

Parsing Old Czech with Modern Czech Models

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unless otherwise stated

Universal Dependencies

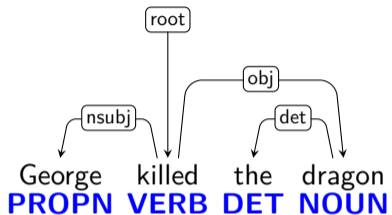
1 Universal Dependencies

2 Czech in UD, Parsing

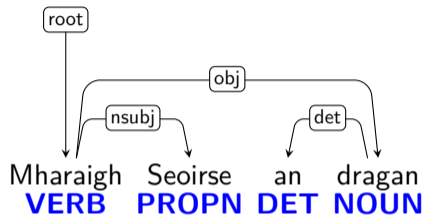
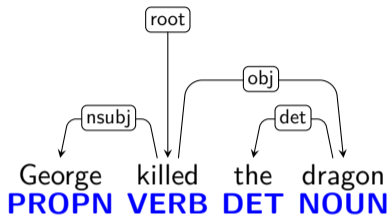
Universal Dependencies

- <https://universaldependencies.org/>
- Same things annotated same way across languages...
- ... while highlighting different **coding strategies**

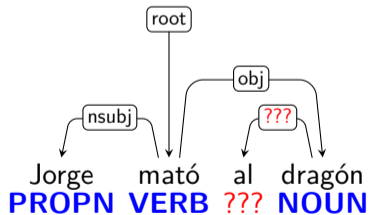
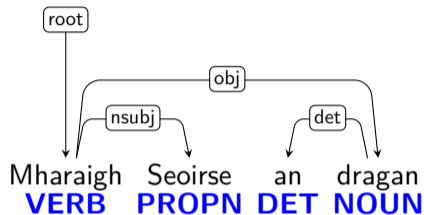
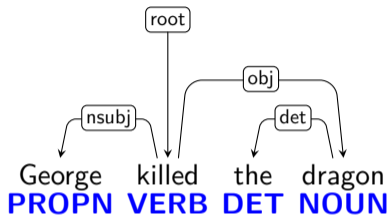
Same Thing Same Way



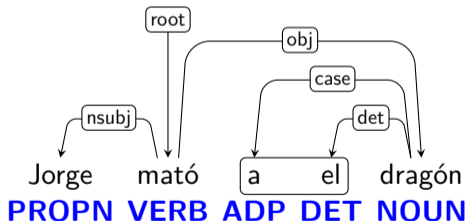
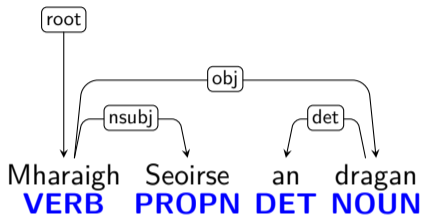
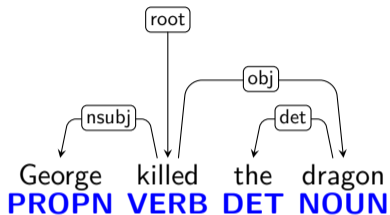
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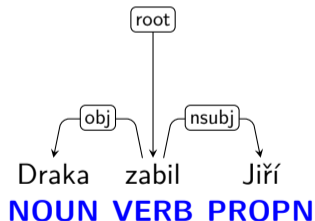
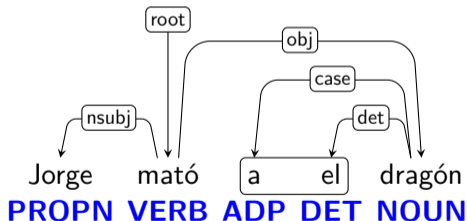
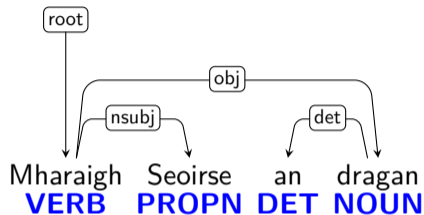
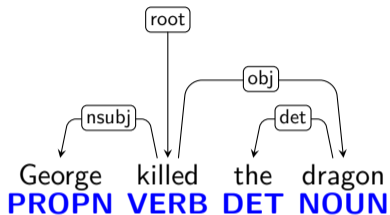
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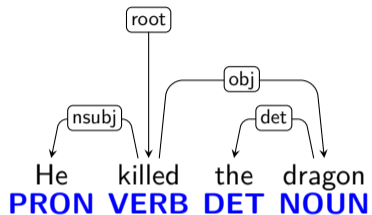
Same Thing Same Way



