Harmonizing Tagsets for Multilingual Corpora via Concept Lattice

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The problem

- In a multilingual parallel corpus, each language comes with a potentially incompatible morphosyntactic tagset.
- The variety of tagsets is a problem for human users and for applications, too.

en	in	the	remotest	exurbs
	IN	**DT**	**JJS**	**NNS**
de	in	den	abgelegensten	Außenbezirken
	APPR	**ART**	**ADJA**	**NN**
nl	in	dit	schitterende	appartement
	600	**370**	**103**	**000**
fr	dans	les	plus lointaines	banlieues
	PRP	**DET:ART**	**ADV ADJ**	**NOM**
sp	en	las	zonas	más remotas
	PREP	**ART**	**NC**	**ADV ADJ**
it	da	queste	lingue	babeliche
	PRE	**PRO:demo**	**NOM**	**ADJ**
ru	v	samych	otdaljonnych	rajonach
	Sp-l	**P—pl**	**Afp-plf**	**Ncmpln**
cs	v	těch	nejodlehlejších	zástavbách
	RR–6	**PDXP6**	**AAFP6—-3A**	**NNFP6—–A**
bg	na	tova	prijatelsko	dviženie
	R	**Pde-os-n**	**Ansi**	**Ncnsi**
pl	w	tym	wspaniałym	apartamencie
	prep:loc:nwok	**adj:sg:loc:m3:pos**	**adj:sg:loc:m3:pos**	**subst:sg:loc:m3**
hu	a	szép	katalán	lányba
	ART	**ADJ**	**ADJ**	**NOUN(CAS(ILL))**

Reasons for the variety of tagsets

- Different labels for the same concept
- Typological differences among languages
- Different choice of a theory or its aspect

A solution

- Map each tag in every language to a common abstract tagset, a kind of tagset interlingua.
- Use *Formal Concept Analysis* to build a hierarchy of categories, linked to language-specific tags.

Linguistically motivated choices can be reflected in the common tagset

- In some tagsets, adjectives, ordinal numerals and possessive pronouns are all in a single class.
- In other tagsets, they are different lexical classes.
- Anyway they share the property of being a syntactic or inflectional adjective.

$\longrightarrow$ We propose a 3-way cross-classification of word classes.

Cross-classification

	lexical	inflectional	syntactic
ordinal numeral *pátý*	num	adj	adj
cardinal numeral *pět*	num	noun	noun
personal prn *ty*	prn	noun	noun
possessive prn *tvůj*	prn	adj	adj
relative prn *který*	prn	adj	noun
interrogative prn *který*	prn	adj	noun/adj
adverbial pple *volajíce*	verb	pple	advb

Further support for the cross-classification: sets of morphological categories appropriate to cross-classified POS

- Czech possessive pronouns show pronoun–antecedent agreement as lexical pronouns
- and attribute–noun agreement as syntactic adjectives

(1) Jana přišla, ale **jejího** syna jsem neviděl.
Jana$_{\text{FEM,3,NOM}}$ came but her$^{\text{FEM,3}}_{\text{MASC,ACC}}$ son$_{\text{MASC,ACC}}$ I haven't seen
'Jana has come, but I haven't seen her son.'

Multiple inheritance hierarchy

- Sets of categories as partially ordered types in multiple inheritance ISA hierarchy.
- Each type denotes a set of language-specific tags.
- 'Translational' ambiguities due to mismatching tags are not resolved but properly represented.

Formal Concept Analysis (FCA)

- A logical formalism and tool to build the hierarchy and to do reasoning about categories.
- FCA classifies objects (tags) according to their properties (categories).

Formal context for adjectives and cardinal/ordinal numerals

- A table to identify objects and their attributes.

