Enhanced *Universal Dependencies*

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Lexical Functional Grammar 1

Lexical Functional Grammar (LFG; Bresnan 1982, Dalrymple 2001, Bresnan *et al.* 2015, Dalrymple *et al.* 2019):

- full-fledged, mature, stable linguistic theory,
- syntax, semantics, information structure...,
- rich body of work on typologically diverse languages,
- platform for computational implementation of LFG grammars (XLE; Crouch *et al.* 2011),
- many implemented grammars (English, Norwegian, Polish...; `http://clarino.uib.no/iness/xle-web`).

Two **syntactic levels** of representation:

- **c-structure** (constituent structure): constituency tree,
- **f-structure** (functional structure): predicate–argument structure, grammatical functions, morphosyntactic information.

Lexical Functional Grammar 2

As of **mid-August**, the INESS platform (`http://clarino.uib.no/iness`; Rosén *et al.* 2007, 2012) hosts **32 LFG structure banks** of **16 languages**:

Croatian, English, Georgian, German, Greek, Hungarian, Indonesian, Italian, Greek, Norwegian (Bokmål and Nynorsk), Polish, Portuguese, Russian, Turkish, Urdu, Wolof.

Polish LFG structure bank:

- based mainly on the data from the **National Corpus of Polish** (`http://nkjp.pl/`; Przepiórkowski *et al.* 2012),
- **parsebank** (manually disambiguated following the 2+1 model),
- **21,732 utterances** (131,085 words).

Universal Dependencies

Universal Dependencies (UD; Nivre *et al.* 2016; version 2.3 announcement):

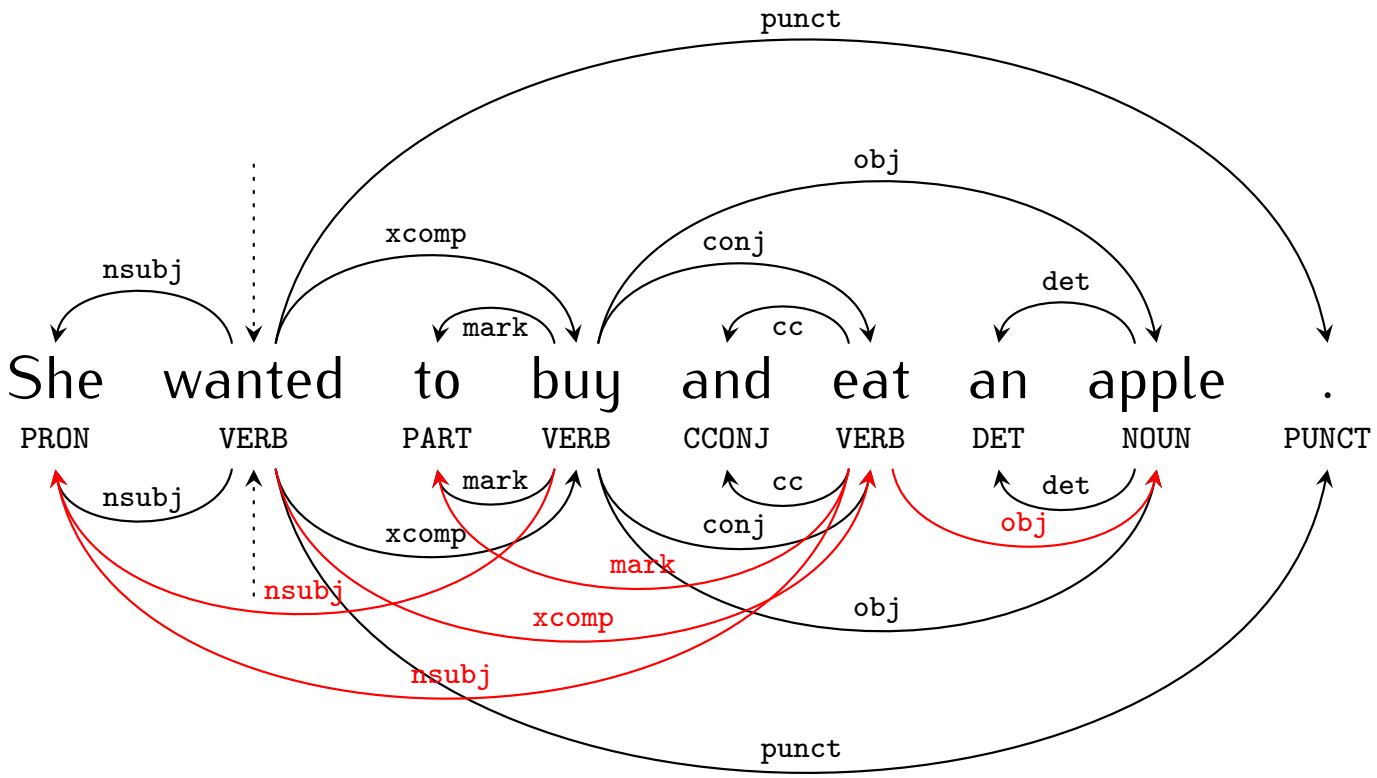
> *a project that seeks to develop* ***cross-linguistically consistent treebank annotation for many languages****...*

Version 2.3 (released on 15 November 2018) – **129 treebanks** of **76 languages**:

Afrikaans, Akkadian, Amharic, Ancient Greek, Arabic, Armenian, Bambara, Basque, Belarusian, Breton, Bulgarian, Buryat, Cantonese, Catalan, Chinese, Coptic, Croatian, Czech, Danish, Dutch, English, Erzya, Estonian, Faroese, Finnish, French, Galician, German, Gothic, Greek, Hebrew, Hindi, Hindi English, Hungarian, Indonesian, Irish, Italian, Japanese, Kazakh, Komi Zyrian, Korean, Kurmanji, Latin, Latvian, Lithuanian, Marathi, Naija, North Sami, Norwegian, Old Church Slavonic, Old French, Persian, Polish, Portuguese, Romanian, Russian, Sanskrit, Serbian, Slovak, Slovenian, Spanish, Swedish, Swedish Sign Language, Tagalog, Tamil, Telugu, Thai, Turkish, Ukrainian, Upper Sorbian, Urdu, Uyghur, Vietnamese, Warlpiri and Yoruba.

She wanted to buy and eat an apple. (UD)

(basic tree)



(enhanced structure)

Outline

New UD treebank of Polish:

- **converted** from the LFG parsebank of Polish,
- officially available **since July 2018** (UD release 2.2) – unofficially since February 2018,
- **17,246 utterances** (130,967 tokens).

Outline:

- **conversion** in two stages:
  - from LFG structures **to LFG-like dependencies**,
  - from LFG-like dependencies **to enhanced UD**,
- what is **lost in translation**

Also **general problems with UD** (and its treatment of core/oblique).

Previous work

Previous **Polish UD** treebank (since UD version 1.2, November 2015):

- data also from the National Corpus of Polish,
- result of 3 conversion steps (constituency to in-house dependency to Prague-style dependency to UD), last two by the Prague team,
- many systematic problems, lack of various kinds of information,
- no enhanced representations,
- smaller (8227 vs. 17,246 utterances).

Previous **LFG to UD** conversion efforts:

- conversion of LFG structures to non-UD dependency trees mentioned in the literature (e.g., Øvrelid *et al.* 2009 and Çetinoğlu *et al.* 2010),
- conversion of LFG structures to UD described in Meurer 2017:
  - based mainly on c-structures,
  - no enhanced representations – considerable loss of structure-sharing information.

