The State of Universal Dependencies

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What is Universal Dependencies?

“Universal Dependencies (UD) is a project developing cross-linguistically consistent treebank annotation for many languages, with the goal of facilitating multilingual parser development, cross-lingual learning, and parsing research from a language typology perspective.”

(https://universaldependencies.org/introduction.html)

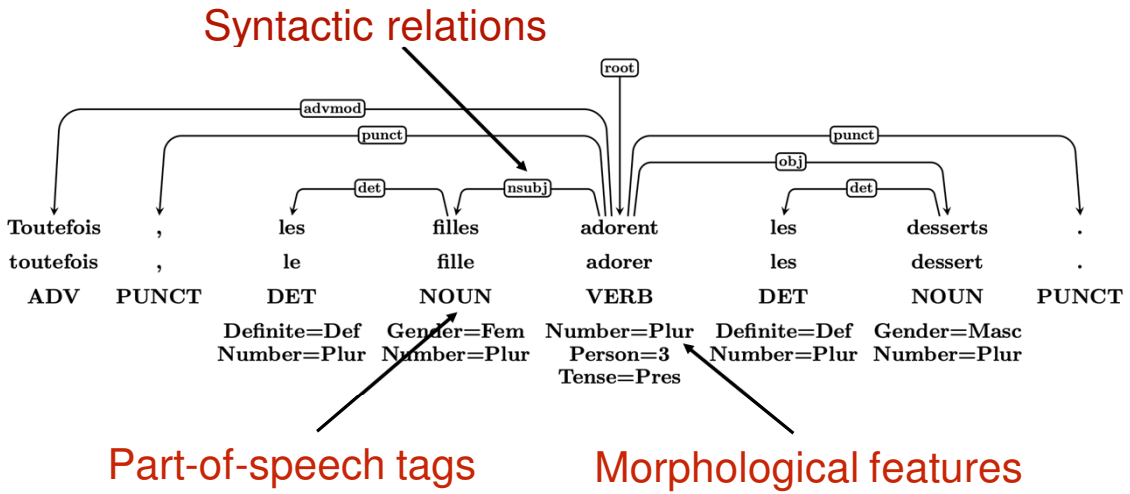
A project – but also an annotation scheme, a data repository and a community.

The UD Annotation Scheme

Basic design principles:

- Words as basic units
- Binary syntactic relations

Built on de facto standards



J. Nivre, M.-C. de Marneffe, F. Ginter, Y. Goldberg, J. Hajič, C. D. Manning, R. McDonald, S. Petrov, S. Pyysalo, N. Silveira, R. Tsarfaty, and D. Zeman (2016) Universal Dependencies v1: A Multilingual Treebank Collection. In *Proceedings of LREC*, 1659–1666.

J. Nivre, M.-C. de Marneffe, F. Ginter, J. Hajič, C. D. Manning, S. Pyysalo, S. Schuster, F. Tyers, and D. Zeman (2020) Universal Dependencies v2: An Evergrowing Multilingual Treebank Collection. In *Proceedings of LREC*, 4034–4043.

M.-C. de Marneffe, C. D. Manning, J.Nivre, and D. Zeman (2021) Universal Dependencies. *Computational Linguistics*, 47(2):255–308, 2021.

CoNLL-U Format

ID	FORM	LEMMA	UPOS	XPOS	FEATS	HEAD	DEPREL	DEPS	MISC
1	Es	es	PRON	_	_	2	nsubj	_	_
2	unterscheidet	unterscheiden	VERB	_	_	0	root	_	_
3	sich	sich	PRON	_	_	2	expl:pv	_	_
4-5	vom	_	_	_	_	_	_	_	_
4	von	von	ADP	_	_	7	case	_	_
5	dem	der	DET	_	_	7	det	_	_
6	westlichen	westlich	ADJ	_	_	7	amod	_	SpaceAfter=No
7	Teil	Teil	NOUN	_	_	2	obl	_	_
8	des	der	DET	_	_	9	det	_	_
9	Landes	Land	NOUN	_	_	7	nmod	_	SpaceAfter=No
10	.	.	PUNCT	_	_	2	punct	_	_

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

Word Segmentation

Let's go to the sea.

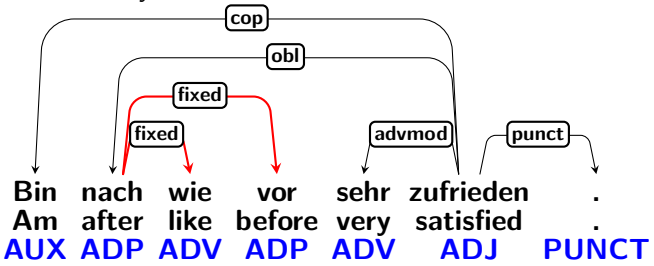
Vámonos	**al**	**mar**	**.**	**Vamos**	**nos**	**a**	**el**	**mar**	**.**
VERB?	**X**	**NOUN**	**PUNCT**	**VERB**	**PRON**	**ADP**	**DET**	**NOUN**	**PUNCT**

- **Syntactic word** vs. orthographic word
- **Multi-word tokens**
- Two-level scheme:
  - Tokenization (low level, punctuation, concatenative)
  - Word segmentation (higher level, not necessarily concatenative)

Fixed Expressions

One syntactic word spans several orthographic words?

I am still very satisfied.



Part-of-Speech Tags

http://universaldependencies.org/u/pos/index.html

Open		Closed		Other	
NOUN	common noun	**PRON**	pronoun	**PUNCT**	punctuation
PROPN	proper noun	**DET**	determiner	**SYM**	symbol
VERB	verb	**AUX**	auxiliary	**X**	unknown
ADJ	adjective	**NUM**	numeral		
ADV	adverb	**ADP**	adposition		
INTJ	interjection	**SCONJ**	subordinator		
		CCONJ	coordinator		
		PART	particle		

- Taxonomy of 17 universal POS tags
- All languages use the same inventory
  - Not all tags have to be used by all languages
  - Need extensions? Use features!

