

# **Multilingual Coreference and Treebanking: Benefits of Interaction**

Anja Nedoluzhko

TLT, 5.12.2024

# Prague treebanking tradition and how it evolved



At the initial meeting it became apparent that

most participants were there to learn more about digital humanities and were not (yet) in the situation where they were able to offer expertise on the subject.

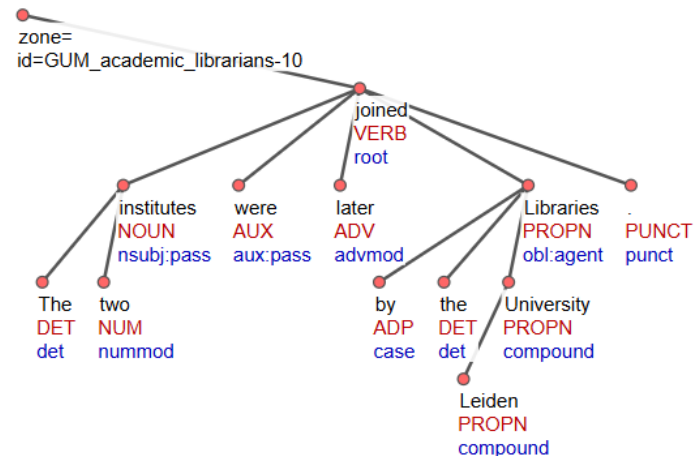
On the administrative level, the directors of the libraries participating in the consortium of Dutch academic libraries (UKB) also expressed the wish that librarians become more fluent in DH.

A year later, the National Library of the Netherlands (Koninklijke Bibliotheek), and the University Library of the Vrije Universiteit Amsterdam again concluded librarians at their institutes who wanted to get involved in DH needed more training to adequately support researchers and students in this field.

Therefore both institutes joined forces to develop a set of clinics on DH for librarians.

The two institutes were later joined by the Leiden University Libraries.

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# Outline

Part 1: CorefUD collection

Part 2: CorefUD and UD Treebanking

(a) Do UD tree structures correspond to mention spans in coreference annotations?

(b) Are syntactic heads in UD equivalent to the head mentions in coreference annotation?

(c) How do zeros in coreference relate to empty nodes in syntactic structures?

Part 3: Discussion, conclusions

benefits of interaction, common challenges, future plans...

## Part 1

# Coreference in Universal Dependencies (CorefUD)

Martin Popel



Michal Novák



Anja Nedoluzhko



Zdeněk Žabokrtský



Daniel Zeman



# Examples of coreference

(1) Mary gave **Peter** an apple. Steve gave **him** another one.

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# CorefUD 1.2

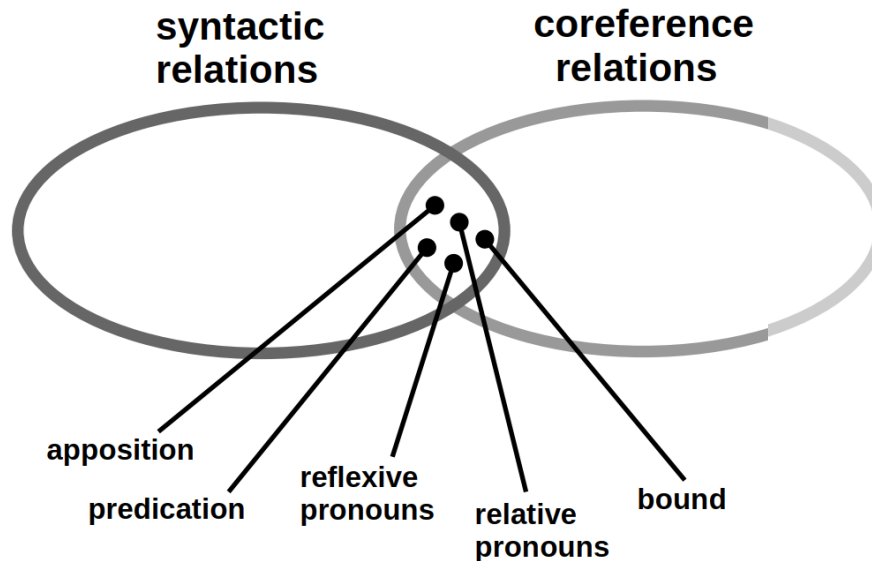
- public edition of CorefUD 1.2 (2024)
- 21 coreference datasets for 15 languages
- harmonized under the same format
- combines annotation of coreference/anaphora (always manual) with annotation of morphology and dependency syntax (manual if available, otherwise automatic)
- the format is valid CoNLL-U; coreference information stored in the MISC column

```
# global.Entity = eid-etype-head-minspan-infstat-link-identity
# sent_id = GUM_academic_art-3
# text = Claire Bailey-Ross xxx@port.ac.uk University of Portsmouth, United Kingdom
1 Claire Claire PROPN NNP Number=Sing 0 root 0:root Entity=(e5-person-1-1,2,4-new-coref|Discourse=attribution:3->57:7
2 Bailey Bailey PROPN NNP Number=Sing 1 flat 1:flat SpaceAfter=No|XML=<w>
3 - - PUNCT HYPH _ 4 punct 4:punct SpaceAfter=No
4 Ross Ross PROPN NNP Number=Sing 2 flat 2:flat Entity=e5)|XML=</w>
5 xxx@port.ac.uk xxx@... PROPN NNP Number=Sing 1 list 1:list Entity=(e6-abstract-1-1-new-sgl)
6 University University PROPN NNP Number=Sing 1 list 1:list Entity=(e7-organization-1-3,5,6-new-sgl-University_of_Portsmouth
7 of of ADP IN _ 8 case 8:case -
8 Portsmouth Portsmouth PROPN NNP Number=Sing 6 nmod 6:nmod:of Entity=(e8-place-1-3,4-new-sgl-Portsmouth|SpaceAfter=No
9 , , PUNCT , _ 11 punct 11:punct _
10 United unite VERB NNP Tense=Past|... 11 amod 11:amod Entity=(e9-place-2-1,2-new-coref-United_Kingdom
11 Kingdom Kingdom PROPN NNP Number=Sing 1 list 1:list Entity=e9)e8)e7)
```

# Motivation hypotheses

## coreference + syntax = friends

- mentions often correspond to syntactically meaningful units (noun phrases, subject)
- some coreference relations are expressed primarily by syntactic means (reflexive and relative constructions, apposition, predication with copula)



- reuse of annotation of coordination structures
- syntax is useful for the identification of zero expressions (such as pro-drop) needed for coreference

## public datasets:

- Czech-PDT (Hajič et al., 2020)
- Czech-PCEDT (Nedoluzhko et al., 2016)
- English-GUM (Zeldes, 2017)
- English-LitBank (Bamman et al., 2019)
- English-ParCorFull (Lapshinova-Koltunski et al., 2018)
- German-ParCorFull (Lapshinova-Koltunski et al., 2018)
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- Russian-RuCor (Toldova et al., 2014)
- Hungarian-SzegedKoref (Vincze et al., 2018)
- Hungarian-KorKor (Vadász, 2022)
- Turkish-ITCC (Pamay and Eryiğit, 2018)
- Ancient Greek-PROIEL (Haug and Jøhndal, 2008)
- Old Church Slavonic-PROIEL (Haug and Jøhndal, 2008)
- Ancient Hebrew-PTNK (Swanson et al., 2024)