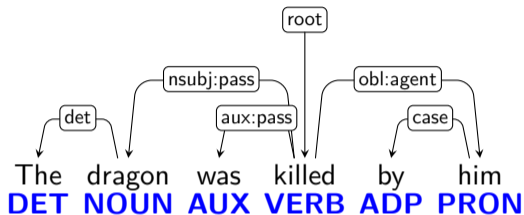
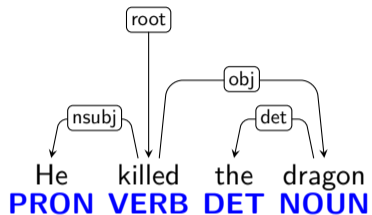
Same Thing Same Way



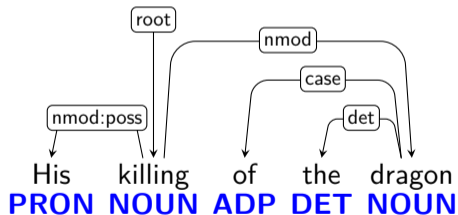
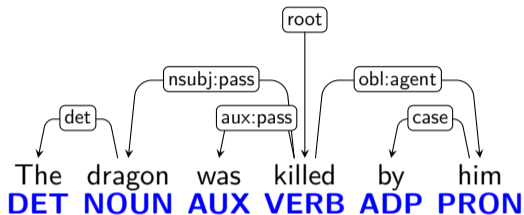
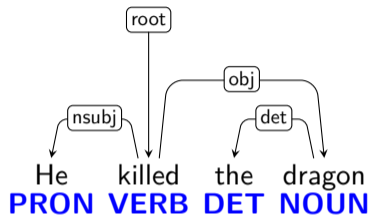
Same Meaning \neq Same Construction!



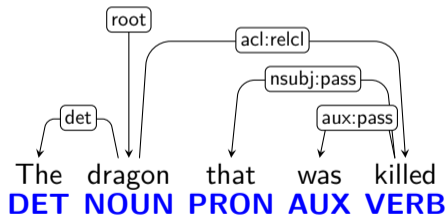
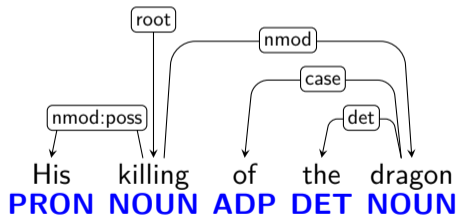
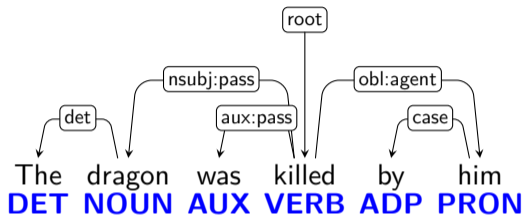
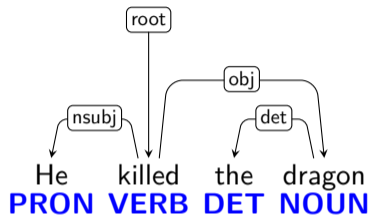
Same Meaning \neq Same Construction!



Same Meaning \neq Same Construction!



Same Meaning \neq Same Construction!



