From the Prague Dependency Treebank to the Uniform Meaning Representation:

Gold-Standard Czech UMR Data and Partial Automatic Conversion

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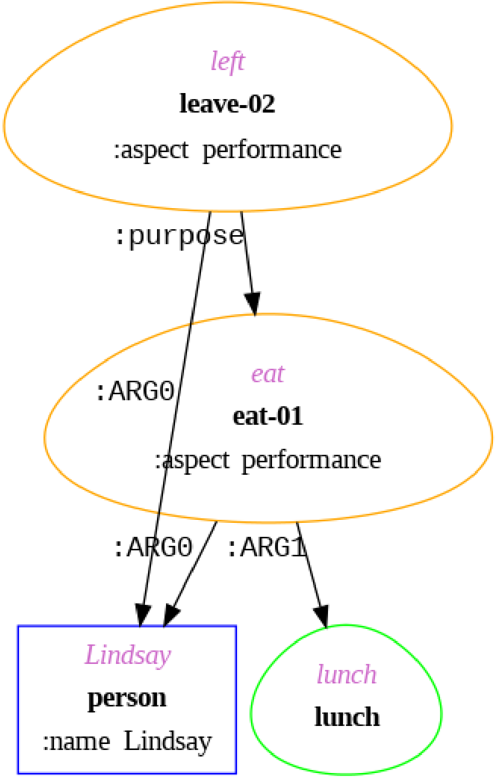
Motivation

- goal: Uniform Meaning Representation for Czech
  - semantics, abstracting away from syntax
  - cross-linguistic applicability
  - broad sem. interpretation of the text for cross-lingual applications
- annotation from scratch:
  - time consuming
  - expertise and training
- re-use existing corpus:
  - **automatic conversion** from Prague Dependency Treebank
  - rich annotation already there
  - the same procedure for all languages with PDT annotation
  - expertise and training still needed
  - evaluation: **manually annotated data**

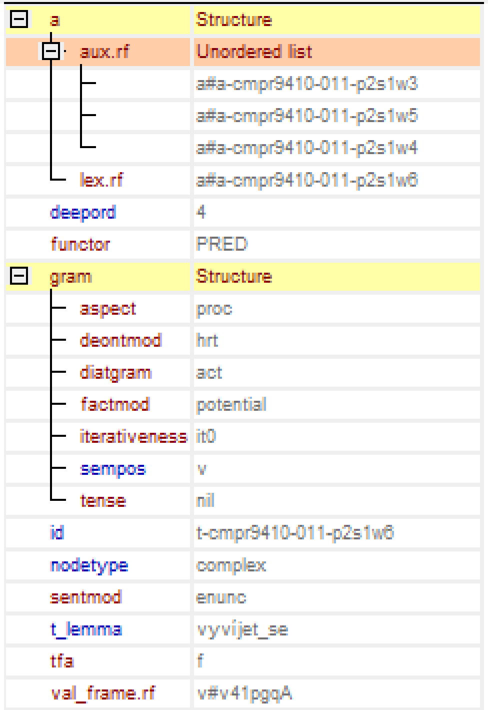
Uniform Meaning Representation

```
################################################################
# meta-info :: sent_id = u_tree-cs-s1-root
# :: snt1
Index: 1       2    3  4     5  6   7     8
Words: Lindsay left in order to eat lunch .

# sentence level graph:
(s1l / leave-02
   :ARG0 (s1p / person
         :name (s1n / name :op1 "Lindsay"))
   :aspect performance
   :purpose (s1e / eat-01
         :ARG0 s1p
         :ARG1 (s1l2 / lunch)
         :aspect performance))

# alignment:
s1l: 2-2 s1p: 1-1 s1n: 0-0 s1e: 6-6 s1l2: 7-7

# document level annotation:
(s1s0 / sentence
   :temporal ((document-creation-time :before s1l)
              (s1l :after s1e))
   :modal ((root :modal author)
           (author :full-affirmative s1l)
           (author :full-negative s1e)))
```