Features

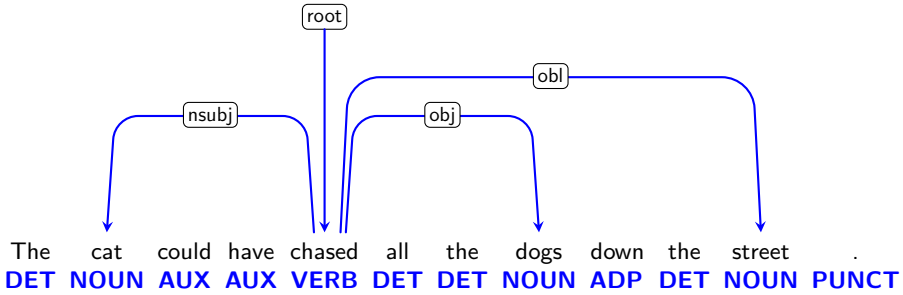
Lexical	Inflectional ("Nominal")	Inflectional ("Verbal, Pronominal")
PronType	Gender	VerbForm
NumType	Animacy	Mood
Poss	NounClass	Tense
Reflect	Number	Aspect
Foreign	Case	Voice
	Definite	Evident
	Degree	Polarity
Abbr		Person
Typo		Polite
		Clusivity

- 24 features, each with a number of possible *values*
- Languages select relevant features
- May add language-specific features or values

Syntax

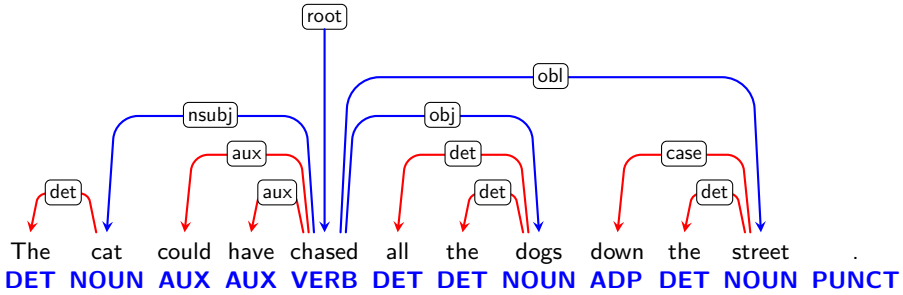
The	cat	could	have	chased	all	the	dogs	down	the	street	.
DET	**NOUN**	**AUX**	**AUX**	**VERB**	**DET**	**DET**	**NOUN**	**ADP**	**DET**	**NOUN**	**PUNCT**

Syntax



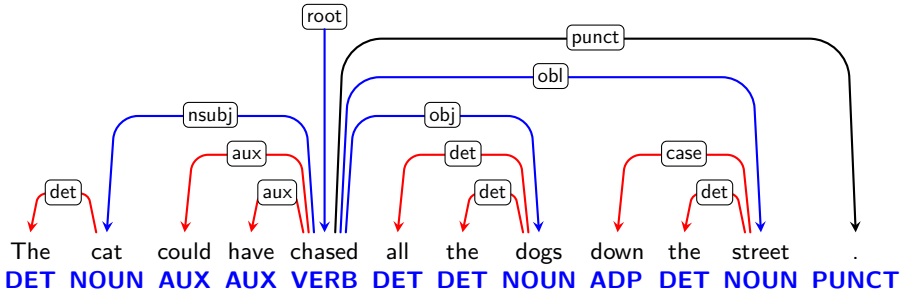
- Content words are related by dependency relations

Syntax



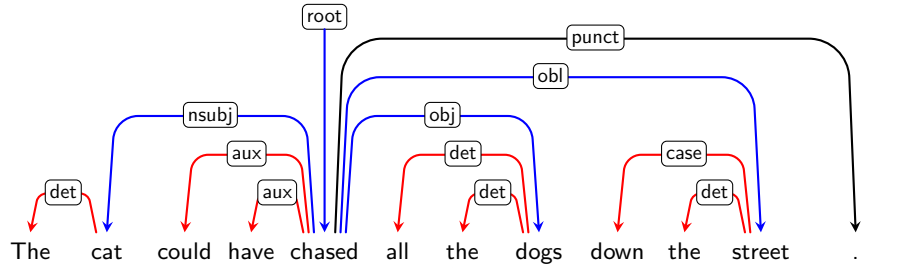
- Content words are related by dependency relations
- Function words attach to closest content words