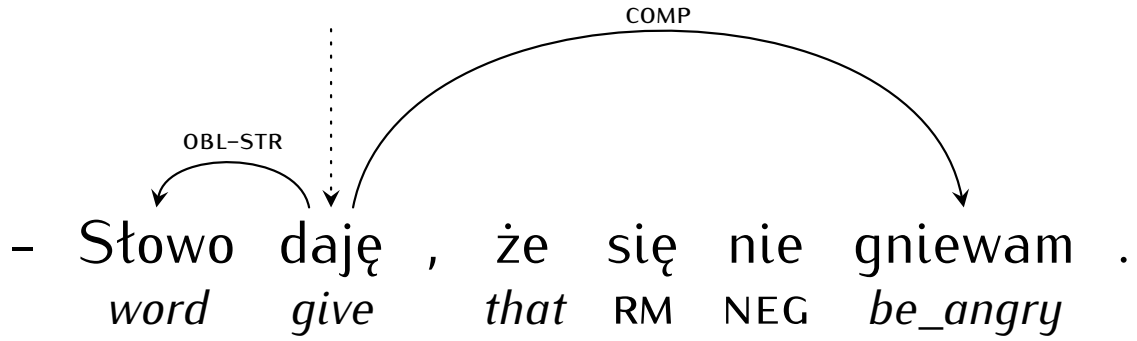
Conversion to LFG-like dependencies 1

Input to conversion:

- **f-structures**,
- **c-structures** – only terminals (tokens) and preterminals (categories).

Example 1:

- - Słowo daję, że się nie gniewam.
  word.ACC give.1SG that RM NEG be_angry.1SG
  'I give you my word that I am not angry.'

- 

Conversion to LFG-like dependencies 2

Co-heads $\stackrel{\text{def}}{=}$ tokens whose preterminals map to the same f-structure.

First step (of the first stage):

- **select true heads** among co-heads,
- **algorithm**: very simple, on the basis of preterminal labels,
- **example**: the verb ***gniewam*** 'be angry' wins with the complementiser *że*, the reflexive marker *się*, the negative particle *nie* and the comma.

Second step: other dependencies mirror c-structure preterminals.

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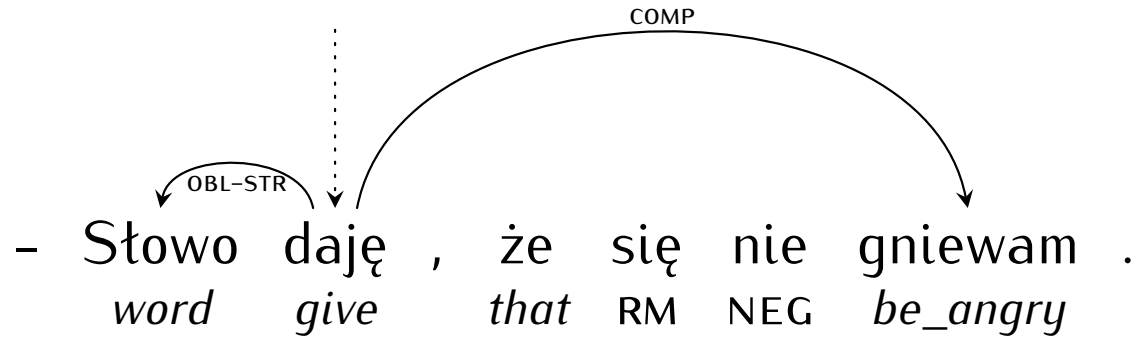
- 

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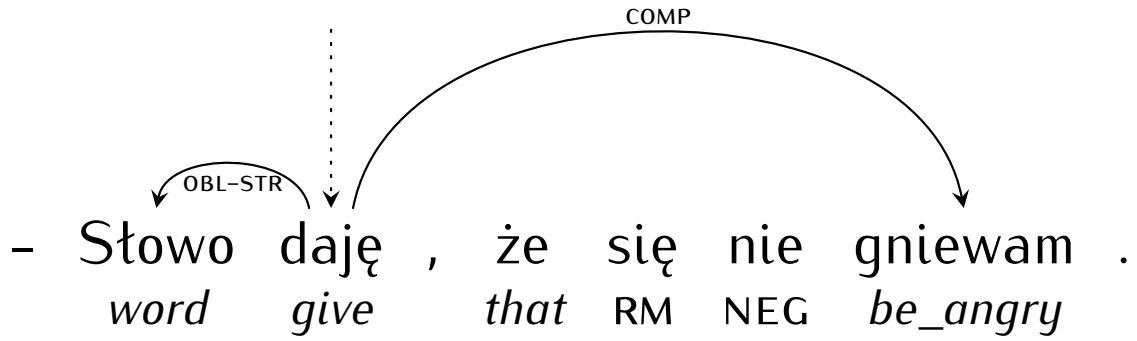
- 

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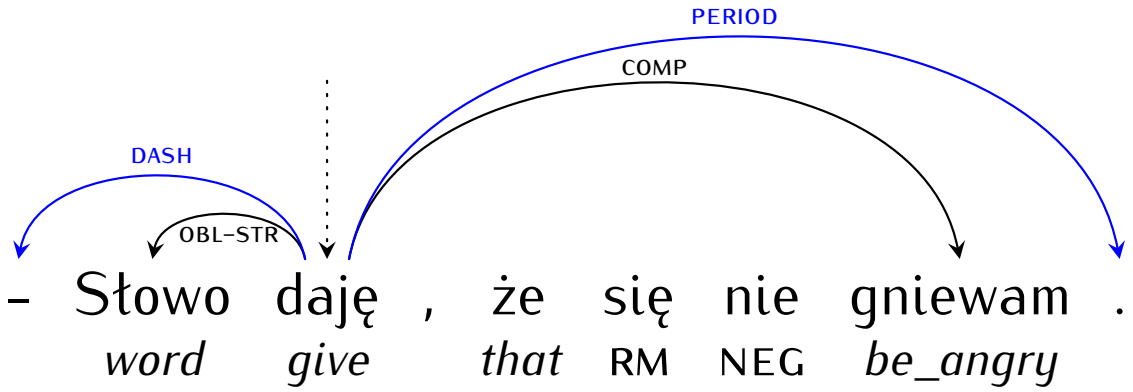
- 

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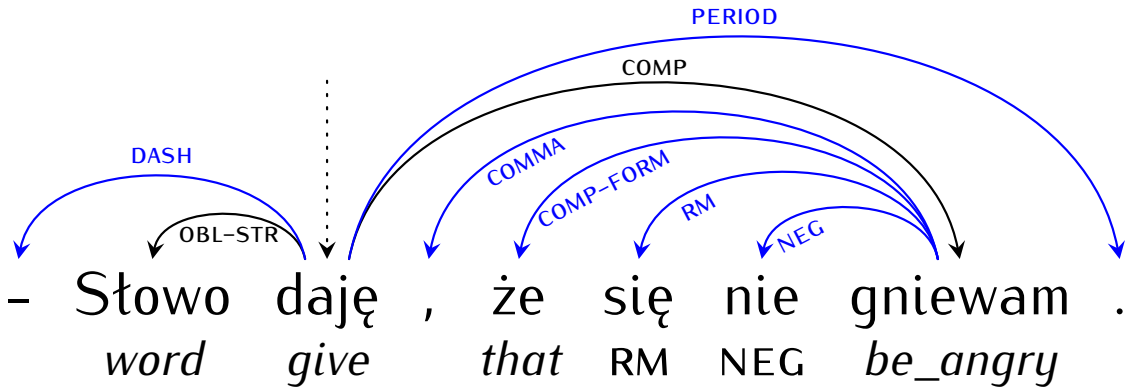
- 

Conversion to LFG-like dependencies 3

Example 2, involving coordination:

- Uderzał rękami w głowę, drapał twarz.
  hit.3SG.M hands.INST in head.ACC scratched.3SG.M face.ACC
  'He pounded his head with his fists, scratched his face.'

