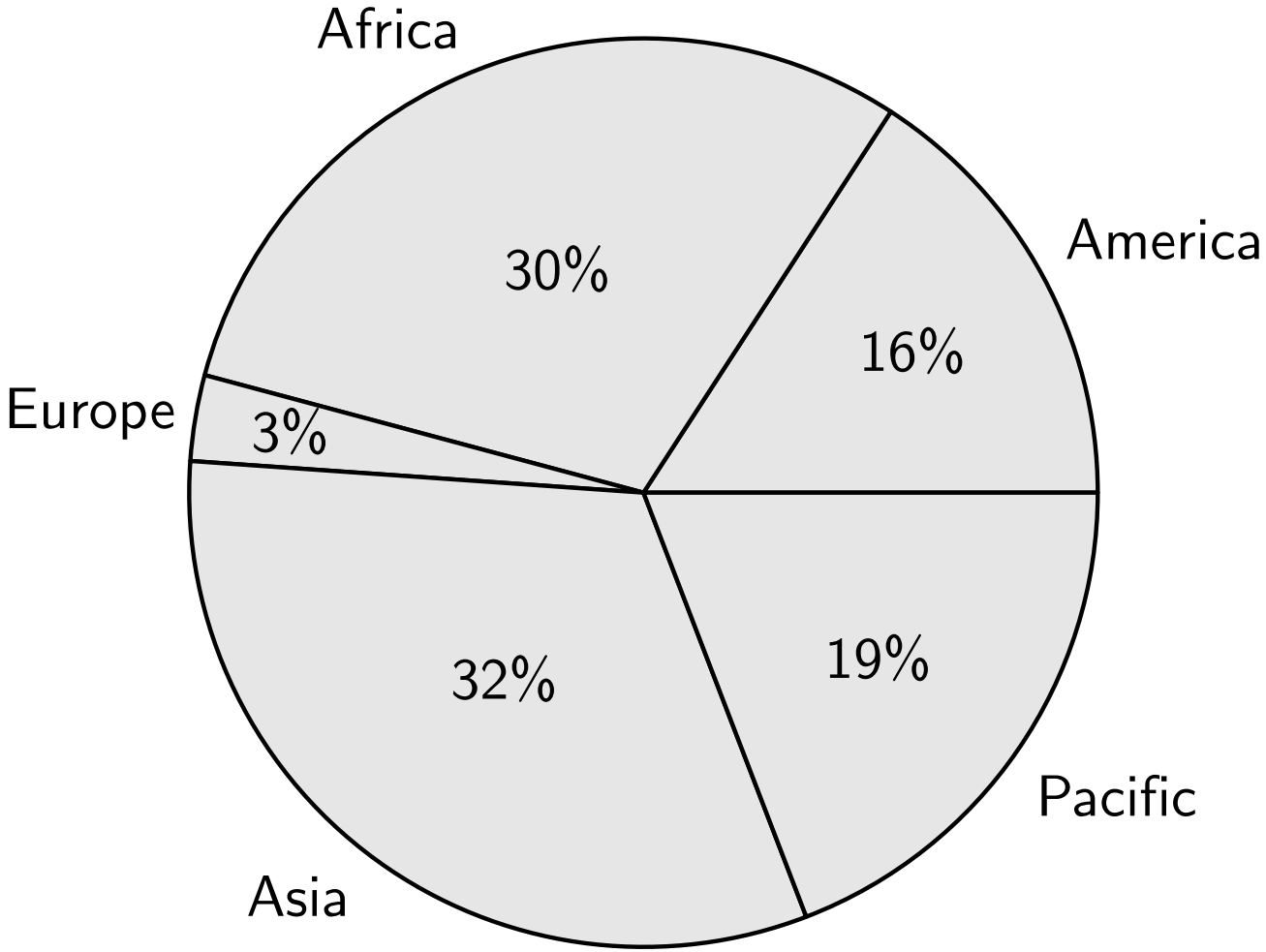
# Languages of the world

The biggest database on the matter is the "Ethnologue[1]" database. It currently contains 6912 living languages in the world that are geographically distributed as follows:




[1] http://www.ethnologue.com/

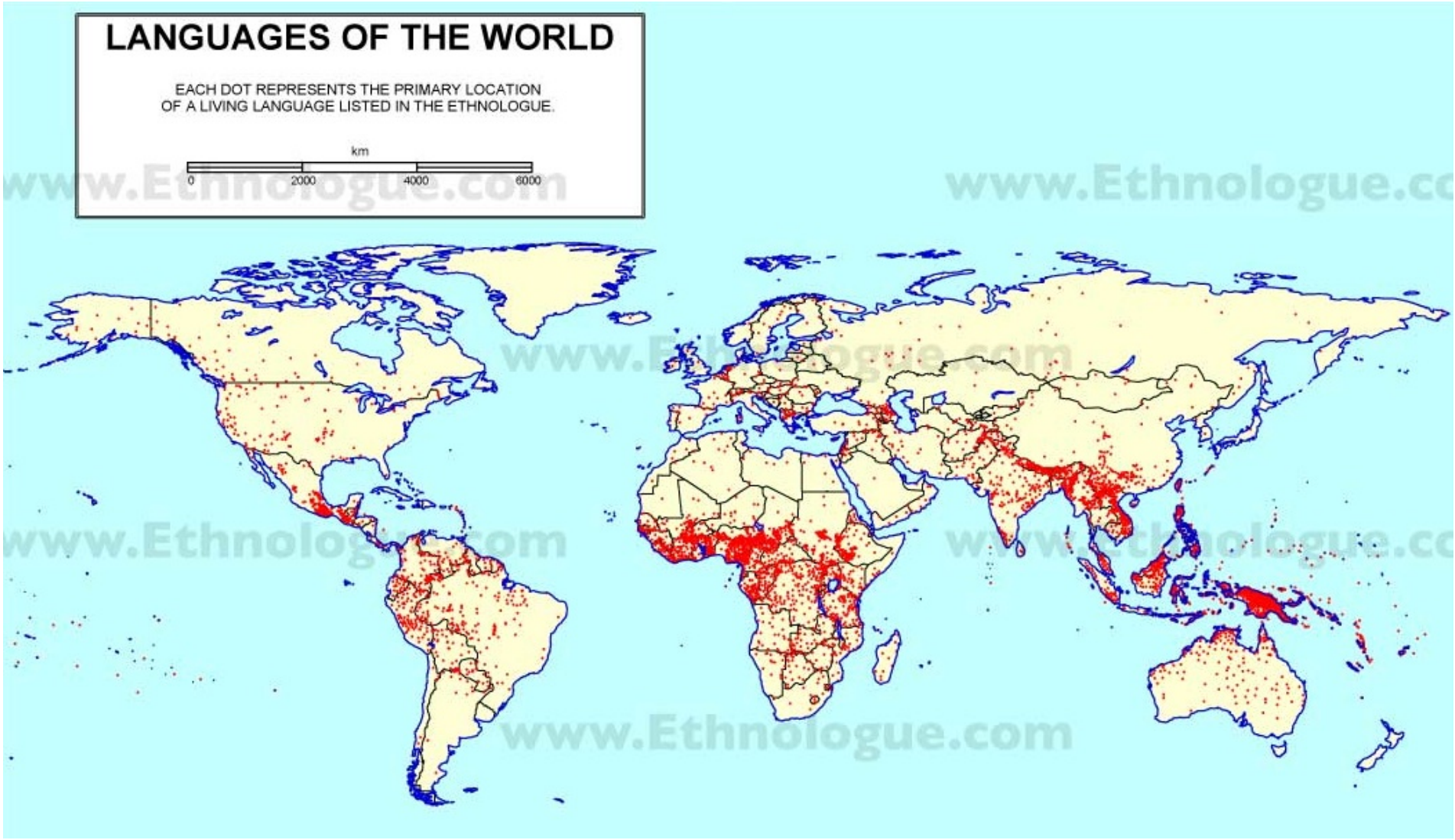



image taken from http://www.ethnologue.com/

# Languages of the world (cont.)

This distribution is the result of difficult work and the precision of the numbers is not easy to evaluate. The problems are:

- Heterogeneity of the sources
- The difficult distinction between langages and dialects.[2]

Depending on the sources, estimations vary between about 3000 and 7000 living languages.

## Max Weinreich

"אַ שפּראַך איז אַ דיאַלעקט מיט אַן אַרמיי און פֿלאָט"

(a shprakh iz a dialekt mit an armey un flot)
a language is a dialect with an army and a navy.

[2] languages are generally the object of statistics, but the definition of a language is based on subjective and variable criteria.

# Written languages, spoken languages

It is even more difficult to know the number of written languages. Depending on sources, 67% to 90% of the languages are spoken languages. This gives around 1500 written languages among the 6912. The Bible Society[3] indicates that the Bible has been translated into 2426 different languages (at least one of the book has been translated). Certain languages, considered as oral languages can be written using a transcription using an existing writing system.

[3] www.biblesociety.org

# Most spoken languages

| Language | Native speakers | Total sp. | Other estimates |
|---|---|---|---|
| Mandarin | 848 (2000) | 1026 | All varieties of Chinese: 1200 million (2000) |
| Spanish | 406 (1995–2011) | 466 | 420 million native.[6] 500 million total (2009)[7] |
| English | 335 (2003–2011) | > 765 | Approximately 375 million L1 speakers, 375 million L2 speakers, and 750 million EFL speakers. Totaling about 1500 million speakers.[9] |
| Hindi | 260 (2001) | 380 | 490 million total speakers of Hindi/Urdu.[11] |
| Arabic | 206 (1999) | 452 [4] | 280 million native.[13] |
| Portuguese | 202 (1998-2005) | 217 | 220 million native, 240 million total.[15] |
| Bengali | 193 (2001) | 250 | |
| Russian | 162 (2010) | 272 | |
| Japanese | 122 (1985) | 123 | |

[4] 100 million are not proficient in Standard Arabic

# Most spoken languages

| Language | Native speakers | Total sp. | Other estimates |
|---|---|---|---|
| Javanese | 84.3 (2000) | — | 85 (2012), 70 million native speak ers (1997) |
| German | 83.8 (1990) | 111.8 | 99M native, 60 second language i EU + 5–20 worldwide. |
| Lahnda [5] | 82.7 (1998–2000) | | |
| Wu (Shanghainese) | 77.2 (1984) | — | 90 |
| Telugu | 74.0 (2001) | 79 | 84.6 (2011 census) |
| Marathi | 71.8 (2001) | — | 72 (2001 census) |
| Tamil | 68.8 (2001) | 76.8 | |
| French | 68.5 (1987-2011) | 118.5 | 128 M native/real, 72 M "bilin guals". > 200 M total. |
| Vietnamese | 67.8 (1999) | — | |
| Korean | 66.4 (1986) | — | 72 (2010 WA) |
| Urdu | 63.4 (1998) | 167.4 | |
| Yue (Cantonese) | 62.2 (1984–2006) | — | 70 |
| Malay | 59.4 (2000–2007) | | |
| Persian | 56.6 (2011) | — | |
| Turkish | 50.7 (1987) | — | 74 & 83 (2005) |
| Italian | — | 61 | |

[5] the boundary between this and Eastern Punjabi is spurious

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# Writing Systems

Writing appeared under different forms in different human civilizations: Egypt, Mesopotamia, China, India and, later, mid-america (the Mayas). The most ancient writing system seems to have appeared in Mesopotamia, around 3500-3400 B.C.

We use the term writing system.

Two main classes:

- Phonologic scripts where phonemes are written (alphabets + syllabaries)
- Semantic scripts where morphemes are written (Chinese script, hieroglyphs or cuneiforms)

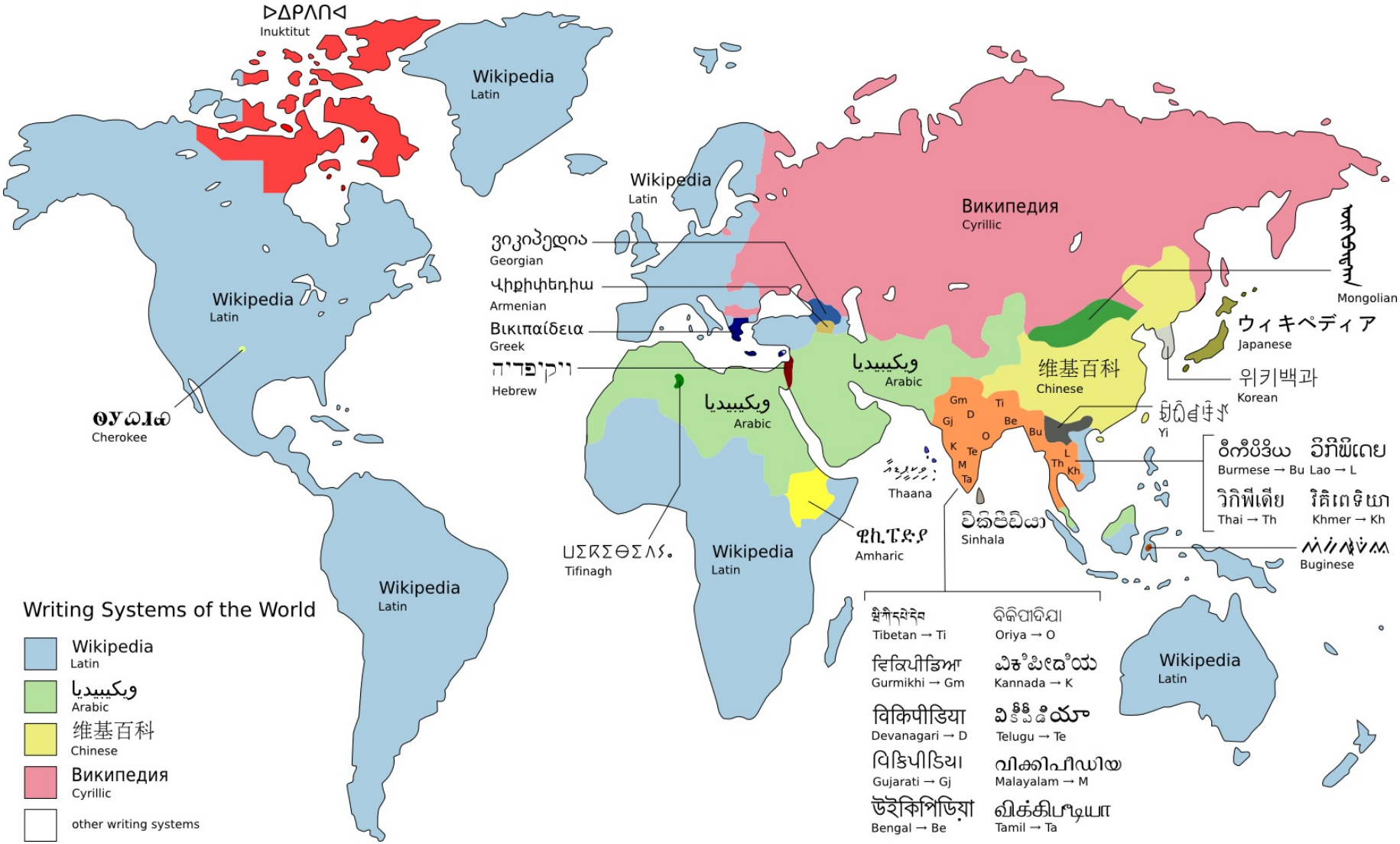


image taken from wikipedia

# Some examples

Japanese writing system:

UNICODE漢字コード分かりません。

This system uses:

- “kanji”, Chinese ideograms: 漢字 (characters)
- “hiragana”, syllabary used for Japanese words, grammatical particles and flexion endings : 分かりません: wakarimasen (don’t understand)
- “katakana”, syllabary used for loan words: コード: côdo (code)
- “romaji”, i.e. latin alphabet, often used for acronyms: UNICODE
- arabic numbers, besides Chinese ones; special punctuation marks, etc.

Note: there is no separation between words...

**Some computer science problems**

How to pronounce kanji; segmenting a text in words; inputing (more characters than available key in a keyboard...), typography according to the writing direction (horizontal/vertical), etc.

# Some examples

Arabic writing system:

- is an abjad, i.e. a writing in system which one may only write consonants (almost),
- written from right to left (except numbers, written from left to right...)
- no upper/lower case, letter are joined together,
- letter changes depending on the context (alone, beginning of a word, end of a word, between letters...
- a space is found between words, but you can also find one (smaller) inside words containing letters that do not join

**Some computer science problems**

What are the (short) vowels (they encode morphology), fine typography (you do not justify text by extending white spaces but letters), discontinuous selection (e.g.: if there is a number), etc.

# Some examples

Briefly describe particularities of your own native writing system...

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# How do you name a language ?

Giving a name to a language is difficult. Indeed, the name of a language is defined by the user language.
ex.: allemand, Deutsch, German, nemško, tedesco, ... are names for the German language (in French, German, English, Slovene, Italian, ...)

It is tedious to chose a particular language to make this designation (e.g. name every language in English...).

You can't either chose to name each language with its "proper" name (e.g. English for English, français for French, Tiếng Việt for Vietnamese,...). This would be difficult to write for oral languages and difficult to pronounce for languages that use writing systems that are not known by the reader...

# How to name a language ?

You need to find a system that is:

- easy to set up,
- easily transportable (uses only ASCII characters),
- understandable by all (a standard).

It is the ISO-639 standard.

# ISO-639 standard

ISO 639 contains 3[6] sets of language codes:

- ISO 639-1 (alpha-2) defines codes with 2 characters, and associates them with French and English names, along with the name in the described language itself;
- ISO 639-2 (alpha-3) uses 3 characters with 2 possible encodings : ISO 639-2/B (bibliographic) et ISO 639-2/T (terminological) ; the codes are associated with their French and English names.
- ISO 639-3 completes ISO 639-2 that has many missing languages ; SIL[7] is the main author of this norm and is in charge of its maintenance (code addition, etc.); codes are associated with their English names.

[6] since 2007

[7] www.sil.org

# ISO-639 standard (suite)

These three code sets have different motivations:

- ISO 639-1 (alpha-2) is mainly intended for terminological, lexicographic and linguistic use; it contains main languages for which many linguistic resources exist;
- ISO 639-2 (alpha-3) is mainly intended for bibliography and terminology; it contains languages of part 1 plus many others having a large literature;
- ISO 639-3 intends to enumerate as many languages as possible, including living languages, dead languages, ancient languages and artificial languages[8], regardless of the number of its speakers/readers and regardless of its written/spoken nature.

[8] like Esperanto, Volapük, Klingon, etc. i.e. artificial natural languages (not Java, xml, etc.)

# Details of ISO 639-3

Set of codes:

```
CREATE TABLE ISO_639-3 (
   Id        char(3) NOT NULL,
             -- The three-letter 639-3 identifier
   Part2B    char(3) NULL,
             -- Equivalent 639-2 identifier of the bibliographic application
             -- code set, if there is one
   Part2T    char(3) NULL,
             -- Equivalent 639-2 identifier of the terminology applications
             -- code set, if there is one
   Part1     char(2) NULL,
             -- Equivalent 639-1 identifier, if there is one
   Scope     char(1) NOT NULL,
             -- I(ndividual), M(acrolanguage), S(pecial)
   Type      char(1) NOT NULL,
             -- A(ncient), C(onstructed),
             -- E(xtinct), H(istorical), L(iving), S(pecial)
   Ref_Name     varchar(150) NOT NULL)
            -- Reference language name
```

# Extract from the codes table

| Id | Part2B | Part2T | Part1 | Scope | Type | Ref_Name |
|---|---|---|---|---|---|---|
| aao | | | | I | L | Algerian Saharan Arabic |
| abh | | | | I | L | Tajiki Arabic |
| ara | ara | ara | ar | **M** | L | Arabic |
| czh | | | | I | L | Huizhou Chinese |
| deu | ger | deu | de | I | L | German |
| epo | epo | epo | eo | I | **C** | Esperanto |
| fra | fre | fra | fr | I | L | French |
| frm | frm | frm | | I | **H** | Middle French (ca. 1400-1600) |
| fro | fro | fro | | I | H | Old French (842-ca. 1400) |
| mis | mis | mis | | S | S | Uncoded languages |
| mjy | | | | I | **E** | Mahican |
| mul | mul | mul | | **S** | **S** | Multiple languages |
| nut | | | | I | L | Nung (Viet Nam) |
| und | und | und | | **S** | **S** | Undetermined |
| vie | vie | vie | vi | I | L | Vietnamese |
| zho | chi | zho | zh | M | L | Chinese |
| zxx | zxx | zxx | | S | S | No linguistic content |

# Details of ISO 639-3

"macrolangues" mapping:

```
CREATE TABLE ISO_639-3_Macrolanguages (
   M_Id  char(3) NOT NULL,  -- The identifier for a macrolanguage
   I_Id  char(3) NOT NULL)  -- The identifier for an individual language
                            -- that is a member of the macrolanguage
```

# Extract from Macrolanguages table

| M_Id | I_Id | Interpretation |
|---|---|---|
| ara | aao | Algerian Saharan Arabic is part of Arabic |
| ara | abh | Tajiki Arabic is part of Arabic |
| ara | abv | |
| zho | cjy | |
| zho | cmn | |
| zho | cpx | |
| zho | czh | Huizhou Chinese is part of Chinese |

# Other informations

- there is a table describing the codes that have been suppressed,
- codes qaa to qtz are reserved for local use; they may be transmitted only if both parties agree to their interpretation,
- ISO 639-3 Registration Authority is SIL International, www.sil.org (Dallas, Texas)
- the code table contains 7642 entries (430 dead languages, 4 special, 63 historic, 114 ancient, 17 artificial)

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   - Denoting languages of the world
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   - Naming a language
   - String Encoding Problems
     - Presentation of the problem
     - What do we code?
     - UNICODE
   - Searching and Sorting
   - RDF and Linked Data

# String Encoding Problems

«In the beginning was the byte...»

# String Encoding Problems

Initialy, each character was represented by a unique code, represented by one byte.
Two main encodings: ASCII and EBCDIC (IBM)
ASCII code only defines 127 characters (using 7 bits). The other 127 characters usually depend on the OS/machine.