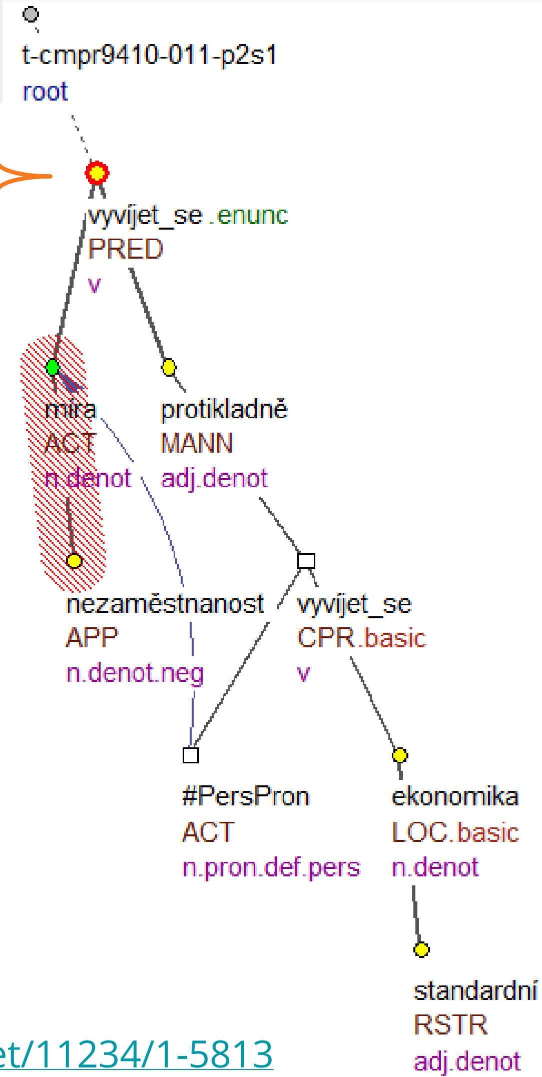


download UMR 2.0 http://hdl.handle.net/11234/1-5902

Prague Dependency Treebank



⊟ a	Structure
⊟ aux.rf	Unordered list
	a#a-cmpr9410-011-p2s1w3
	a#a-cmpr9410-011-p2s1w5
	a#a-cmpr9410-011-p2s1w4
lex.rf	a#a-cmpr9410-011-p2s1w6
deepord	4
functor	PRED
⊟ gram	Structure
aspect	proc
deontmod	hrt
diatgram	act
factmod	potential
iterativeness	it0
sempos	v
tense	nil
id	t-cmpr9410-011-p2s1w6
nodetype	complex
sentmod	enunc
t_lemma	vyvíjet_se
tfa	f
val_frame.rf	v#v41pgqA



Míra nezaměstnanosti by se měla vyvíjet protikladně než ve standardní ekonomice.

The unemployment rate should develop in the opposite direction to that in a standard economy.

download PDT-C 2.0 http://hdl.handle.net/11234/1-5813

UMR vs. PDT

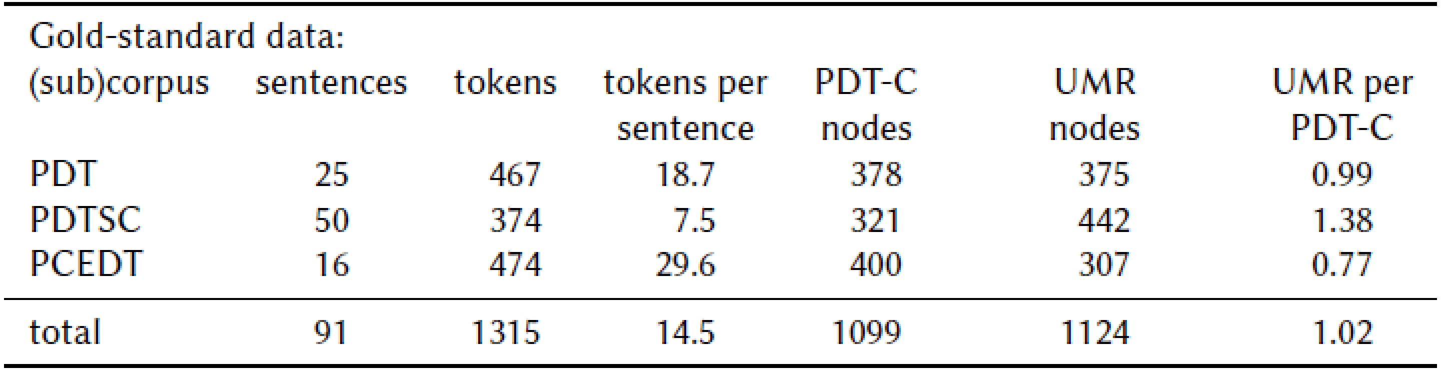
UMR

- represents meaning
- encodes the frame-based predicate-argument structure of all eventive concepts
- for each event, complex information
  - aspect
  - temporal chains
  - epistemic modality
- coreference