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```
0 | { 47 | PRED 'drapać<[81:pro], [50:twarz]>'
         | OBJ  50 | PRED 'twarz' |
         | SUBJ 81 | PRED 'pro' |
  , 1 | PRED     'uderzać<[81:pro], [39:ręka], [38:głowa]>'
      | OBL-INST 39 | PRED 'ręka' |
      | OBL      38 | PRED 'głowa' |
      | SUBJ     [81]
  }
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```
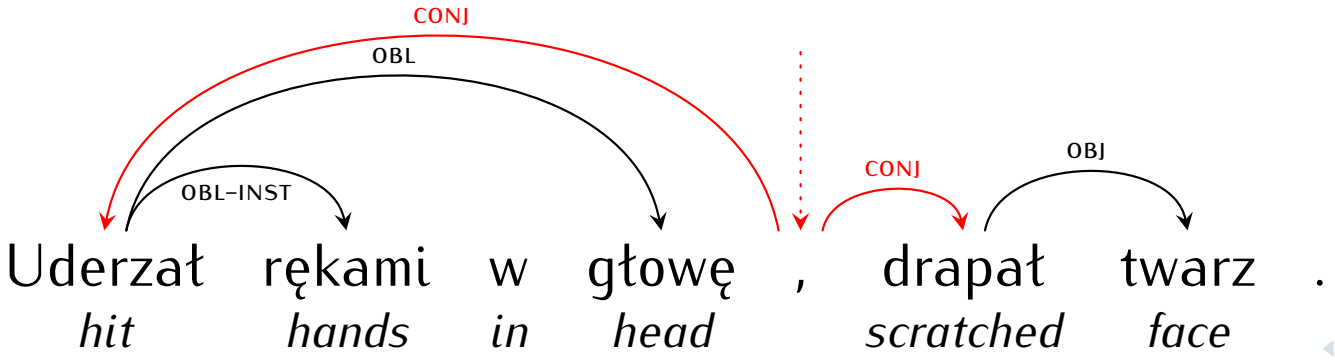

Set membership in coordination translated into CONJ, resulting in the following **result of first step of the first stage** (backbone):

- 

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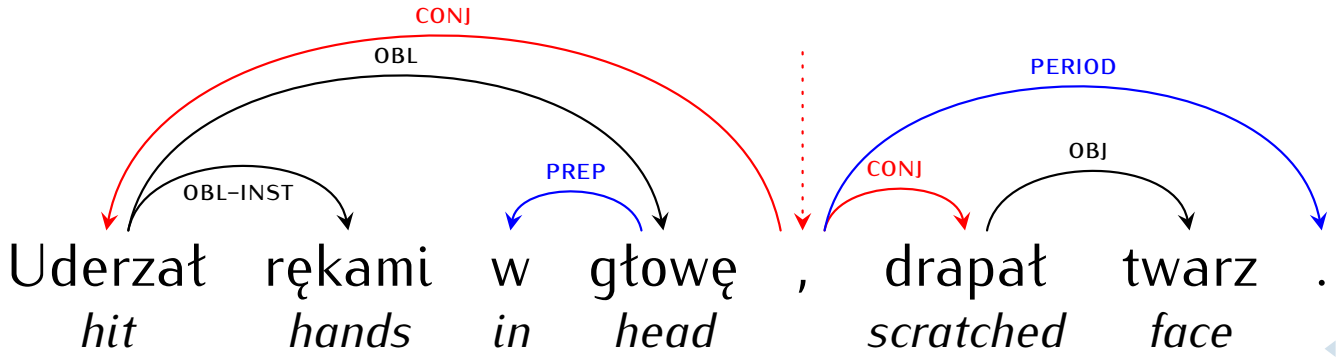
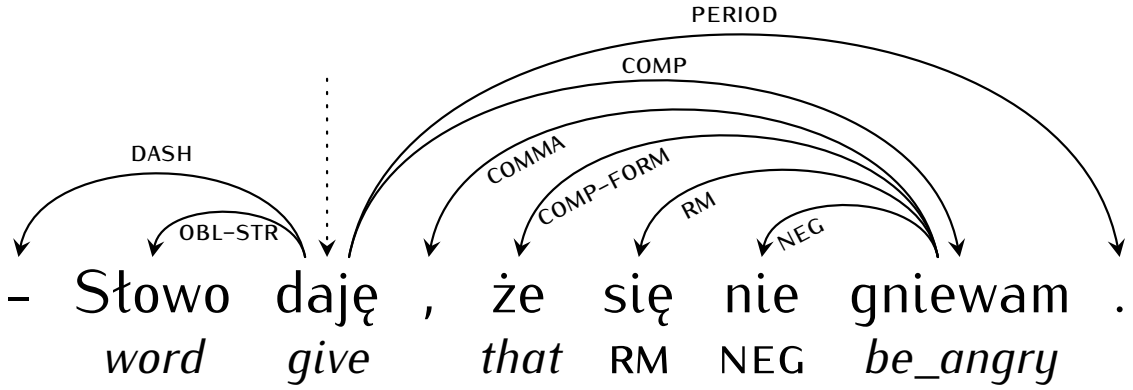
Set membership in coordination translated into CONJ, resulting in the following **result of second (last) step of the first stage**:

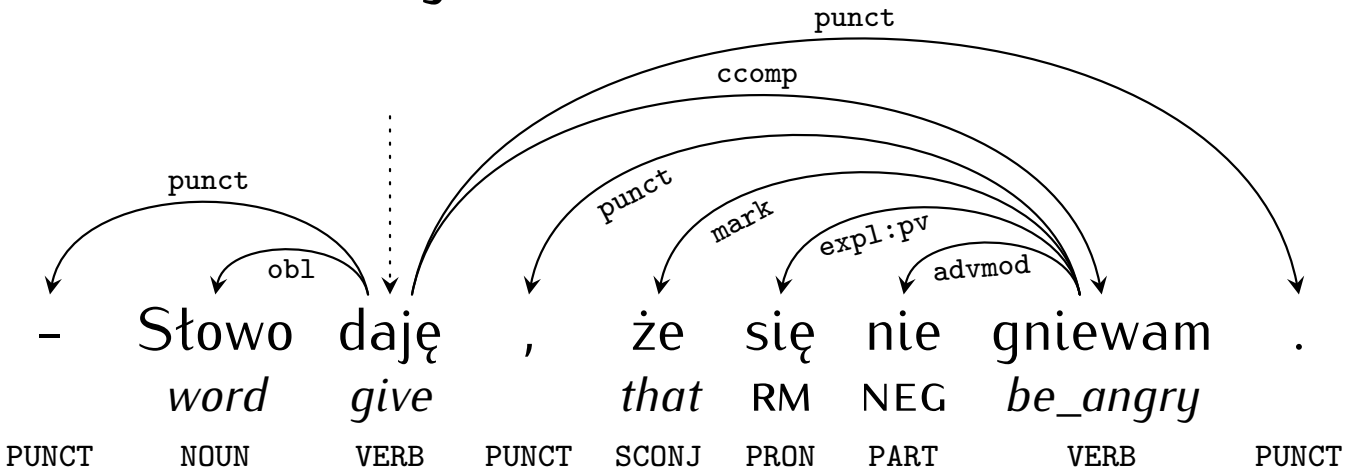
- 

Conversion to enhanced UD 1

Second stage – in the simplest (but very rare) case, it is sufficient to translate dependency labels. Example 1 **after the first stage** (repeated):

- 

After the second stage:

- 

Conversion to enhanced UD 2

Usually, the **dependency graph needs to be rearranged**:

- to **rearrange coordination dependencies**,
- more generally, to **reverse dependencies between function words and content words**.