Syntax

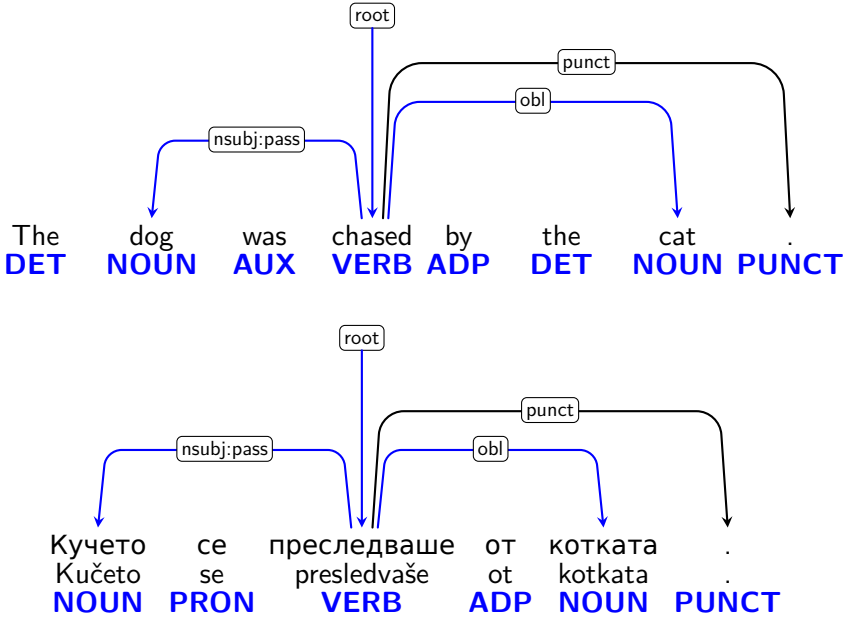


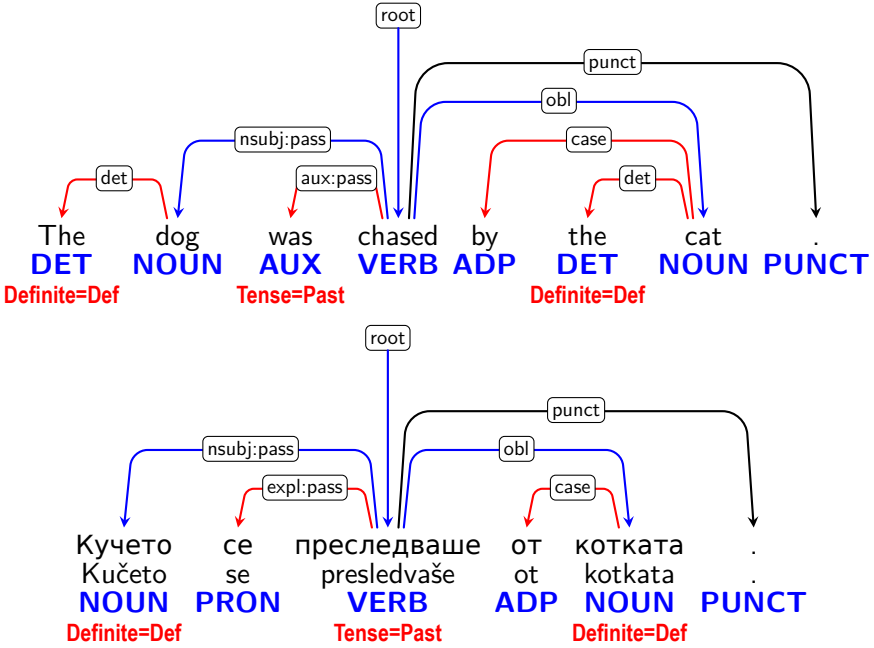
- Content words are related by dependency relations
- Function words attach to closest content words
- Punctuation attach to head of phrase or clause

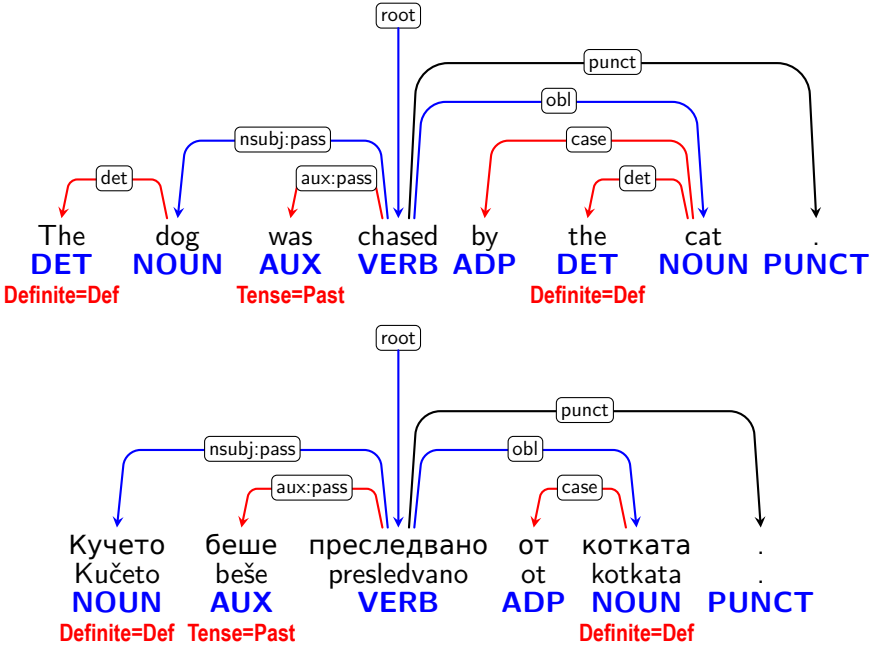
Syntax



Not "dependency" in the strictly syntactic sense!


root
punct
obl
nsubj:pass
The dog was chased by the cat .
DET NOUN AUX VERB ADP DET NOUN PUNCT
root
punct
nsubj:pass
obl
Кучето се преследваше от котката .
Kučeto se presledvaše ot kotkata .
NOUN PRON VERB ADP NOUN PUNCT


root
punct
obl
nsubj:pass
case
det
aux:pass
det
The dog was chased by the cat .
DET NOUN AUX VERB ADP DET NOUN PUNCT
Definite=Def Tense=Past Definite=Def
root
punct
nsubj:pass
obl
expl:pass
case
Кучето се преследваше от котката .
Kučeto se presledvaše ot kotkata .
NOUN PRON VERB ADP NOUN PUNCT
Definite=Def Tense=Past Definite=Def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punct
obl
nsubj:pass
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aux:pass
det
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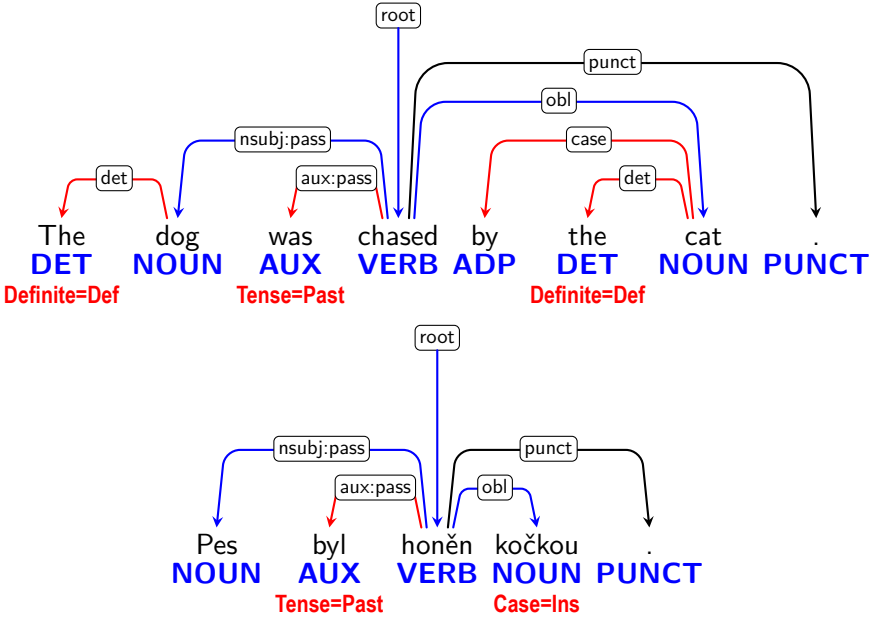
DET NOUN AUX VERB ADP DET NOUN PUNCT
Definite=Def
Tense=Past
Definite=Def
root
punct
nsubj:pass
obl
aux:pass
case
Кучето беше преследвано от котката .
Kučeto beše presledvano ot kotkata .
NOUN AUX VERB ADP NOUN PUNCT
Definite=Def
Tense=Past
Definite=Def


