Vincent Kríž

Improving Dependency Parsing Using Sentence Clause Charts

Linguistic Mondays, 10.10.2016
MFF UK

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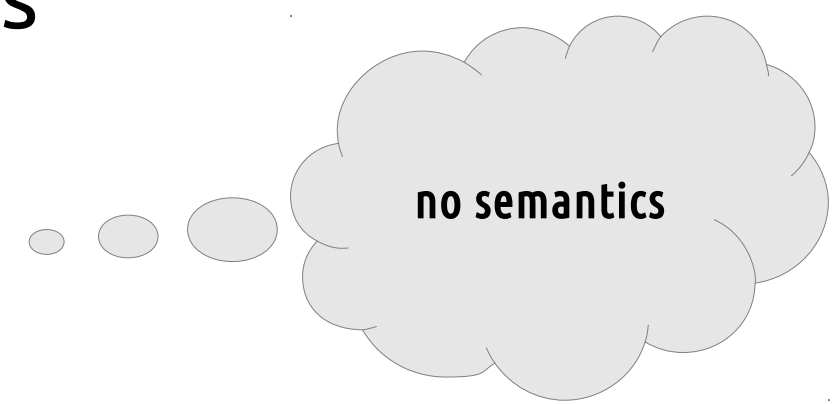
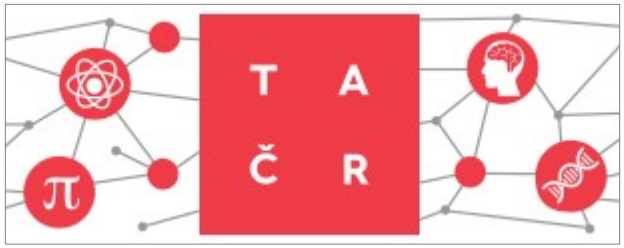
Motivation

- large collections of documents
- efficient browsing & querying
- typical approaches
  - full-text search
  - meta-data search



INTLIB

- **Intelligent Library (INTLIB)**
  - founded by



  - 2012–2015
  - partners

INTLIB

- **New search approach**
  - semantic interpretation of documents
  - suitable DB & query language
  - user-friendly browsing & querying

INTLIB

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  - semantic interpretation of documents
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- **Knowledge base**
  - set of entities and relations between them

INTLIB

- **New search approach**
  - semantic interpretation of documents
  - suitable DB & query language
  - user-friendly browsing & querying
- **Knowledge base**
  - set of entities and relations between them
- **RExtractor**
  - information extraction system

RExtractor

- entity and relation extraction from plain-texts
- server architecture
  - process client's requests
  - REST API
  - web interface (~ demo)

http://quest.ms.mff.cuni.cz:14280

RExtractor

- **extract entities and relations**
  - queries over dependency trees
  - domain and language independent
- **real use-case defined by INTLIB**
  - definitions, rights and obligations in Czech laws
  - Czech extraction strategy

RExtractor

- **extract entities and relations**
  - queries over dependency trees
  - domain and language independent
- **real use-case defined by INTLIB**
  - definitions, rights and obligations in Czech laws
  - Czech extraction strategy
  - English extraction strategy

Evaluation

Czech Legal Text Treebank 1.0 (CLTT)

- Accounting Act (563/1991 Coll.)
- Decree on Double-entry Accounting for undertakers (500/2002 Coll.)
- automatically parsed, then manually checked
  - 1,133 manually annotated dependency trees
  - 35,085 tokens

Evaluation

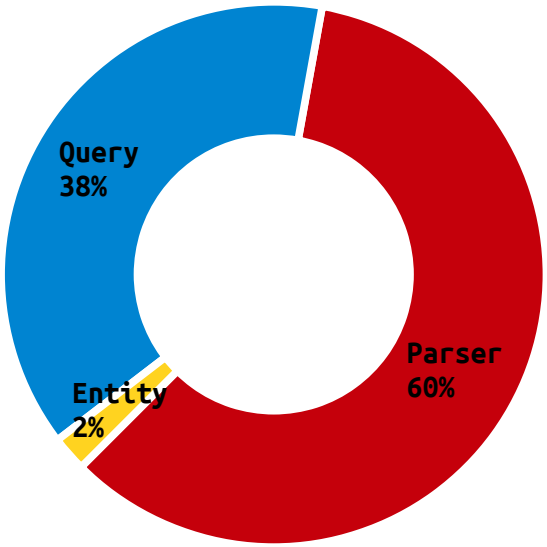
Czech Legal Text Treebank 1.0 (CLTT)