PDT

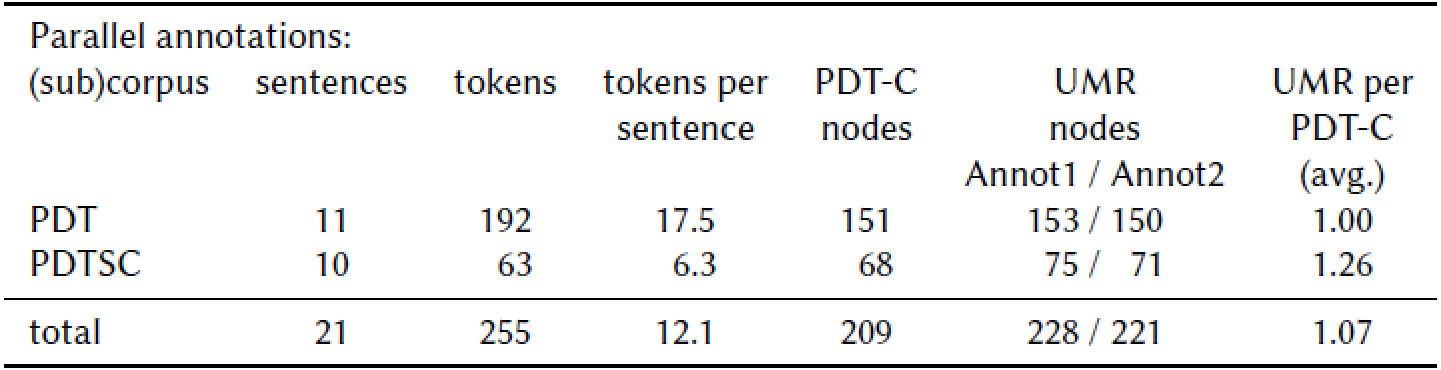
- represents linguistically structured meaning (vs. situational meaning)
- topic-focus articulation
- predicate-argument structure (valency) and dependency relations
- meaning of individual morphological categories
- coreference

Towards Gold-Standard UMR Data for Czech



Gold-standard data:

(sub)corpus	sentences	tokens	tokens per sentence	PDT-C nodes	UMR nodes	UMR per PDT-C
PDT	25	467	18.7	378	375	0.99
PDTSC	50	374	7.5	321	442	1.38
PCEDT	16	474	29.6	400	307	0.77
total	91	1315	14.5	1099	1124	1.02



Parallel annotations:

(sub)corpus	sentences	tokens	tokens per sentence	PDT-C nodes	UMR nodes Annot1 / Annot2	UMR per PDT-C (avg.)
PDT	11	192	17.5	151	153 / 150	1.00
PDTSC	10	63	6.3	68	75 / 71	1.26
total	21	255	12.1	209	228 / 221	1.07

Download the data: http://hdl.handle.net/11234/1-5951

Inter-Annotator Agreement (IAA)

UMR graphs = as a set of triples (x, y, z):

- `(node, relation, node)`
- `(node, attribute, value)`

Metric for graph comparison:

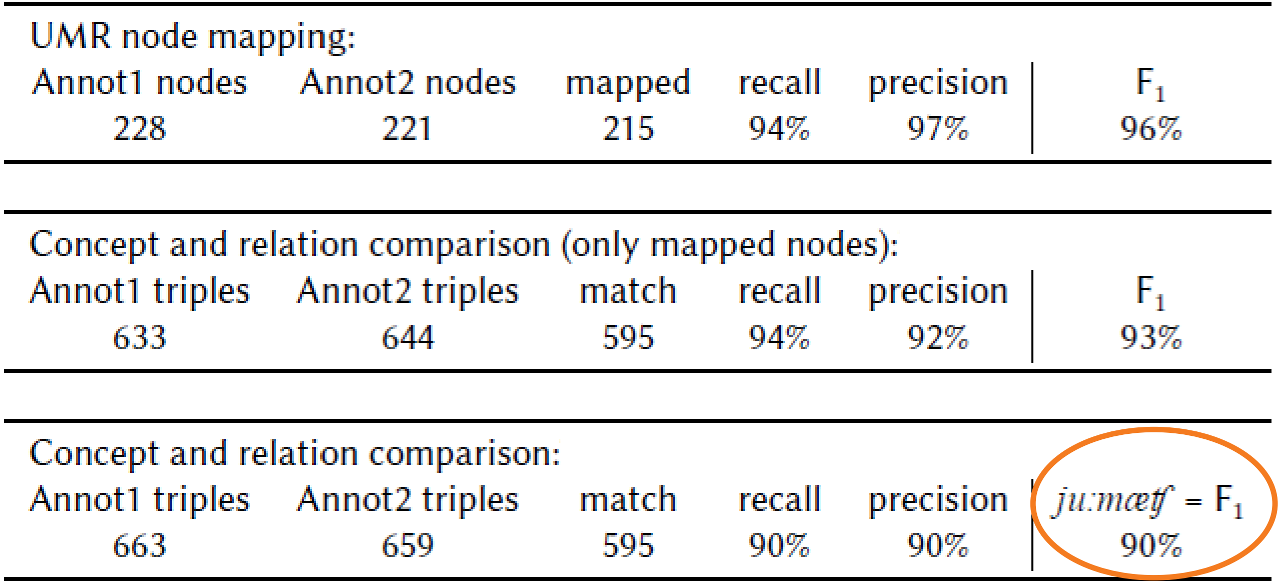
1) Match nodes:
   - different number of nodes
   - different alignment (nodes to words)

   ⇒ ***ju:mæʧ***
   - maps nodes primarily by word alignment
   - for nodes without alignment, requires concept identity
   - forces 1:1 mapping (selected the "best" node from 1:N)

2) Similarity is measured as the **F_1-score** of the triples

Towards Gold-Standard UMR Data for Czech

- final IAA (after reconciliation; table taken from Štěpánek et al., 2025)



UMR node mapping:

Annot1 nodes	Annot2 nodes	mapped	recall	precision	F_1
228	221	215	94%	97%	96%

Concept and relation comparison (only mapped nodes):

Annot1 triples	Annot2 triples	match	recall	precision	F_1
633	644	595	94%	92%	93%

Concept and relation comparison:

Annot1 triples	Annot2 triples	match	recall	precision	*ju:mæʧ* = F_1
663	659	595	90%	90%	90%

- analysis of main mismatches in the paper (events and argument structure, ellipses, granularity of NE classification, relations vs. attributes, attributes and their values)
- UMR allows for multiple valid annotations of the same meaning !!!

Automatic (Partial) Conversion

based on the tectogrammatical structure:

- structural transformations
  - coordination
  - coreference
  - relative clauses
  - raising and control verbs
- node labels
  - `t_lemma` → `concept`
- edge labeling
  - valency lexicon → PropBank
    default table
- selected attributes
  - `aspect`
  - `refer-person`, `refer-number`
  - `degree`, `polarity`, `quant`
- node alignment

often interact ⇒ further increases the conversion complexity

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often interact ⇨ further increases the conversion complexity

ignored (so far)

- attributes:
  - `mode, polite`
  - `quote, modal-strength`
  - `wiki`
- most of the document level annotation
  - `temporal`
  - `modal`