Coordination in LFG-like dependencies:

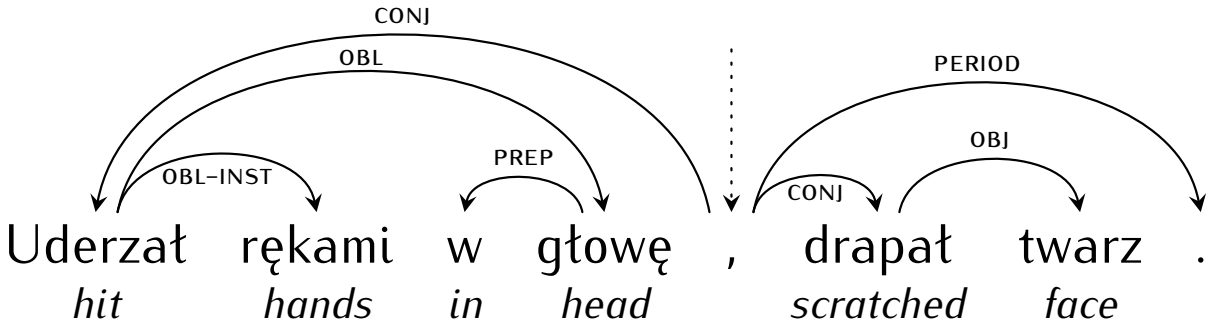
- headed by the conjunction,
- conjuncts are its CONJ dependents.

Coordination in UD:

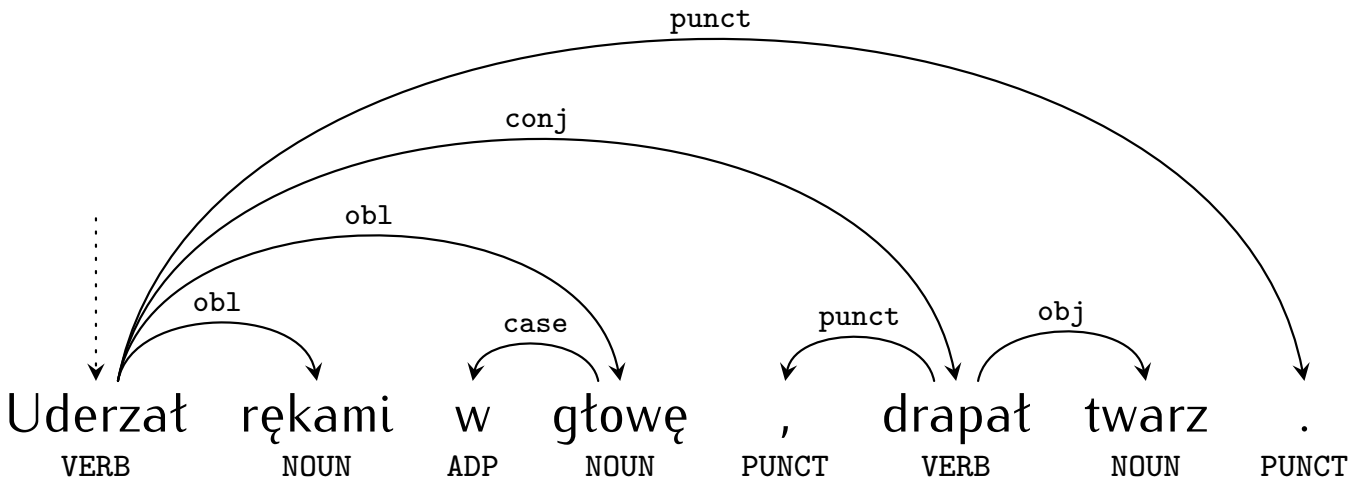
- headed by the 1st conjunct,
- all other conjuncts are its CONJ dependents,
- conjunction is a CC dependent of the following conjunct.

Conversion to enhanced UD 3

after 1st stage:



after 2nd stage:



Conversion to enhanced UD 4

Reversing dependencies between function words and content words; in UD:

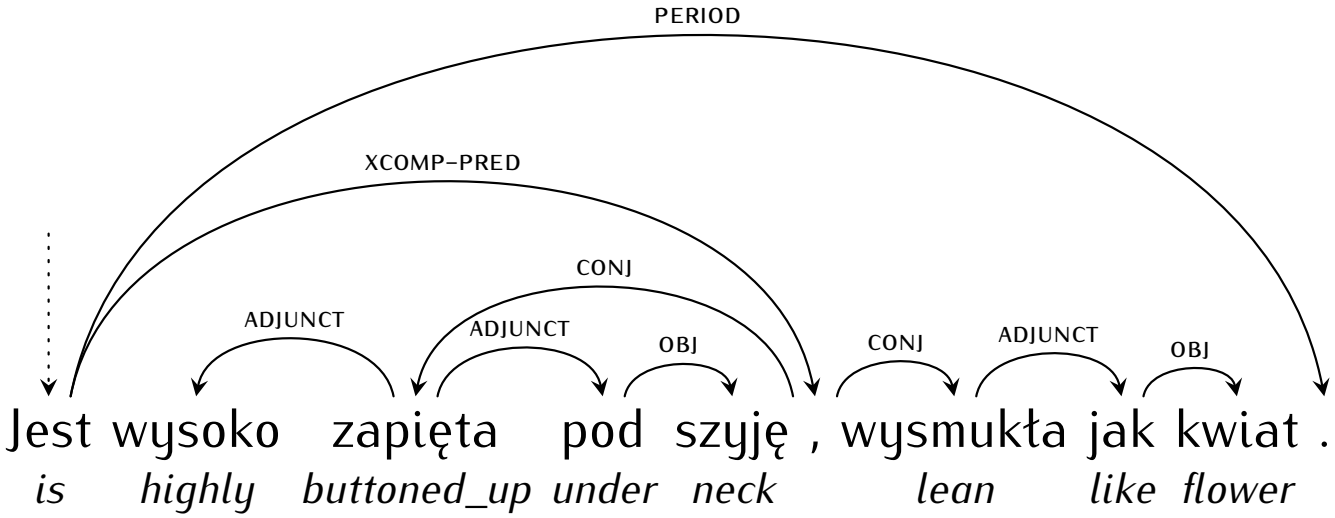
- **prepositions** (both: non-semantic and semantic) are dependents of nouns,
- **numerals** are dependents of nouns (contrary to morphosyntactic tests on headedness in Polish),
- **auxiliaries and copulas** are dependents of verbs.

Example 3:

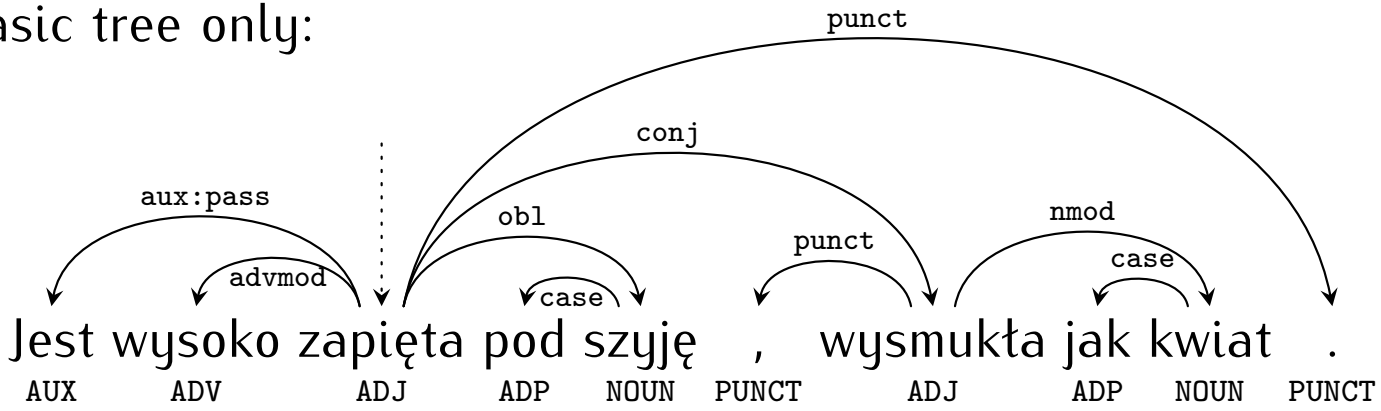
- Jest wysoko zapięta pod szyję, wysmukła jak
  is.3SG highly buttoned_up.NOM.SG.F under neck.ACC lean.NOM.SG.F like
  kwiat.
  flower.NOM.SG.M
  'She is buttoned up high to the neck, lean like a flower.'