- Kríž Vincent, Hladká Barbora, Urešová Zdeňka: Czech Legal Text Treebank 1.0. In: Proceedings of the 10th International Conference on Language Resources and Evaluation (LREC 2016), Copyright © European Language Resources Association, Paris, France, ISBN 978-2-9517408-9-1, pp. 2387-2392, 2016

Evaluation

Error analysis

Error	# of errors	Ratio
Parser	145	59.7%
Query	93	38.3%
Entity	5	2.1%



Baseline

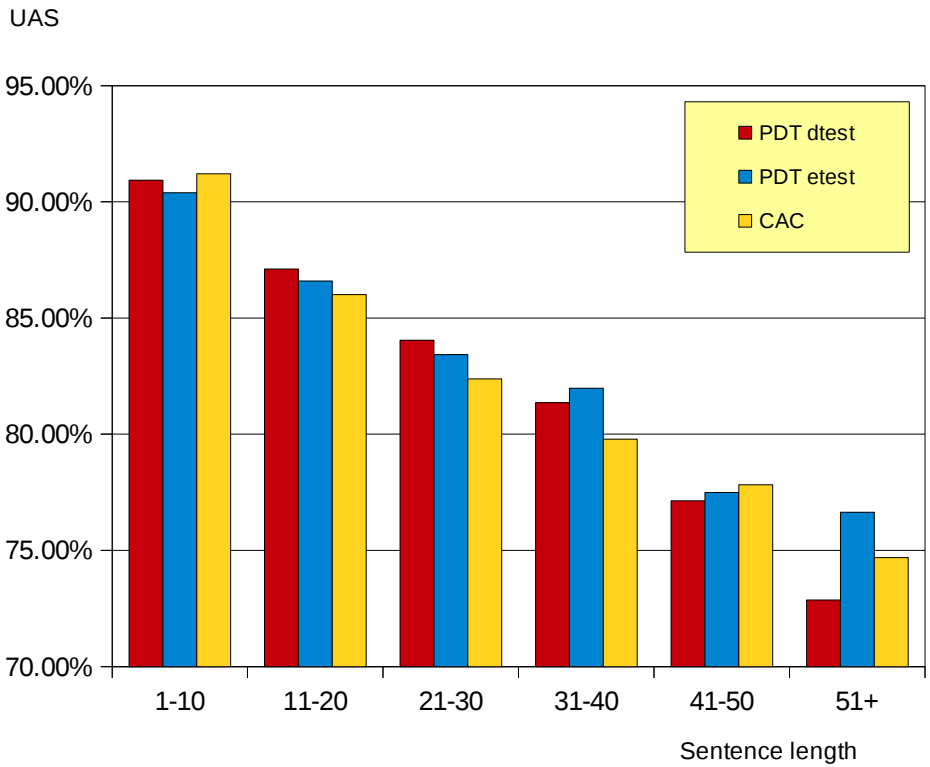
Automatic parser for Czech

- **MST parser**
  - Ryan McDonald, Fernando Pereira, Kiril Ribarov, Jan Hajič (2005): Non-projective Dependency Parsing using Spanning Tree Algorithms. In: Proceedings of HLT/EMNLP, Vancouver, British Columbia.
- trained on **newspaper texts**
- **long sentences** still problematic

Baseline

Long sentences dependency parsing

- as the sentence length increases,
  the unlabeled attachment score (UAS) decreases



Related Work

- **segmentation of complex sentences**
  - Kuboň (2001), Kuboň et al. (2007)
  - segments – easily detectable and linguistically motivated units
  - may be combined into clauses
  - provide a structure of a complex sentence with regard to the mutual relationship of individual clauses

Related Work

- **segmentation of complex sentences**
  - Lopatková and Holan (2009)
  - a new module between morphological and syntactic analysis
  - determine the overall sentence structure
  - **segmentation chart**
    - relationship among segments
    - especially relations of coordination, apposition and subordination

Related Work

S tím byly trochu problémy, protože starosta v řeči rád zdůrazňoval své vzdělání.

Credits: Lopatková and Holan (2009)

Related Work

S tím byly trochu problémy, protože starosta v řeči rád zdůrazňoval své vzdělání.