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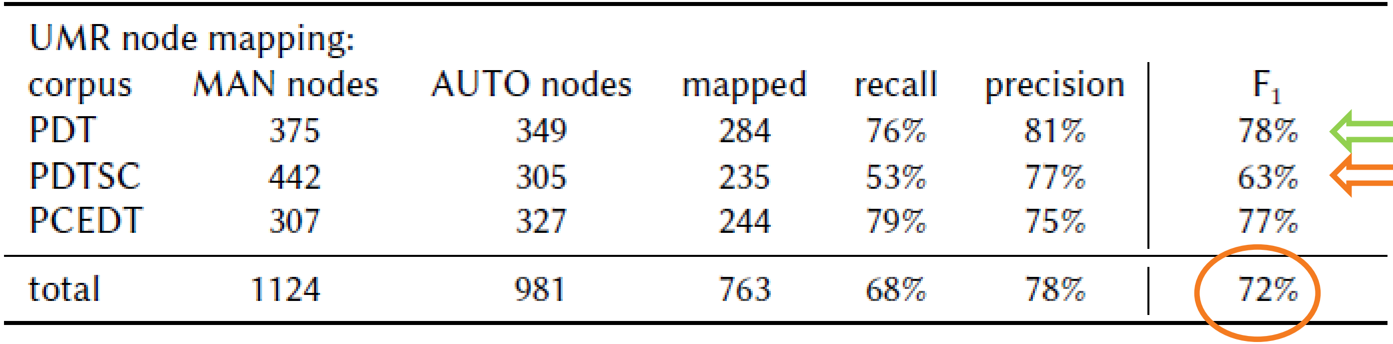
Automatic (Partial) Conversion – Quantitative Comparison

(tables taken from Štěpánek et al., 2025)

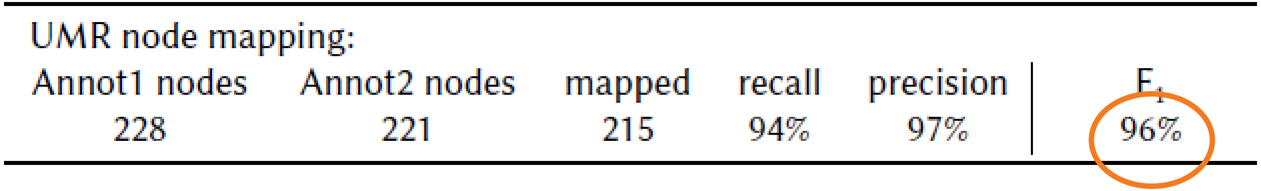
- Automatic conversion:



UMR node mapping:

corpus	MAN nodes	AUTO nodes	mapped	recall	precision	F_1
PDT	375	349	284	76%	81%	78%
PDTSC	442	305	235	53%	77%	63%
PCEDT	307	327	244	79%	75%	77%
total	1124	981	763	68%	78%	72%

- Manual annotation (inter-annotator agreement):



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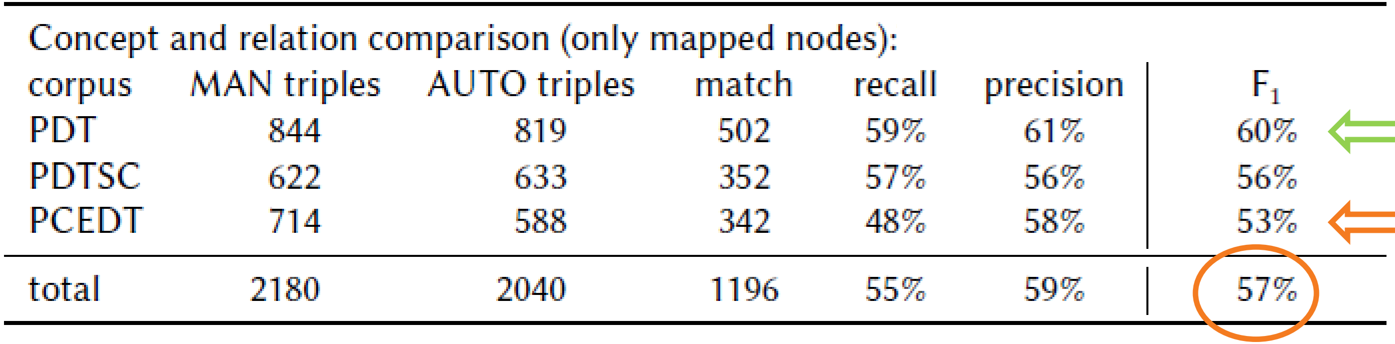
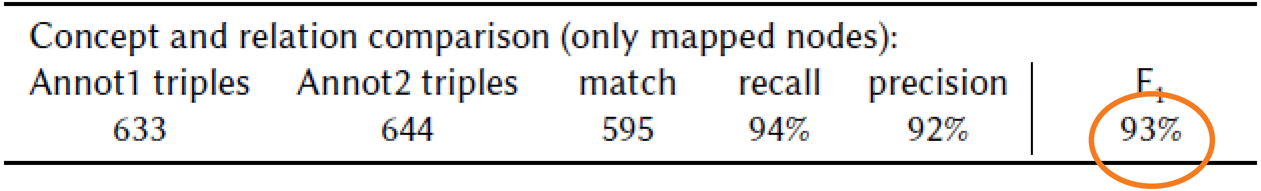