Conversion to enhanced UD 5

after 1st stage:

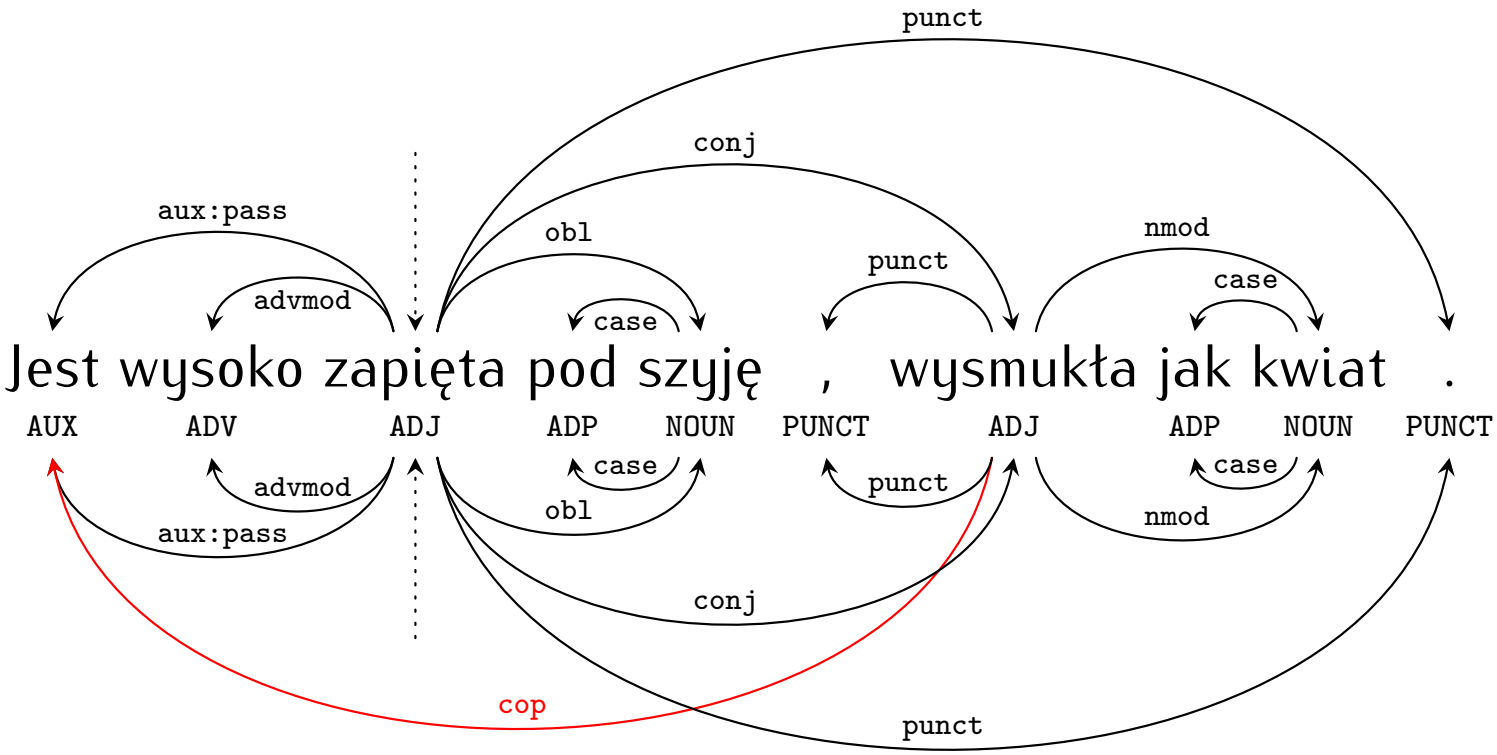


after 2nd stage – basic tree only:



Conversion to enhanced UD 6

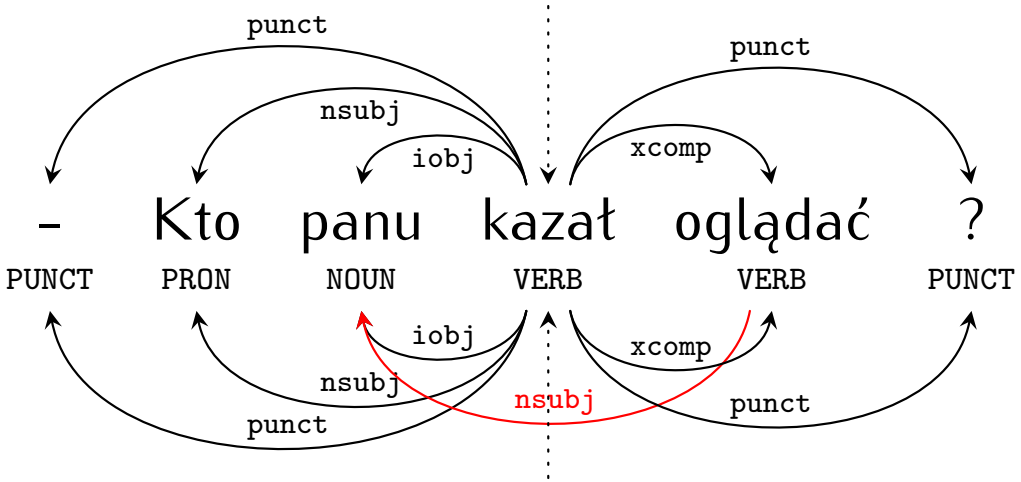
after 2nd stage – also (partial) enhanced structure:



Note: the auxiliary/copula *jest* 'is' is **a shared dependent** of the passive participle (aux:pass) and the predicative adjective (cop).

Lost in translation

Dependent-sharing is not a problem for enhanced UD (also in control).

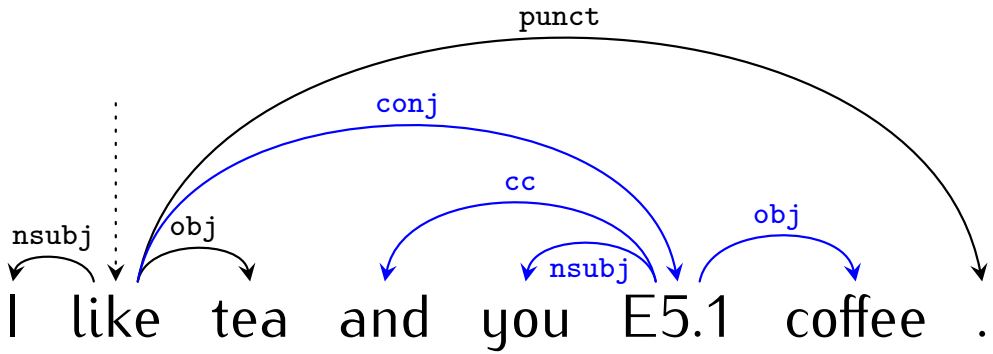
- – Kto panu kazał oglądać?
  who.NOM.SG.M you.DAT ordered.3SG.M watch.INF
  'Who asked you to watch?'
- PRED 'kazać<[14:kto], [12:pan], [20:oglądać]>'
  XCOMP 20 PRED 'oglądać<[12:pan]>'
  SUBJ 12 PRED 'pan'
  OBJ-TH [12]
  SUBJ 14 PRED 'kto'
  0
- 

Lost in translation – *pro*-drop 1

So **what kind of information** – if any – is **lost in translation** from LFG to UD?