- **split sentence into segments**
  - rule-based boundaries identification
    - punctuation marks, coordinating conjunctions, brackets, …

Credits: Lopatková and Holan (2009)

Related Work

S tím byly trochu problémy	,	protože starosta … vzdělání	.

- **determine mutual relations**
  - manually designed rules
    - finite verb
    - subordinating expression
    - opening bracket

Credits: Lopatková and Holan (2009)

Related Work

S tím byly trochu problémy

protože starosta … vzdělání

Credits: Lopatková and Holan (2009)

Related Work

S tím byly trochu problémy

protože starosta … vzdělání

- **segmentation chart**
  - captures the layer of embedding for individual segments

Credits: Lopatková and Holan (2009)

Related Work

0	1
S tím byly trochu problémy	
	protože starosta … vzdělání

- **segmentation chart principles**
  - main segments belong to layer 0
  - segments that depend on segment on layer *k* belong to *k+1*
  - coordinated segments have the same layer
  - segments in parenthesis/brackets belong to *k+1* layer

Credits: Lopatková and Holan (2009)

Related Work

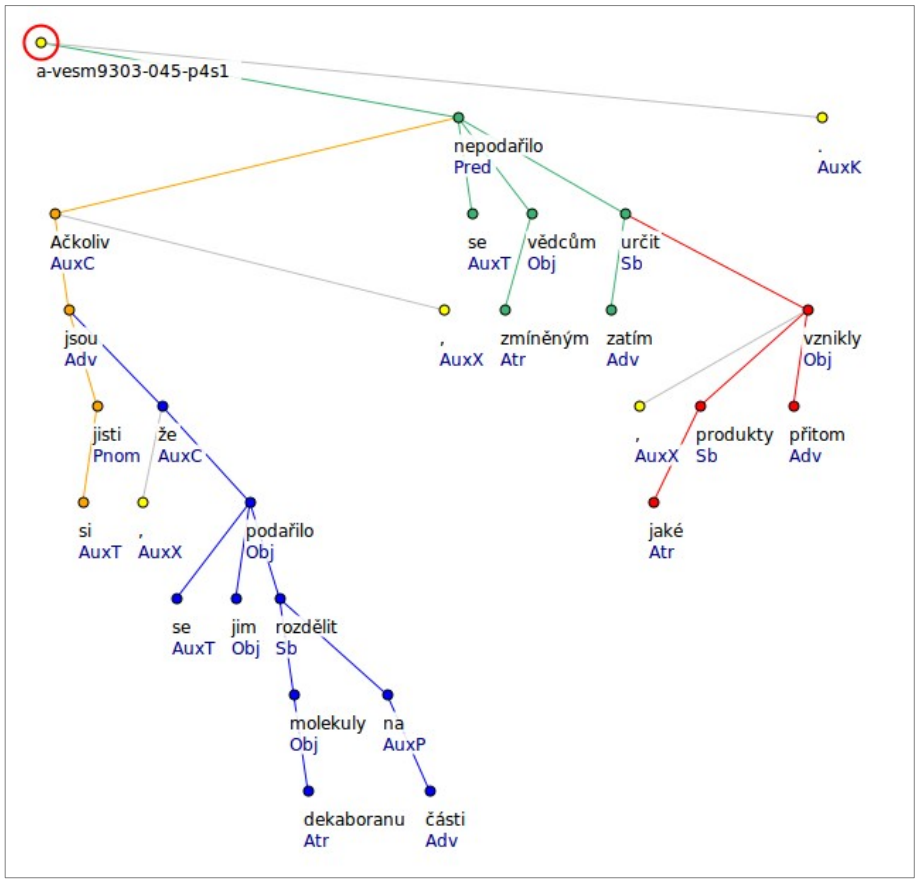
- **sentence clause structure**
  - Lopatková et al. (2012)
  - manual clause structure annotation based on the concept of segments
  - 2,699 annotated sentences

Related Work

- **sentence clause structure**
  - Krůza and Kuboň (2014)
  - automatic procedure for recognizing clauses and their mutual relationship **from plain-texts**
  - Bejček et al. (2013)
  - automatic procedure for recognizing clauses and their mutual relationship **from dependency trees**
  - used for clause annotation in PDT 3.0