root
punct
obl
nsubj:pass
case
det
aux:pass
det
The dog was chased by the cat .
DET NOUN AUX VERB ADP DET NOUN PUNCT
Definite=Def
Tense=Past
Definite=Def
root
nsubj:pass
punct
aux:pass
obl
Pes byl honěn kočkou .
NOUN AUX VERB NOUN PUNCT
Tense=Past
Case=Ins

Dependents of Clauses (Verbal or Not)

	Nominal	Clausal	Modifier	Function
Core	**nsubj**	csubj		
Non-Core	**obl**	advcl	advmod	aux
	vocative		discourse	cop
	dislocated			mark
	expl			

Dependents of Verbs, Adjectives and Adverbs

	Nominal	Clausal	Modifier
Core	**obj**	ccomp	
	iobj	xcomp	
Non-Core	**obl**	advcl	advmod
	expl		

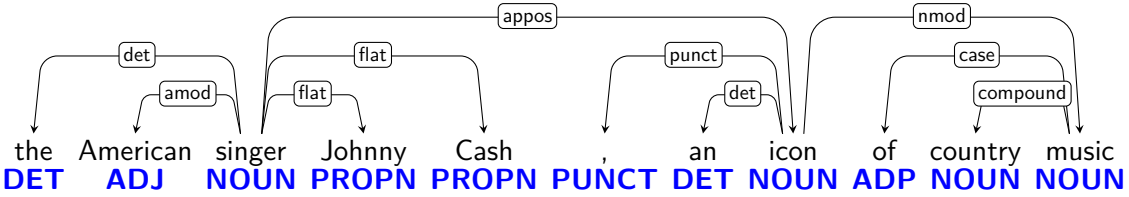
Dependents of Nominals

Nominal	Clausal	Modifier	Function
nmod	acl	amod	det
appos		nummod	case

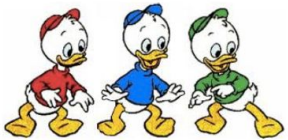
Noun Phrase

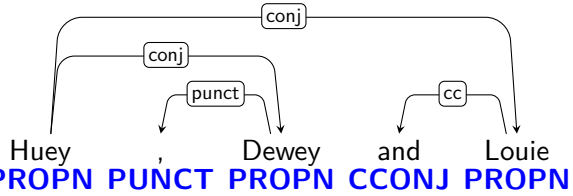
Dependents of Nominals

Nominal	**Clausal**	**Modifier**	**Function**
nmod	acl	amod	det
appos		nummod	case
compound			clf
flat			



Coordination





- Coordinate structures are headed by the first conjunct
  - Subsequent conjuncts depend on it via the conj relation
  - Conjunctions depend on the next conjunct via the cc relation
  - Punctuation marks depend on the next conjunct via the punct relation

Multiword Expressions

Relation	Examples
fixed	*as well, by and large, according to, more than*
flat	*president Havel, New York, four thousand*
compound	*phone book, dress up*
goeswith	*notwith standing, with out*

- UD annotation almost does not permit "words with spaces"
  - Multiword expressions are analyzed using special relations
  - The fixed, flat and goeswith relations are always head-initial
  - The compound relation reflects the internal structure
- Words with spaces allowed in exceptional cases:
  - Vietnamese (spaces delimit syllables, not words)
  - Numbers ("1 000 000")
  - Possibly other approved cases, e.g. multi-word abbreviations

Other Relations

Other Relations

Relation	Explanation
parataxis	Loosely linked clauses of same rank
list	Lists without syntactic structure
orphan	Orphans in ellipsis linked together
reparandum	Disfluency linked to (speech) repair
dep	Unspecified dependency
root	The single syntactically independent element of the sentence

Language-specific Relation Subtypes

- Language-specific relations are subtypes of universal relations added to capture important phenomena
- Subtyping permits us to "back off" to universal relations