Morphological Annotation

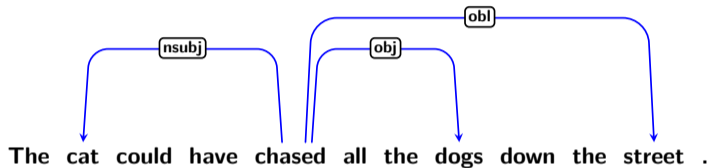
Le	chat	chasse	les	chiens	.
le	chat	chasser	le	chien	.
DET	NOUN	VERB	DET	NOUN	PUNCT
Definite=Def Gender=Masc Number=Sing	Gender=Masc Number=Sing	Mood=Ind Number=Sing Person=3 Tense=Pres VerbForm=Fin	Definite=Def Gender=Masc Number=Plur	Gender=Masc Number=Plur	

- Lemma representing the semantic content of a word
- Part-of-speech tag representing its grammatical class
- Features representing lexical and grammatical properties of the lemma or the particular word form

The cat could have chased all the dogs down the street .

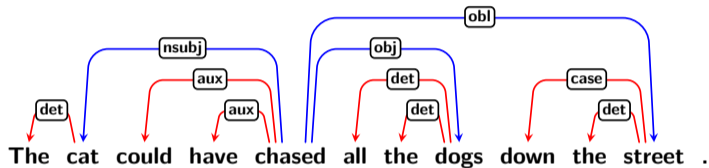
- Content words are related by dependency relations
- Function words attach to the content word they modify
- Punctuation attach to head of phrase or clause

Syntactic Annotation



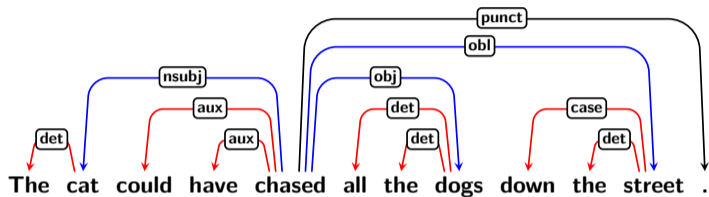
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Syntactic Annotation



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Syntactic Annotation



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CoNLL-U Format

ID	FORM	LEMMA	UPOS	XPOS	FEATS	HEAD	DEPREL	DEPS	MISC
1	Le	le	DET	-	-	2	det	-	-
2	chat	chat	NOUN	-	-	3	nsubj	-	-
3	boit	boire	VERB	-	-	0	root	-	-
4-5	du	-	-	-	-	-	-	-	-
4	de	de	ADP	-	-	6	case	-	-
5	le	le	DET	-	-	6	det	-	-
6	lait	lait	NOUN	-	-	3	obj	-	SpaceAfter=No
7	.	.	PUNCT	-	-	3	punct	-	-

- Revised and extended version of CoNLL-X format
- Two-level segmentation and enhanced dependencies

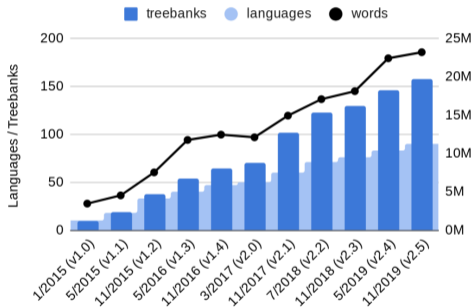
Basic Universal Dependencies: 130 (128) Languages and Growing