Related Work

- **clause annotation in PDT 3.0**



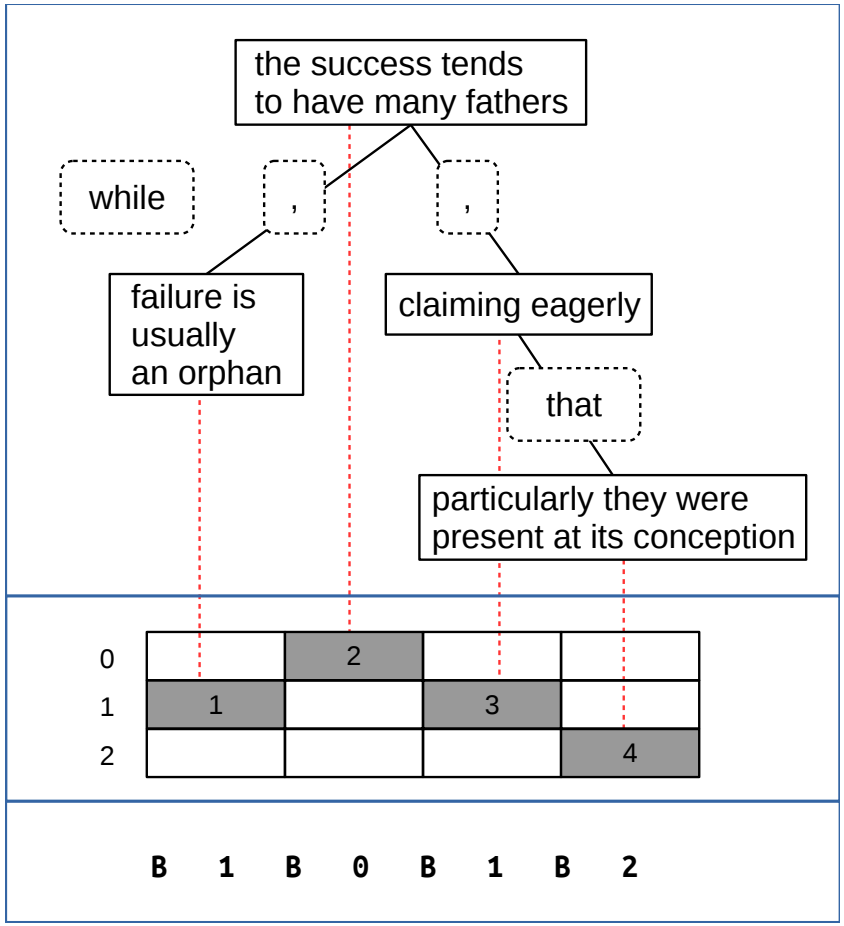
Clause Charts

- analogous to a segmentation chart
  - Lopatková and Holan (2009)
  - two differences
    - subordinating conjunctions at the beginning of each clause are considered as boundaries
    - clauses split into two parts (by an embedded clause) are considered as two different clauses

Clause Charts

- example

While failure is usually an orphan, the success tends to have many fathers, claiming eagerly that particularly they were present at its conception.



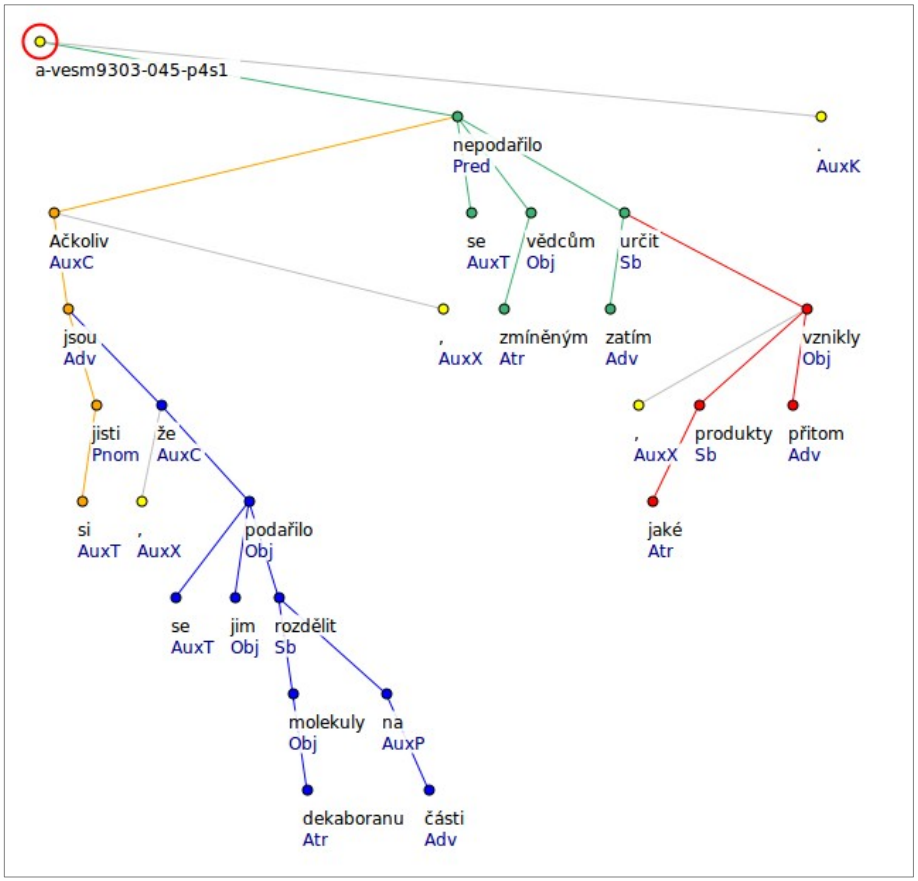
Credits: Kuboň et al. (2007)