## non-public datasets:

- English-OntoNotes (Weischedel et al., 2011)
- English-ARRAU (Uryupina et al., 2020)
- Dutch-COREA (Hendrickx et al., 2008)
- English-PCEDT (Nedoluzhko et al., 2016)



# CorefUD 1.2

## statistics in the public datasets

CorefUD dataset	docs	sents	words	empty n.	entities	avg. len.	mentions
Ancient_Greek-PROIEL	19	6,475	64,111	6,283	3,215	6.6	21,354
Ancient_Hebrew-PTNK	40	1,161	28,485	0	870	7.2	6,247
Catalan-AnCora	1,298	13,613	429,313	6,377	17,558	3.6	62,417
Czech-PCEDT	2,312	49,208	1,155,755	35,654	49,225	3.4	168,055
Czech-PDT	3,165	49,428	834,720	21,808	46,628	3.3	154,905
English-GUM	217	12,147	211,920	115	8,270	4.4	36,733
English-LitBank	100	8,560	210,530	0	2,164	10.8	23,340
English-ParCorFull	19	543	10,798	0	188	4.4	835
French-Democrat	126	13,057	284,883	0	7,162	6.5	46,487
German-ParCorFull	19	543	10,602	0	243	3.7	896
German-PotsdamCC	176	2,238	33,222	0	880	2.9	2,519
Hungarian-KorKor	94	1,351	24,568	1,988	1,124	3.7	4,103
Hungarian-SzegedKoref	400	8,820	123,968	4,857	4,769	3.2	15,165
Lithuanian-LCC	100	1,714	37,014	0	1,087	4.0	4,337
Norwegian-BokmaalNARC	346	15,742	245,515	0	5,658	4.7	26,611
Norwegian-NynorskNARC	394	12,481	206,660	0	5,079	4.3	21,847
Old_Church_Slavonic-PROIEL	26	6,832	61,759	6,289	3,396	6.5	22,116
Polish-PCC	1,828	35,874	538,885	18,615	22,143	3.7	82,706
Russian-RuCor	181	9,035	156,636	0	3,515	4.6	16,193
Spanish-AnCora	1,356	14,159	458,418	8,112	19,445	3.6	70,663
Turkish-ITCC	24	4,732	55,358	11,584	4,019	5.4	21,569

# Examples of coreference

(1) Mary gave **Peter** an apple. Steve gave **him** another one.

ANTECEDENT

ANAPHOR

(2) Mary gave Peter **an apple**. Steve gave him **another one**. Peter took **them** and left.

*(split antecedent)*

(3) I didn't like **this apple**. I bit **it** off several times and threw **it** out of the window.

*(near-identity)*

(4) I finished **my apple** and threw **the stub** out the window. *(bridging)*

(5) I ate **Peter's apple**. He will never forgive me for **that**. *(discourse deixis)*

(6) **My apple, the red one**, is really good. *(apposition)*

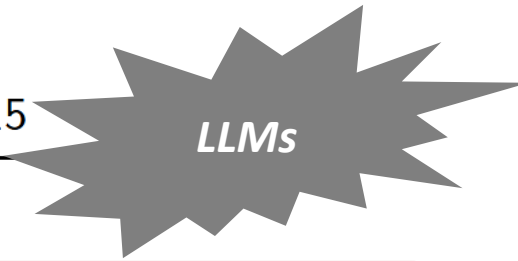
(7) **This red apple** is a symbol of happiness. *(predication)*

# Diversity in existing resources: relations (in CorefUD 1.0)

CorefUD dataset	Coref. grouping		Relations among mentions					
	cluster-based	link-based	singletons	appos.	pred.	split antec.	disc. deixis	bridg.
Catalan-AnCora	✓	×	✓	✓	✓	✓	✓	×
Czech-PCEDT	×	✓	(✓)	(✓)	(✓)	✓	✓	×
Czech-PDT	×	✓	(✓)	(✓)	(✓)	✓	✓	✓
English-GUM	✓	×	✓	✓	✓	✓	✓	✓
English-ParCorFull	✓	×	×	✓	(✓)	✓	✓	×
French-Democrat	✓	×	✓	×	×	×	×	×
German-ParCorFull	✓	×	×	✓	(✓)	✓	✓	×
German-PotsdamCC	×	✓	✓	✓	✓?	×	✓	×
Hungarian-SzegedKoref	✓	×	×	✓	?	×	✓	✓
Lithuanian-LCC	×	✓	×	×	×	✓	×	×
Polish-PCC	✓	×	✓	✓	✓	×	✓	✓
Russian-RuCor	✓	×	×	✓	✓	×	×	×
Spanish-AnCora	✓	×	✓	✓	✓	✓	✓	×
Dutch-COREA	×	✓	✓	✓	✓	×	✓	✓
English-ARRAU	✓	✓	✓	✓	✓	✓	✓	✓
English-OntoNotes	✓	×	×	✓	×	×	✓	×
English-PCEDT	×	✓	(✓)	(✓)	(✓)	✓	✓	×

# Shared Tasks on multilingual coreference resolution based on the CorefUD dataset

Shared task	Languages	<a href="https://ufal.mff.cuni.cz/corefud/crac24">https://ufal.mff.cuni.cz/corefud/crac24</a>
CRAC 2022	10	
CRAC 2023	12	
CRAC 2024	15	
CRAC 2025 <i>planned</i>	more than 15	



- systems
  - no syntax use (except for heads),
  - no POS tags, ignore all columns except for forms
- baselines
  - only for zeros
- evaluation
  - for head-matching (BUT given by CorefUD)
    - gold mention heads determined from the dependency tree using the Udapi block `corefud.MoveHead`
  - for zeros alignment (9 DEPS column)

## Part 2

# CorefUD and Treebanks



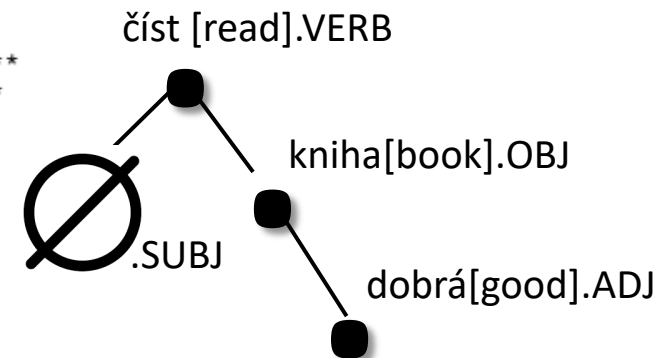
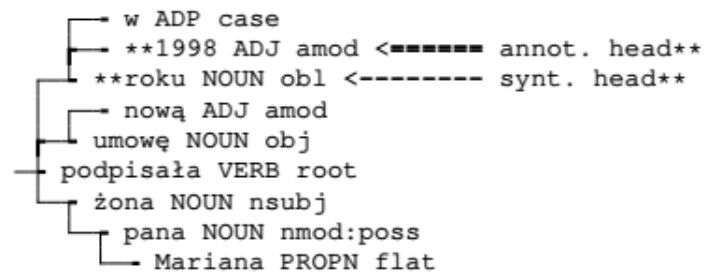
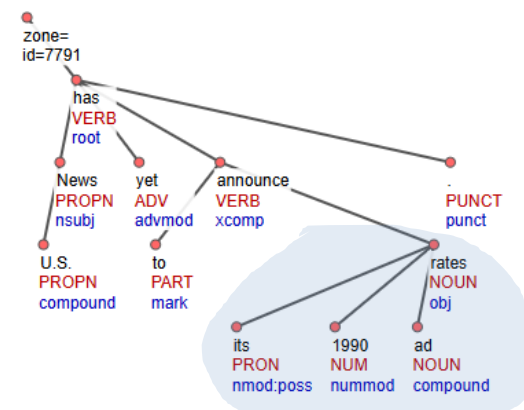
UD tree structures  
and mention spans