▪ **I.-E.:**  Armenian (+West),  Greek (+Ancient),  Albanian,  Hittite,  Breton,  Irish,  Manx,  Scottish,  Welsh,  Afrikaans,  Danish,  Dutch,  English,  Faroese,  Frisian,  German,  Gothic,  Icelandic,  Low Saxon,  Norwegian,  Swedish,  Swiss German,  Catalan,  French,  Galician,  Italian,  Latin,  Ligurian,  Neapolitan,  Old French,  Portuguese,  Romanian,  Spanish,  Umbrian,  Belarusian,  Bulgarian,  Church Slavonic,  Croatian,  Czech,  Old Russian,  Polish,  Pomak,  Russian,  Serbian,  Slovak,  Slovenian,  Ukrainian,  Upper Sorbian,  Latvian,  Lithuanian,  Kurmanji,  Persian, Khunsari, Nayini, Soi,  Urdu,  Hindi, Kangri, Bhojpuri, Bengali, Marathi, Sanskrit ▪ **Dravidian:**  Tamil, Telugu ▪ **Uralic:**  Erzya,  Estonian,  Finnish,  Hungarian,  Karelian, Livvi,  Komi Permyak+Zyrian,  Moksha,  Sámi North+Skolt ▪ **Turkic:**  Kazakh,  Old Turkish,  Tatar,  Turkish,  Uyghur,  Yakut ▪  Buryat ▪  Xibe ▪  Korean ▪  Japanese ▪ **Sino-T.:**  Cantonese,  Classical Chinese,  Chinese ▪ **Tai-Kadai:**  Thai ▪ **Aus.-As.:**  Vietnamese ▪ **Austron.:**  Indonesian, Javanese,  Tagalog, Cebuano ▪ **Pama-Nyu.:**  Warlpiri ▪ **Chu.-Kam.:**  Chukchi ▪ **Esk.-Al.:**  Yupik ▪ **Mayan:**  Kiche ▪ **Arawakan:**  Apurinã ▪ **Arawan:**  Madi ▪ **Tupian:**  Akuntsu, Guajajara, Kaapor, Karo, Makurap, Mundurukú, Tupinambá,  Mbyá, Guaraní,  Teko ▪ **Af.-As.:**  Akkadian,  Amharic,  Arabic Standard+Levantine,  Assyrian,  Beja,  Coptic,  Hebrew (+Ancient),  Maltese ▪ **Niger-Congo:**

 Yoruba ▪ **Other:**  Basque,  Sw. Sign,  Naija

Where are we today?

- Brief history of UD:
 - First guidelines launched in October 2014
 - Treebank releases (roughly) **every six months**
 - Version 2 guidelines/treebanks in 2016–2017
 - New: guideline amendments since May 2022
 - Extensions: MWEs, PropBanks, Coreference
- UD in numbers:
 - 130 languages
 - 228 treebanks
 - 502 contributors
 - 150,000+ downloads
- Past and current UD events:
 - 4 CoNLL and IWPT shared tasks on UD parsing
 - UD workshops: next in Washington 2023
 - COST action: UniDive (since 2022)
 - Next release in November 2022 (v2.11)



Linguists Can Search Treebanks

<https://lindat.mff.cuni.cz/services/pmltq/>

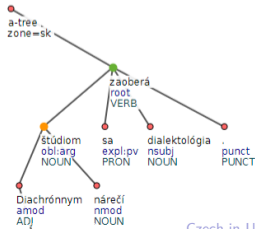
Relations ▾ Node Types ▾ Attributes ▾ Operators ▾ Functions ▾

```
a-node $v := [  
  tag="VERB",  
  child a-node $o := [deprel="obl:arg", iset/case="ins", &empty; child a-node [deprel="case"]]  
];
```

Execute query w/o Filters Suggest (0)

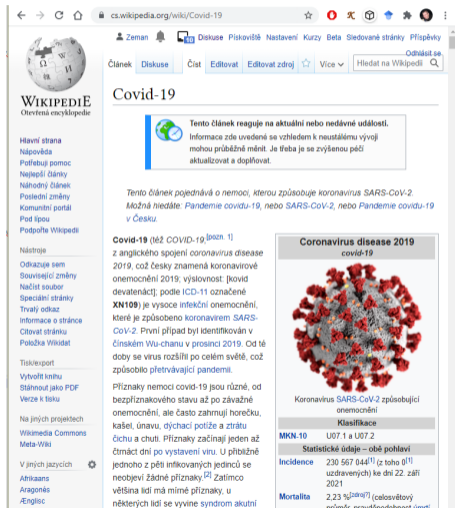
Result: 3 / 100

[sk] Diachrónnym a synchronným štúdiom nárečí sa zaoberá dialektológia.