Clause Charts

- **generating clause charts**
  - from dependency trees with the clause annotation
  - a layer of embedding → number of different clauses on the path from the clause to the root in the dependency tree

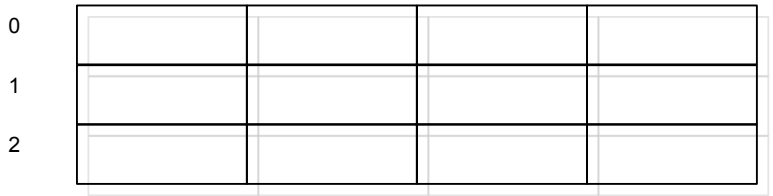
Clause Charts

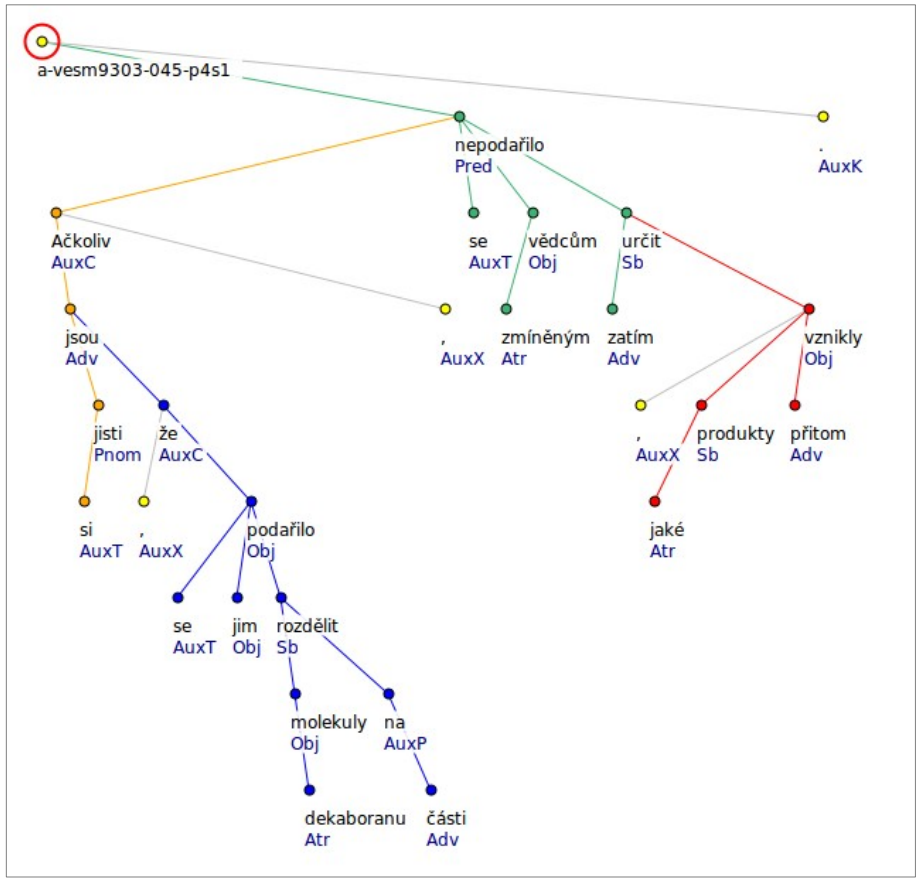
Ačkoliv jsou si jisti, *že se jim podařilo rozdělit molekuly dekaboranu na části*, *nepodařilo se zmíněným vědcům zatím určit*, *jaké produkty přitom vznikly*.