ANSI extended ASCII

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | □ | □ | ‚ | ƒ | „ | … | † | ‡ | ˆ | ‰ | Š | ‹ | Œ | □ | □ | □ |
| 9 | □ | ‘ | ’ | “ | ” | • | – | — | ˜ | ™ | š | › | œ | □ | □ | Ÿ |
| A | | ¡ | ¢ | £ | ¤ | ¥ | ¦ | § | ¨ | © | ª | « | ¬ | - | ® | ¯ |
| B | ° | ± | ² | ³ | ´ | µ | ¶ | · | ¸ | ¹ | º | » | ¼ | ½ | ¾ | ¿ |
| C | À | Á | Â | Ã | Ä | Å | Æ | Ç | È | É | Ê | Ë | Ì | Í | Î | Ï |
| D | Ð | Ñ | Ò | Ó | Ô | Õ | Ö | × | Ø | Ù | Ú | Û | Ü | Ý | Þ | ß |
| E | à | á | â | ã | ä | å | æ | ç | è | é | ê | ë | ì | í | î | ï |
| F | ð | ñ | ò | ó | ô | õ | ö | ÷ | ø | ù | ú | û | ü | ý | þ | ÿ |

OEM extended ASCII (first IBM PCs)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Ç | ü | é | â | ä | à | å | ç | ê | ë | è | ï | î | ì | Ä | Å |
| 9 | É | æ | Æ | ô | ö | ò | û | ù | ÿ | Ö | Ü | ¢ | £ | ¥ | ₧ | ƒ |
| A | á | í | ó | ú | ñ | Ñ | ª | º | ¿ | ⌐ | ¬ | ½ | ¼ | ¡ | « | » |
| B | ░ | ▒ | ▓ | │ | ┤ | ╡ | ╢ | ╖ | ╕ | ╣ | ║ | ╗ | ╝ | ╜ | ╛ | ┐ |
| C | └ | ┴ | ┬ | ├ | ─ | ┼ | ╞ | ╟ | ╚ | ╔ | ╩ | ╦ | ╠ | ═ | ╬ | ╧ |
| D | ╨ | ╤ | ╥ | ╙ | ╘ | ╒ | ╓ | ╫ | ╪ | ┘ | ┌ | ▀ | ▄ | ▌ | ▐ | ▪ |
| E | α | ß | Γ | π | Σ | σ | µ | τ | Φ | Θ | Ω | δ | ∞ | ø | ∈ | ∩ |
| F | ≡ | ± | ≥ | ≤ | ⌠ | ⌡ | ÷ | ≈ | ° | ∙ | · | √ | ⁿ | ² | ■ | |

# String Encoding Problems

"National" encodings also used the 127 higher characters to represent characters of their script[9].
This, plus the fact that everybody called this THE ASCII code...
Hence, begun what can be called:

"the happy mess of encodings..."

[9] the lower 127 characters were not modified because the were necessary to write programs

# String Encoding Problems

Some national encodings:

- MacRoman, Windows-1252, Latin1 (= ISO-8859-1) for western european languages (French, Italian, ...),
- ISO-8859-2 for Slavic languages written with Latin characters (Czech, Polish, ...),
- ISO-8859-3 for Esperanto, Galician, Maltese, Turkish,
- ISO-8859-4 for Estonian, Lithuanian, Letton...
- ISO-8859-5 or KOI8-R for Cyrillic languages (Russian, Bulgarian, ...)
- ISO-8859-6 for Arabic,
- ISO-8859-7 for modern Greek,
- ISO-8859-8 for Hebrew,
- ISO-8859-9 (= Latin 5) almost the same as Latin1, but Islandic characters were removed in favor of Turkish ones,
- ISO-8859-15 (= Latin 9) same as Latin 1, plus €, œ, Œ... characters

# String Encoding Problems

Scripts with large character sets cannot use this technique.
**First strategy**: using an escape sequence that indicates the encoding of following characters.
**e.g.**: ISO-2022-JP: uses 7 bits per byte and 1 to 2 bytes per character. An escape sequence is inserted in the flow to indicate if the following characters use 1 or 2 bytes.
**Second strategy**: using 1 or 2 bytes, the form of which determines the number to be used.
**e.g.**: Shift-JIS: uses 8 bits per byte and 1 or 2 byte for a character. The value of the first byte determines if the character uses 1 or 2 bytes.

# String Encoding Problems

All these encodings present a major problem: they are mutually exclusive one of the other !

Hence, it is impossible with a standard treatment[10], to mix different scripts...

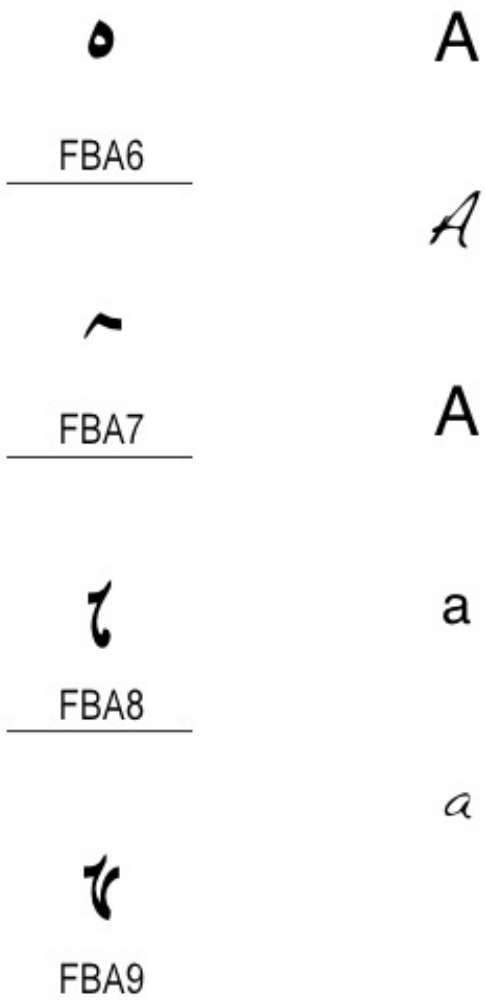
This is a major problem when dealing with a bilingual dictionary (which is in essence, multilingual).

Hence, an encoding was introduced that is able to represent all currently known scripts: UNICODE.

[10] For instance, some word processing software could mix encodings and use the font information to infer the proper encoding and display. This led to even more confusion between encoding and font...

# What do we code?

How many characters are there below ?



# Some definitions

**Character** Abstract entity, considered as atomic, used for writting a language,

**Glyph** Abstract graphical form taken by a character in a certain context,

**Font** Set of concrete graphical forms representing a set of glyphs,

**Code Point** Association between a character and an integer (its code), as defined by a norm.

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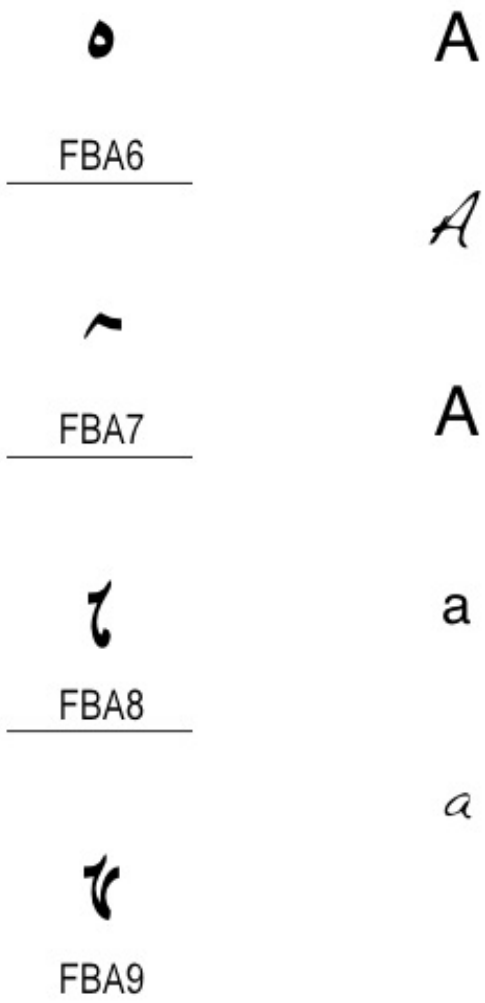

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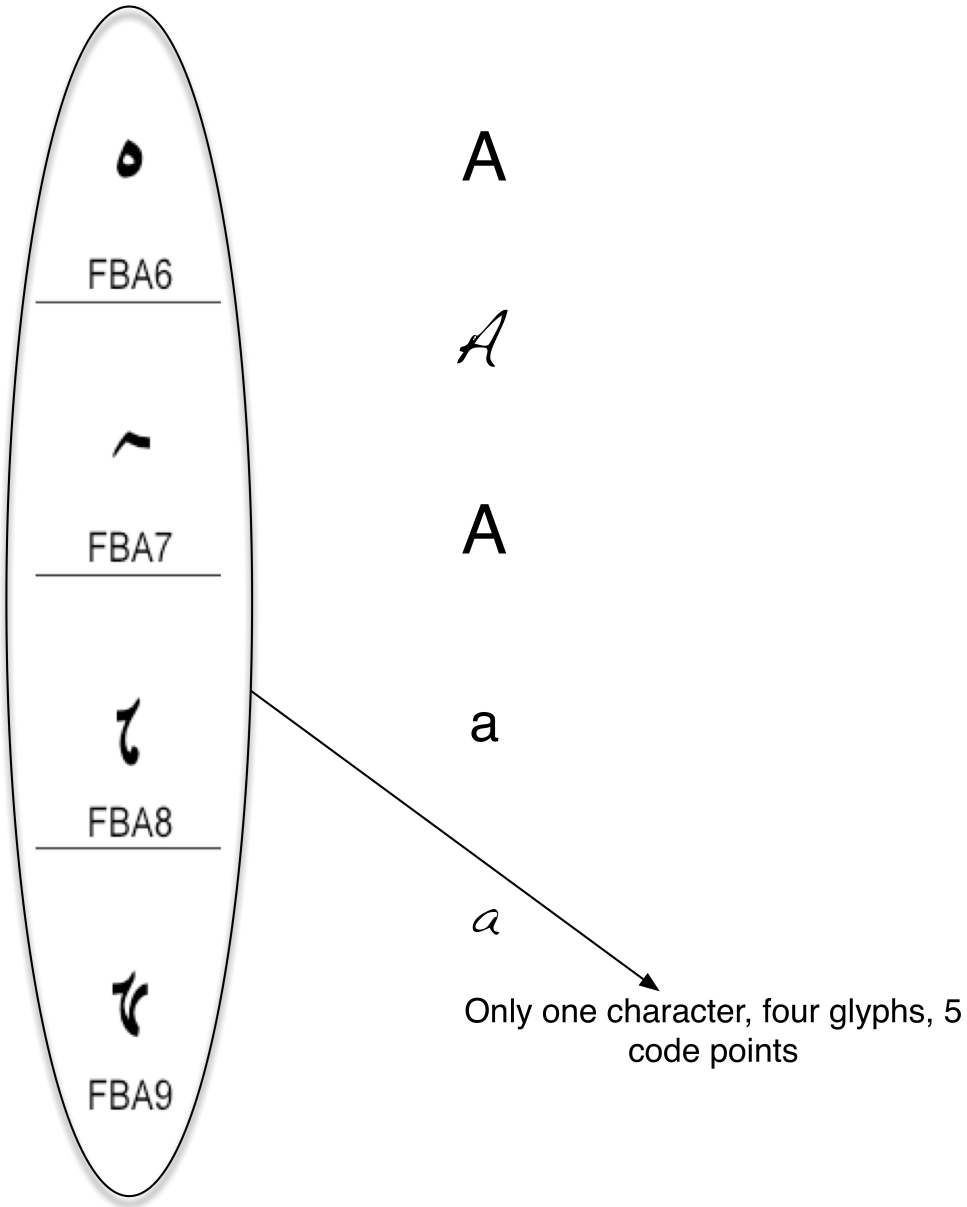

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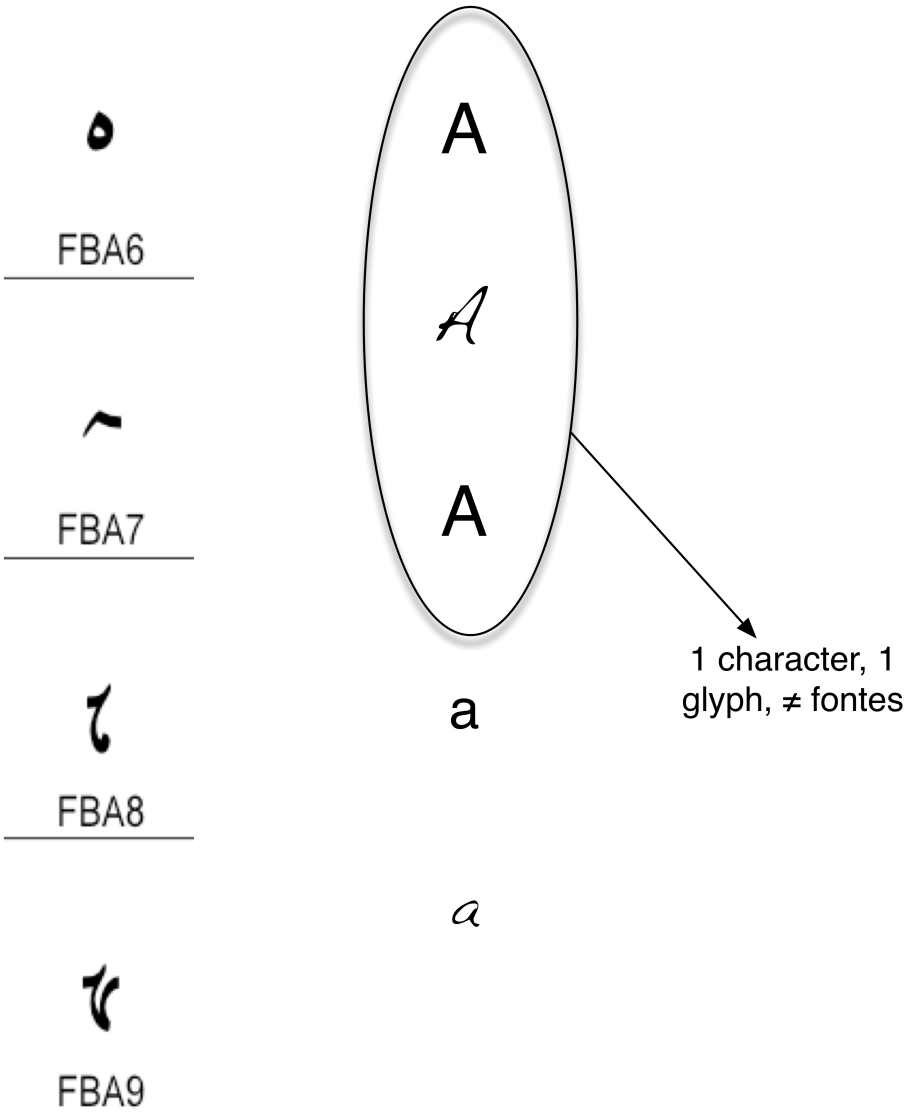

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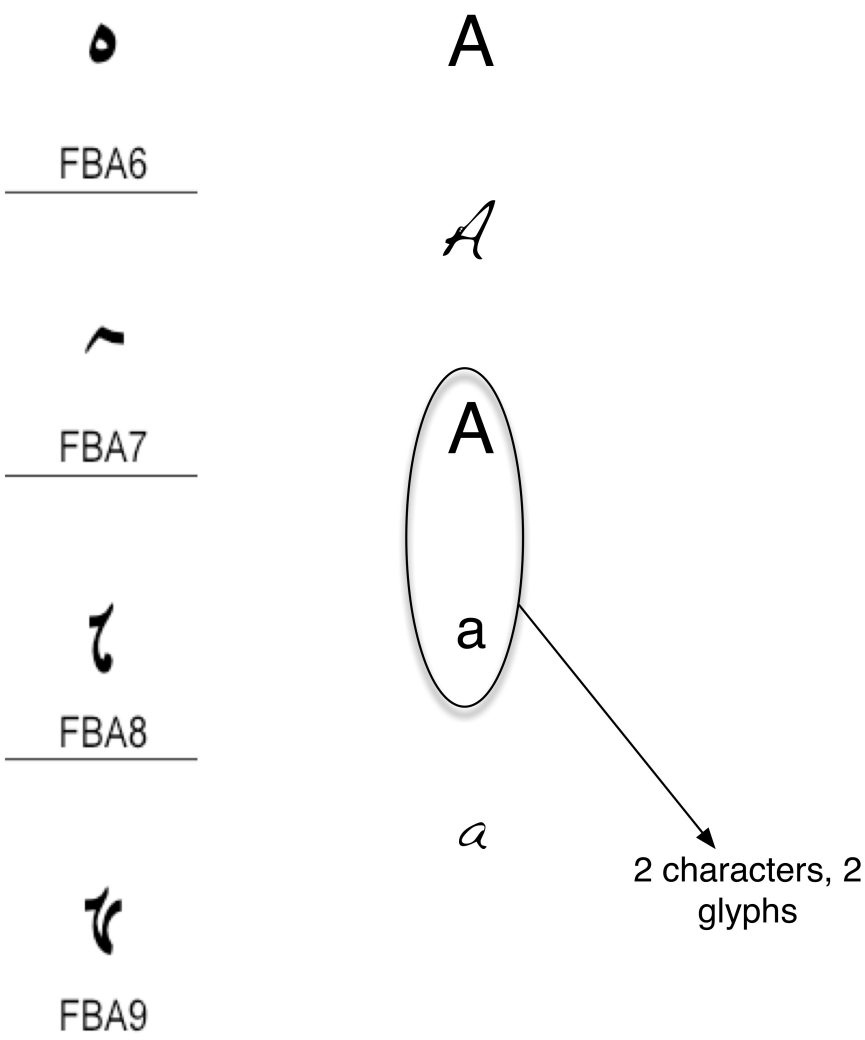

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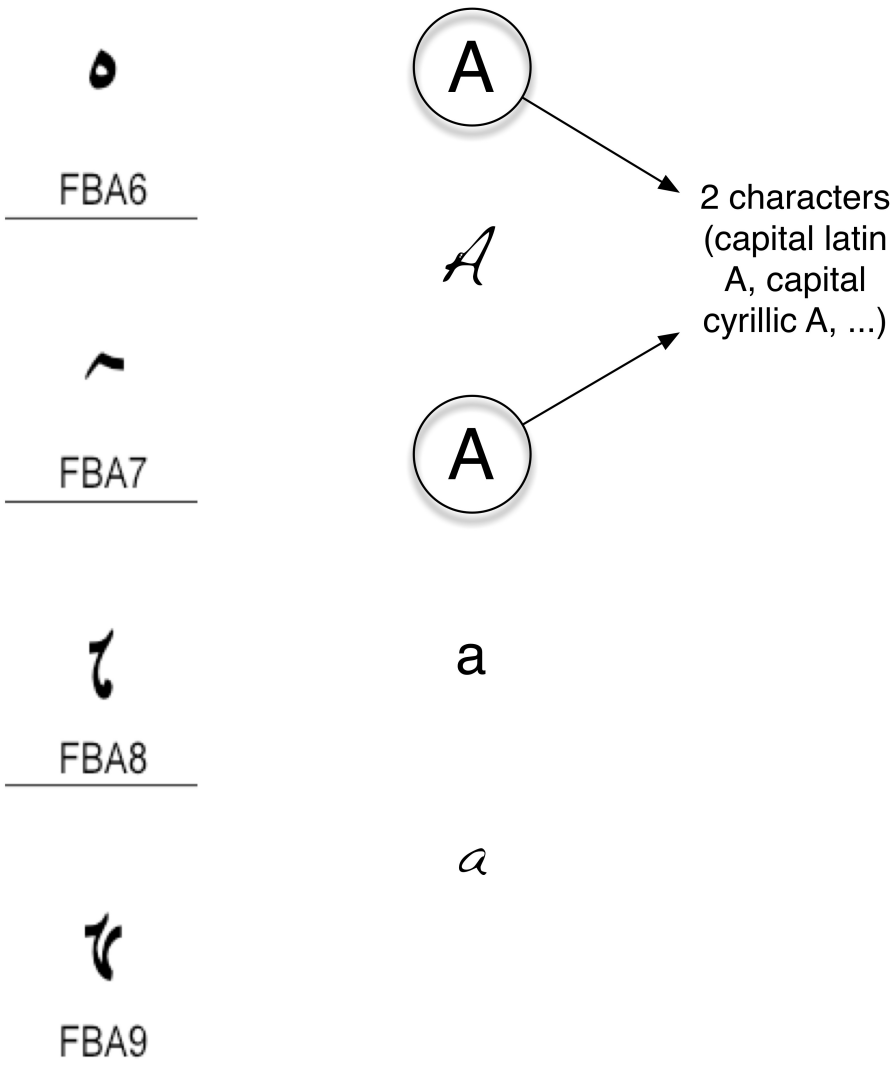


# UNICODE

The ISO 10646 norm defines a set of abstract characters, along with their names in English and French. It assigns code points to these characters. The UNICODE consortium, use these code points and defines the way they are represented in memory along with other elements necessary for the representation of texts.

# Design Principles

| | |
|---|---|
| Characters, not glyphs | The UNICODE standard encodes characters and not glyphs. |
| Semantics | Characters have a well defined semantics. |
| Raw Text | The UNICODE defines the encoding of raw text. |
| Logical order | Implicit relation in memory is the logical order. |
| Unification | The UNICODE standard unifies identical characters in writing systems, independently of the languages. |
| Dynamic Composition | Accentuated forms can be composed dynamically. |
| Equivalent sequences | Each static precomposed form has a list of equivalent dynamically composed characters. |
| Convertibility | A one-one convertibility is guaranteed between UNICODE and other norms. |

# Two Antagonistic Principles

One-one convertibility means that characters defined by other encodings must be present in the UNICODE character set.

Hence, UNICODE defines a code point for each form of arabic characters (as these do exist in existing norms).