Linguists Can Parse and Search New Data

<https://lindat.mff.cuni.cz/services/udpipe/>

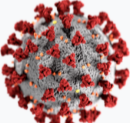


The screenshot shows the Czech Wikipedia page for COVID-19. The article title is "Covid-19". A notice at the top states: "Tento článek reaguje na aktuální nebo nedávné události. Informace zde uvedené se vzhledem k neustálému vývoji mohou průběžně měnit. Je třeba je se zvýšenou péčí aktualizovat a doplňovat." Below this, a summary paragraph reads: "Tento článek pojednává o nemoci, kterou způsobuje koronavirus SARS-CoV-2. Možná hledáte: *Pandemie covidu-19, nebo SARS-CoV-2, nebo Pandemie covidu-19 v Česku.*"

Covid-19 (těž COVID-19^[zdroj 1] z anglického spojení *coronavirus disease 2019*, což česky znamená koronavirové onemocnění 2019; výslovnost: [kovid devatenáct]; podle ICD-11 označené **XN109**) je vysoce infekční onemocnění, které je způsobeno koronavirem SARS-CoV-2. První případ byl identifikován v čínském Wu-chanu v prosinci 2019. Od té doby se virus rozšířil po celém světě, což způsobilo pletnávající pandemii.

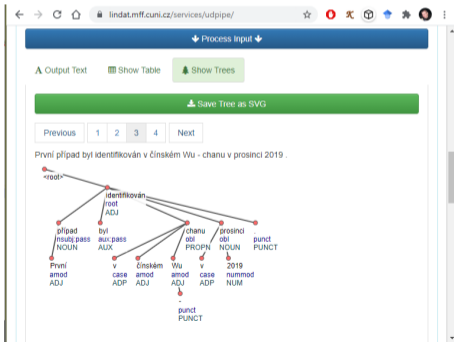
Příznaky nemoci covid-19 jsou různé, od bezpříznakového stavu až po závažné onemocnění, ale často zahrnují horečku, kašel, únavu, dýchací potíže a ztrátu čichu a chuti. Příznaky začínají jeden až čtrnáct dní po vystavení viru. U přibližně jednoho z pěti infikovaných jedinců se neobjeví žádné příznaky.^[2] Zatímco většina lidí má mírné příznaky, u některých lidí se vyvine syndrom akutní

Coronavirus disease 2019
covid-19



Koronavirus SARS-CoV-2 způsobující onemocnění

Klasifikace
MKN-10 U07.1 a U07.2
Statistické údaje – obě pohlaví
Incidence 230 567 044 ^[1] (z toho 0 ^[1] uzdravených) ke dni 22. září 2021
Mortalita 2,23 % ^[20497] (celosvětový průměr: <i>uzdravenost</i> úmrtí)



The screenshot shows the UDpipe web interface. At the top, there are buttons for "Process Input", "Output Text", "Show Table", "Show Trees", and "Save Tree as SVG". Below these are navigation buttons "Previous", "1", "2", "3", "4", and "Next".

První případ byl identifikován v čínském Wu-chanu v prosinci 2019.