Clause Charts

Ačkoliv jsou si jisti, že se jim podařilo rozdělit molekuly dekaboranu na části, nepodařilo se zmíněným vědcům zatím určit, jaké produkty přitom vznikly.





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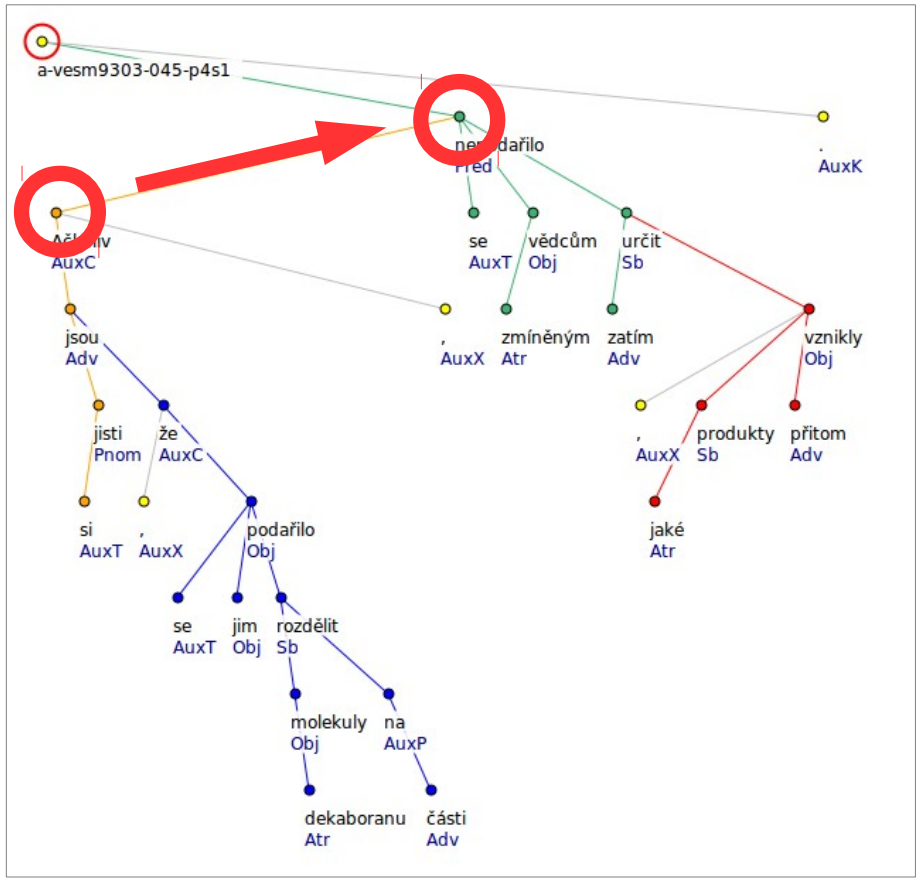
0				
1	1			
2				



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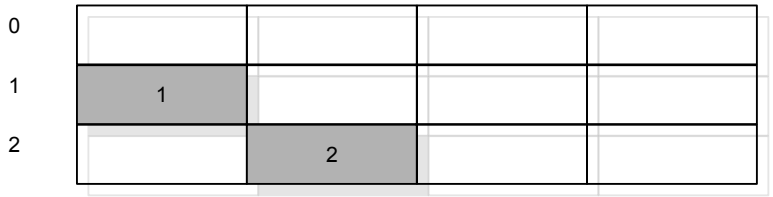