The main reason for loss of information: **ban on empty dependents**.

Note: there is **no general ban on empty nodes in UD**, e.g.:



http://universaldependencies.org/u/overview/enhanced-syntax.html#ellipsis

Lost in translation – *pro*-drop 2

Problem in expressing **control** relations, etc.:

- Kazał wszystko odsyłać do ambasady.
  ordered.3SG.M all.ACC send_back.INF to embassy
  'He ordered to send everything back to the embassy.'

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  - XCOMP 28 PRED 'odsyłać<[25:pro], [31:wszystko], [32:do]>'
    - OBL-ADL 32 PRED 'do<[33:ambasada]>'
      - OBJ 33 PRED 'ambasada'
    - OBJ 31 PRED 'wszystko'
    - SUBJ 25 PRED 'pro'
  - OBJ-TH [25]
  - SUBJ 26 PRED 'pro'

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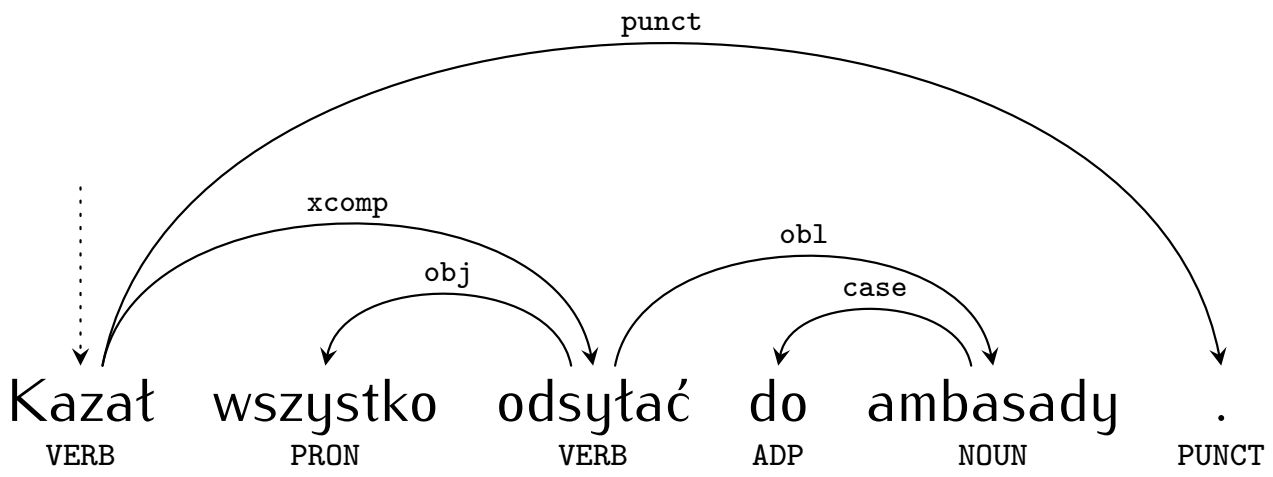
- 

Lost in translation – *pro*-drop 3

Problem in expressing shared *pro*-dropped dependents in **coordination**:

- Uderzał rękami w głowę, drapał twarz.
  hit.3SG.M hands.INST in head.ACC scratched.3SG.M face.ACC
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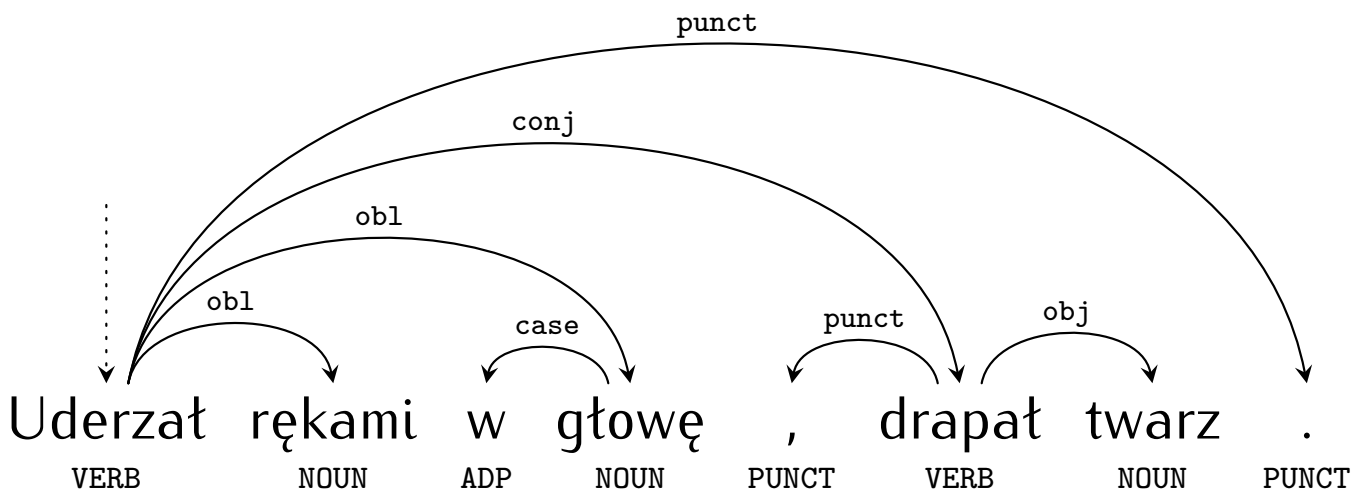
- 

Lost in translation – multiple edges

Another structural **prohibition**: **up to one edge from A to B**.

Problem in cases of the **haplology of the reflexive marker** (Kupść 1999, Patejuk and Przepiórkowski 2015):

- W Laskach w liturgii uczestniczyło się przez cały dzień i
  in Laski in liturgy participated.3SG.N RM for whole day and
  modliło się wszędzie.
  prayed.3SG.N RM everywhere
  'In Laski, one would participate in the liturgy for the whole day and one would pray everywhere.'

- *się* in *uczestniczyło się* 'one would participate' – purely impersonal (`expl:impers`),
- *się* in *modliło się* 'one would pray' — both impersonal (`expl:impers`) and inherent (`expl:pv`) in the verb MODLIĆ SIĘ 'pray'.

Lost in translation – coordination

Known structural problem in the UD representation of **coordination**:

- Przewróciłem jakieś puszki, straciłem kamerę, ale
  overturned.1SG.M some.ACC cans.ACC lost.1SG.M camera.ACC but
  świeca płonie.
  candle.NOM.SG.F burns.3SG
  'I overturned some cans, lost my camera, but the candle still burns.'