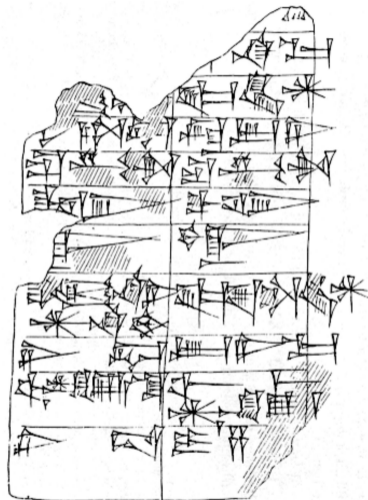
```
graph TD
    root["-root-"] --- identifikovan["identifikován  
root  
ADJ"]
    root --- byl["byl  
aux:pass  
AUX"]
    root --- v["v  
case  
ADP"]
    root --- čínském["čínském  
amod  
ADJ"]
    root --- Wu["Wu  
amod  
ADJ"]
    root --- v2["v  
case  
ADP"]
    root --- 2019["2019  
nummod  
NUM"]
    root --- prosinci["prosinci  
obl  
NOUN"]
    root --- punct["punct  
PUNCT"]
    identifikovan --- pripad["případ  
nsub:pass  
NOUN"]
    identifikovan --- Wu2["Wu  
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```

- Check grammar usage in the corpus
- Learner corpora

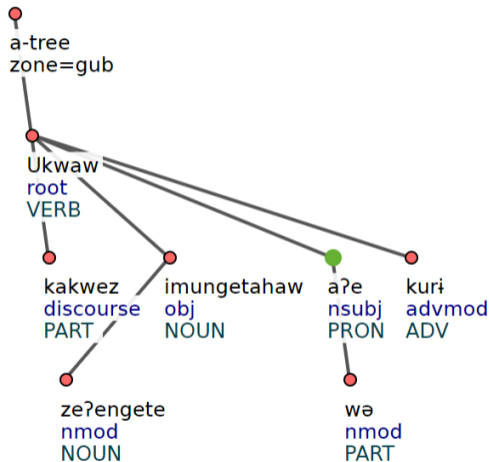


Historical Linguistics, Classical Languages

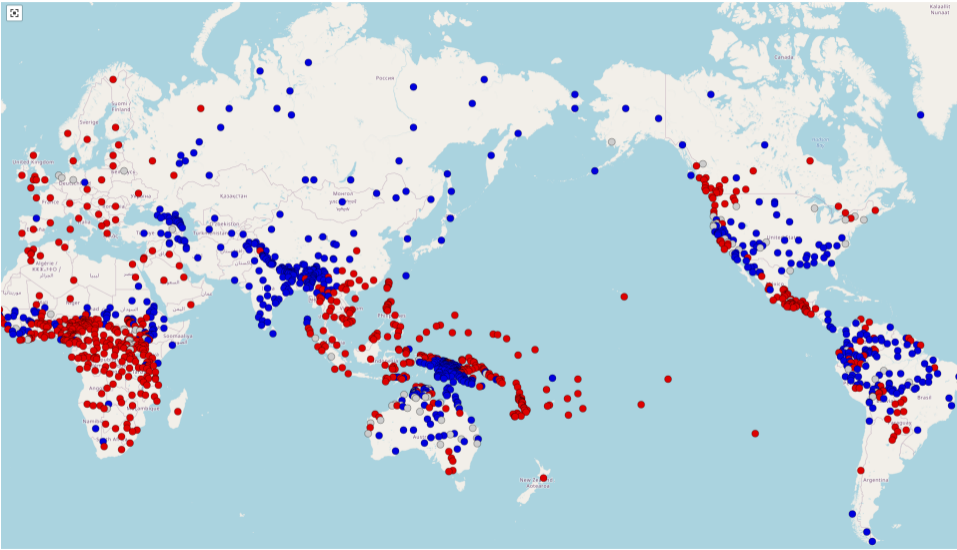
- Old Turkish
- Classical Chinese
- Sanskrit
- Hittite
- Akkadian
- Coptic
- Ancient Hebrew
- Ancient Greek
- Latin
- Old French
- Gothic
- Old Church Slavonic
- Old East Slavic



Documentation of Endangered Languages



Linguistic Typology



Linguistic Typology

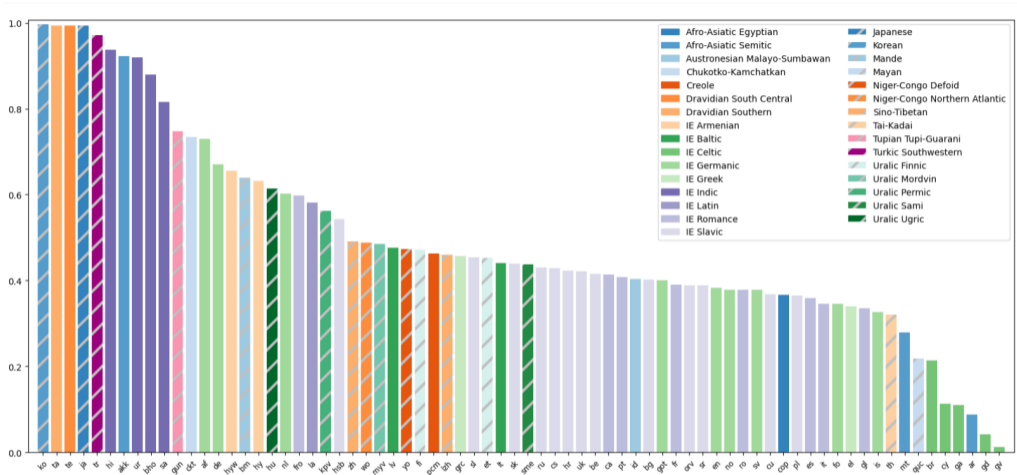


Figure 7 Percentage of head-final dependencies. Each bar is one language.

Czech in UD, Parsing

1 Universal Dependencies

2 Czech in UD, Parsing

- PDT (Prague Dependency Treebank)
 - Lidové noviny + Mladá Fronta + ČM Profit + Vesmír, 1993–1994
 - 87K sentences, 1.5M words
- CAC (Czech Academic Corpus / Korpus věcného stylu)
 - non-fiction, 1971–1985
 - 24K sentences, 493K words
- FicTree
 - fiction, from Czech National Corpus, 1991–2007
 - 12K sentences, 166K words
- CLTT (Czech Legal Text Treebank)
 - The Accounting Act (Zákon o účetnictví)
 - 1K sentences, 36K words
- PUD (Parallel Universal Dependencies)