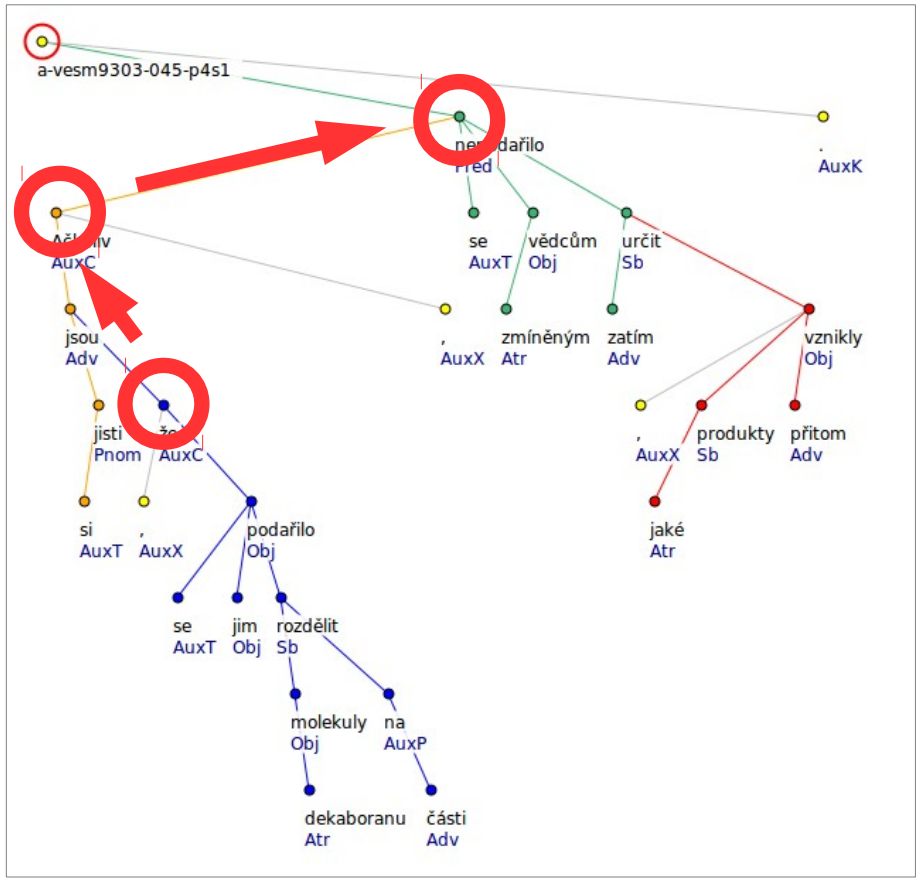

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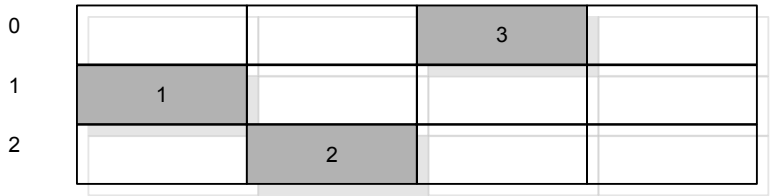