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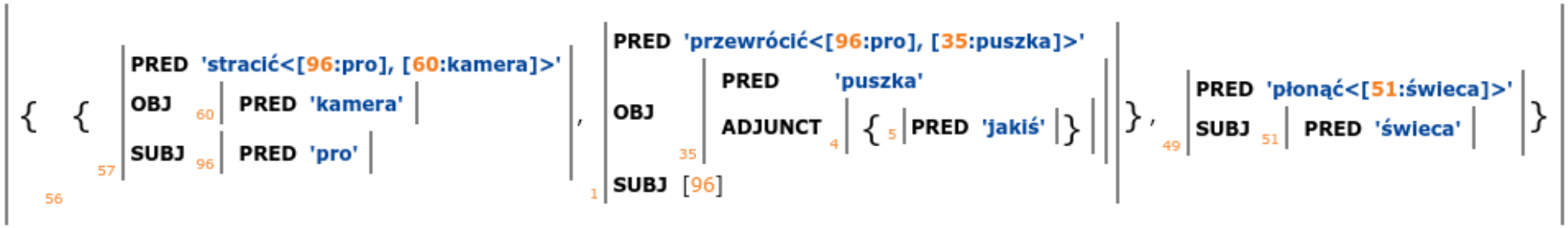

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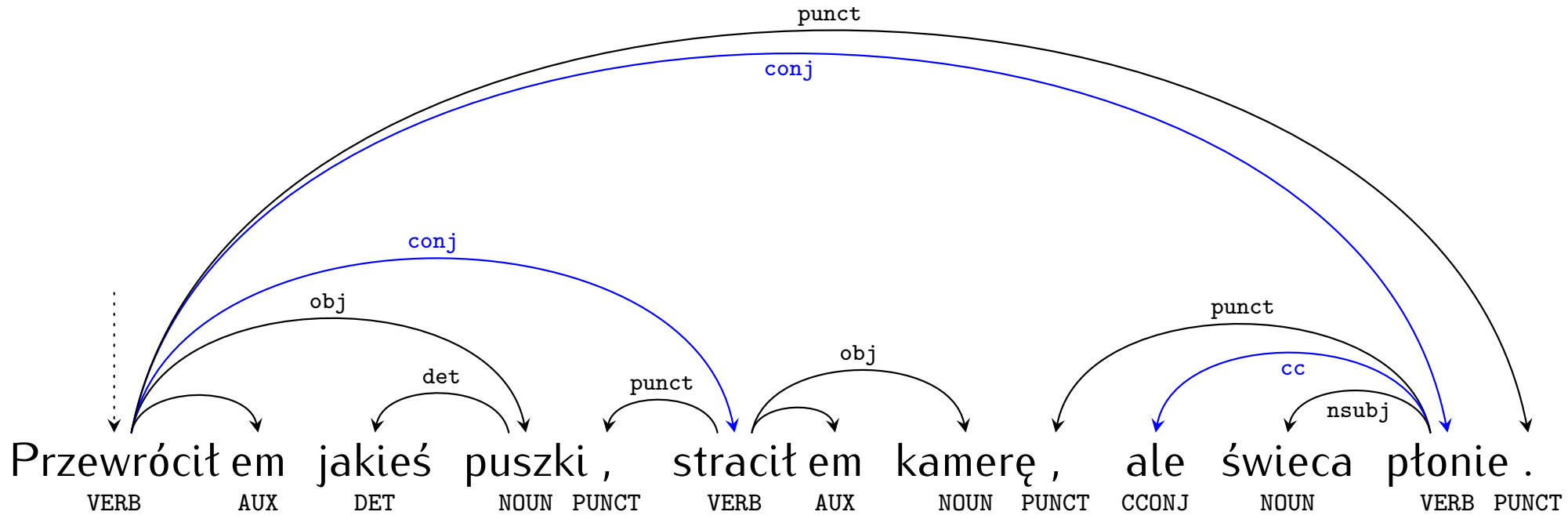


Lost in translation – underspecified labels

Loss of structural information above. Also loss of information because of **underspecification of UD labels**:

- distinction between different kinds of oblique arguments (e.g., OBL-INST, OBL-ADL, etc.), and between **obliques and adjuncts**; UD treats all as `obl` (but subtypes of `obl` could be used to represent some distinctions; Zeman 2017),
- the different grammatical functions of **dependents of gerunds** (now all broadly nominal dependents of gerunds are marked as `nmod`, but they could be subtyped to `nmod:obj`, `nmod:obl`, etc.),
- the **distinction between controlled infinitivals and predicative complements**, both marked in UD as `xcomp` (e.g., by subtyping the latter to `xcomp:pred`),
- the **distinction between raising and control** (e.g., by representing raising via `xcomp:raising`),
- the distinction between **eventuality and constituent negation** (Przepiórkowski and Patejuk 2015), e.g., via the subtypes `advmod:eneg` and `advmod:cneg`,
- the distinction between **semantic and non-semantic prepositions**, e.g., by subtyping the `case` relation in the former to `case:sem`; **etc.**

Partial summary

Partial summary, conclusions:

- **largest officially released UD treebank of Polish** (over 17K utterances, almost 131K tokens), linguistically advanced and detailed,
- conversion from LFG to enhanced UD **preserves much of structure-sharing**, etc.,
- main reasons for **loss of information**:
  - no representation of ***pro*-dropped dependents**,
  - **underspecification of labels**,
- statistically insignificant:
  - **ban on multiple relations** between same tokens,
  - representation of **coordination** which does not distinguish between (certain) flat and embedded structures.

Long version...

The input LFG structure bank, the conversion procedure and the output enhanced UD treebank presented in **gory detail** in:

Agnieszka Patejuk and Adam Przepiórkowski. *From Lexical Functional Grammar to Enhanced Universal Dependencies: Linguistically informed treebanks of Polish.* Institute of Computer Science, Polish Academy of Sciences, Warsaw, 2018. (263 pages)

`http://nlp.ipipan.waw.pl/Bib/pat:prz:18:book.pdf`

Shorter version:

Adam Przepiórkowski and Agnieszka Patejuk. *From Lexical Functional Grammar to enhanced Universal Dependencies: The UD-LFG treebank of Polish*. To appear in *Language Resources and Evaluation*, 2019.

Arguments and Adjuncts in UD 1

All major linguistic theories distinguish between **arguments** **and** **adjuncts**:

- *In the US*, *he* *always* ***relies*** *on buses*.
- *In the US*, *he* *always* ***reads*** *on buses*.

- *He* ***treats*** *them* *well*.
- *He* ***teaches*** *them* *well*.

Many proposed **criteria for distinguishing arguments from adjuncts**, but:

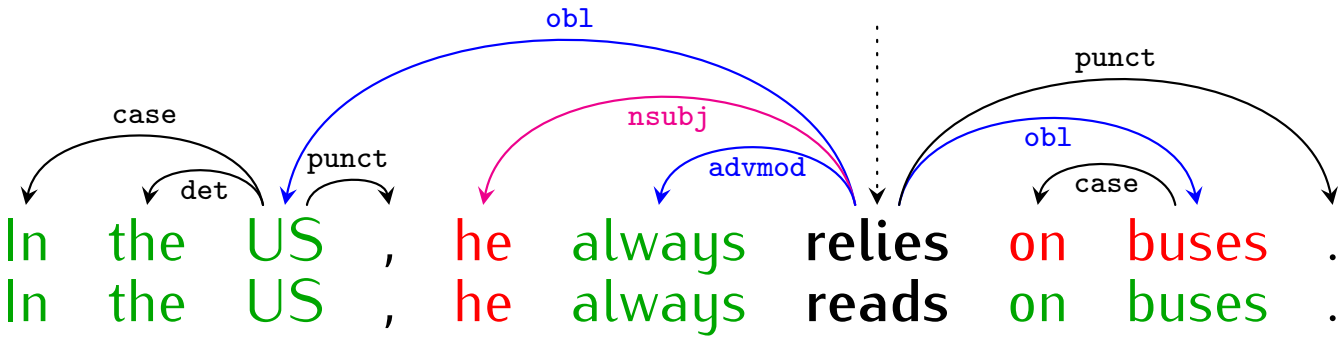
- they are **pairwise incompatible**,
- **none fully agrees with intuitions** of linguists,
- **no real progress** for the last 50–60 years (since Tesnière 1959 and Chomsky 1965).