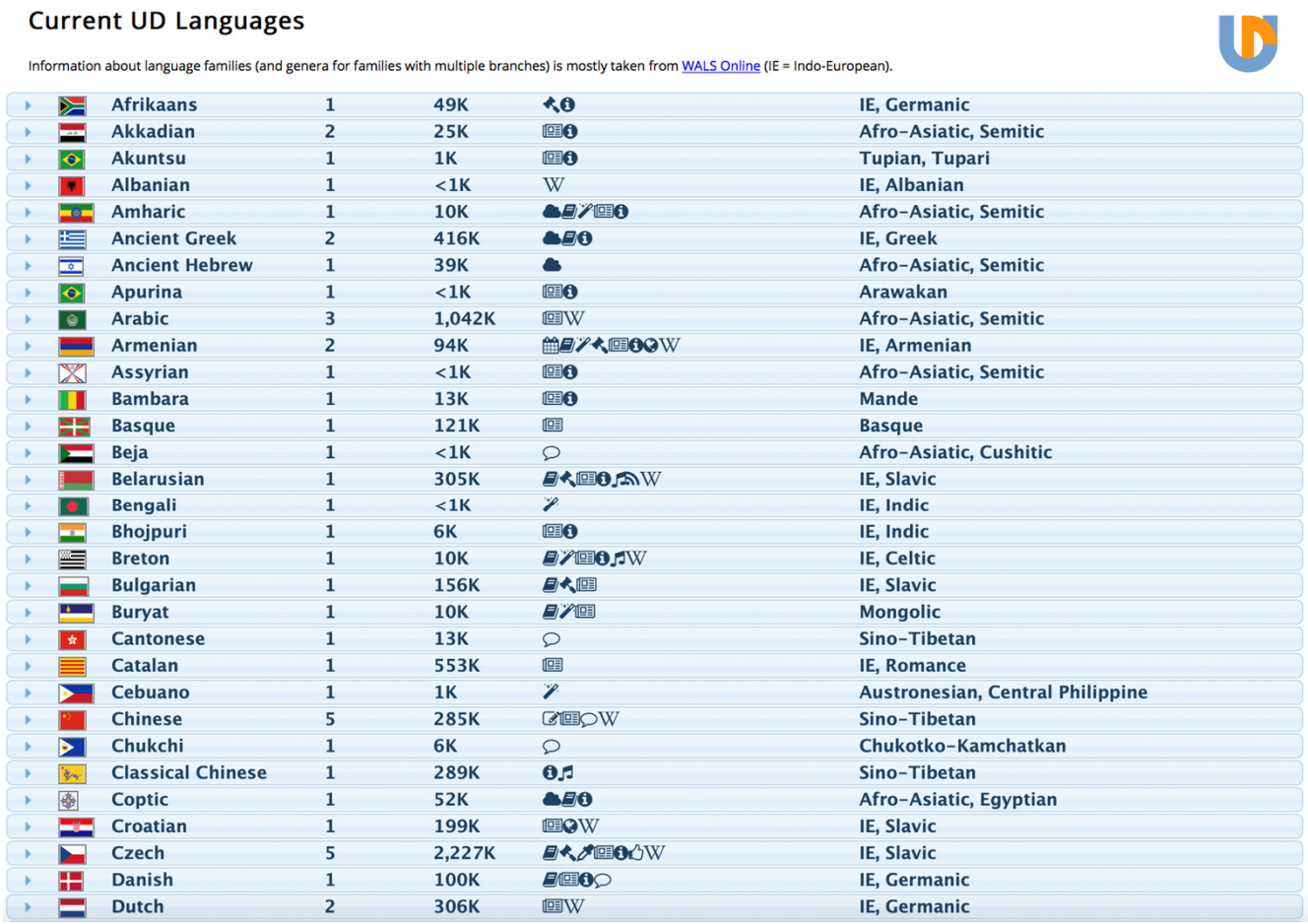
Language-specific Relation Subtypes

Relation	Explanation
acl:relcl	Relative clause (the boy who lived)
compound:prt	Verb particle (dress up)
nmod:poss	Possessive nominal (Mary 's book)
obl:agent	Agent in passive (saved by the bell)
cc:preconj	Preconjunction (both ... and)
det:predet	Predeterminer (all those ...)

The UD Repository

UD v2.11:

- 25 language families
- 138 languages
- 243 treebanks
- 535 contributors
- 1.8 million sentences
- 31 million words

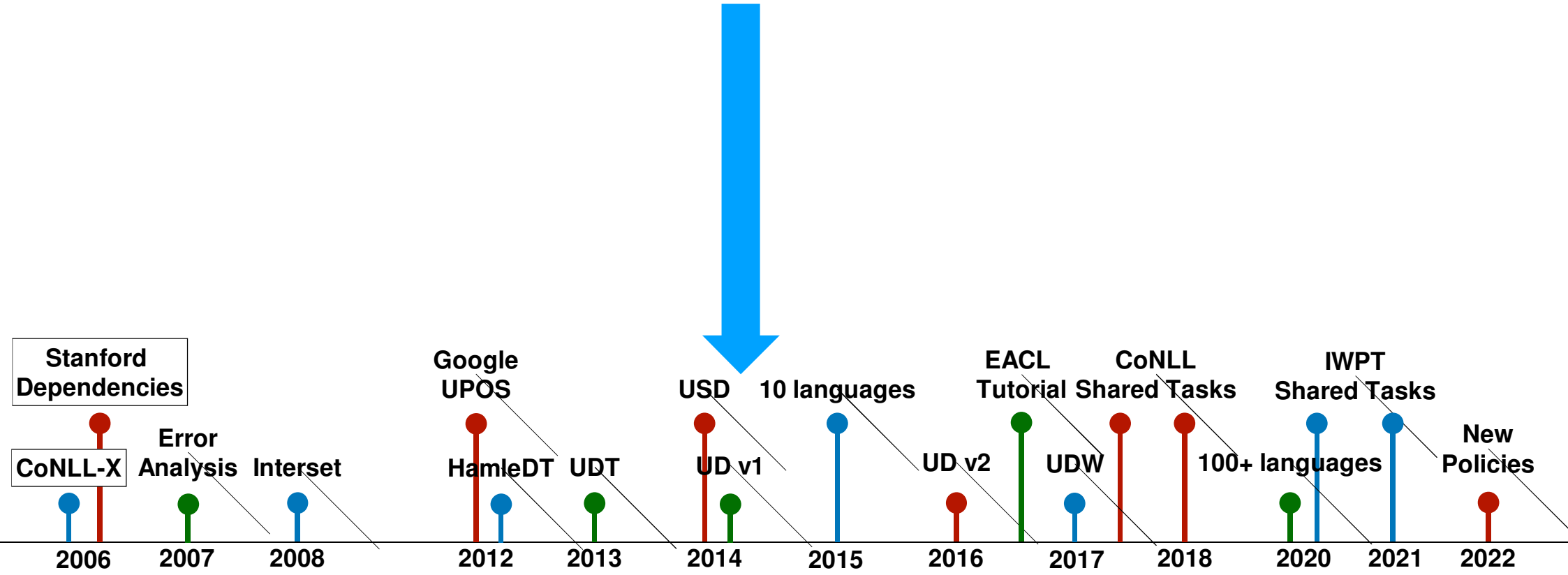


Current UD Languages

Information about language families (and genera for families with multiple branches) is mostly taken from WALS Online (IE = Indo-European).