Concept and relation comparison (only mapped nodes):

corpus	MAN triples	AUTO triples	match	recall	precision	F_1
PDT	844	819	502	59%	61%	60%
PDTSC	622	633	352	57%	56%	56%
PCEDT	714	588	342	48%	58%	53%
total	2180	2040	1196	55%	59%	57%

- Manual annotation (inter-annotator agreement):



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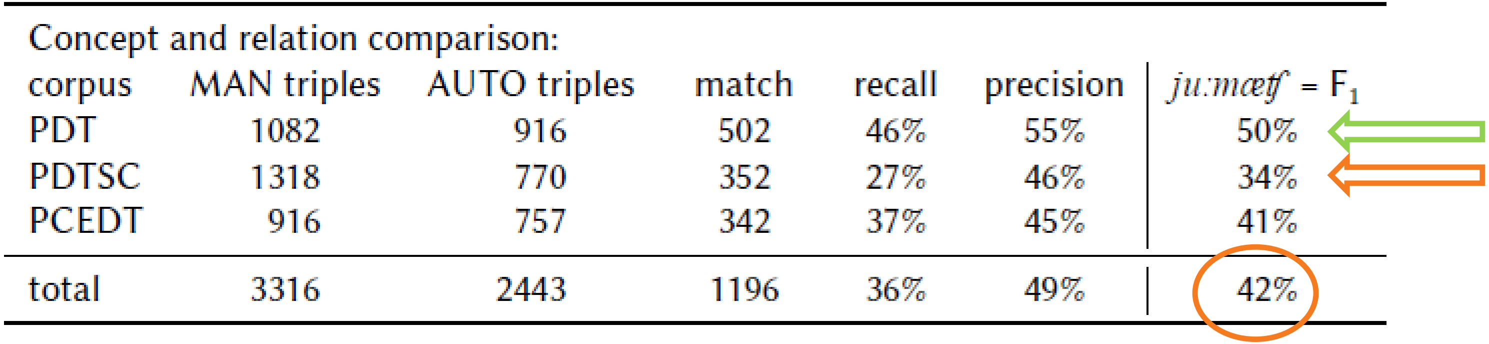
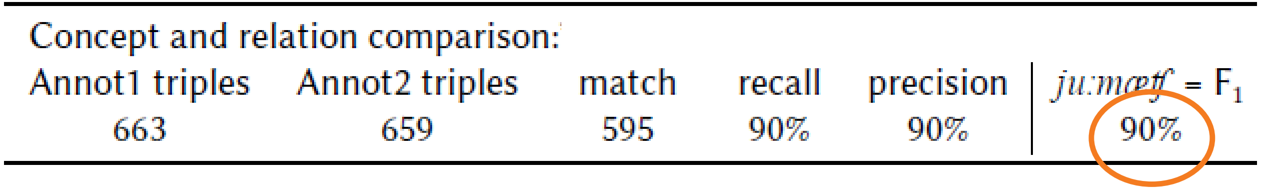


Concept and relation comparison:

corpus	MAN triples	AUTO triples	match	recall	precision	*ju:mæf* = F_1
PDT	1082	916	502	46%	55%	50%
PDTSC	1318	770	352	27%	46%	34%
PCEDT	916	757	342	37%	45%	41%
total	3316	2443	1196	36%	49%	42%

- Manual annotation (inter-annotator agreement):



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From PDT to UMR:

Gold-Standard Czech UMR Data and Partial Automatic Conversion

- two different meaning representations
- manually annotated Czech UMR gold-standard data
  - IAA 90 %
- evaluation of the automatic (partial) conversion
  - transforms selected language phenomena from PDT to UMR
  - 53-60% accuracy on the aligned nodes
  - plan: cover more phenomena in the (near) future
- automatic conversion as an essential first step to reduce costs for full manual annotation

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