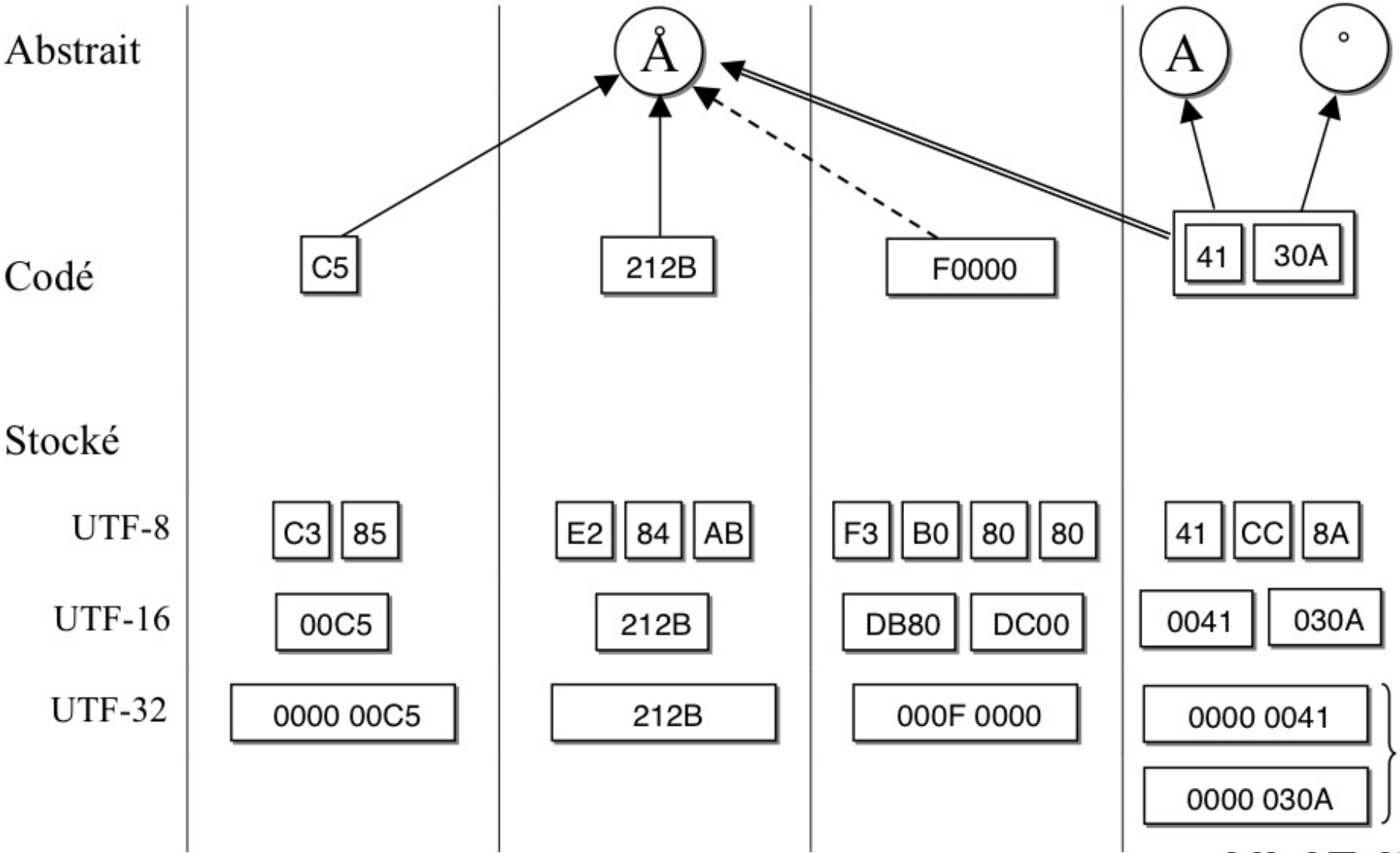
But these forms are not characters... but glyphs...

# Representation Levels

The definition model of characters is based on different levels:

1. abstract character repertory
2. coded character sets [The code points]
3. storage form of the characters [relation between the set of code points and the set of storage units]
4. character serialisation mechanism [correspondence between storage units and serialized sequence of bytes]
5. transfer encodings [reversible transformation of a sequence of bytes]

# Representation Levels



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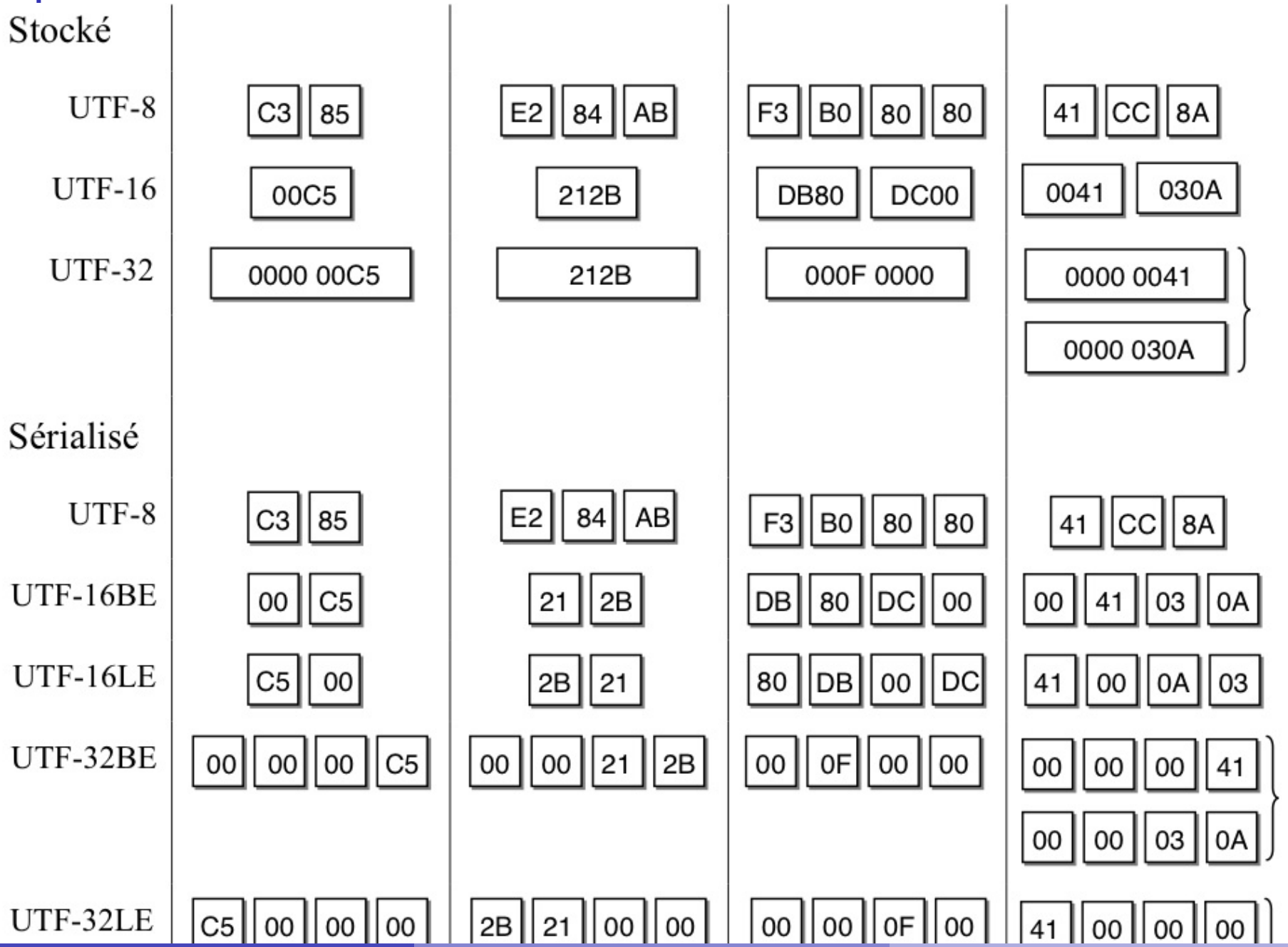

# Motivations

UTF-32 uses 32 bits, UTF-16 uses 16 bits (with the possibility of using a pair of `short word` to represent code points > 0xFFFF).
This causes many problems:

**example in C**

```
char* str = ...; // str = "été", représenté en UTF-16
printf("%d", strlen(str));
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Hence, the vast majority of programs do have problems with UNICODE data (SMTP servers, gateways, etc...)

# UTF-8

Principles

- Any ASCII character (0x00 $\leq$ code point $\leq$ 0x7F) is represented as is,
- Any character $\geq$ 0x80 is represented using the "little train" technique.

## The "little train"

Let x be a code point using $n$ significative bits ($7 > n > 21$)
x = $b_n b_{n-1} ... b_1$
We scatter these bits in "wagons", pulled by a strong enough locomotive (110xxxxx, 1110xxxx ou 11110xxx).

if $(7 < n \leq 11)$ $\rightarrow$ 110*xxxxx* 10*xxxxxx*
if $(11 < n \leq 16)$ $\rightarrow$ 1110*xxxx* 10*xxxxxx* 10*xxxxxx*
if $(16 < n \leq 21)$ $\rightarrow$ 11110*xxx* 10*xxxxxx* 10*xxxxxx* 10*xxxxxx*

# UTF-8

Advantages of this encoding:

- Any ASCII character ($0x00 \leq x \leq 0x7F$) is coded as is, hence it does not break protocols that are based on the ASCII character set,
- Byte 0x00 never appears in a UNICODE UTF-8 stream,
- Repositioning at the beginning of a char is always possible after a move in the byte stream (go back 3 bytes in the worst case),
- There is no difference between in memory storage units and serialized form as endianness is not an issue for bytes.

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   - Searching and Sorting
   - RDF and Linked Data

# Searching: some examples

- Naechste vs Nächste ?
- weiss vs weiß ?
- bleu vs Bleu ?
- blau vs Blau ?

# Understanding the Problem: a Practical Example

1. Go to page `http://de.wiktionary.org/`,
2. Search Maß
3. Using a css editor (firebug under firefox will do this easily), change the form of title so that they appear in uppercase add `text-transform:uppercase;` in the `h1` css)
4. You will see that Maß in now rendered as MASS
5. Search MASS, what do you see ?

# Understanding the Problem: a Practical Example

1. Go to page
   `http://dict.tu-chemnitz.de/dings.cgi?lang=en;service=deen`,
2. search Maß
3. search Mass, what do you see ?

# Sorting: Some Examples

In Swedish : z < ö
In German: ö < z
In a German dictionary: ö is interpreted as o+e: öf < of
In a German phonebook: of < öf
In an Irish phonebook: McAllan < Macbeth
Sometimes: A < a, other times: a < A
In French: cote < côte < coté < côté

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# Multilinguality in Semantic Web

One may think that "modern" languages are able to handle multilinguality...
For instance, RDF should encode data using different languages.

## Literals

- no real encoding problem, most representations (n3, TTL, RDF-XML) use UTF-8.
- one may qualify a String with a language, but it uses 2 letters language code.

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## URLs

- URIs cannot use extended char. You should use en entity (%3C...).
- IRIs may be used in different serialization forms.

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## Linked Data

- HTTP limitations: only accepts URLs...
- hence, the server should transform HTTP URL request and (optionally) transform URLs into IRIs before querying the triple store.

# Part II

# Example of Multilingual Lexical Databases

4 Electronic Dictionary Research

5 Wordnet and EuroWordnet

6 Wiki projects as Lexical Knowledge

7 BabelNet

8 The Papillon dictionary

9 The LexALP project

# Electronic Dictionary Research (EDR) dictionary

One of the biggest lexical database currently available, it started in 1986 and lasted 9 years (1200 men.years for 14 G¥).

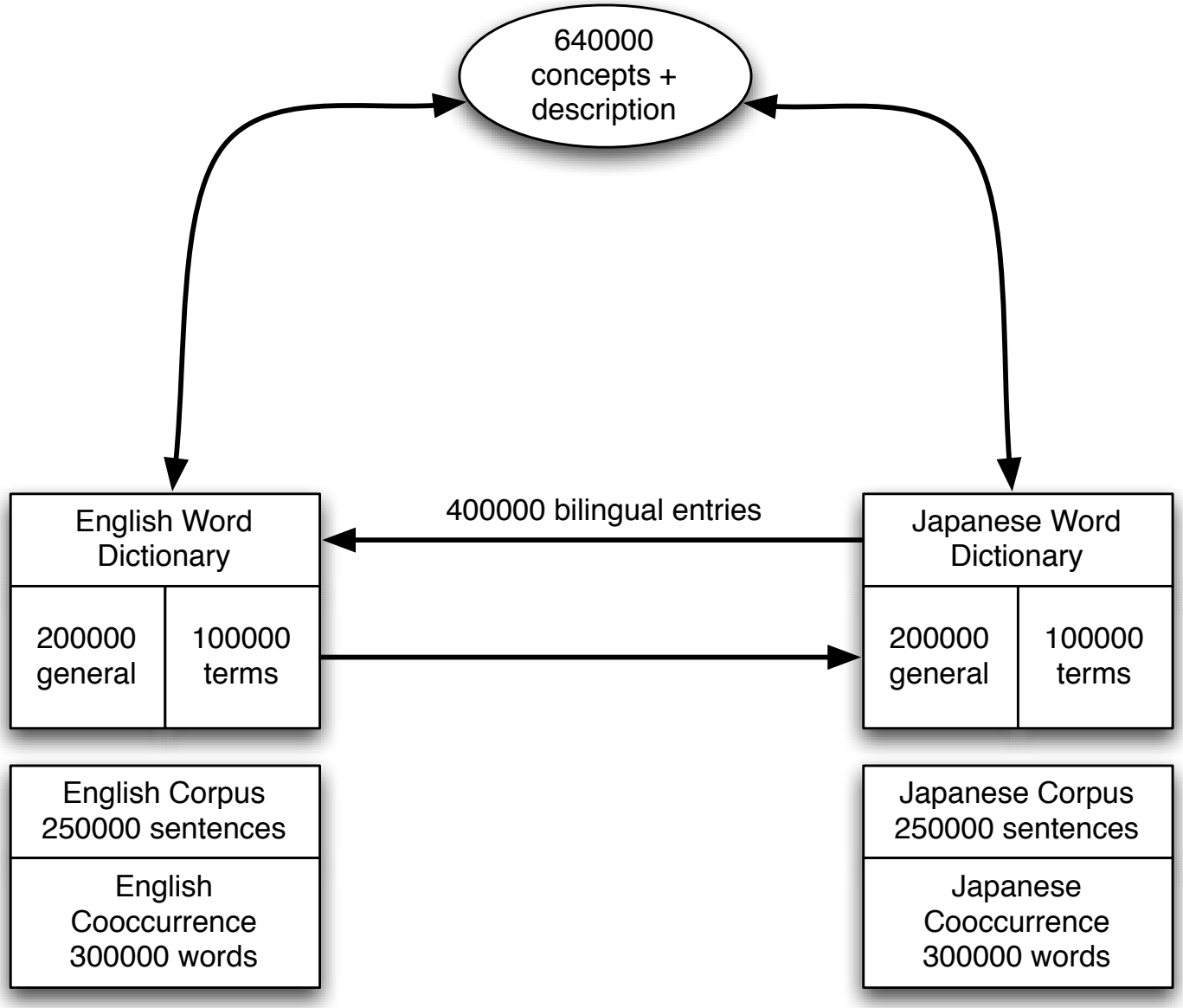
EDR built a bilingual lexical database with about 300000 entries in Japanese and english.

EDR architecture is somewhat unique as it gathers classical bilingual relations AND a concept dictionary that is used as a pivot.

Other lexical data was also produced, namely, coocurrence dictionary and corpus (250000 analysed sentences, 10-20M raw sentences).

The data was aimed at machine translation systems.

# Electronic Dictionary Research (EDR) dictionary



# EDR concept dictionary

| HeadWord | Concept Illustration | |
|---|---|---|
| | Primary Illustration | Concept Explanation |
| plane(ELN1,ECN1) | airplane(vehicle) | A vehicle called airplane |
| plane(ELN1,ECN1) | plane(tool) | A carpentry tool called plane |

Concepts are classified hierarchically. Moreover, many relations (agent, patient, etc.) are used to define/describe concepts.

# Analysis of this dictionary

- Lots of data, directly usable by computer systems,
- Use of a pivot architecture that allows for the easy integration of new languages (see CICC project),
- But creating the concept dictionary was difficult (mainly for methodological problems).

4 Electronic Dictionary Research

5 Wordnet and EuroWordnet

6 Wiki projects as Lexical Knowledge

7 BabelNet

8 The Papillon dictionary

9 The LexALP project

# Wordnet

- Wordnet lexical unit is called a synset,
- Each synset represents a concept,
- A synset is represented by a set of strings, each string denoting a word that bears the concept as one of its meanings.
- each synset has a definition,
- synsets are related by several relations (*nyms).

| **POS** | **Unique Strings** | **Synsets** | **Total Wordsense Pair** |
|---|---|---|---|
| Noun | 117798 | 82115 | 146312 |
| Verb | 11529 | 13767 | 25047 |
| Adjective | 21479 | 18156 | 30002 |
| Adverb | 4481 | 3621 | 5580 |
| **Totals** | **155287** | **117659** | **206941** |

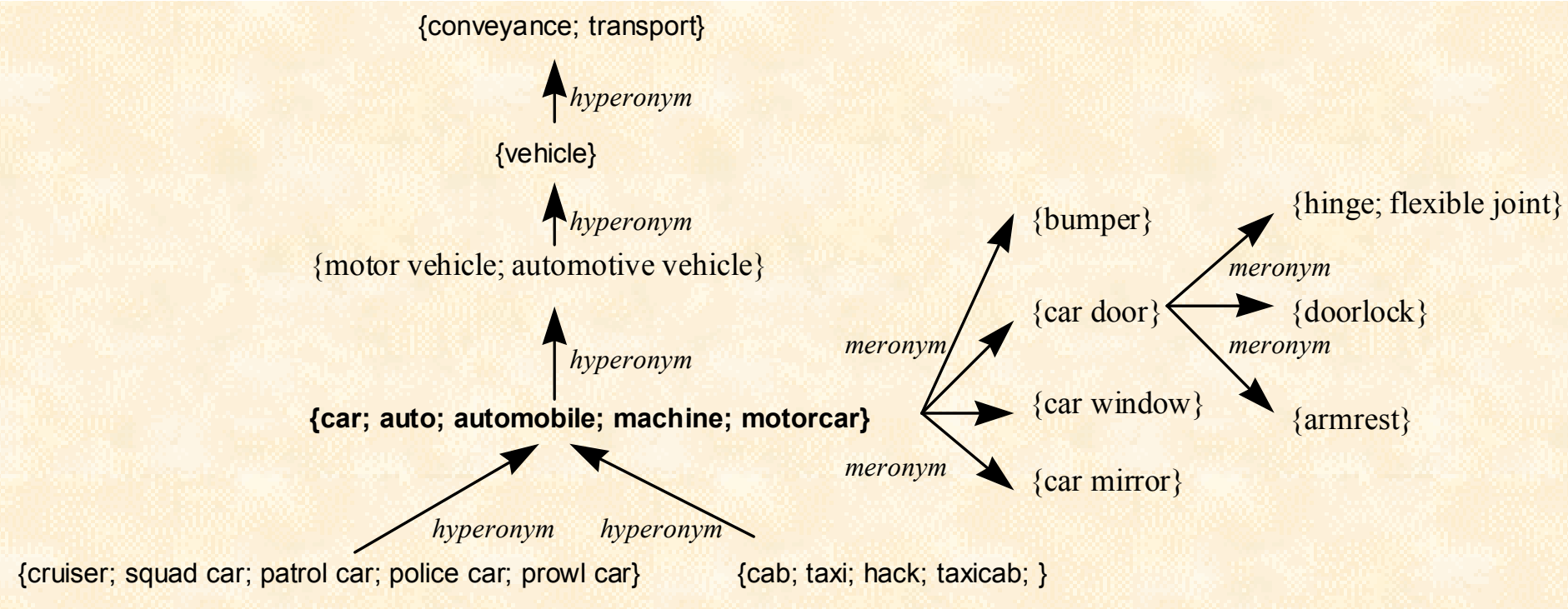
# Wordnet: an example

As such, Wordnet is not a dictionary. However, by providing a search by denotation strings, it behaves as a dictionary.
Hence, searching "compose" gives:

**Verb**

- S: (v) **compose** (form the substance of) "*Greed and ambition composed his personality*"
- S: (v) **compose**, write (write music) "*Beethoven composed nine symphonies*"
- S: (v) write, **compose**, pen, indite (produce a literary work) "*She composed a poem*"; "*He wrote four novels*"
- S: (v) **compose**, compile (put together out of existing material) "*compile a list*"
- S: (v) **compose** (calm (someone, especially oneself); make quiet) "*She had to compose herself before she could reply to this terrible insult*"
- S: (v) frame, **compose**, draw up (make up plans or basic details for) "*frame a policy*"

# Relations between synsets in Wordnet

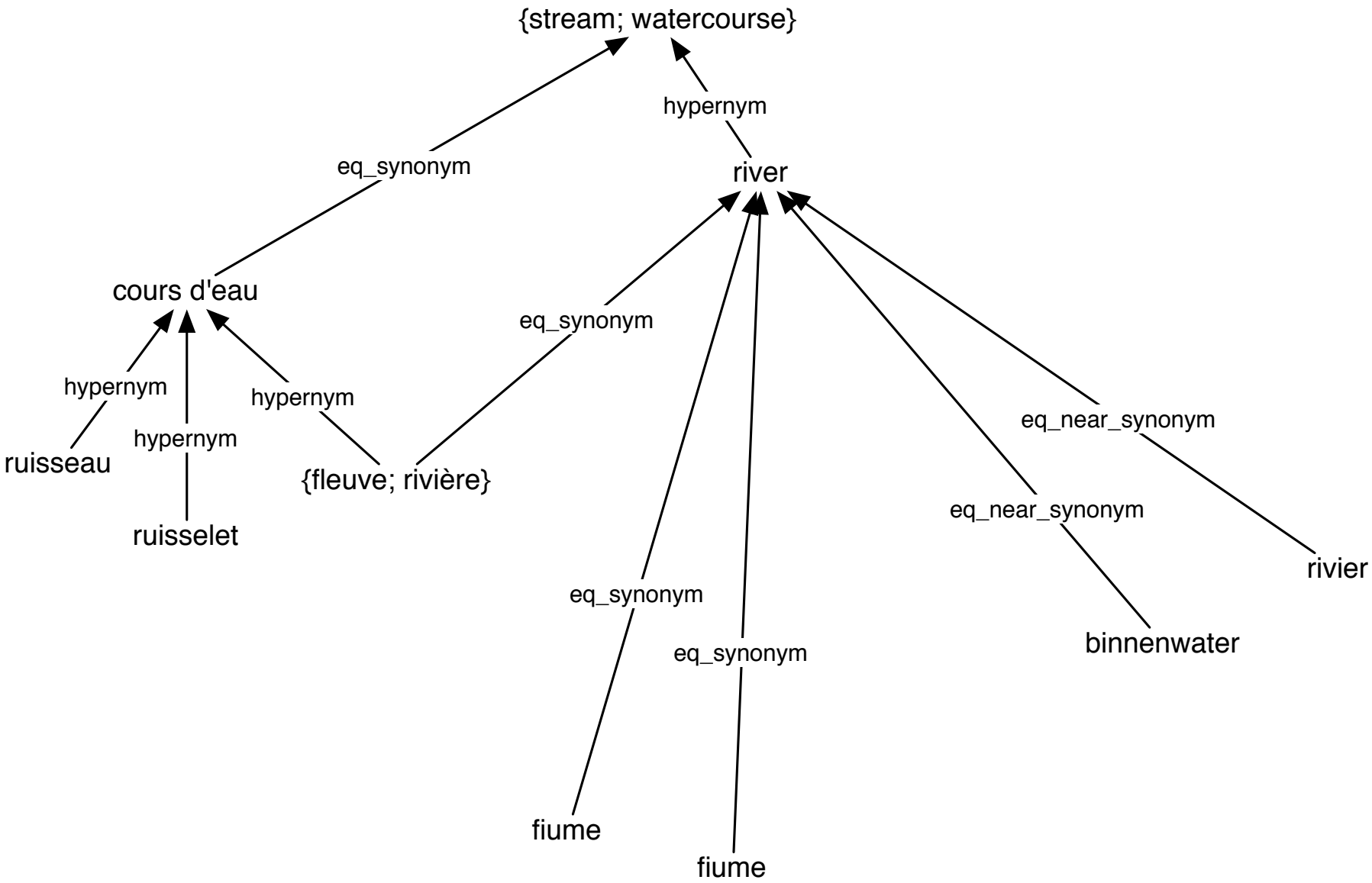


# EuroWordnet

Eurowordnet is a multilingual database build on the wordnet model.

- Relations between synsets are given in different european languages
- Synsets in european languages are linked by special relations to an ILI, an interlingual index,
- In theory, ILI are interlingual,
- In theory, there is an almost systematic one to one correspondance between ILI and English synset.

# Eurowordnet: an example



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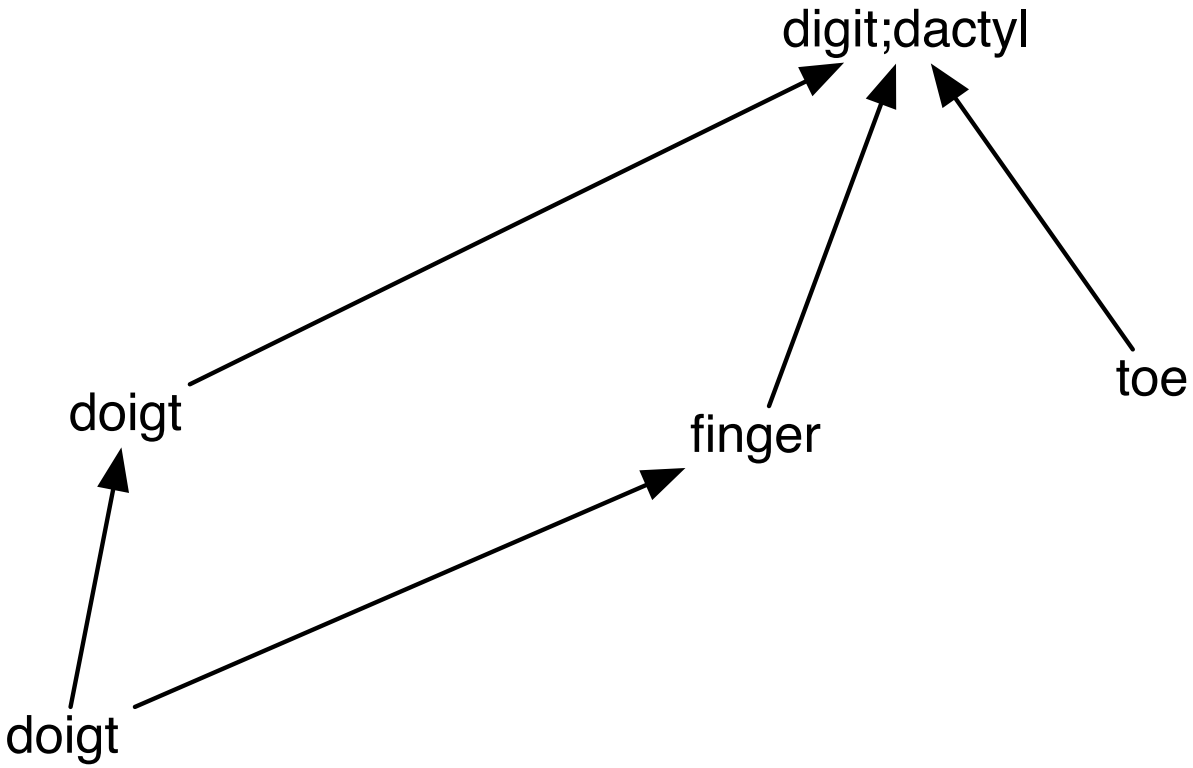

# Analysis of Wordnet/EuroWordnet

- Wordnet is not a dictionary. It is a set of concept,
- it does not use any notion of word, hence, you don't know anything about the word, e.g. its level of language, etc.
- part of speech is defined by the concept, there is no such thing as a verb/noun entity (even if, in English, any noun may be used as a verb...)

- EuroWodnet uses English as a pivot (if not in theory, at least practically), this leads to mistakes in other languages, and, even if mistakes are avoided, this leads to artificial contrastive differences between languages.
- as a positive note: using a pivot allowed for different teams to work dependently on each language; using English as a pivot reduces the need for accurate competence in foreign languages.

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# Mediawiki promotes several projects with lexical knowledge

- Wikipedia: Community Built Multilingual Encyclopedic Database
  - Pages represent an encyclopedic entry (a concept ?)
  - Disambiguation pages, pages redirects, links to other Wikipedia language editions

# Mediawiki promotes several projects with lexical knowledge

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WIKI LOVES AFRICA

Wiki Loves Africa: share African cultural fashion and adornment pictures with the world!

## Play (theatre)

From Wikipedia, the free encyclopedia
(Redirected from Play (theater))

A **play** is a form of literature written by a playwright, usually consisting of dialogue between characters, intended for theatrical performance rather than just reading. Plays are performed at a variety of levels, from Broadway, Off-Broadway, regional theater, to Community theatre, as well as University or school productions. There are rare dramatists, notably George Bernard Shaw, who have had little preference whether their plays were performed or read. The term "play" can refer to both the written works of playwrights and to their complete theatrical performance.[1]

**Contents** [hide]

1 Genres
1.1 Comedy
1.1.1 Farce
1.1.2 Satirical

A children's play depicting The Nativity

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## Play (theatre)

The following pages redirect to **Play (theatre)** and are grouped by target anchor.

Non-existent anchors are marked with [Invalid]. These redirects can be retargete
Incorrect redirects are sometimes caused by bots fixing double redirects.

### *No anchor or section*

- Play (theater)
- Play (theatrical)
- Playgoer
- Playlet
- Playlets
- Script (performing arts)
- Script (theater)
- Stage play
- Stage plays
- Stageplay
- Stageplays
- Theater play
- Theater/play
- Theatre play
- Theatre/play

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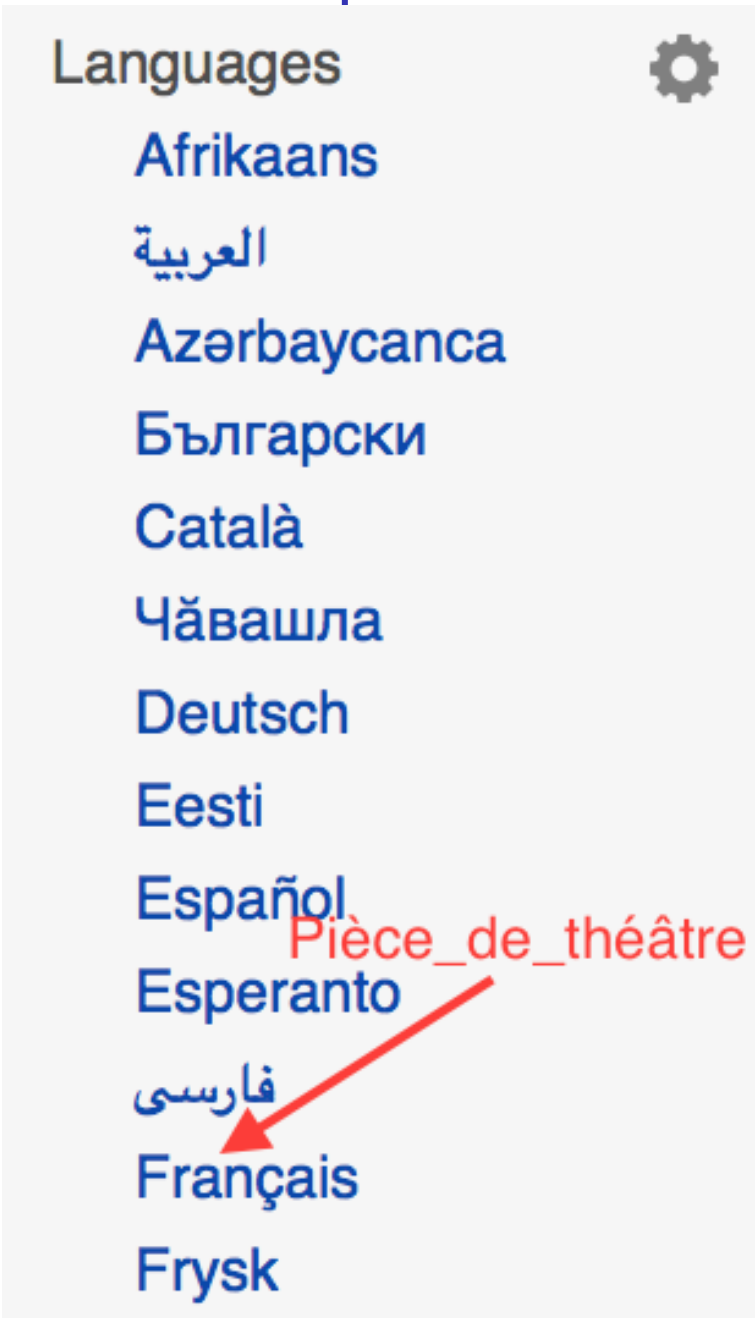

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- Wikipedia: Community Built Multilingual Encyclopedic Database
  - Pages represent an encyclopedic entry (a concept ?)
  - Disambiguation pages, pages redirects, links to other Wikipedia language editions
- Wiktionary: community built multilingual dictionaries
  - Many different language editions, most of them containing entries in different languages
  - Language editions are poorly structured (different macro-structures, different use of the wiki markup language)

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### Pronunciation [edit]

- enPR: plā, IPA(key): /pleɪ/
- Audio (US) 0:00 MENU
- Rhymes: -eɪ

### Verb [edit]

**play** (*third-person singular simple present* **plays**, *present participle* **playing**, *simple past and past participle* **played**)

1. (*intransitive*) To act in a manner such that one has fun; to engage in activities expressly for the purpose of recreation or entertainment. [quotations ▼]

   *They **played** long and hard.*

2. (*ergative*) To perform in (a sport); to participate in (a game).

   *He **plays** on three teams. Who's **playing** now? **play** football; **play** sports; **play** games*

   1. (*transitive*) To compete against, in a game. [quotations ▼]

3. (*intransitive*) To take part in amorous activity; to make love, fornicate; to have sex. [quotations ▼]
4. (*transitive*) To act as the indicated role, especially in a performance. [quotations ▼]

   *He **plays** the King, and she's the Queen. No part of the brain **plays** the role of permanent memory.*

5. (*heading*, *transitive*, *intransitive*) *To produce music or theatre.*

   1. (*intransitive*, *of a music*) To produce music. [quotations ▼]
   2. (*intransitive*, *chiefly of a person*) To produce music using a musical instrument.

# Mediawiki promotes several projects with lexical knowledge

**Translations** [edit]

**playful activity** [show ▼]

**literary composition** [show ▼]

**theatrical performance** [hide ▲]

Select targeted languages

- American Sign Language: A@Left1Chesthigh-A@Right1Chesthigh Upanddown
- Arabic: مَسْرَح *m* (masraḥ), مَسْرَحِيَّة *f* (masraḥiyya)
- Armenian: ներկայացում (nerkayacʻum)
- Catalan: obra *f*
- Chinese:
  - Mandarin: 戲劇, 戏剧 (zh) (xìjù), 話劇, 话剧 (zh) (huàjù)
- Czech: hra (cs) *f*
- Danish: stykke (da), spil
- Dutch: optreden (nl) *n*, schouwspel (nl) *n*, toneelstuk (nl) *n*, stuk (nl) *n*
- Erzya: налкума (nalkuma)
- Esperanto: teatraĵo
- Ewe: fefe
- Finnish: näytelmä (fi)
- French: pièce de théâtre (fr) *f*
- German: Schauspiel (de) *n*
- Hebrew: מִשְׁחָק (he) *m* (mishāq)
- Hungarian: színdarab (hu), darab (hu)
- Indonesian: pentas (id), drama (id)
- Irish: dráma *m*
- Italian: dramma (it) *m*
- Japanese: 演劇 (ja) (えんげき, engeki), 戯曲 (ぎきょく, gikyoku)
- Korean: 연극 (ko) (yeon-geuk), 희곡 (ko) (huigok)
- Kurdish: şano (ku) *f*, piyes (ku) *f*, tiyatro (ku) *f*
- Latin: fabula (la) *f*
- Macedonian: представа *f* (predstava)
- Malayalam: നാടകം (ml) (nāṭakaṃ)
- Norwegian:
  - Bokmål: skuespill *n*
  - Nynorsk: skodespel *n*
- Persian: پیس (pies)
- Polish: sztuka (pl) *f*
- Portuguese: peça *f*
- Russian: пье́са (ru) *f* (pʹjésa), спекта́кль (ru) *m* (spektákl')
- Serbo-Croatian:
  - Cyrillic: представа *f*
  - Roman: prèdstava *f*
- Slovak: hra *f*
- Slovene: igra (sl) *f*
- Spanish: (please verify) obra teatral *f*
- Swahili: tamthilia (sw)
- Swedish: pjäs (sv) *c*, skådespel (sv) *n*, teaterpjäs (sv) *c*, teaterstycke *n*, drama (sv) *n*
- Tagalog: dula (tl)
- Telugu: నాటకం (te) (nāṭakaṃ)
- Turkish: oyun (tr), tiyatro oyunu
- Welsh: drama (cy) *f*

- Add translation : Preview translation More

# Mediawiki promotes several projects with lexical knowledge

## play

**Sommaire** [masquer]

[−] Anglais
- [×] Étymologie
- [+] Nom commun
- [+] Verbe
- [×] Prononciation
- [×] Voir aussi