Syntactic heads in UD  
and head mentions

Empty nodes in UD  
and zero anaphora

U.S. News has yet to announce its 1990 ad rates .

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## Part 2

# CorefUD and Treebanks



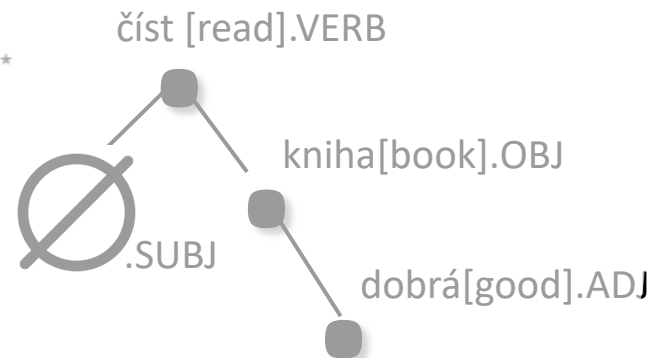
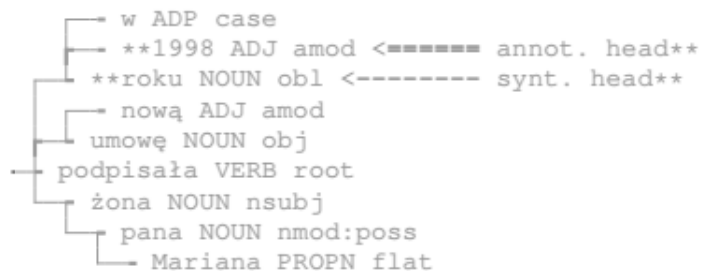
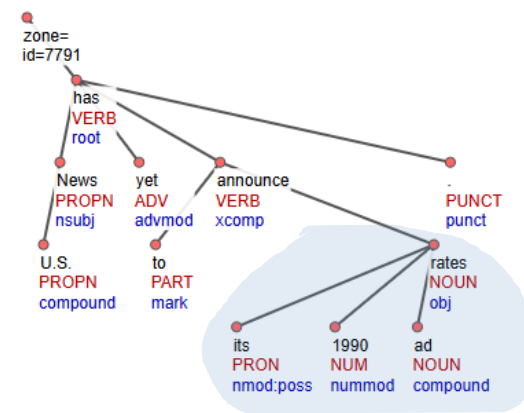
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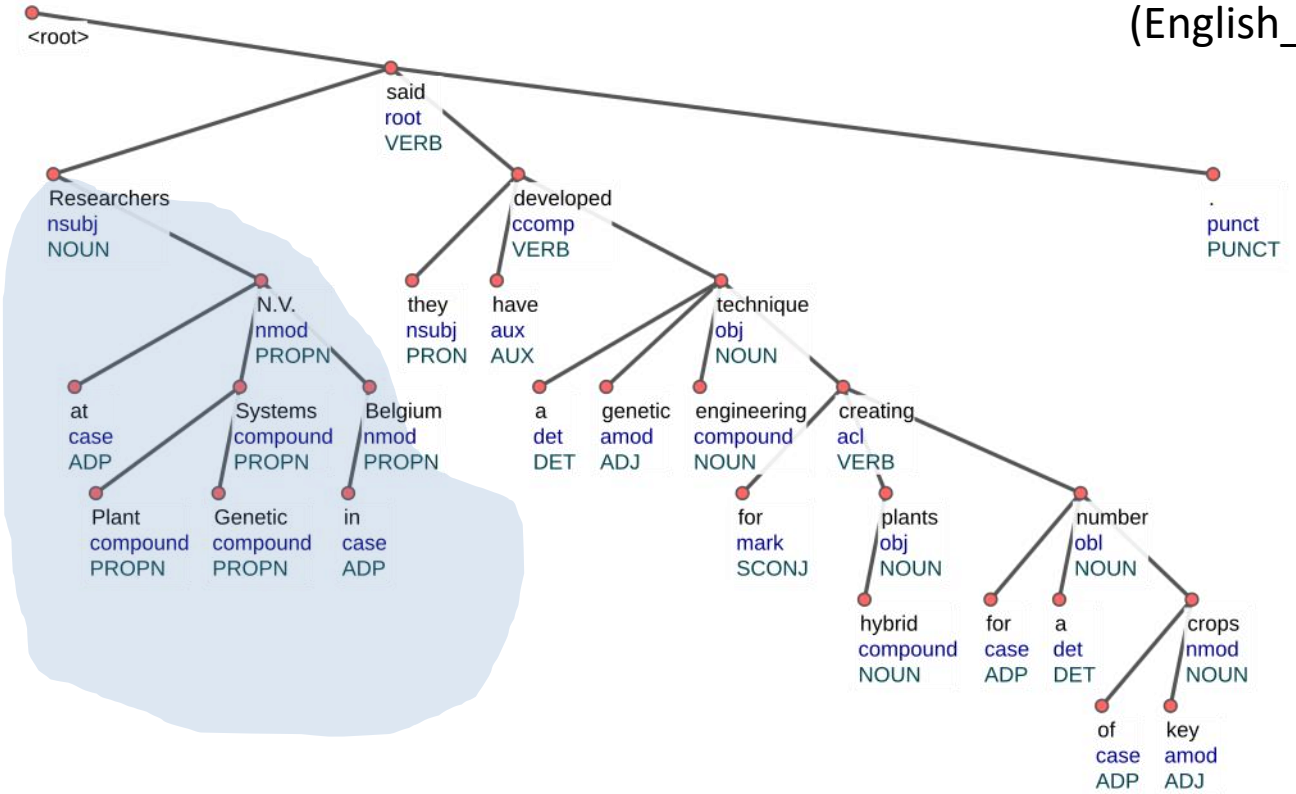


# Do UD tree structures correspond to mention spans in coreference annotations?

**mention**
**coreference**

*Researchers at Plant Generic Systems N.V. in Belgium said they have developed a genetic engineering technique for creating hybrid plants for a number of key crops.*

(English\_ARRAU)