Afrikaans	1	49K		IE, Germanic
Akkadian	2	25K		Afro-Asiatic, Semitic
Akuntsu	1	1K		Tupian, Tupari
Albanian	1	<1K	W	IE, Albanian
Amharic	1	10K		Afro-Asiatic, Semitic
Ancient Greek	2	416K		IE, Greek
Ancient Hebrew	1	39K		Afro-Asiatic, Semitic
Apurina	1	<1K		Arawakan
Arabic	3	1,042K	W	Afro-Asiatic, Semitic
Armenian	2	94K	W	IE, Armenian
Assyrian	1	<1K		Afro-Asiatic, Semitic
Bambara	1	13K		Mande
Basque	1	121K		Basque
Beja	1	<1K		Afro-Asiatic, Cushitic
Belarusian	1	305K	W	IE, Slavic
Bengali	1	<1K		IE, Indic
Bhojpuri	1	6K		IE, Indic
Breton	1	10K	W	IE, Celtic
Bulgarian	1	156K		IE, Slavic
Buryat	1	10K		Mongolic
Cantonese	1	13K		Sino-Tibetan
Catalan	1	553K		IE, Romance
Cebuano	1	1K		Austronesian, Central Philippine
Chinese	5	285K	W	Sino-Tibetan
Chukchi	1	6K		Chukotko-Kamchatkan
Classical Chinese	1	289K		Sino-Tibetan
Coptic	1	52K		Afro-Asiatic, Egyptian
Croatian	1	199K	W	IE, Slavic
Czech	5	2,227K	W	IE, Slavic
Danish	1	100K		IE, Germanic
Dutch	2	306K	W	IE, Germanic

A Brief History of UD



So where are we now?

Achievements:

- Amazing growth in terms of contributors and treebanks
- Data sets widely used for research in NLP and linguistics

Challenges:

- Annotation scheme and documentation can be improved
- Data sets are uneven in terms of quality and quantity
- Relevance to the research community cannot be taken for granted

Annotation Scheme

Old policy:

- A version change requires a complete revision of all guidelines
- Guidelines cannot be changed between major versions
- Documentation can be updated only with clarifications

Considerations:

- The old policy favors stability at the expense of improvement
- Implementing a major version change has become increasingly difficult
- We need to be able to make incremental changes to the guidelines

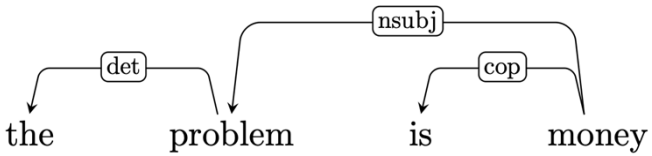
Changes

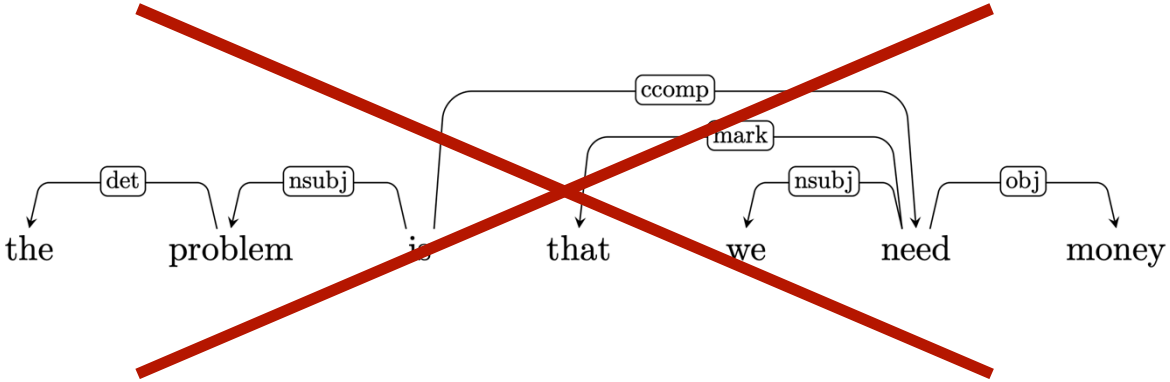
Change	Explanation
CLARIFICATION	Resolution of an ambiguity in the guidelines (without contradicting any previous version).
AMENDMENT	Change that negates a policy articulated in an earlier version of the guidelines.
VALIDATION	Important change (clarification or amendment) that will be checked by the UD validator.