### Anglais [ modifier | modifier le wikicode ]

#### Étymologie [ modifier | modifier le wikicode ]

*Étymologie manquante ou incomplète*. Si vous la connaissez, vous pouvez l'ajouter en cliquant ici.

Du moyen anglais.

#### Nom commun [ modifier | modifier le wikicode ]

**play** \'pleɪ\

1. Pièce de théâtre, pièce.
2. Activité de jouer.
   - *Not all **play** is learning and not all learning is **play**.* — (Jan VAN GILS, *Several Perspectives on Children's Play: Scientific Reflections for Practitioners*, 1 janvier 2007)
   - *The elementary school places an emphasis on learning, but also on **play** activities.*

| Singulier | Pluriel |
|---|---|
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  - Many different language editions, most of them containing entries in different languages
  - Language editions are poorly structured (different macro-structures, different use of the wiki markup language)
- Omegawiki: A structured dictionary
  - A common dictionary for all languages
  - DefinedMeanings: Definitions in several languages
  - Expressions: Term in a language associated to a defined meaning

# Mediawiki promotes several projects with lexical knowledge

## play

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# Mediawiki promotes several projects with lexical knowledge

## DefinedMeaning:852347 - act

▼ **Definition**

| Language | Text |
|---|---|
| Castilian | Participar como actor en una obra teatral. |
| English | To perform a theatrical role. |
| French | Participer comme acteur dans un film ou au théâtre. |
| Italian | Partecipare come attore in un ruolo teatrale o cinematografico. |
| Turkish | Bir aktör olarak film veya sahne gösterisine katılmak. |

▼ **Synonyms and translations**

| | Expression | | |
|---|---|---|---|
| | **Language** | **Spelling** | **Annotation** |
| | Bavarian | spöin | show ▼ |
| | Bavarian | spuin | show ▼ |
| | Castilian | actuar | show ▼ |
| | Castilian | escenificar | show ▼ |
| | Castilian | interpretar | show ▼ |
| ≈ | Castilian | declamar | show ▼ |
| ≈ | Castilian | protagonizar | show ▼ |
| ≈ | Castilian | recitar | show ▼ |
| | Dutch | acteren | show ▼ |
| | Dutch | spelen | show ▼ |
| | English | act | show ▼ |
| | English | do | show ▼ |

4 Electronic Dictionary Research

5 Wordnet and EuroWordnet

6 Wiki projects as Lexical Knowledge

7 BabelNet

8 The Papillon dictionary

9 The LexALP project

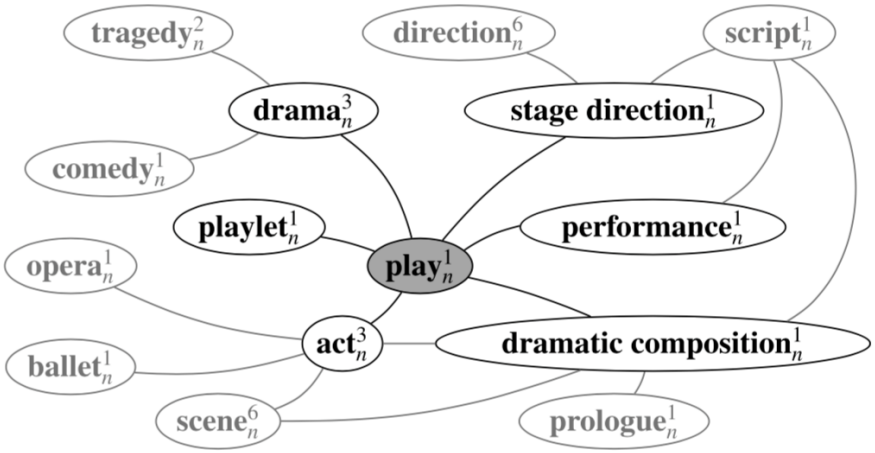
# Overview of the BabelNet data set

- One of the results of the MultiJEDI ERC Grant (Europe)
- R. Navigli, Sapienza University of Rome
- A HUGE Multilingual Network of Words/Concepts
- Structure inspired by Wordnet
- Most data aggregated from other existing lexical data
  - Originally, Wordnet + Wikipedia (+ MT systems)
  - Open Multilingual Wordnet, OmegaWiki, Wiktionary, Wikidata, GeoNames, Verbnet, Wikiquotes, WoNeF, Microsoft multilingual terminology

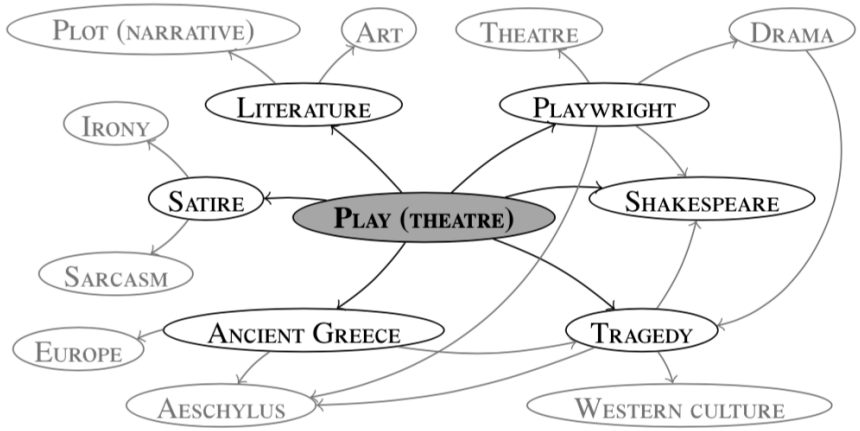
# Structure of the BabelNet data set

- Babel synsets (a set of words, like wordnet synsets, but in different languages),
- Defined by aggregating Wordnet synsets and wikipedia pages
- Then, missing translations are computed using an MT System
- data is now available as Lexical Linked Data (Lemon Model, see later)

# Structure of the BabelNet data set




(a) Excerpt of the WordNet graph centered on the synset play$^1_n$.




(b) Excerpt of the Wikipedia graph centered on the Wikipage PLAY (THEATRE).

# Structure of the BabelNet data set



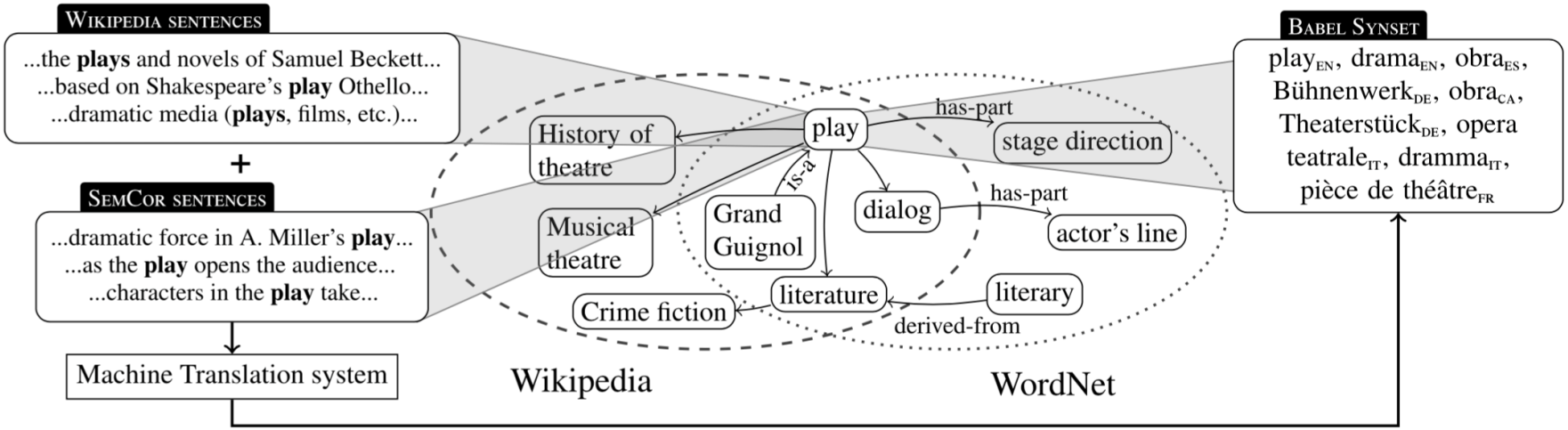



**Fig. 2.** An illustrative overview of BabelNet (we label nodes with English lexicalizations only): unlabeled edges are obtained from links in the Wikipages (e.g., PLAY (THEATRE) links to MUSICAL THEATRE), whereas labeled ones from WordNet (e.g., play$^1_n$ *has-part* stage direction$^1_n$).

# Structure of the BabelNet data set

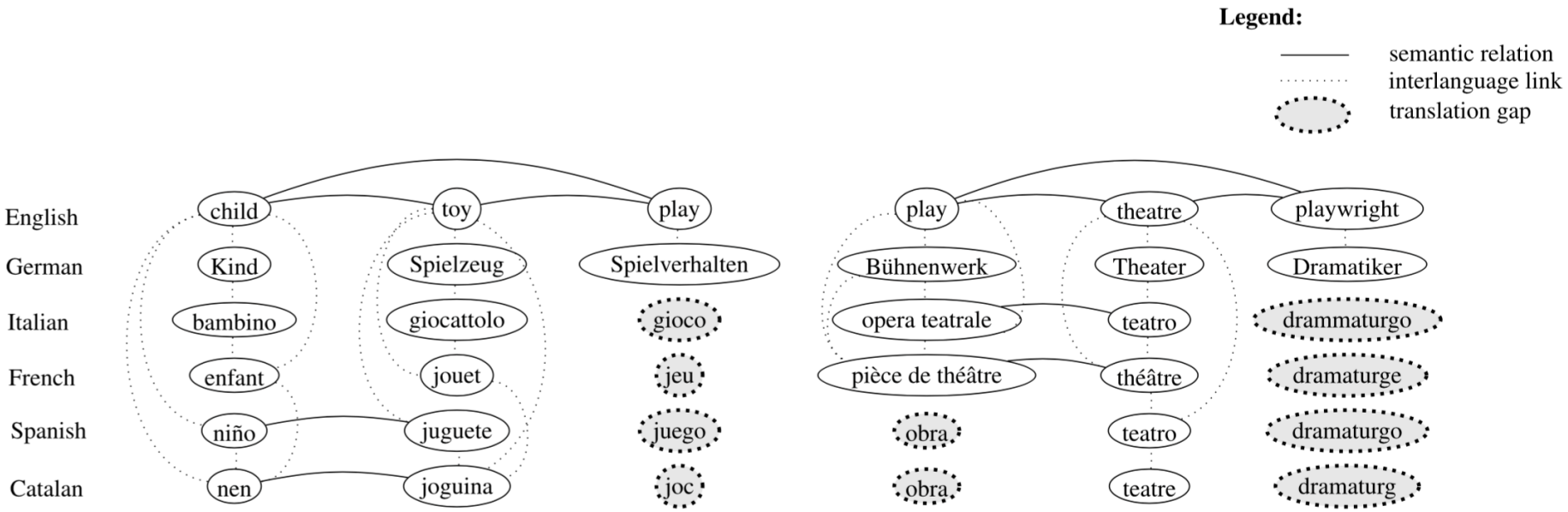



**Fig. 4.** Translating Babel synsets based on a Machine Translation system. In order to fill lexical gaps (i.e., missing translations, typically for resource-poor languages), sense-annotated data are collected from SemCor and Wikipedia, and their most frequent translations are included as additional lexicalizations in the network.

# Structure of the BabelNet data set

## BabelNet 3.5: General statistics

| | |
|---|---|
| **Number of languages:** | 272 |
| **Total number of Babel synsets:** | 13,801,844 |
| **Total number of Babel senses:** | 119,036,997 |
| **Total number of concepts:** | 6,066,256 |
| **Total number of Named Entities:** | 7,735,588 |
| **Total number of lexico-semantic relations:** | 380,239,084 |
| **Total number of glosses (textual definitions):** | 40,634,604 |
| **Total number of images:** | 10,767,833 |
| **Total number of Babel synsets with at least one domain:** | 1,558,806 |
| **Total number of compounds:** | 743,296 |
| **Total number of Babel synsets with at least one picture:** | 2,948,668 |
| **Total number of RDF triples:** | 1,951,194,299 |

4 Electronic Dictionary Research

5 Wordnet and EuroWordnet

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8 The Papillon dictionary

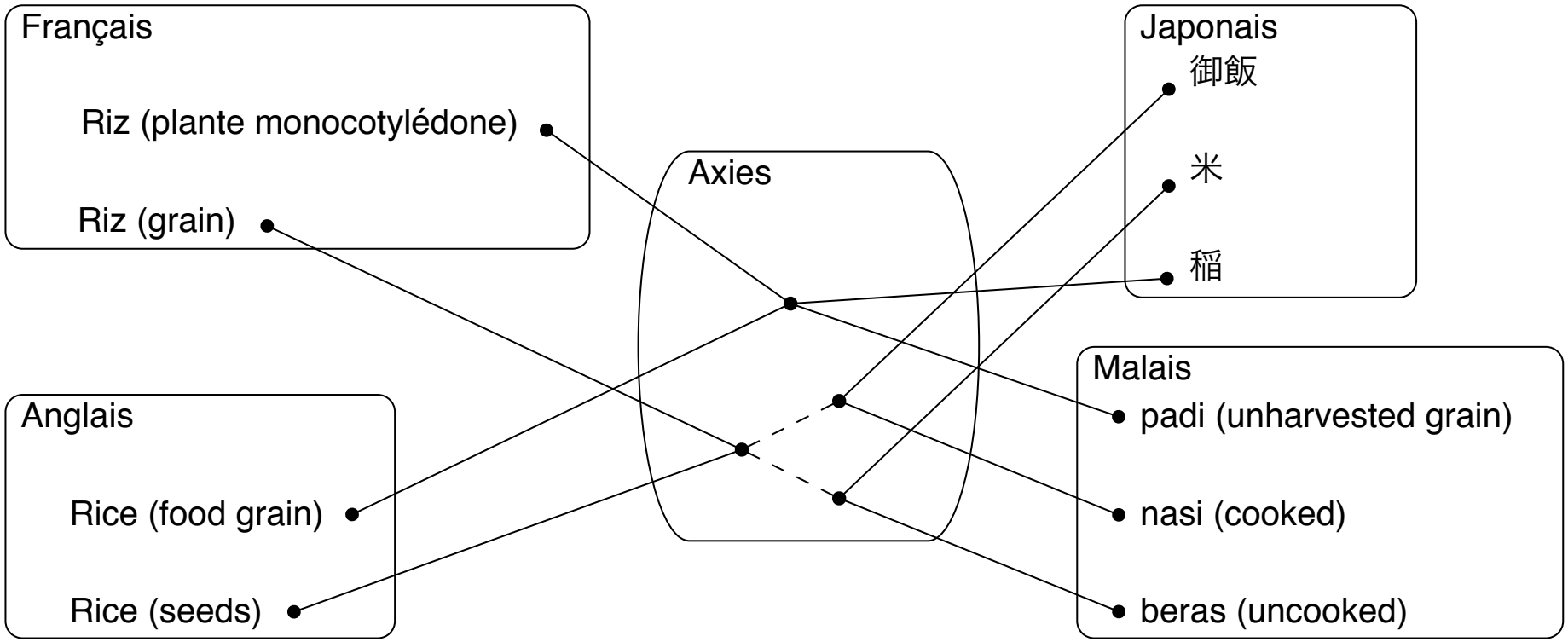
9 The LexALP project

# Overview of the Papillon Project

- Initialy launch by a French Japanese consortium (2000)
- Quickly extended itself to a larger consortium
  - with partners in Australia, Canada, China, France, Germany, Japan, Malaysia, Thailand, Vietnam...
  - ...and accepting any new partner motivated enough to join the adventure...
- Aims at the development of a rich, "open source", multilingual lexical database

# Architecture of the Data

## Macrostructure: An acception based multilingual lexical database



# Architecture of the Data

## A microstructure inspired by Mel'čuk's ECD and Polguère's DICO

**regretter ,**

**v.tr.**

sentiment LA personne X ~ SON action Y

**GOVERNMENT PATTERN**

X = I  Y = II

1 . N
1 . N
2 . de V-inf

**LEXICAL FUNCTIONS**

QSyn : se repentir

S0 : regret#1

Able2 : ( *Que l'on peut R.* ) regrettable

Magn : ( *Intensément* ) beaucoup

Y étant grave, Magn : amèrement , cruellement ; _se mordre les doigts_

**EXAMPLES**

1 . *C'est une décision qu'il va regretter cruellement.*

2 . *Il ne regrette pas d'avoir investi 4 000 F dans ce nouveau programme.*

# Mel'čuk's ECD and Lexical Functions: Motivations

| | | |
|---|---|---|
| gros fumeur | lit. trans. | big smoker |
| | actual trans. | heavy smoker |

An MT system has to identify that gros fumeur is a collocation, something between a free combination and a full idiom

# Mel'čuk's ECD and Lexical Functions

Following Meaning-Text terminology, we call collocation a linguistic expression made up of two components:

- the base of the collocation: a full lexical unit which is "freely" chosen by the speaker on the basis of its meaning (e.g. 'smoker' $\rightarrow$ smoker);
- the collocate: a lexical unit or a multilexical expression which is chosen in a (partially) arbitrary way to express a given meaning and/or a grammatical structure contingent upon the choice of the base (e.g. 'intense' $\rightarrow$ heavy).

# Mel'čuk's ECD and Lexical Functions

Rich bilingual dictionary

- fumeur $\Leftrightarrow$ smoker
- gros fumeur $\Leftrightarrow$ heavy smoker

Minimal bilingual dictionary

- fumeur $\Leftrightarrow$ smoker

+ rich monolingual dictionaries

- intensification(fumeur) = gros
- intensification(smoker) = heavy

# Mel'čuk's ECD and Lexical Functions

Collocations are numerous and various in nature.

E.g.: COLÈRE 'anger'

- colère aveugle/noire, lit. 'blind/black anger'
- colère sourde/froide, lit. 'deaf/cold anger'
- fou/ivre de colère, lit. 'mad/drunk of anger'
- rouge/blanc de colère, lit. 'red/white of anger'

etc.

# Mel'čuk's ECD and Lexical Functions: Collocation and Semantic Derivation

Intensification of rain:

- torrential (collocate)
- downpour (semantic derivation)
- torrential rain  downpour

Semantic derivations

- (quasi)synonymy/antonymy
- verbal, nominal, adjectival or adverbial derivations
- name of a participant or circonstant, e.g. crime is linked to author [of a crime] or criminal, victim, instrument [of a crime], etc.

Both types of lexical relation could and should be encoded by the same conceptual device

# Mel'čuk's ECD and Lexical Functions: Collocations as Functions

Concept of LF: Zholkovskij & Mel'čuk 1965
Base-collocate relations are oriented

| | | |
|---|---|---|
| Magn | (rain) | = torrential |
| function | (base) | = collocate |

# Architecture of the Data

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# LexALP Project Motivations

- The Alpine Convention gathers European countries who agrees on certain rules on
  - environment, spatial planning, transport infrastructure, ...
  - for the Alpine Space (from Monaco to Slovenia)

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- But these rules need to be carefully worded
  - and negotiators often disagree on the wording of documents
  - (half the time of meetings spent in discussions about the minutes)

# LexALP Project Motivations

- The Alpine Convention gathers European countries who agrees on certain rules on
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- But these rules need to be carefully worded
  - and negotiators often disagree on the wording of documents
  - (half the time of meetings spent in discussions about the minutes)
- Moreover, these rules should be implemented by participating states
  - hence, adequate terminology should be used in each country
  - to correctly refer to existing laws

# Examples of Legal Language Problems

- Different terms for the same meaning
  - chien drogue is used in European texts...
  - ...when texts from France use chien renifleur

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- Different meanings for the same term
  - Landeshauptmann in Bolzano (Italy)...
  - ...has much less power than an Austrian Landeshauptmann
- Superficial translation leads to legal differences
  - elezione suppletiva is commonly held whenever an elected deputy or senator either resigns or dies
  - Ersatzwahlen are very rare, as in Germany the first non-elected candidate is called to parliament

# A Legal Language Harmonisation System

## For Environment and Spatial Planning within the Multilingual Alps

- Describe legal terminology of the Alpine Convention (in its four languages)
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- Link it to the equivalent/near-equivalent terms in the national legal systems

# A Legal Language Harmonisation System

## For Environment and Spatial Planning within the Multilingual Alps

- Describe legal terminology of the Alpine Convention (in its four languages)
- Harmonise it

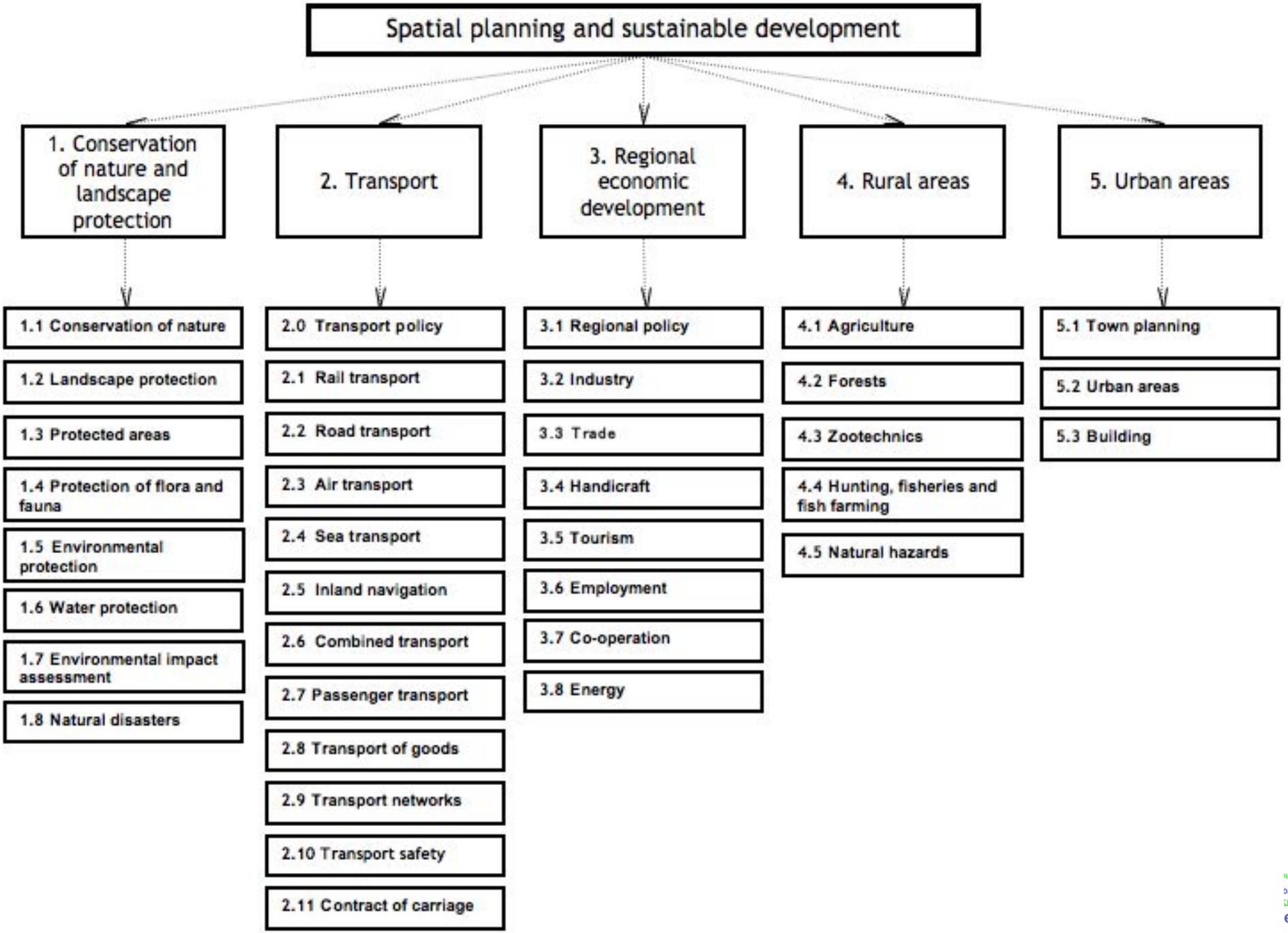
→ For use by negotiators and translators of the Alpine Convention

- Link it to the equivalent/near-equivalent terms in the national legal systems

→ For use by jurist who will implement the law in other legal systems

# LexALP Bibliographic Database

- Legal documents are collected (in raw text format)
- Along with their classification:
  - title of the document
  - short title of the document
  - abbreviation of the document
  - language
  - legal system
  - legal hierarchy (e.g. national, regional, supranational)
  - legal text type
  - translation status (original or translation)
  - subfield


Spatial planning and sustainable development
1. Conservation of nature and landscape protection
2. Transport
3. Regional economic development
4. Rural areas
5. Urban areas
1.1 Conservation of nature
1.2 Landscape protection
1.3 Protected areas
1.4 Protection of flora and fauna
1.5 Environmental protection
1.6 Water protection
1.7 Environmental impact assessment
1.8 Natural disasters
2.0 Transport policy
2.1 Rail transport
2.2 Road transport
2.3 Air transport
2.4 Sea transport
2.5 Inland navigation
2.6 Combined transport
2.7 Passenger transport
2.8 Transport of goods
2.9 Transport networks
2.10 Transport safety
2.11 Contract of carriage
3.1 Regional policy
3.2 Industry
3.3 Trade
3.4 Handicraft
3.5 Tourism
3.6 Employment
3.7 Co-operation
3.8 Energy
4.1 Agriculture
4.2 Forests
4.3 Zootechnics
4.4 Hunting, fisheries and fish farming
4.5 Natural hazards
5.1 Town planning
5.2 Urban areas
5.3 Building

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  - subfield
  - + additional fields depending on the legal system

# LexALP Bibliographic Database

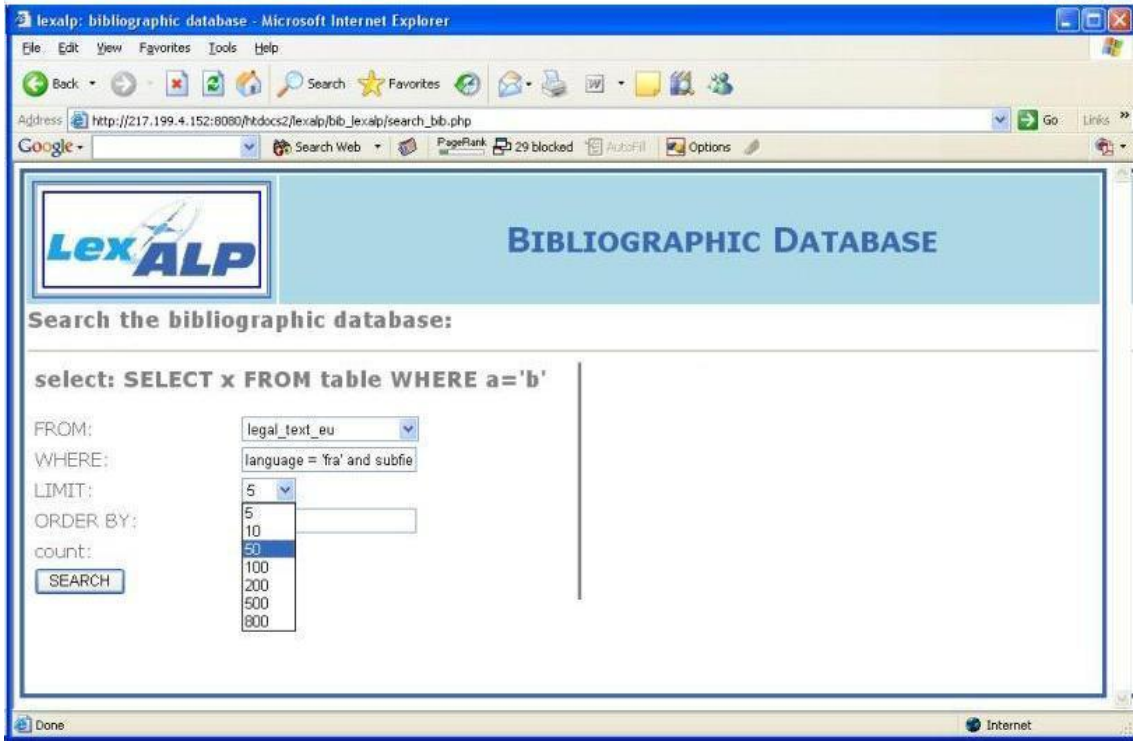
**Title:**
**92/421/CEE: Décision du Conseil, du 13 juillet 1992, concernant un plan d'actions communautaires en faveur du tourisme**

created the 10.03.2006 by GrP_EURAC

| | |
|---|---|
| abbreviation: | déc. |
| language: | fra |
| translation status: | OL |
| legal system: | EU |
| legal hierarchy: | supranational |
| legal text type: | décision |
| subfield1: | 3.5 Tourism |
| official date: | 13.07.1992 |
| official journal date: | 13.08.1992 |
| official journal nb: | L 231 |
| number: | 92/421 |
| identification number: | 88836 |
| show: | * doc in cache |
| | * doc in www |

# LexALP Bibliographic Database

→ this leads to a bibliographic database
that contains documents of the corpus,
but also documents that are not available in the corpus



# LexALP Document Structure

- The documents of each legal system are automatically annotated by the means of several scripts.
- The annotation is done on a structural level taking into account textual subdivisions (sentences etc.) as well as subdivisions particular to legal documents (chapters, articles, ...).