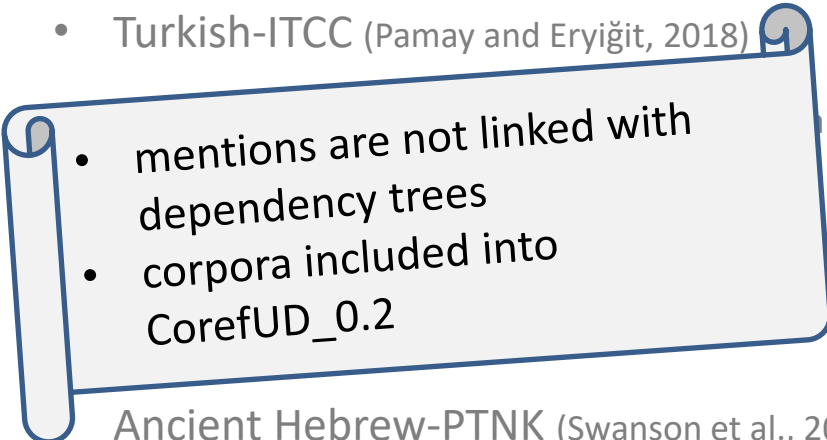


*Hypothesis:*

mentions are not just unconstrained subsequences of tokens, but mostly correspond to syntactically meaningful units

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- 
- mentions are not linked with dependency trees
  - corpora included into CorefUD\_0.2

Ancient Hebrew-PTNK (Swanson et al., 2024)

## non-public datasets:

- English-OntoNotes (Weischedel et al., 2011)
- **English-ARRAU** (Uryupina et al., 2020)
- **Dutch-COREA** (Hendrickx et al., 2008)
- English-PCEDT (Nedoluzhko et al., 2016)<sub>16</sub>



# Do UD tree structures correspond to mention spans in coreference annotations?

CorefUD dataset	non-catena		OK [%]		AMBIG. [%]	WRONG [%]	
	% of all	annotated	COORD	FLAT	TREE/SPAN	TREE	SPAN
English-GUM	1.5	100	10	9	15	52	22
French-Democrat	1.9	100	3	1	7	81	10
German-PotsdamCC	5.3	101	14	0	5	57	28
Hungarian-SzegedKoref	3.3	25	0	0	0	88	12
Lithuanian-LCC	4.6	50	0	0	0	76	64
Polish-PCC	13.5	100	0	2	2	95	1
Russian-RuCor	4.3	100	0	1	6	86	7
Dutch-COREA	5.8	51	0	0	0	88	18
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We analyzed a sample of mentions that are not catenae (Popel et al. 2021)

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- WRONGTREE – parsing error
- WRONGSPAN – errors in coreference annotation

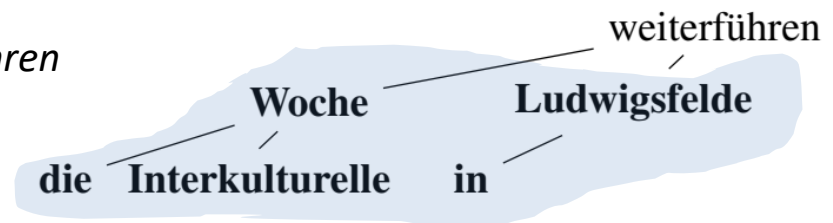
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- WRONGTREE – parsing error
- WRONGSPAN – errors in coreference annotation
- AMBIGUOUS – both could be OK

*[die Interkulturelle Woche in Ludwigsfelde] weiterführen*  
'to continue the Intercultural Week in Ludwigsfelde'



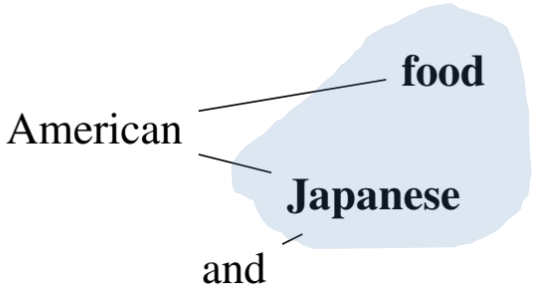
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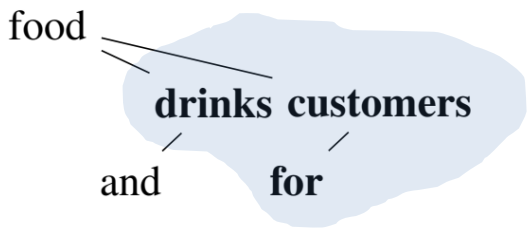
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- WRONGTREE – parsing error
- WRONGSPAN – errors in coreference annotation
- AMBIGUOUS – both could be OK
- OK – caused by the UD syntactic guidelines
  - COORDination
  - FLAT structures
    - names, foreign phrases, dates, complex numerals...

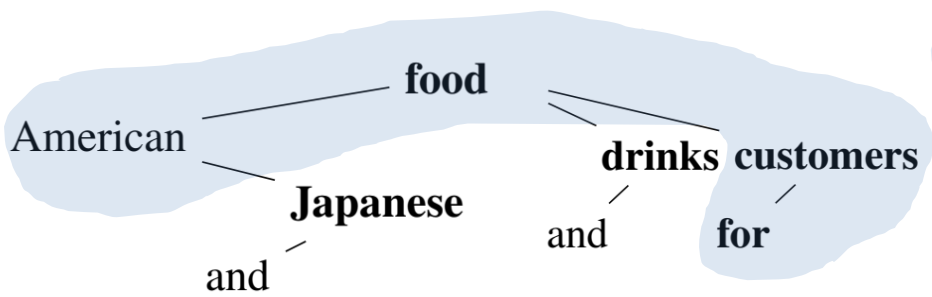
# Coordination in UD tree structures vs. coordination in mention spans



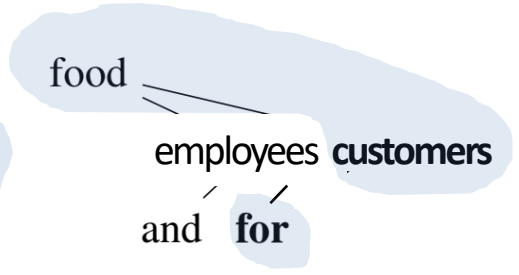
*American and [Japanese food]*



*food and [drinks for customers]*



*American and Japanese food and drinks for customers*



*food for employees or customers*

# Do UD tree structures correspond to mention spans in coreference annotations?

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## *Hypothesis:*

mentions are not just unconstrained subsequences of tokens, but mostly correspond to syntactically meaningful units

## *Conclusion:*

mention spans usually correspond to subtrees of dependency trees quite straightforwardly; and if they do not, it can be explained by errors in dependency trees or by mention span errors in most cases