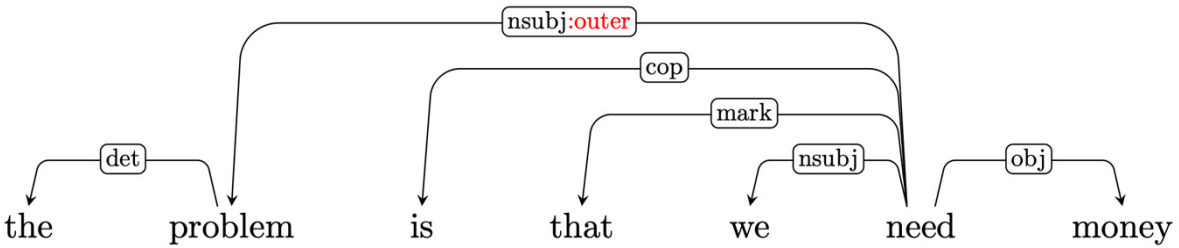
Guidelines remain at UDv2 as long as the inventories of universal part-of-speech tags and syntactic relations remain the same.

https://universaldependencies.org/changes.html

Recent Changes





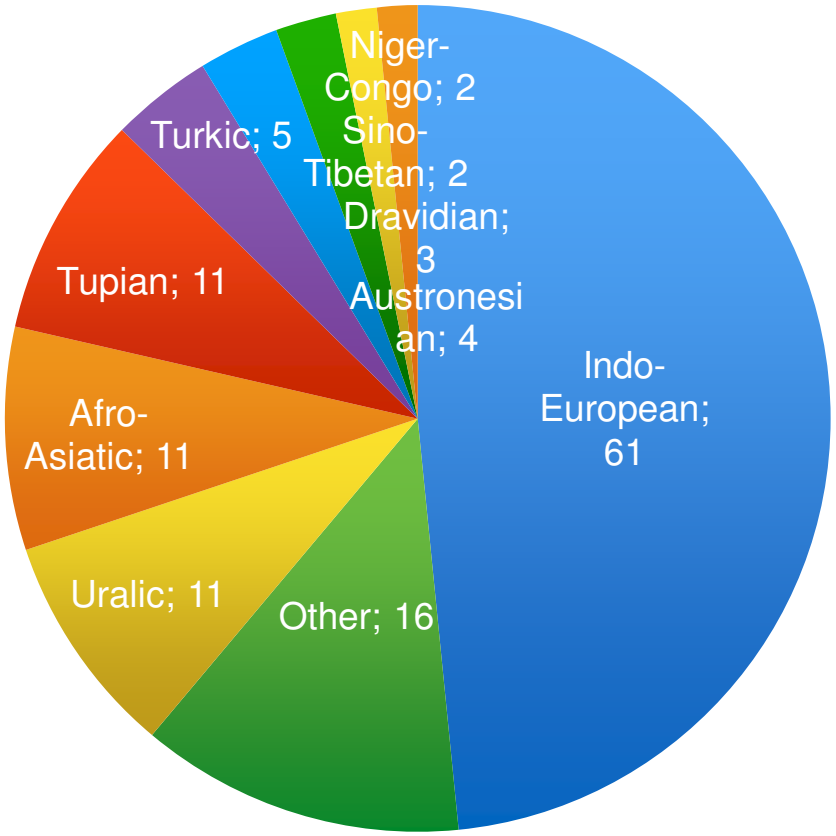


Nonverbal predication with clausal predicates

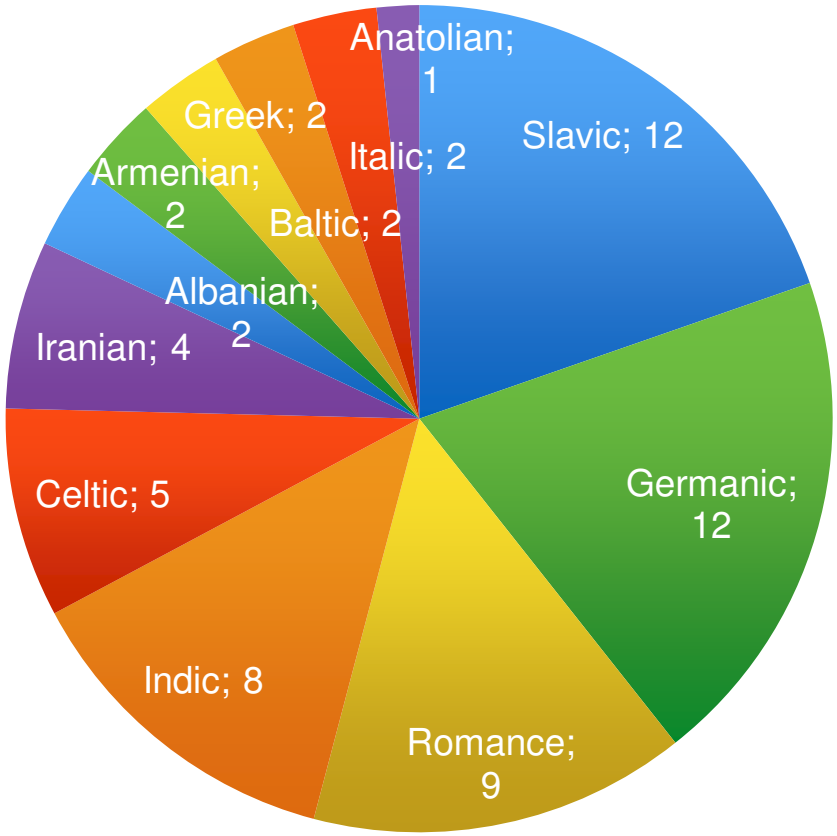
Treebank Status

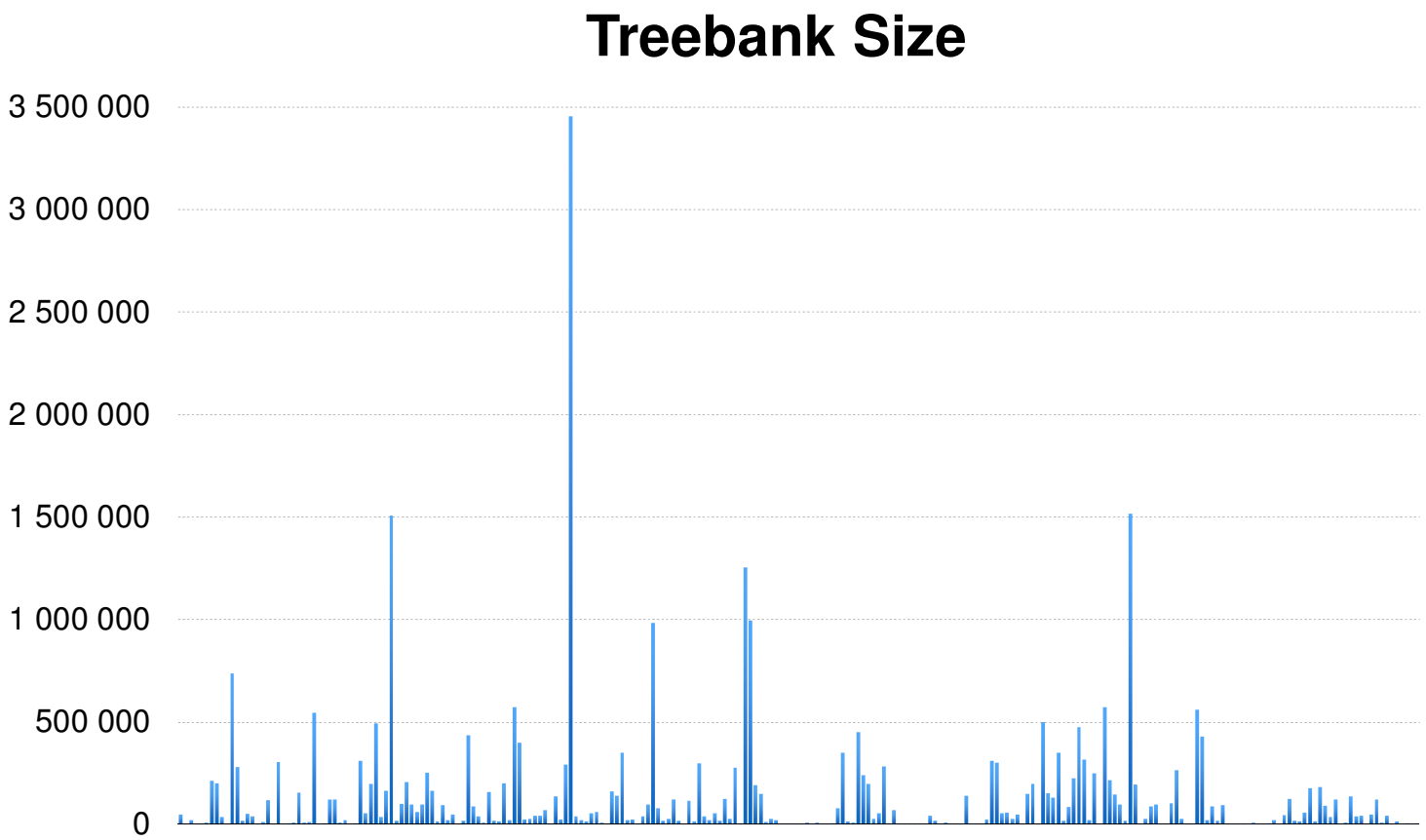
Status	Explanation
SAPLING	New treebank not yet released.
VALID	1. Passes all validation tests. 2. Contains at least 20 sentences and 100 words.
LEGACY	1. Fails at least one validation test. 2. Oldest validation error < 3 years old.
NEGLECTED	1. Fails at least one validation test. 2. Oldest validation error > 3 and < 4 years old.
INVALID	1. Fails at least one validation test. 2. Oldest validation error > 4 years old.

Language Family



Indo-European




Treebank Size
3 500 000
3 000 000
2 500 000
2 000 000
1 500 000
1 000 000
500 000
0

Extensions

- Enhanced Universal Dependencies
- Deep Universal Dependencies
- Universal Proposition Banks
- CorefUD
- Named Entities
- Surface Syntactic UD (SUD)
- PARSEME

Universal PropBank

PARSEME

Thanks to all UD contributors!

Daniel Zeman, Joakim Nivre, Mitchell Abrams, Elia Ackermann, Noëmi Aepli, Hamid Aghaei, Željko Agić, Amir Ahmadi, Lars Ahrenberg, Chika Kennedy Ajede, Salih Furkan Akkurt, Gabrielė Aleksandravičiūtė, Ika Alfina, Avner