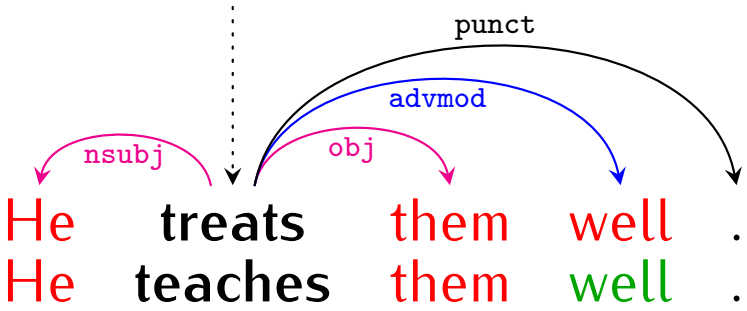
I don't believe in this dichotomy (Przepiórkowski 2016a,b, 2017a,b,c).

Arguments and Adjuncts in UD 2

The **main distinction** in UD:

- ***not*** **between arguments and adjuncts**,
- but rather **between core** (subject, object) **and non-core** (other dependents).





Arguments and Adjuncts in UD 3

Core vs. non-core distinction:

- UD guidelines offer **no hard criteria** (`http://universaldependencies.org/u/overview/syntax.html`),
- the following (here simplified) **rules of thumb** for dependents of verbs assumed in English and other treebanks:
  - NPs (DPs) are core (`nsubj`, `obj`, `iobj`),
  - but PPs are non-core (`obl`),
  - required clauses are core (`csubj`, `ccomp`),
  - required infinitival dependents are core (`xcomp`),
  - required secondary predicates (depictives) are core (`xcomp`),
  - other dependents are non-core.

Problems:

- these rules of thumb **reintroduce the argument/adjunct distinction** (claimed to be eschewed in UD),
- they make the **core/non-core** status of certain **coordinate dependents incoherent**.

Clausal dependents 1

Consider the indicated dependent of *asked*:

- *We **asked** the president [whether Americans are safe at home]*$_{ccomp}$.
- *We **asked** the president [about the hunt for Osama bin Laden]*$_{obl}$.

It is core in the first example, but non-core in the second.

What about the following attested example?

- *At the White House, we **asked** the president*
  [[whether Americans are safe at home]$_{ccomp}$
  and
  [about the hunt for Osama bin Laden]$_{obl}$*].*

(iWeb corpus; `https://corpus.byu.edu/iweb/`)

Here, the coordinate dependent seems to be partially core, partially non-core.

Clausal dependents 2

Reasoning revealing the problem:

- common linguistic assumption: normally, **only same grammatical functions may be coordinated**:
  - *John and Mary have **eaten** apples and oranges yesterday or earlier.*
  - **I and an apple have already **eaten**.*
  - **I have already **eaten** an apple and today.*
- two classes of **exceptions are limited and easy to recognise**:
  - zeugma, e.g.: *He **made** [[his apologies]$_{obj}$ and [for the door]$_{obl}$].* (Amir Zeldes, p.c.)
  - so-called lexico-semantic coordination, e.g.: *[[What]$_{obj}$ and [when]$_{obl}$] to **eat** to reduce insulin* (attested)
- a given **grammatical function is either always core or always non-core**; i.e., two dependents of different coreness status cannot have the same grammatical function,
- hence, **two dependents of different coreness status cannot be coordinated**.

Infinitival dependents

Similar problem:

- *...he **asked** her [[for a kiss]$_{obl}$ and [to go on a date with him]$_{xcomp}$].*

(attested)

Reasoning again:

- only same grammatical functions may be coordinated,
- a given grammatical function is either core or non-core,
- so either both `obl` and `xcomp` are core, or both are non-core,
- contrary to UD assumptions.

Solution

Outline of the solution:

- **constrain core dependents to subjects and objects** (this agrees with current UD treatment of broadly nominal dependents),
- **define subjects and objects** carefully:
  - following **typological** literature (e.g., Andrews 2007),
  - using **coding strategies**: case, agreement, word order,
  - as well as **diathesis alternations**, esp., passivisation,
  - possibly **in a language-specific way**,
  - possibly **departing from linguistic tradition**, which sometimes mixes grammatical functions and semantic roles,
- **coordination** should not lead to the incoherent coreness of dependents.

Example: English 1

If a dependent agrees with the verb, it is its **subject**.

If a dependent passivises (becomes subject in the passive voice), it is the **direct object** (Andrews 2007).

Anything else is **non-core** – contrary to tradition, it is not clear that it makes sense to distinguish *indirect objects* in English (Andrews 2007).

For **example**:

- *[I]*$_{subj}$ ***told*** *[this girl]*$_{obj}$ *[about my own experiences]*$_{obl}$.
- *[I]*$_{subj}$ ***told*** *[this girl]*$_{obj}$ *[the story]*$_{obl}$.

Hence, **no incoherence** in the following attested examples (otherwise problematic for UD):

- *[I]*$_{subj}$ ***told*** *[this girl]*$_{obj}$ *[[the story]*$_{obl}$ *and [about my own experiences]*$_{obl}$*]*.

Example: English 2

This means that **some required clauses are non-core**:

- *[He]$_{subj}$* ***told*** *[that girl]$_{obj}$ [that he thought this idea was viable]$_{obl}$.*

Again, **coordination facts confirm** this:

- *[He]$_{subj}$* ***told*** *[that girl]$_{obj}$ [[about an idea]$_{obl}$ and [that he thought it was viable]$_{obl}$].*
- *[He]$_{subj}$* ***told*** *[that girl]$_{obj}$ [[an idea]$_{obl}$ and [that he thought it was viable]$_{obl}$].*

(based on examples by Nathan Schneider, p.c.)

This contradicts the current UD practice but it is **consistent with the general UD philosophy**: just as **required PPs are non-core** (unless they are subjects or objects), so **required clauses may be non-core** (unless they are subjects or objects).

Summary

Problem – **inconsistent treatment of dependents of verbs**:

- **broadly nominal dependents** (NPs and PPs): only some typical arguments are core, other are non-core (just like typical adjuncts),
- **broadly verbal dependents**: all typical arguments are core.

Consequence – **incoherence of some coordinate dependents**.

Solution – **define core dependents more carefully**, with reference to:

- **coding strategies**,
- **diathesis**,
- **coordination**.

Consequence – **only some required verbal dependents are core** (exactly as in the case of broadly nominal dependents).

What else is in the paper 1

- demonstration that **not only object-like dependents may be obligatorily controlled**, i.e., apart from `xcomp` we need something like `xsubj` (or `subj:x`; see below) and `xadvcl` (or `obl:x`),
- suggestion of a more **transparent naming scheme** of dependency relations, i.e., **replacing**:

	subject	object	non-core
nominal	`nsubj`	`obj/iobj`	`obl`
clausal	`csubj`	`ccomp`	`advcl`
open		`xcomp`	

with:

	subject	object	non-core
nominal	`subj:n`	`obj:n`	`obl:n`
clausal	`subj:c`	`obj:c`	`obl:c`
open	`subj:x`	`obj:x`	`obl:x`

What else is in the paper 2

- demonstration that also **the treatment of secondary predicates** presupposes the argument/adjunct distinction,
- discussion of various **inconsistencies** in UD guidelines and current UD practice,
- **many more examples**, also from **Polish**.

Take home messages:

- **UD** is on the right track, trying to **replace the argument/adjunct distinction with the core/non-core distinction**,
- but **at the moment** it implements this idea **only partially**, which results in **internal inconsistency**;
- this paper: **suggestion how to implement this idea more completely and coherently**.

Thank you for your attention!

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