```
<div type="section" id="FR_U3_ENVIR-PL-L4-T2-44-14-11.xml.b.c0.se3">
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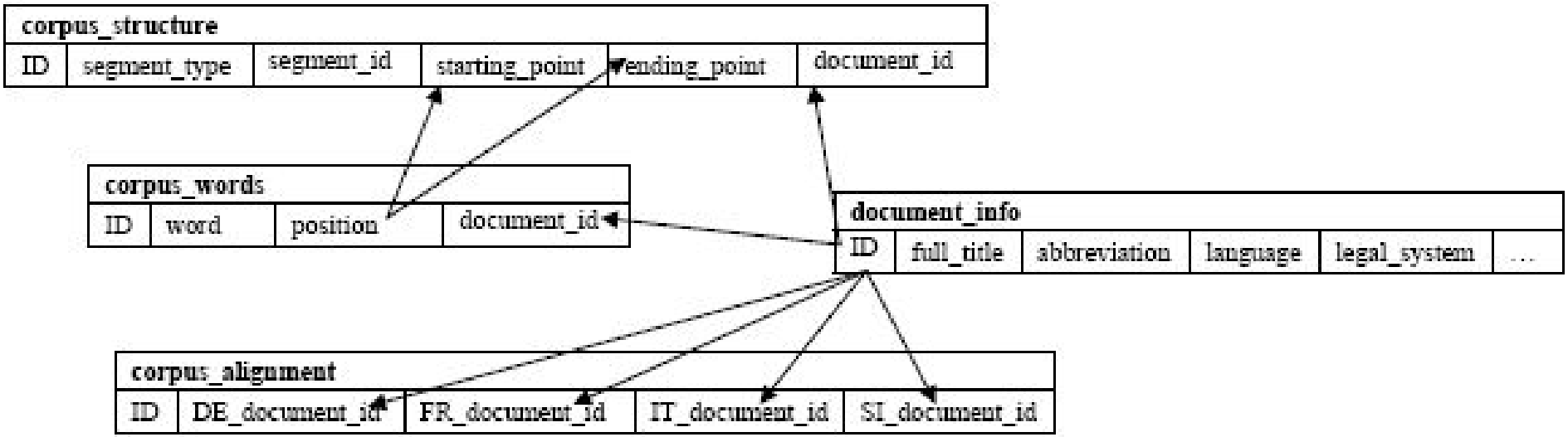
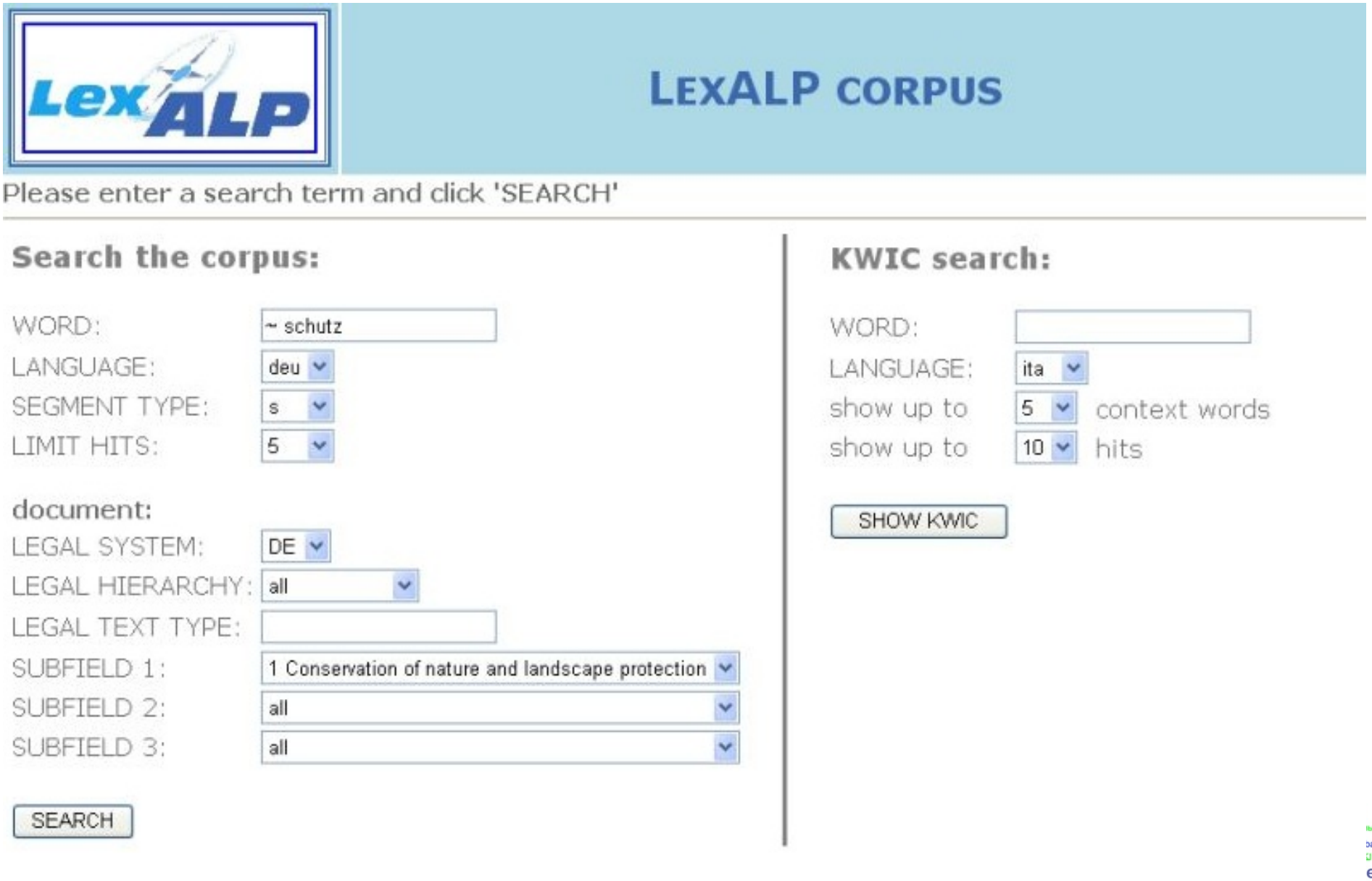
  <title id="FR_U3_ENVIR-PL-L4-T2-44-14-11.xml.b.c0.se3.p0.ti1">
   Article L420-3
   (Loi n° 2005-157 du 23 février 2005 art. 150, art. 151,
    art. 154 Journal Officiel du 24 février 2005)
  </title></p>
 <p id="FR_U3_ENVIR-PL-L4-T2-44-14-11.xml.b.c0.se3.p1">
  <s id="FR_U3_ENVIR-PL-L4-T2-44-14-11.xml.b.c0.se3.p1.s1">
   Constitue un acte de chasse tout acte volontaire lié à la recherche,
   à la poursuite ou à l'attente du gibier ayant pour but ou pour résultat
   la capture ou la mort de celui-ci.
  </s></p>
```

# LexALP Corpus Structure



# LexALP Corpus Search



# LexALP Corpus Search

**LEXALP CORPUS**

**Output of your search for the word '~ schutz':**

| N | bib infos | segment | key |
|---|---|---|---|
| 1 | DETAILS | In den Fällen des Satzes 1 hat der Arbeitgeber den betreffenden Beschäftigten Schutzkleidung und Atemschutzgeräte zur Verfügung zu stellen , die sie während der gesamten Dauer der erhöhten Exposition tragen müssen . | art. 11 |
| 2 | DETAILS | ( 1 ) Im Rahmen der nach § 3 des Arbeitsschutzgesetzes zu treffenden Maßnahmen hat der Arbeitgeber für eine angemessene arbeitsmedizinische Vorsorge zu sorgen . | art. 15 |
| 3 | DETAILS | 5 . die Fortentwicklung des betrieblichen Gesundheitsschutzes bei Tätigkeiten mit Gefahrstoffen auf der Grundlage gewonnener Erkenntnisse . | art. 15 |
| 4 | DETAILS | ( 2 ) Unbeschadet des § 22 des Arbeitsschutzgesetzes ist der zuständigen Behörde auf ihr Verlangen Folgendes mitzuteilen: | art. 19 |
| 5 | DETAILS | 3 . die nach § 13 des Arbeitsschutzgesetzes verantwortlichen Personen, | art. 19 |
| 6 | DETAILS | 5 . die geplanten Sicherheitsmaßnahmen zur Gewährleistung des Gesundheitsschutzes und der Sicherheit der betroffenen Beschäftigen, | art. 20 |
| 7 | DETAILS | ( 1 ) Zur Beratung in allen Fragen des Arbeitsschutzes zu Gefahrstoffen wird beim Bundesministerium für Wirtschaft und Arbeit der Ausschuss für Gefahrstoffe ( AGS ) gebildet , in dem fachkundige Vertreter der Arbeitgeberverbände , der Gewerkschaften, der Länderbehörden , der Träger der gesetzlichen Unfallversicherung und weitere fachkundige Personen , insbesondere der Wissenschaft , in angemessener Zahl vertreten sein sollen . | art. 21 |
| 8 | DETAILS | d ) das Gefährdungspotential der Untersuchungstechnik für den Beschäftigten . Bei der Wahrnehmung seiner Aufgaben berücksichtigt der Ausschuss für Gefahrstoffe die allgemeinen Grundsätze des Arbeitsschutzes nach § 4 des Arbeitsschutzgesetzes . | art. 21 |
| 9 | DETAILS | ( 6 ) Die Geschäfte des Ausschusses führt die Bundesanstalt für Arbeitsschutz und Arbeitsmedizin . | art. 21 |

# The LexALP term bank

- The term bank is a collection of "lexies"
- Each lexie represents a word sense (or acceptation) of the domain
  - ex: principe de précaution $\neq$ principe de précaution
  - ex: chien renifleur $\neq$ chien drogue
- Lexies are linked by interlingual relations called "axies"

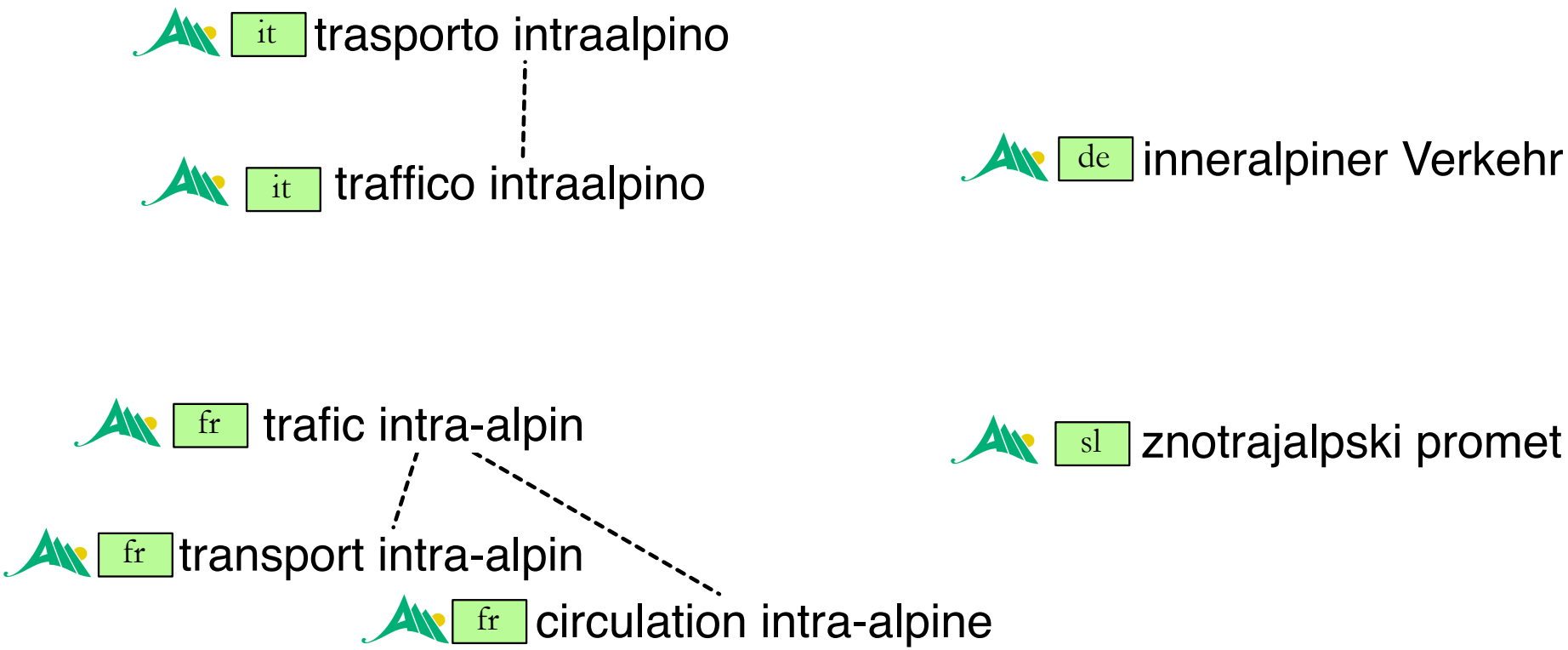
# Building the LexALP Term Bank

## Monolingual step

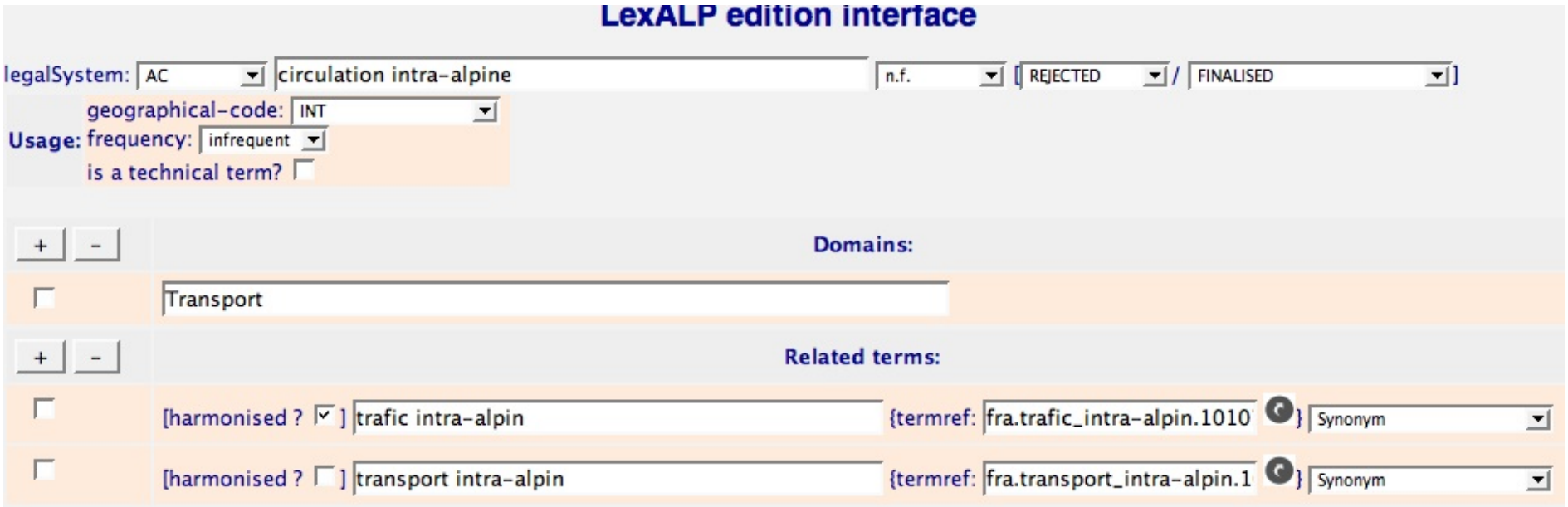