 - online news + Wikipedia, translated from en/de/fr/it/es, around 2016
 - 1K sentences, 18K words

Old Czech UD Treebank?

- Pilot study (with colleagues from MU, Brno, and ÚJČ, Prague)
- Dresden Bible (around 1360)
- Olomouc Bible (1417)
- Gospel of Matthew (from both versions)
 - 2K sentences, 44K words

Old Czech UD Treebank?

- Pilot study (with colleagues from MU, Brno, and ÚJČ, Prague)
- Dresden Bible (around 1360)
- Olomouc Bible (1417)
- Gospel of Matthew (from both versions)
 - 2K sentences, 44K words
- Bootstrapping:
 - Parse a part using a parser
 - Manually check and fix
 - Re-train the parser
 - Parse another part
 - Manually check and fix
 - ...

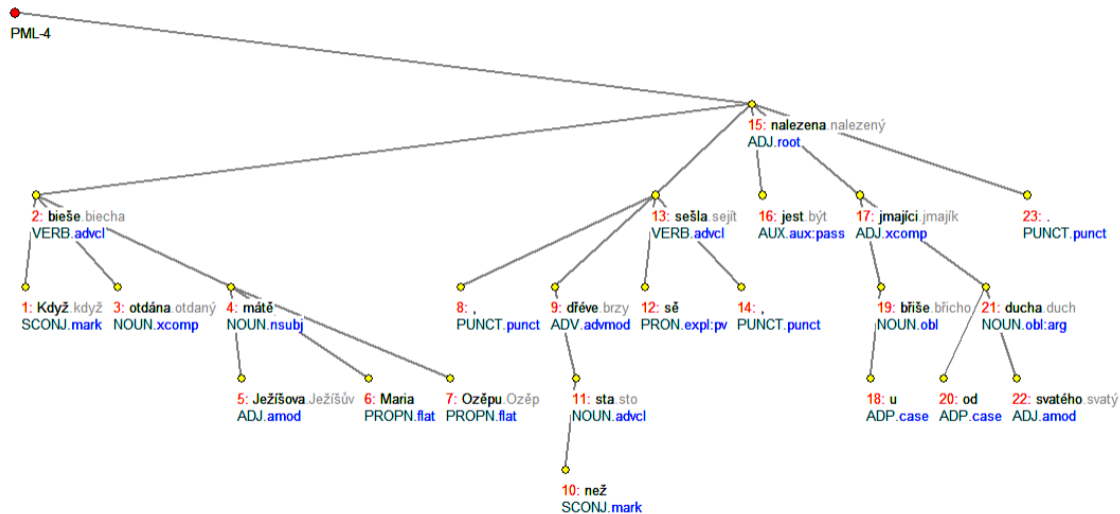
Old Czech UD Treebank?

- Pilot study (with colleagues from MU, Brno, and ÚJČ, Prague)
- Dresden Bible (around 1360)
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- Gospel of Matthew (from both versions)
 - 2K sentences, 44K words
- Bootstrapping:
 - Parse a part using a parser **but available models are modern Czech!**
 - Manually check and fix
 - Re-train the parser
 - Parse another part
 - Manually check and fix
 - ...

PDT Model vs. Old Czech Data

- Genre, vocabulary: news vs. Bible
- Old vocabulary
- Orthography
 - Cleaned, transcribed, unified
 - But still not modern forms: *sě*, *viece*
- Grammar:
 - Dual number
 - Simple past (imperfect, aorist) (*bieše*, *vecě*, *jide*)
 - Converbs (přechodníky) (*řka*, *přistúpiv*)

Example Parse (UDPipe 2.0 on UD PDT 2.6)



First Manually Checked Old Czech Sample

- Dresden Bible, Matthew chapters 1–5
- 148 sentences, 2665 words

Tagging Accuracy

UDPipe 2 Model	PDT 2.6	CAC 2.6	CLTT 2.6	FicTree 2.6
(Modern) Lemma	74.96	74.90	74.63	76.67