## Part 2

# CorefUD and Treebanks



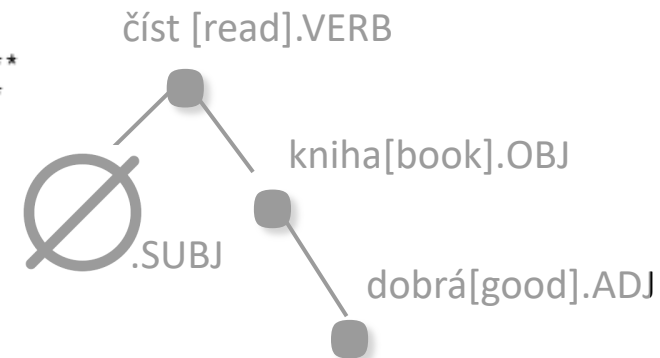
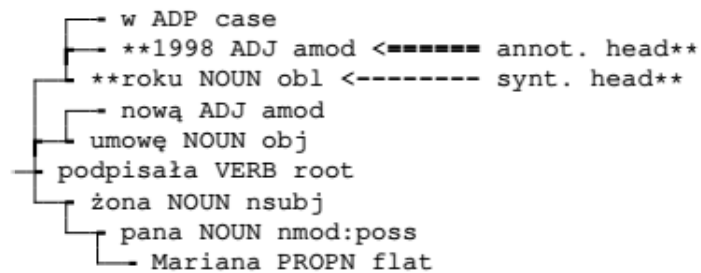
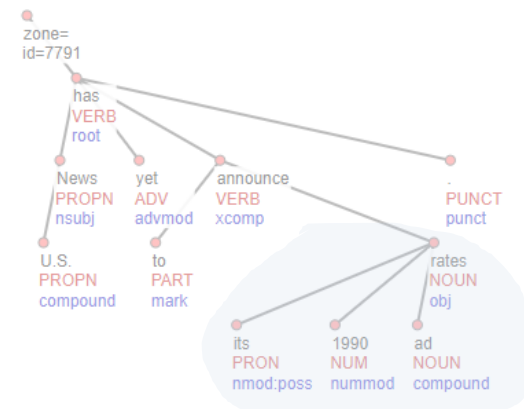
UD tree structures and mention spans

Syntactic heads in UD and head mentions

Empty nodes in UD and zero anaphora

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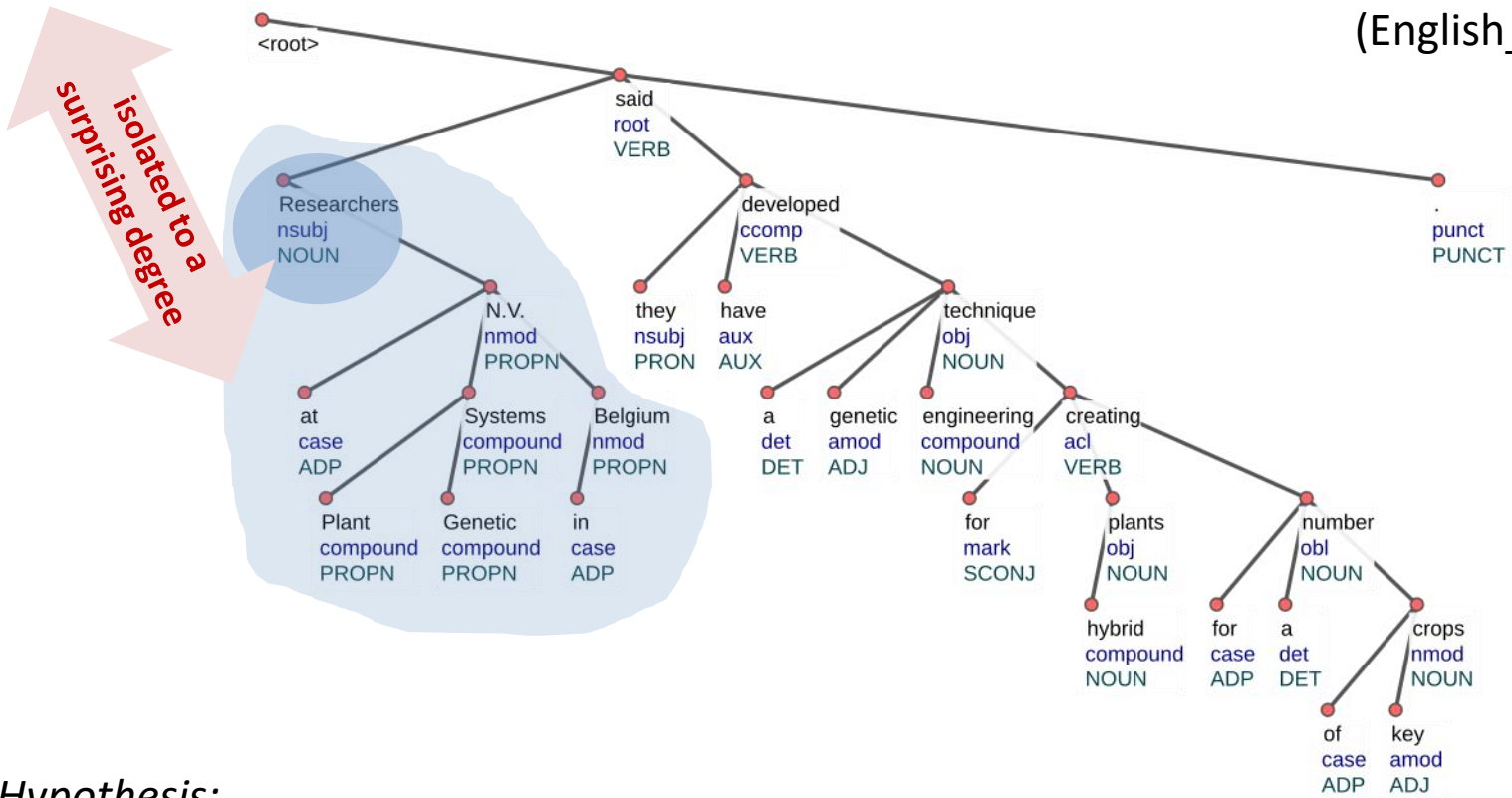


# Are syntactic heads in UD equivalent to the head mentions in coreference annotation?

mention head (min span)
mention
coreference

Researchers
at Plant Generic Systems N.V. in Belgium
said
they
have developed a genetic engineering technique for creating hybrid plants for a number of key crops.