Algom, Chiara Alzetta, Erik Andersen, Lene Antonsen, Katya Aplonova, Angelina Aquino, Carolina Aragon, Glyd Aranes, Maria Jesus Aranzabe, Bilge Nas Arıcan, Þórunn Arnardóttir, Gashaw Arutie, Jessica Naraiswari Arwidarasti, Masayuki Asahara, Katla Ásgeirsdóttir, Deniz Baran Aslan, Cengiz Asmazoğlu, Luma Ateyah, Furkan Atmaca, Mohammed Attia, Aitziber Atutxa, Liesbeth Augustinus, Elena Badmaeva, Keerthana Balasubramani, Miguel Ballesteros, Esha Banerjee, Sebastian Bank, Verginica Barbu Mititelu, Starkaður Barkarson, Rodolfo Basile, Victoria Basmov, Colin Batchelor, John Bauer, Seyyit Talha Bedir, Juan Belieni, Kepa Bengoetxea, Yifat Ben Moshe, Gözde Berk, Yevgeni Berzak, Irshad Ahmad Bhat, Riyaz Ahmad Bhat, Erica Biagetti, Eckhard Bick, Agnė Bielinskienė, Kristín Bjarnadóttir, Rogier Blokland, Victoria Bobicev, Loïc Boizou, Emanuel Borges Völker, Carl Börstell, Cristina Bosco, Gosse Bouma, Sam Bowman, Adriane Boyd, Anouck Braggaar, Kristina Brokaitė, Aljoscha Burchardt, Marie Candito, Bernard Caron, Gauthier Caron, Lauren Cassidy, Maria Clara Castro, Tatiana Cavalcanti, Gülşen Cebiroğlu Eryiğit, Flavio Massimiliano Cecchini, Giuseppe G. A. Celano, Slavomír Čéplö, Neslihan Cesur, Savas Cetin, Özlem Çetinoğlu, Fabricio Chalub, Liyanage Chamila, Shweta Chauhan, Ethan Chi, Taishi Chika, Yongseok Cho, Jinho Choi, Jayeol Chun, Juyeon Chung, Alessandra T. 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