1. Develop a quadrilingual term bank
   - French, German, Italian and Slovenian
   - based on Alpine Convention texts

# Building the LexALP Term Bank

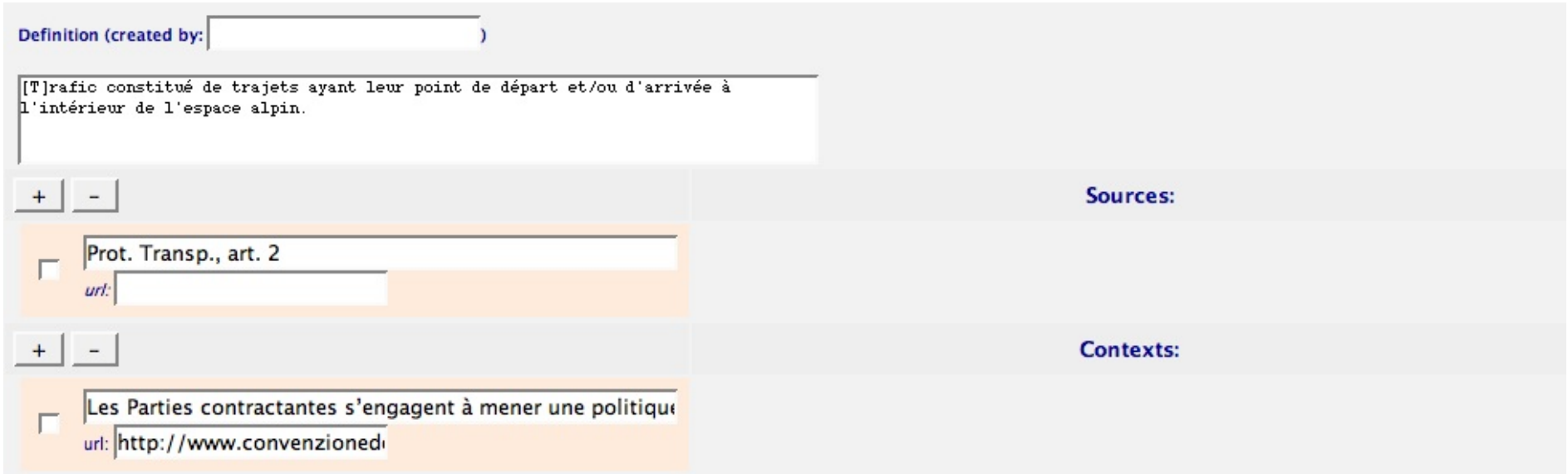
## Monolingual step



# LexALP Microstructure



# LexALP Microstructure



# Building the LexALP Term Bank

## Multilingual steps

- Develop a quadrilingual term bank
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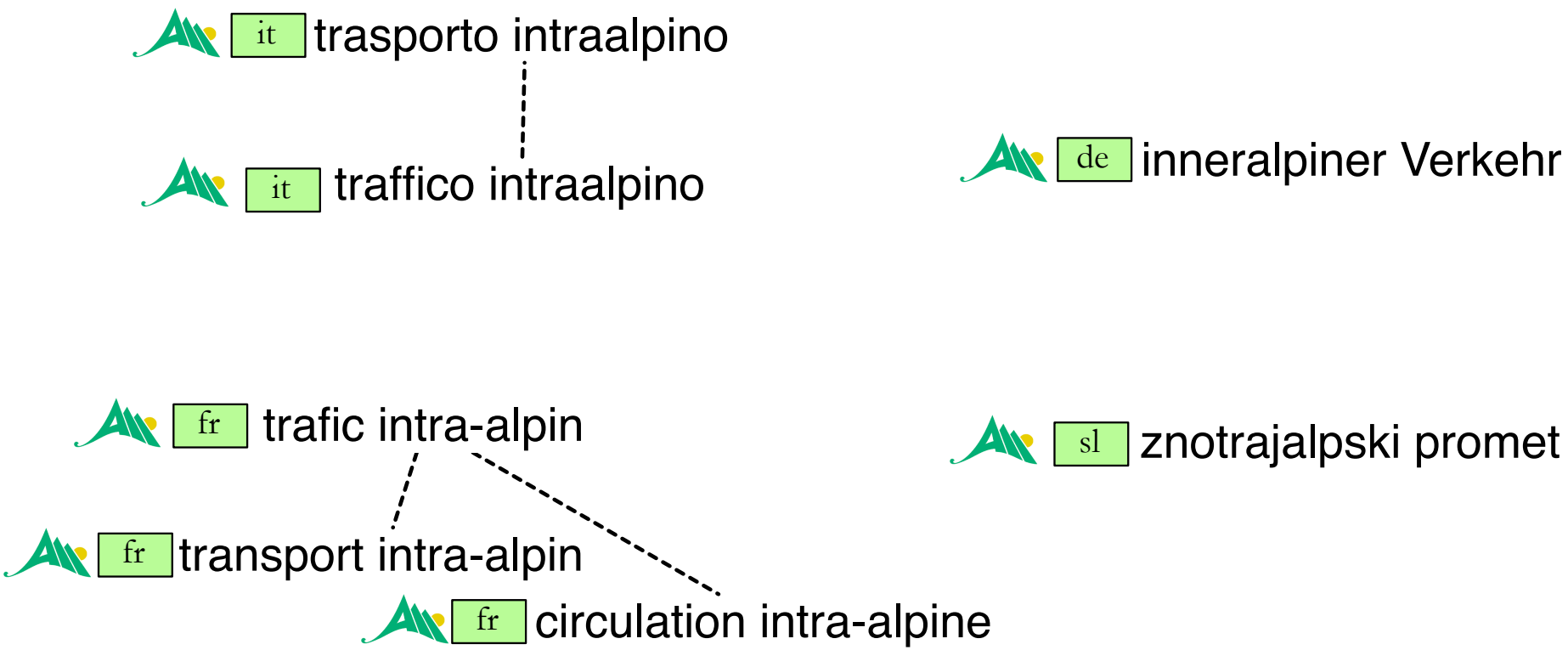
# Building the LexALP Term Bank

## Multilingual steps



# Building the LexALP Term Bank

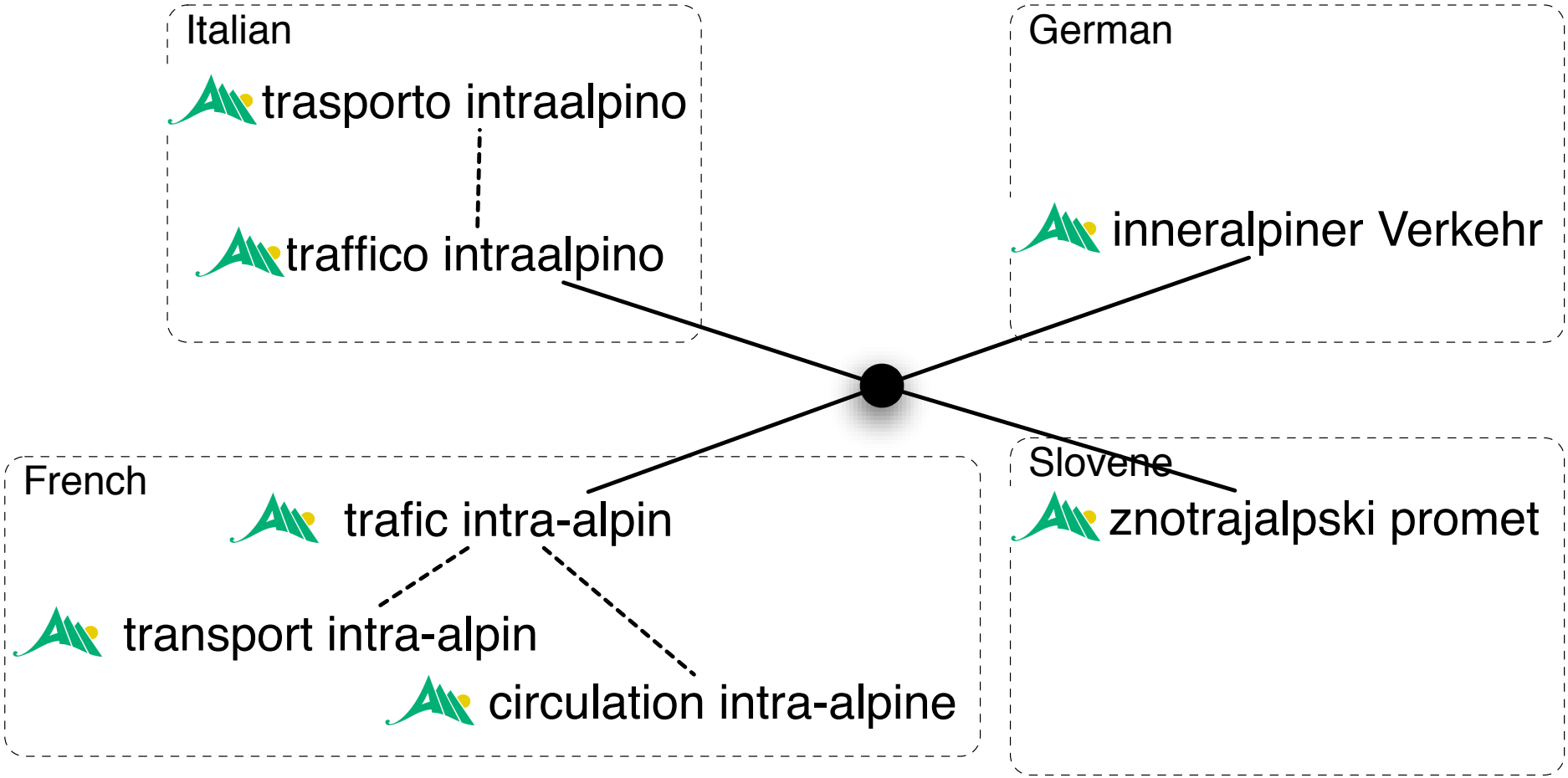
## Multilingual steps

- Develop a quadrilingual term bank
  - French, German, Italian and Slovenian
  - based on Alpine Convention texts
- Link equivalents on the Alpine Convention level

→ We use "axies" (with an e) for the multilingual interoperability

# Building the LexALP Term Bank

## Multilingual steps



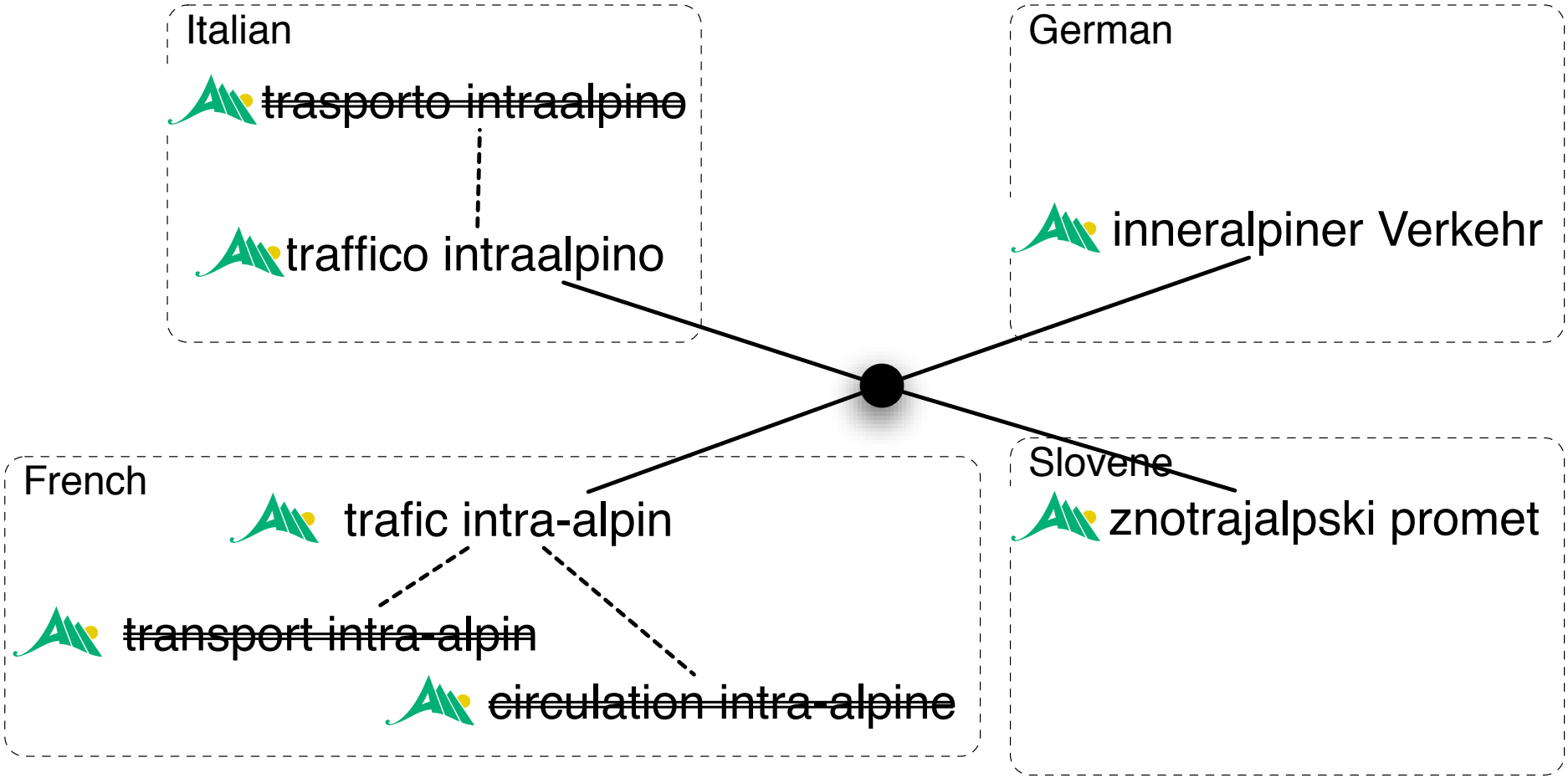
# Building the LexALP Term Bank

## Multilingual steps

- Develop a quadrilingual term bank
  - French, German, Italian and Slovenian
  - based on Alpine Convention texts
- Link equivalents on the Alpine Convention level
- Harmonize the terms at the Alpine Convention level

# Building the LexALP Term Bank

## Multilingual steps



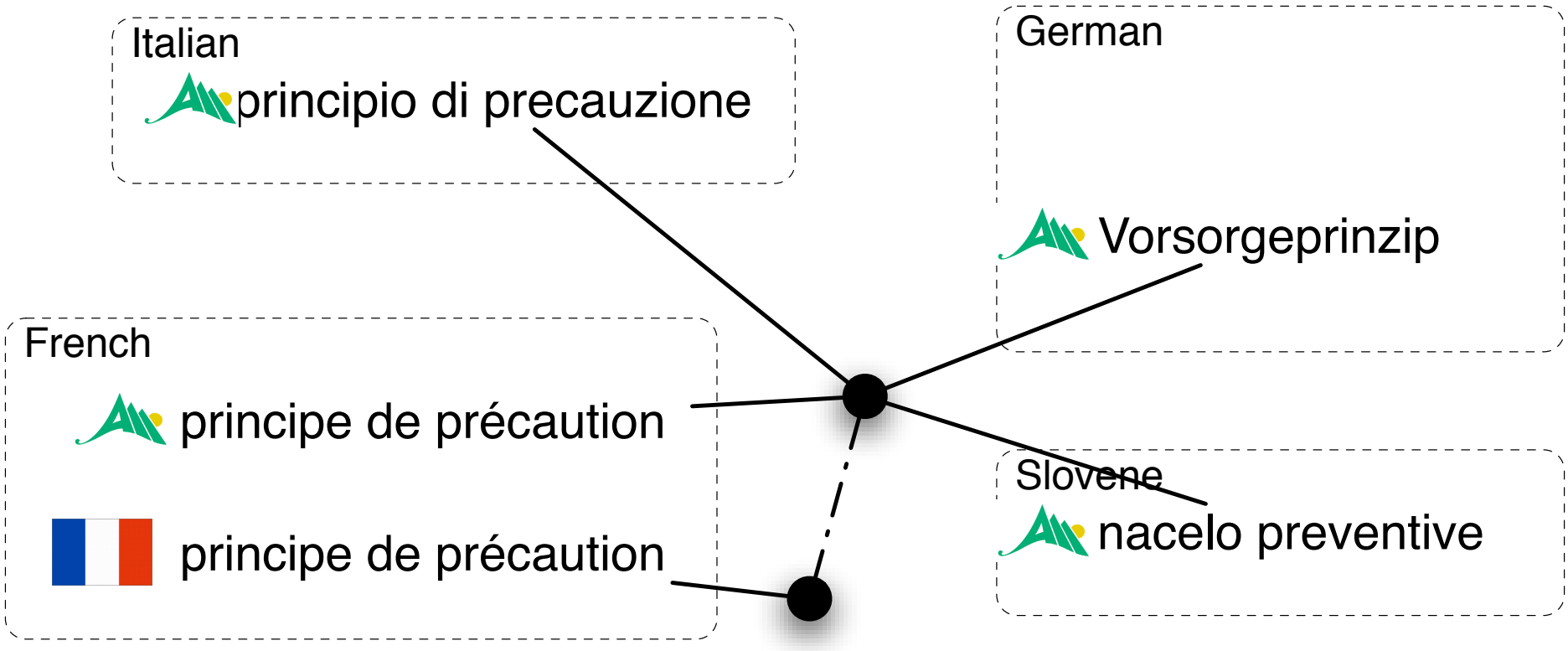
# Building the LexALP Term Bank

## Multilingual steps

- Develop a quadrilingual term bank
  - French, German, Italian and Slovenian
  - based on Alpine Convention texts
- Link equivalents on the Alpine Convention level
- Harmonize the terms at the Alpine Convention level
- Link these terms with related terms defined in national legal texts
  - Austria, France, Germany, Italy, Slovenia, Switzerland (Monaco, Liechtenstein)
  - based on national/regional legal texts

# Building the LexALP Term Bank

## Multilingual steps



# Part III

# Ontologies and the Lexicon

10 Introduction

11 Lexical Systems (Polguère)

12 Ontolex/Lemon Model

13 DBnary

# Structuring the dictionary as a graph

1. No more "entry" (but you need to type your nodes somehow)

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# Structuring the dictionary as a graph

1. No more "entry" (but you need to type your nodes somehow)
2. May be represented in RDF
3. Leads to the Lexical Web
4. Properties of arcs may be used to rationalize the MLDB data
   - you can still provide a "natural" way to present your data

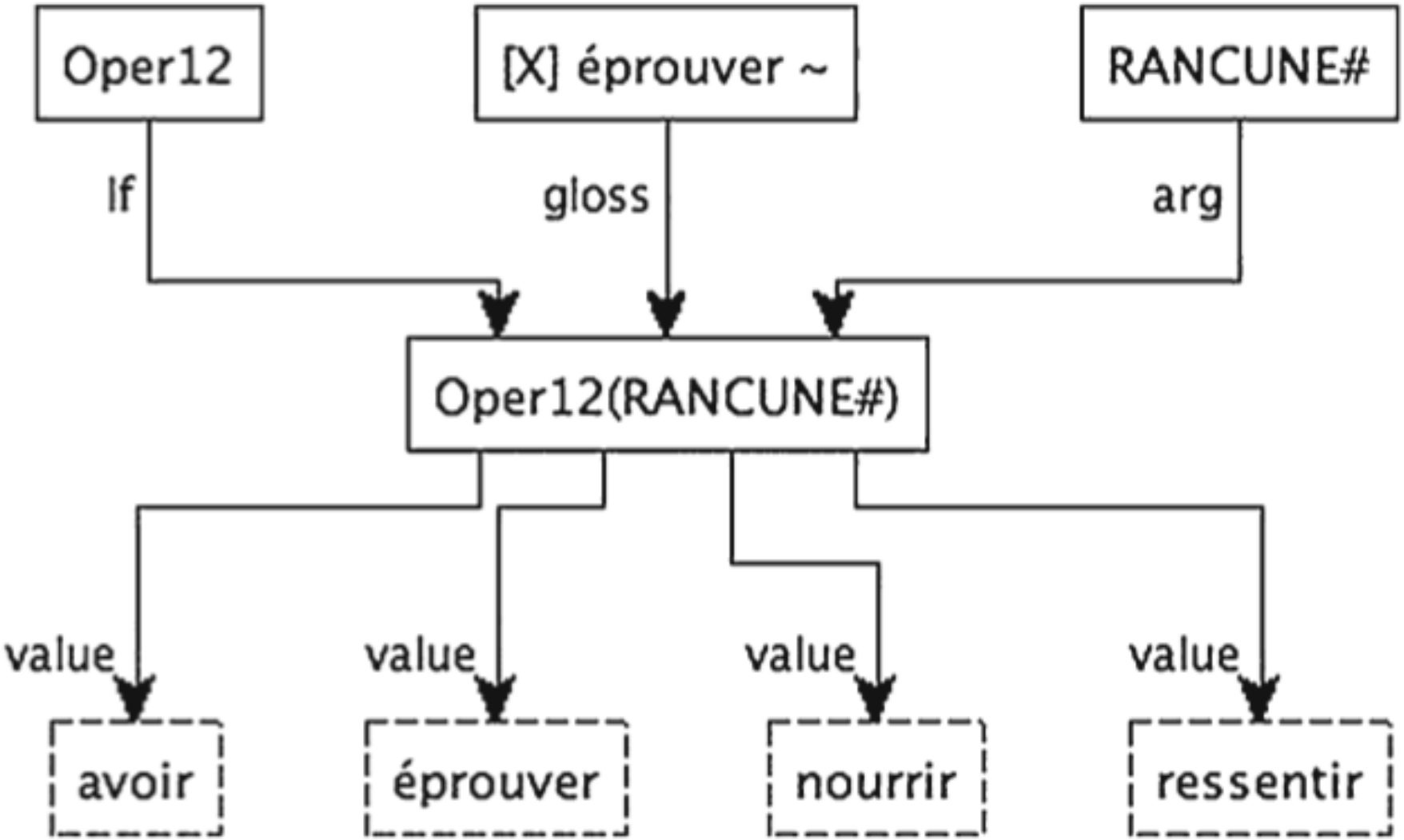
10 Introduction

11 Lexical Systems (Polguère)

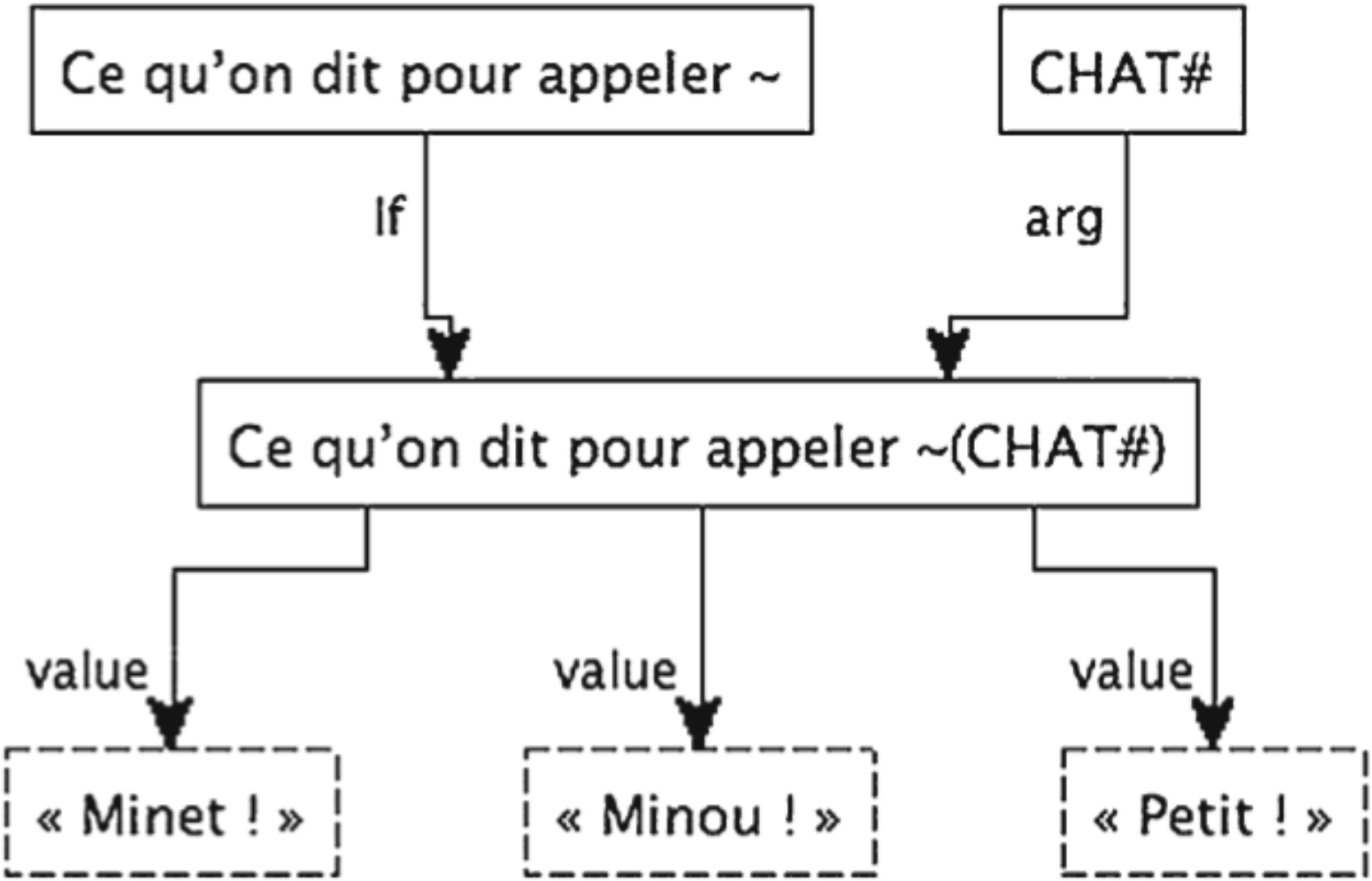
12 Ontolex/Lemon Model

13 DBnary

# Example: Mel'čuk ECD as a Lexical System (A. Polguère)



# Example: Mel'čuk ECD as a Lexical System (A. Polguère)



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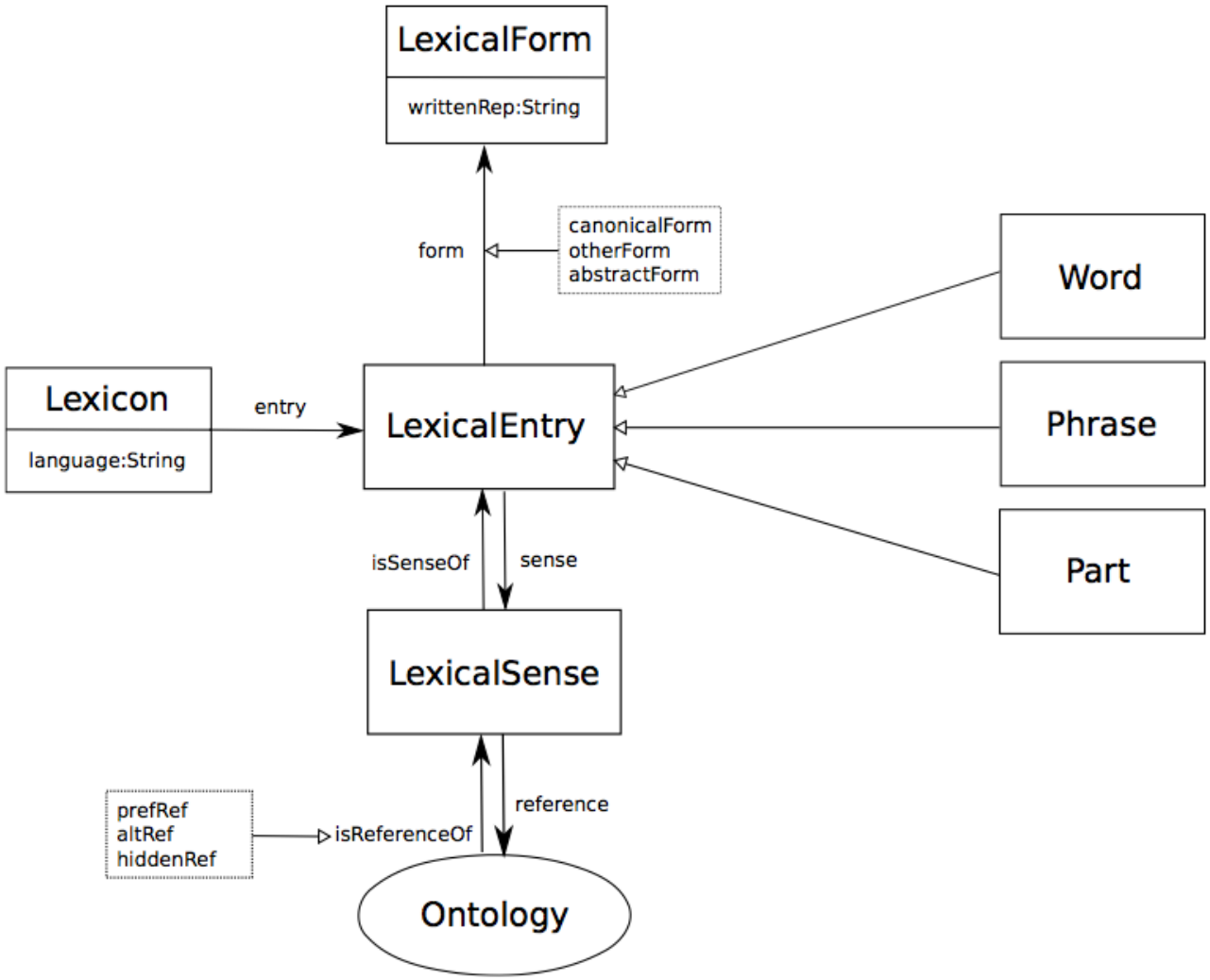
# The Ontolex/Lemon Model (current w3c discussion group)



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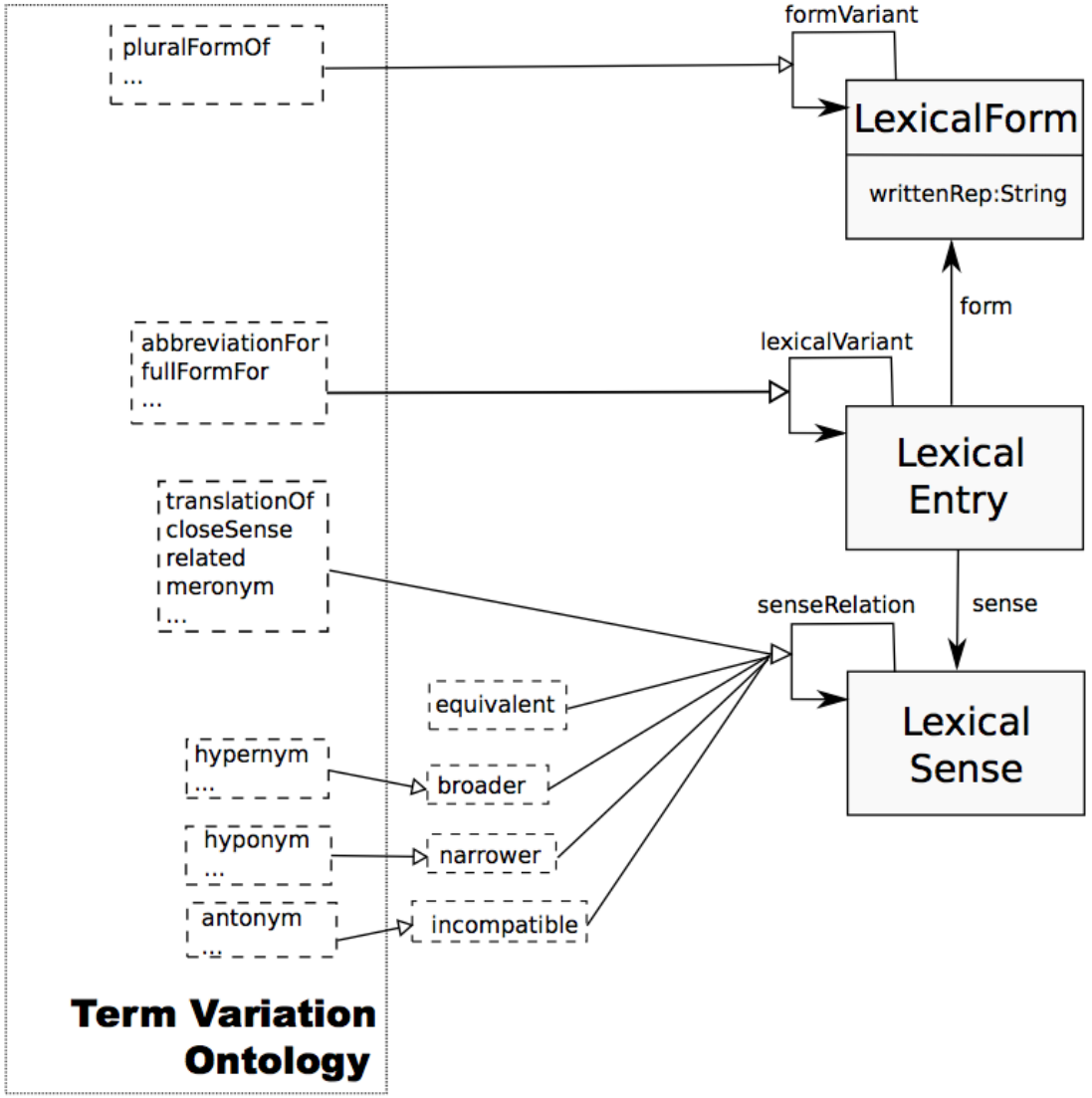

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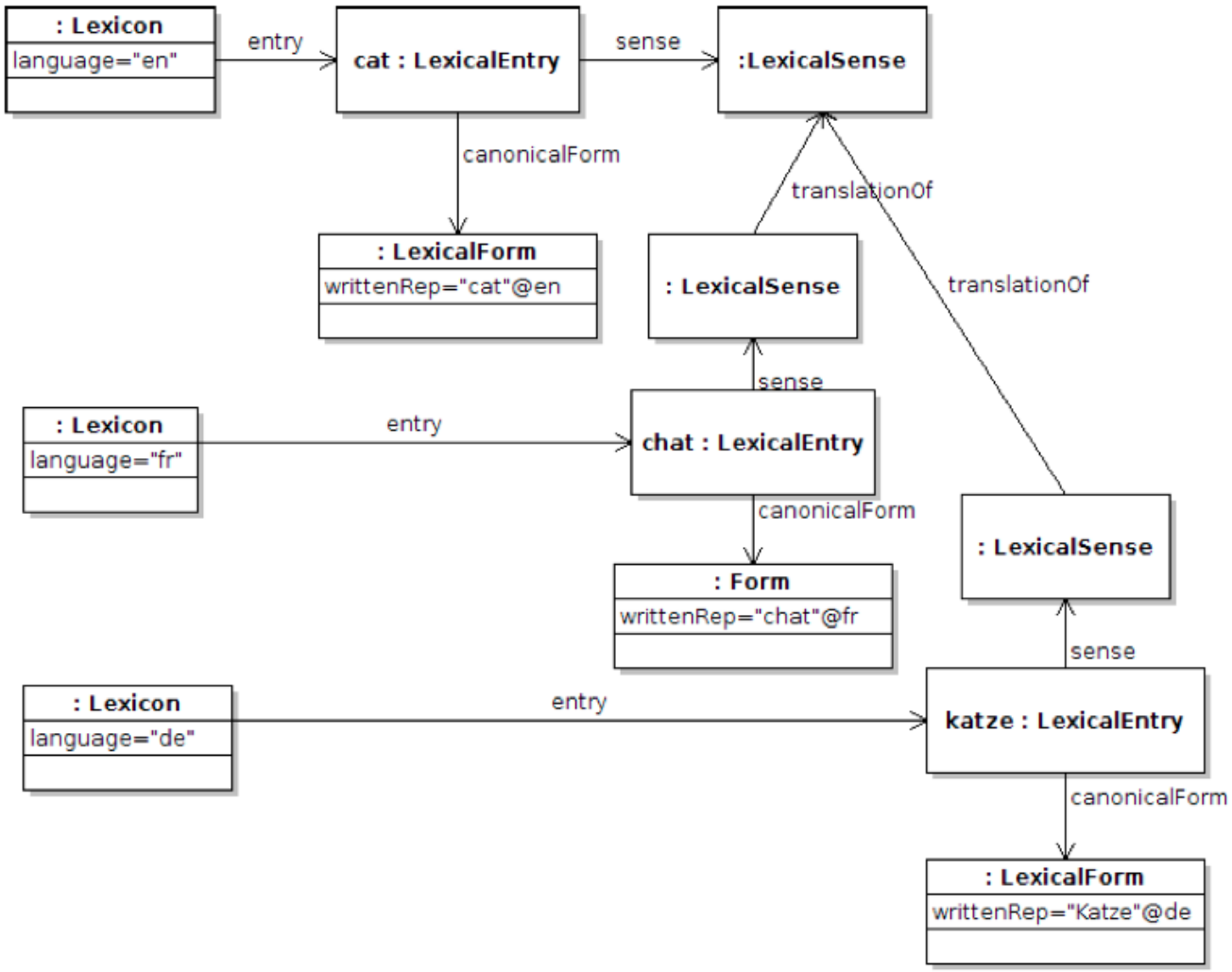

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# Example: Wiktionary data as an RDF lexical resource (The DBnary project)