(English\_ARRAU)

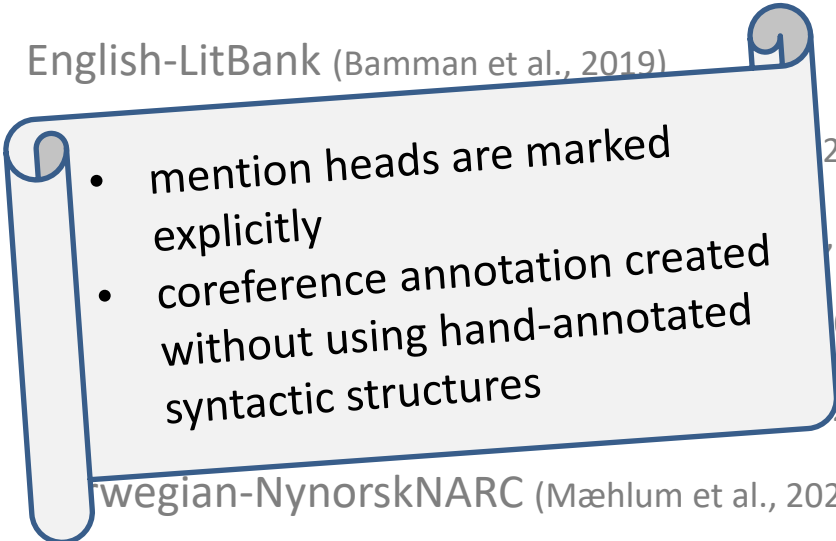


*Hypothesis:*

mention heads in annotations and syntactic heads in syntactic trees are closely related and compatible

## public datasets:

- Czech-PDT (Hajič et al., 2020)
- Czech-PCEDT (Nedoluzhko et al., 2016)
- English-GUM (Zeldes, 2017)
- English-LitBank (Bamman et al., 2019)
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- Ancient Hebrew-PTNK (Swanson et al., 2024)
- Norwegian-NynorskNARC (Mæhlum et al., 2022)
- Spanish-AnCora (Recasens and Martí, 2010)
- Catalan-AnCora (Recasens and Martí, 2010)



- mention heads are marked explicitly
- coreference annotation created without using hand-annotated syntactic structures

## non-public datasets:

- English-OntoNotes (Weischedel et al., 2011)
- **English-ARRAU** (Uryupina et al., 2020)
- **Dutch-COREA** (Hendrickx et al., 2008)
- English-PCEDT (Nedoluzhko et al., 2016)<sub>26</sub>

# Are syntactic heads in UD equivalent to the head mentions in coreference annotation?

we analyzed mentions, where mention heads differ from dependency heads

CorefUD dataset	count		[%]			
	all	one-word	non-catena	annotated head		
				missing	same	different
Dutch-COREA	26,476	38.9	2.7	4.6	47.2	6.6
English-ARRAU	57,681	30.0	5.4	3.1	56.3	5.3
Polish-PCC	150,706	49.1	5.0	0.1	44.3	1.5
Russian-RuCor	12,632	68.9	1.1	0.1	27.3	2.5

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sampled 100 examples to be analyzed

- WRONG
  - WRONG-TREE – parsing error
  - WRONG-SPAN – error in coreference annotation
  - WRONG-HEAD – wrongly identified head
- OK
  - OK-COORD – coordination issues
  - OK-FLAT – names, foreign phrases, dates
  - OK-NUM - numerals
  - OK-OTHER

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CorefUD dataset	OK				WRONG		
	COORD	FLAT	NUM	OTHER	TREE	SPAN	HEAD
Dutch-COREA	25	31	11	7	7	7	16
English-ARRAU	1	44	14	13	4	0	25
Polish-PCC	11	21	23	9	15	1	13
Russian-RuCor	0	85	7	2	5	0	1

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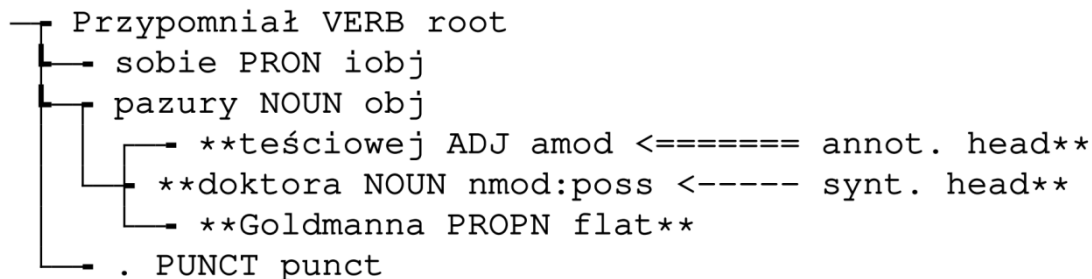
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- relatively low number of mismatches caused by wrong parsing
  - parsing of NPs is rather simple
- errors in specific constructions

*Przypomniał      sobie      pazury      teściowej              doktora      Goldmanna.*  
 He remembered   himself   claws   of mother-in-law   of dr.   Goldman.

‘He remembered Dr. Goldmann’s mother-in-law’s claws.’



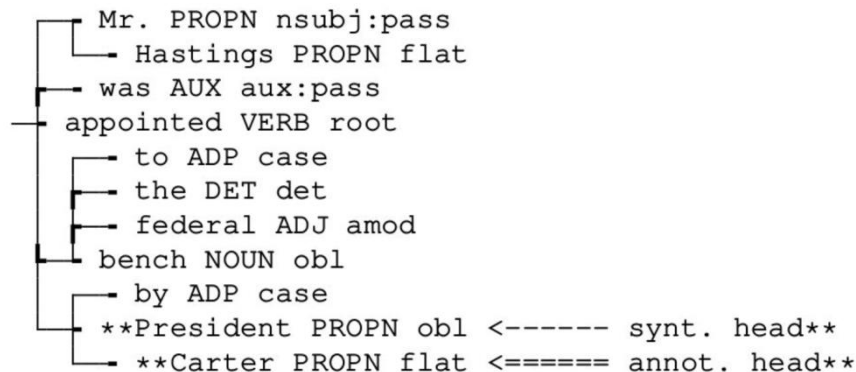


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- form a great deal of OK category
- head in “common noun + proper noun” constructions:
  - proper noun in coref. corpora vs. first word according to UD

*Mr. Hastings was appointed to the federal bench by President Carter.*



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	COORD	FLAT	NUM	OTHER	TREE	SPAN	HEAD
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- mention heads inconsistent *across* and also *within* the datasets
- inconsistencies in parse trees (even in the gold ones)
- syntactically governing numerals (e.g. “one of the candidates”) and containers (e.g. “group of tourists”)

5 *тысяч* *военных*  
 5 thousand.GEN.PL soldiers

40 *milionów złotych*  
 40 million złoty

```

  **5 NUM nummod**
  -- **тысяч NOUN nsubj:pass <-- synt. head**
  -- **военных NOUN nmod <==== annot. head**
  
```

```

  **40 NUM nummod**
  -- **milionów NOUN flat <==== annot. head**
  -- **złotych NOUN nmod:poss <---- synt. head**
  
```

# Are syntactic heads in UD equivalent to the head mentions in coreference annotation?

## *Hypothesis:*

mention heads in annotations and syntactic heads in syntactic trees are closely related and compatible

## *Observations and Conclusions:*

- the heads are mostly aligned
- mismatches due to parsing errors are low (4%–15%)
- many mismatches are due to a technical reason
- hence, it can be transformed automatically