UPOS	91.29	90.69	91.03	90.73
Features	63.00	62.74	60.38	62.21

(In-domain Tagging Accuracy)

UDPipe 2 Model	PDT 2.6	CAC 2.6	CLTT 2.6	FicTree 2.6
(Modern) Lemma	99.17	98.95	99.30	99.21
UPOS	99.30	99.54	99.49	98.69
Features	97.70	97.07	95.16	96.80

UDPipe 1.2 Models

Test data from the same treebank but UD 2.10

UDPipe 1.2 Model	PDT 2.5	CAC 2.5	CLTT 2.5	FicTree 2.5
(Modern) Lemma	97.75	96.53	96.05	96.99
UPOS	98.32	98.15	97.50	97.04
Features	90.39	86.08	87.40	90.69

UDPipe 1.2 Models

Test data from the same treebank but UD 2.10

UDPipe 1.2 Model	PDT 2.5	CAC 2.5	CLTT 2.5	FicTree 2.5
(Modern) Lemma	97.75	96.53	96.05	96.99
UPOS	98.32	98.15	97.50	97.04
Features	90.39	86.08	87.40	90.69

Test data from PDT UD 2.10

UDPipe 1.2 Model	PDT 2.5	CAC 2.5	CLTT 2.5	FicTree 2.5
(Modern) Lemma		95.00	78.73	90.67
UPOS		95.98	80.48	90.83
Features		84.32	60.83	67.68

Split the Manually Checked Sample

- Dresden Bible, Matthew chapters 1–5
 - 148 sentences, 2665 words
- Chapters 1–4 for training
 - 86 sentences, 1669 words
- Chapter 5 for testing
 - 62 sentences, 996 words

Tagging Chapter 5: UDPipe 1.2 Trained on UD 2.5

UDPipe 1.2 Model	PDT 2.5	CAC 2.5	CLTT 2.5	FicTree 2.5
(Modern) Lemma	69.68	68.67	51.20	66.97
UPOS	76.71	74.00	55.82	70.58
Features	54.82	52.71	38.55	48.19

Tagging Chapter 5

UDPipe 1.2 Model	PDT 2.5	CAC 2.5	CLTT 2.5	FicTree 2.5	BDMt1-4
(Modern) Lemma	69.68	68.67	51.20	66.97	67.27
UPOS	76.71	74.00	55.82	70.58	74.90
Features	54.82	52.71	38.55	48.19	58.84

Tagging Chapter 5

UDPipe 1.2 Model	PDT 2.5	FicTree 2.5	BDMt1-4	Fic2.10+BDMt
(Modern) Lemma	69.68	66.97	67.27	78.41
UPOS	76.71	70.58	74.90	85.44
Features	54.82	48.19	58.84	64.86

Thanks!
Díky!

<https://universaldependencies.org/>