```
{{also|chặt}}
==English==
{{wikipedia}}

===Pronunciation===
* {{IPA|/tʃæt/}}
* {{audio|en-us-chat.ogg|Audio (US)}}
* {{rhymes|æt}}

===Etymology 1===
Abbreviation of ''[[chatter]]''.
{{rfe|bird and louse also from chatter??}}

====Verb====
{{en-verb|chat|t|ing}}
[[image:Wikimania 2009 - Chatting (3).jpg|thumb|Two people '''chatting'''. (1) (2)]]

# To be [[engage]]d in informal [[conversation]].
#: ''She '''chatted''' with her friend in the cafe.''
#: ''I like to '''chat''' over a coffee with a friend.''
# To talk more than a few words.
#: ''I met my old friend in the street, so we '''chatted''' for a while.''
# To exchange [[text]] or [[voice]] [[message]]s in [[real time]] through a [[computer network]], ..
#: ''Do you want to '''chat''' online later?''

=====Translations=====
{{trans-top|be engaged in informal conversation}}
* Bulgarian: {{t|bg|бъбря}}
* [[Catalan]]: {{t|ca|xerrar}}
* Danish: {{t-|da|snakke}}, {{t|da|sludre}}
```

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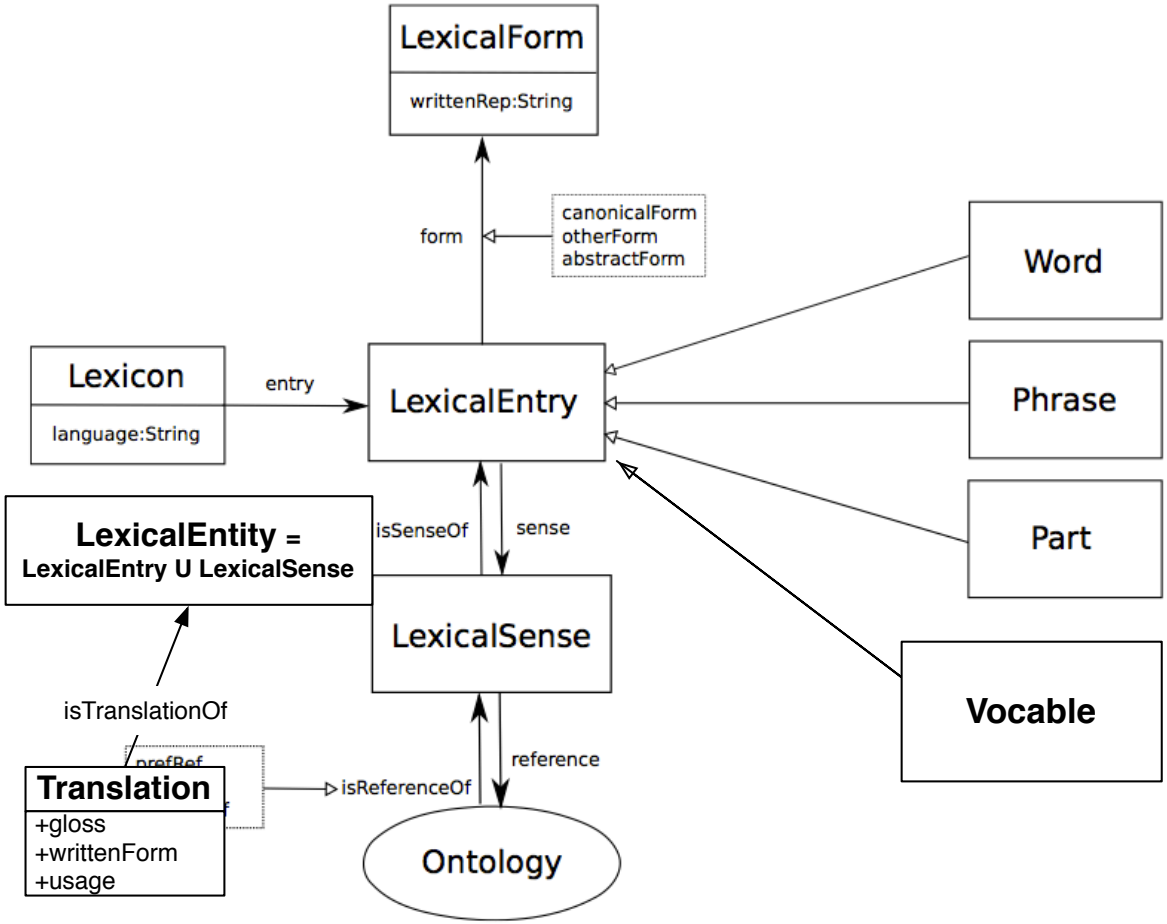

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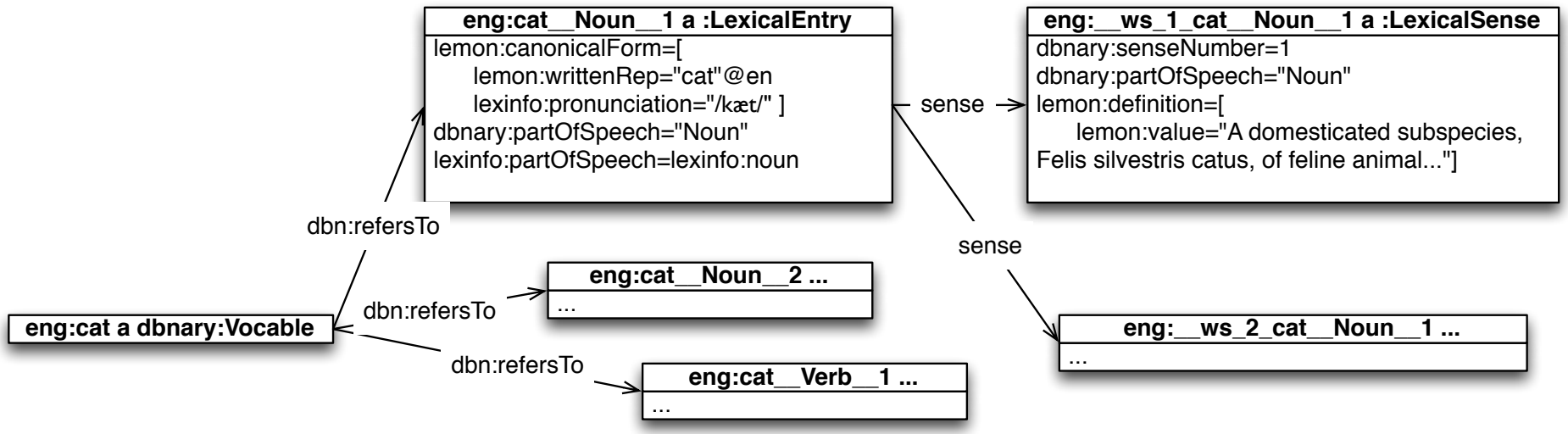

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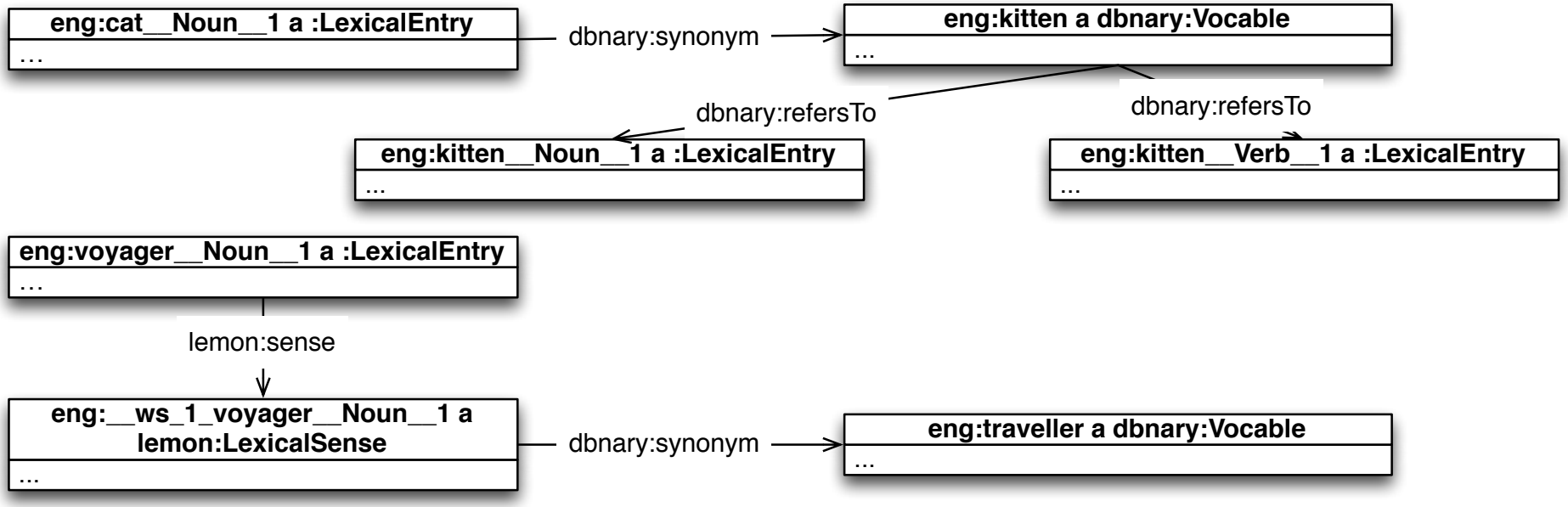

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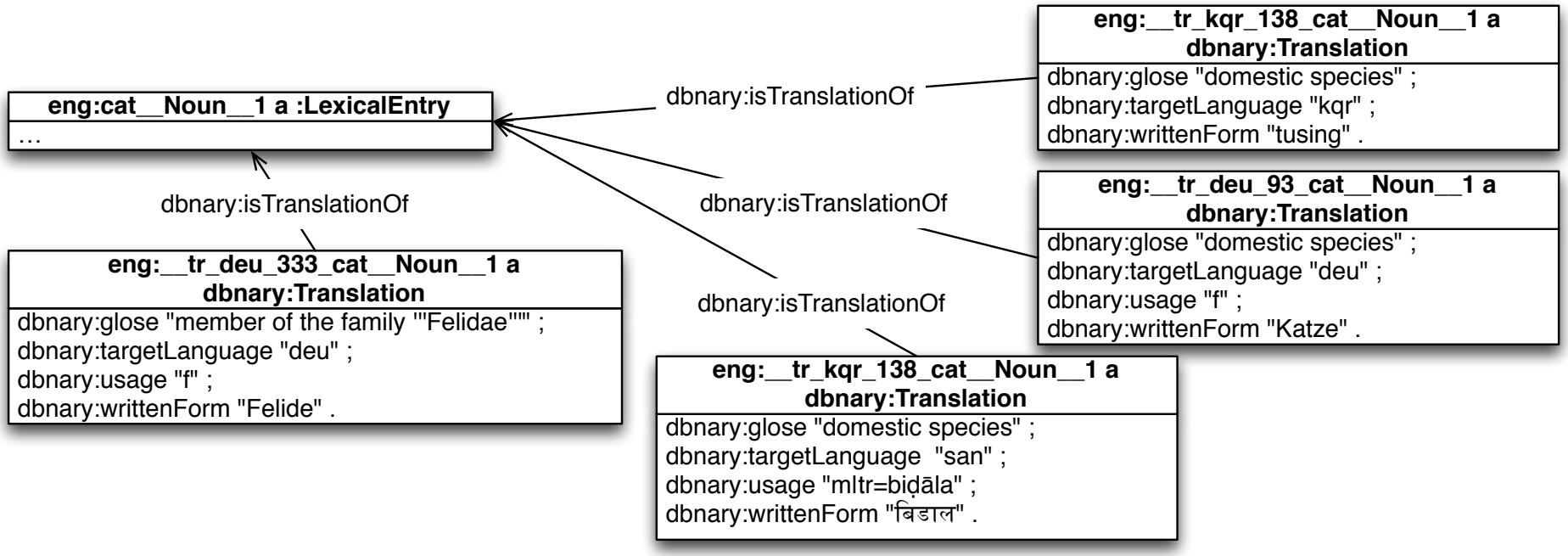

# DBnary as it is today

see http://kaiko.getalp.org/about-dbnary

# Current developments in DBnary

## To be done (Master and PhDs still possible)

- Assigning translations sources to their correct LexicalSense
- Assigning translations targets to their correct LexicalSense
- Same for Lexico-semantic relations
- Aligning dbnary lexical senses with sense from other resources.

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## What do we need for this ?

- Word Sense Disambiguation
- Cross lingual semantic similarity

# Conclusion

## Lexical Resources are interesting

- Lexical Resources are now a key element in Semantic Analysis application.
- After losing some interest, they are now regaining attention
- As we are now approaching the limits of statistical/learning based methods
- Lexical Resources are a key element for future hybrid approaches...

# Conclusion

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- Lexical Resources are now a key element in Semantic Analysis application.
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- As we are now approaching the limits of statistical/learning based methods
- Lexical Resources are a key element for future hybrid approaches...

## But still hard to produce

- Wiktionary/Wikipedia have changed the story
- But data quality is variable
- Lexical Architecture is still a debate (and English tends to take a central role...)
- We still need good data and non ethnologically centered multilingual data