## Part 2

# CorefUD and Treebanks



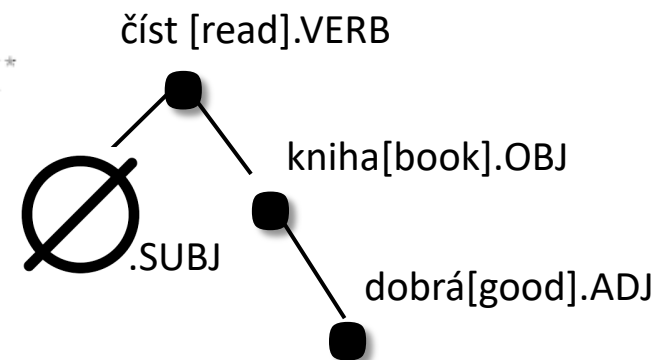
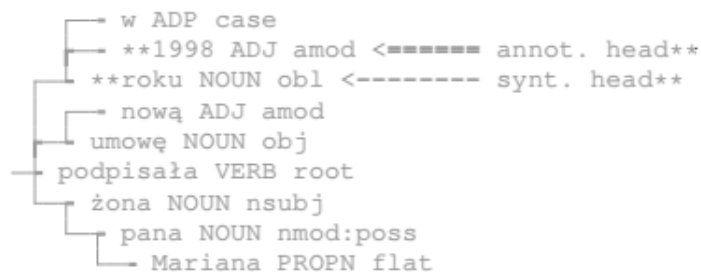
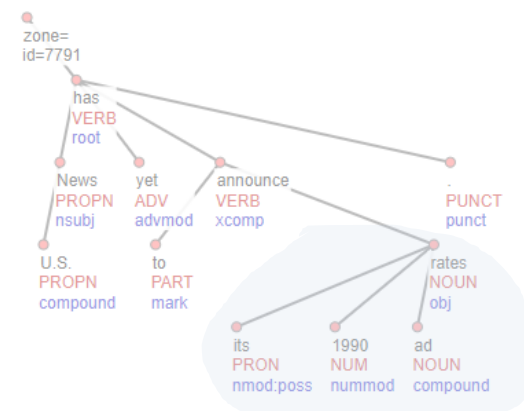
UD tree structures  
and mention spans

Syntactic heads in UD  
and head mentions

Empty nodes in UD  
and zero anaphora

U.S. News has yet to announce its 1990 ad rates .

U.S. News has yet to announce its 1990 ad rates .



## Empty nodes in CorefUD 1.2

- zeros are integral part of some of the datasets
- represented using empty nodes from enhanced UD

CorefUD dataset	docs	sents	words	empty n.	entities	avg. len.	mentions
Ancient_Greek-PROIEL	19	6,475	64,111	6,283	3,215	6.6	21,354
Ancient_Hebrew-PTNK	40	1,161	28,485	0	870	7.2	6,247
Catalan-AnCora	1,298	13,613	429,313	6,377	17,558	3.6	62,417
Czech-PCEDT	2,312	49,208	1,155,755	35,654	49,225	3.4	168,055
Czech-PDT	3,165	49,428	834,720	21,808	46,628	3.3	154,905
English-GUM	217	12,147	211,920	115	8,270	4.4	36,733
English-LitBank	100	8,560	210,530	0	2,164	10.8	23,340
English-ParCorFull	19	543	10,798	0	188	4.4	835
French-Democrat	126	13,057	284,883	0	7,162	6.5	46,487
German-ParCorFull	19	543	10,602	0	243	3.7	896
German-PotsdamCC	176	2,238	33,222	0	880	2.9	2,519
Hungarian-KorKor	94	1,351	24,568	1,988	1,124	3.7	4,103
Hungarian-SzegedKoref	400	8,820	123,968	4,857	4,769	3.2	15,165
Lithuanian-LCC	100	1,714	37,014	0	1,087	4.0	4,337
Norwegian-BokmaalNARC	346	15,742	245,515	0	5,658	4.7	26,611
Norwegian-NynorskNARC	394	12,481	206,660	0	5,079	4.3	21,847
Old_Church_Slavonic-PROIEL	26	6,832	61,759	6,289	3,396	6.5	22,116
Polish-PCC	1,828	35,874	538,885	18,615	22,143	3.7	82,706
Russian-RuCor	181	9,035	156,636	0	3,515	4.6	16,193
Spanish-AnCora	1,356	14,159	458,418	8,112	19,445	3.6	70,663
Turkish-ITCC	24	4,732	55,358	11,584	4,019	5.4	21,569

## Zeros in the public edition of CorefUD 1.2

- **Czech-PDT** (Hajič et al., 2020)
- **Czech-PCEDT** (Nedoluzhko et al., 2016)
- **English-GUM** (Zeldes, 2017)
- English-LitBank (Bamman et al., 2019)
- English-ParCorFull (Lapshinova-Koltunski et al., 2018)
- German-ParCorFull (Lapshinova-Koltunski et al., 2018)
- German-PotsdamCC (Bourgonje and Stede, 2020)
- Norwegian-BokmaalNARC (Mæhlum et al., 2022)
- Norwegian-NynorskNARC (Mæhlum et al., 2022)
- **Spanish-AnCora** (Recasens and Martí, 2010)
- **Catalan-AnCora** (Recasens and Martí, 2010)
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- **Ancient Greek-PROIEL** (Haug and Jøhndal, 2008)
- **Old Church Slavonic-PROIEL** (Haug and Jøhndal, 2008)
- Ancient Hebrew-PTNK (Swanson et al., 2024)

# How do zeros in coreference relate to empty nodes in syntactic structures?

Dataset	Empty nodes	Empty n. %
Ancient_Greek-PROIEL	6,283	10
Catalan-AnCora	6,377	1.5
Czech-PCEDT	35,654	1.5
Czech-PDT	21,808	2.5
English-GUM	115	<1
Hungarian-KorKor	1,988	8
Hungarian-SzegedKoref	4,857	8
Old_Church_Slavonic-PROIEL	6,289	10
Polish-PCC	18,615	3.5
Spanish-AnCora	8,112	2
Turkish-ITCC	11,584	20

- difference across languages
- difference across annotation approaches in what is annotated as zero mentions

# Empty nodes and zero mentions in English datasets in CorefUD 1.2 numbers and examples

Dataset	Empty nodes	Empty n. %	Zero mentions	Zero m. %
English-GUM	115	<0.1	1?	<1
English-PCEDT	5,810	0.5	5,295	91
English-ARRAU	0	0	0	0
English-OntoNotes	0	0	0	0

*After the death of his mother in 1846 and [the death of] his father in 1848, he sailed west, arriving in San Francisco possibly in November 1849. (English\_GUM)*

*Four of the five surviving workers have asbestos-related diseases, including three [workers] with recently diagnosed cancer. (English\_PCEDT)*



# Distribution of zero mentions

Reconstructed zeros for coreference may have different “functions”

- zero subjects
- zero objects
- possessives
- ellipses
- ...