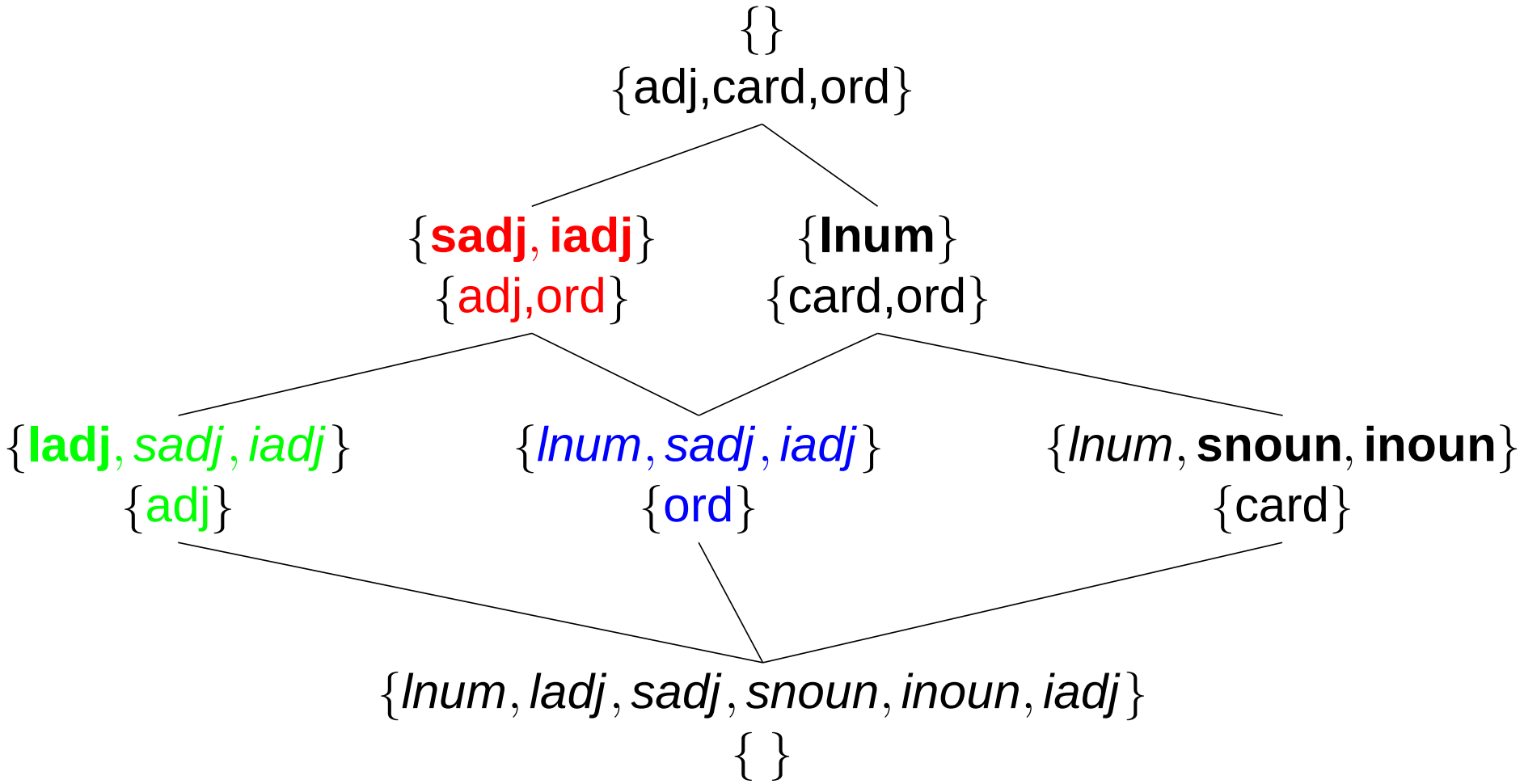
	ladj	*lnum*	*iadj*	*inoun*	*sadj*	*snoun*
adj	✓		✓		✓	
ord		✓	✓		✓	
card		✓		✓		✓

Formal concepts derived from the formal context table

1	⟨{adj,ord,card},	{}⟩
2	⟨{ord,card},	{*lnum*}⟩
2	⟨{adj,ord},	{*iadj,sadj*}⟩
3	⟨{adj},	{*ladj,iadj,sadj*}⟩
3	⟨{ord},	{*lnum,iadj,sadj*}⟩
3	⟨{card},	{*lnum,inoun,snoun*}⟩
4	⟨{},	{*ladj,lnum,iadj,inoun,sadj,snoun*}⟩

- **Concept**: a set of objects and a set of attributes.
- Objects of a concept are also part of its superconcept.
- Concepts are partially ordered by specificity (roughly: the more attributes, the more specific).

Concept lattice for adjectives and ordinal numerals



Reasoning about attributes

- Possible implications: *ladj* $\Rightarrow$ *sadj* or *snoun* $\Rightarrow$ *lnum*
- ... useful for general queries ("show me all adjectives")
- ... or to match incompatible language-specific tags

Problems

- Attributes in FCA formal contexts interpreted in conjunction, for disjunctive attributes we have to introduce a more general attribute, perhaps in a pre-processing step.
- The main task: manually specifying formal context for all tags.