Dataset	NullSubj	NullObj	NullPoss	ellipsis
Ancient_Greek-PROIEL	✓	✓	×	×
Catalan-AnCora	✓	×	×	✓
Czech-PCEDT	✓	✓	(✓)	✓
Czech-PDT	✓	✓	(✓)	✓
English-GUM	×	×	×	✓
Hungarian-KorKor	✓	✓	✓	
Hungarian-SzegedKoref	✓	✓	✓	
Old_Church_Slavonic-PROIEL	✓	✓	×	×
Polish-PCC	✓	×	×	✓
Spanish-AnCora	✓	×	×	✓
Turkish-ITCC	✓	×	✓	

# Reconstructed zero subjects

## Examples

*Bilmiyorum*  $\emptyset_{subj}$ . ‘I don't know’ (Turkish\_ITCC)

*Przemysł atomowy zapowiedział, że*  $\emptyset_{subj}$  *wystąpi o odszkodowania w miliardowej wysokości.* ‘The nuclear industry has announced that [it] will seek billions in damages.’  
(Polish\_PCC)

*A szeleketet ízlés szerint vajjal vagy olívaolajjal*  $\emptyset_{subj}$  *kenik meg.* ‘[They] spread the slices with butter, sandwich spread, or olive oil according to taste.’  
(Hungarian\_KorKor)

$\emptyset_{subj}$  *οὐκ ἤλθον καταλῦσαι ἀλλὰ πληρῶσαι.* ‘[I] have not come to abolish but to fulfill.’  
(Ancient\_Greek\_PROIEL)

*Avšak nyní se již*  $\emptyset_{subj}$  *těší na své zimní zasedání.* ‘But now [they] are looking forward to their winter session.’ (Czech\_PCEDT)

# Reconstructed zero objects

## Examples

*Μὴ νομίσητε ὅτι ἦλθον καταλῦσαι τὸν νόμον ἢ τοὺς προφήτας. οὐκ ἦλθον  $\emptyset_{obj}$  καταλῦσαι ἀλλὰ  $\emptyset$  πληρῶσαι.* ‘Do not think that I have come to abolish the law or the prophets. I have not come to abolish but to fulfill.’ (Ancient\_Greek\_PROIEL)

*Az angol John Montaguról, Sandwich negyedik grófjáról nevezték el  $\emptyset_{subj}$   $\emptyset_{obj}$ .* “It was named after the English John Montagu, the fourth Earl of Sandwich.”  
(Hungarian\_KorKor)

*видѣвъ  $\emptyset_{obj}$  же воєвода избѣже вѣнъ* ‘As [he] saw [this] the commander went out’ (Old\_Church\_Slavonic\_PROIEL)

*Ve spojení s tím, že vyrovnávání obchodů není tak pružné, jak bychom si představovali  $\emptyset_{obj}$ , to vede ke dvěma věcem.* ‘Coupled with the fact that trade balancing is not as flexible as we would imagine [it], this leads to two things.’  
(Czech\_PDT)

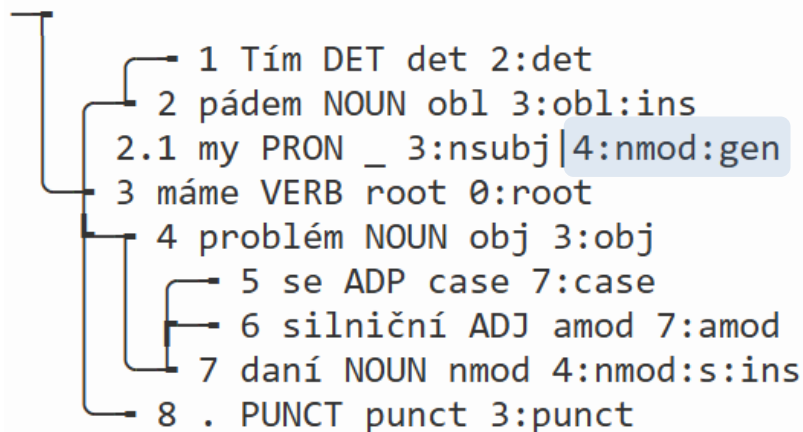
# Reconstructed zero possessives

## Examples

*Göğsü*  $\emptyset_{\text{poss}}$  *[onun] körük gibi inip kalkıyordu o.* ‘Her chest was rising and falling like a bellows.’ (Turkish\_ITCC)

*Úgy tűnik, hogy a kérése*  $\emptyset_{\text{poss}}$  *nyitott fülekre talált, vagy legalábbis az orosz törvényalkotók hasonlóan gondolkodnak.* ‘It seems that her request has fallen on deaf ears, or at least Russian lawmakers think similarly.’ (Hungarian\_KorKor)

*Tím pádem*  $\emptyset_{\text{poss}}$  *máme problém se silniční daní.* ‘So, we have a problem with road tax.’ (Czech\_PDT)





## Part 3

# Conclusions and Discussion

# Discussion and conclusions

- Initial hypotheses: deep integration of coreference and syntax
- “Positive” findings
  - mention spans usually correspond to subtrees
  - mention heads usually correspond to heads in UD trees
  - more questions with zeros, looking for reasons
- “Negative” findings
  - CRAC shared tasks showed that systems don’t need syntactic information

# Discussion and conclusions

- Observations:
  - there are linguistic phenomena that are relevant – but at the same time difficult to handle – both for dependency syntax and for coreference annotation schemes and it seems natural to use the same annotation conventions for both.
    - coordination and other paratactic relations, zeros, named entities etc.
- syntactic viewpoint increases annotation consistency
  - e.g. in defining mention spans or heads

# Future plans for near future

- extension of CorefUD is always welcome
- detailed improvement of many special issues in CorefUD is also very welcome
- definitely more research is needed on data,
  - zeros
  - other phenomena, e.g. coordination
- CRAC2025 shared task: focus on LLMs



# Acknowledgements

**I thank ChatGPT for inventing (almost) the same topic for my presentation!**

**prompt** (originally in Czech):

What is the best topic for Anna Nedoluzhko to present as a key-note talk at the conference Treebanks and Linguistic Theories?



**ChatGPT said:**

"Coreference and Syntax: Bridging Treebanks and Cross-Linguistic Phenomena"

**Abstract:**

The lecture could present the relationship between dependency syntax and coreference based on data from CorefUD. It would focus on questions such as:

- How syntactic structures influence coreference relations.
- Multilingual challenges in annotating coreference and dependency structures.
- The role of zero elements (null anaphora, omitted arguments) in tree representations and their relationship to coreference chains.

**Reason:**

This topic connects the core areas of TLT—tree structures and their application in linguistic theory—with practical and theoretical insights into coreference.

# Acknowledgements

**Thank you for attention!**

**Questions?**

# References

All information about CorefUD, shared tasks and guidelines may be found here:

<https://ufal.mff.cuni.cz/corefud>

Papers most relevant for the talk:

- Nedoluzhko Anna, Novák Michal, Popel Martin, Žabokrtský Zdeněk, Zeldes Amir, Zeman Daniel: **CorefUD 1.0: Coreference Meets Universal Dependencies**. In: LREC 2022
- Popel Martin, Žabokrtský Zdeněk, Nedoluzhko Anna, Novák Michal, Zeman Daniel: **Do UD Trees Match Mention Spans in Coreference Annotations?**. In: *Findings of the Association for Computational Linguistics: EMNLP 2021*, Copyright © Association for Computational Linguistics, Stroudsburg, PA, USA, ISBN 978-1-955917-10-0, pp. 3570-3576, 2021
- Nedoluzhko Anna, Novák Michal, Popel Martin, Žabokrtský Zdeněk, Zeman Daniel: **Is one head enough? Mention heads in coreference annotations compared with UD-style heads**. In: Depling, SyntaxFest 2021