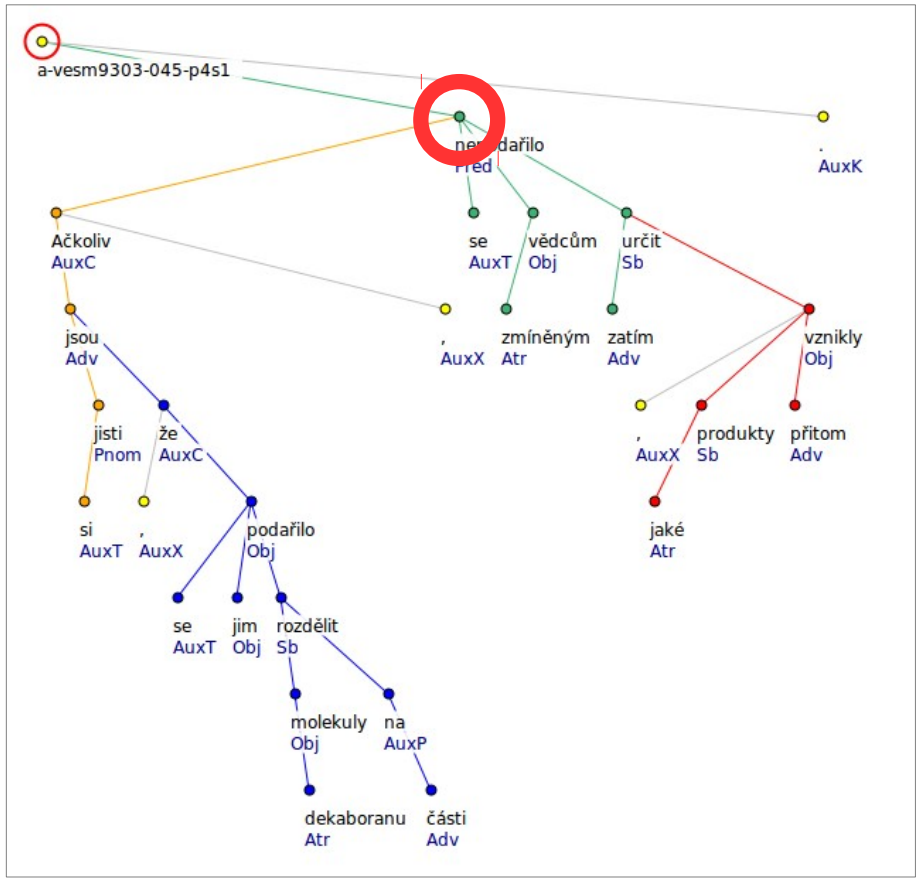

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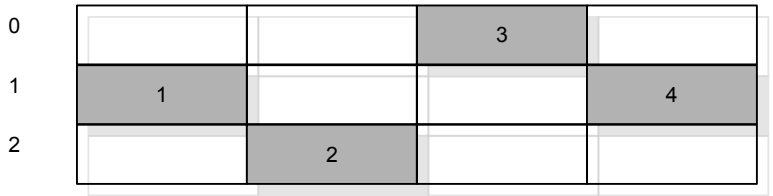

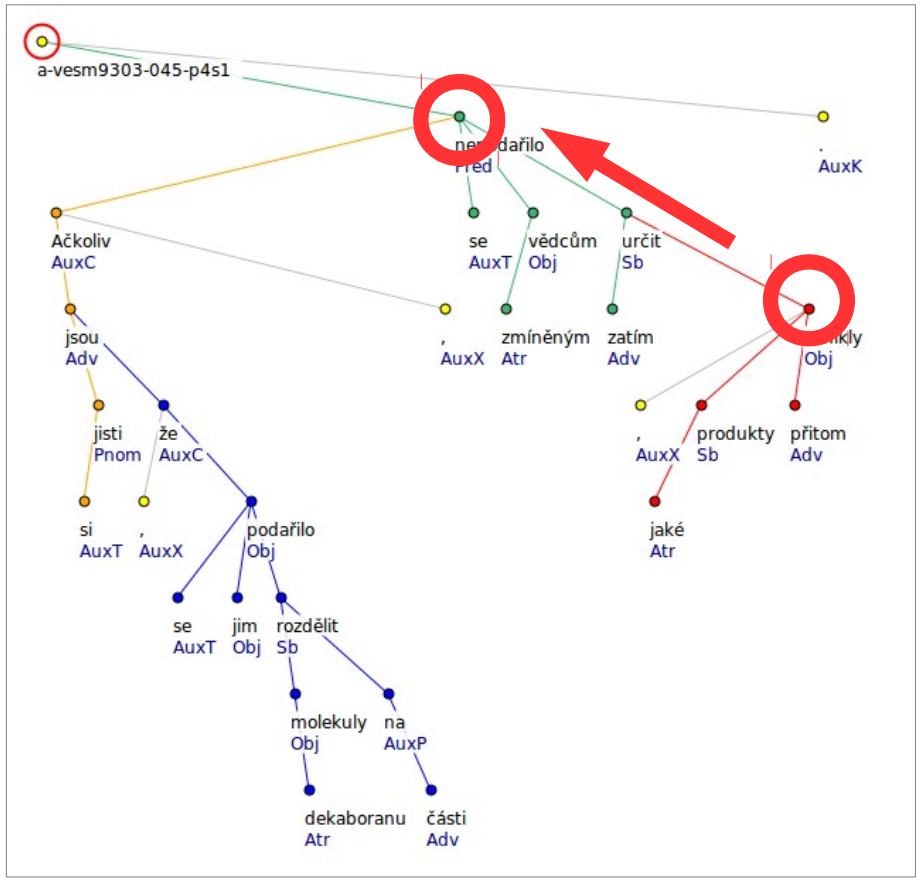

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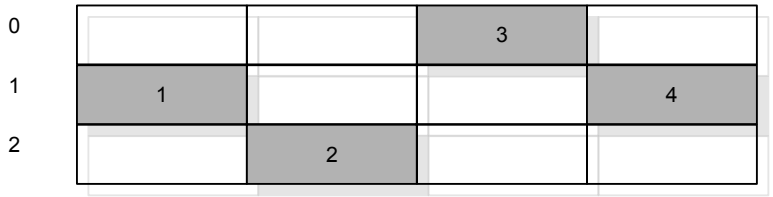

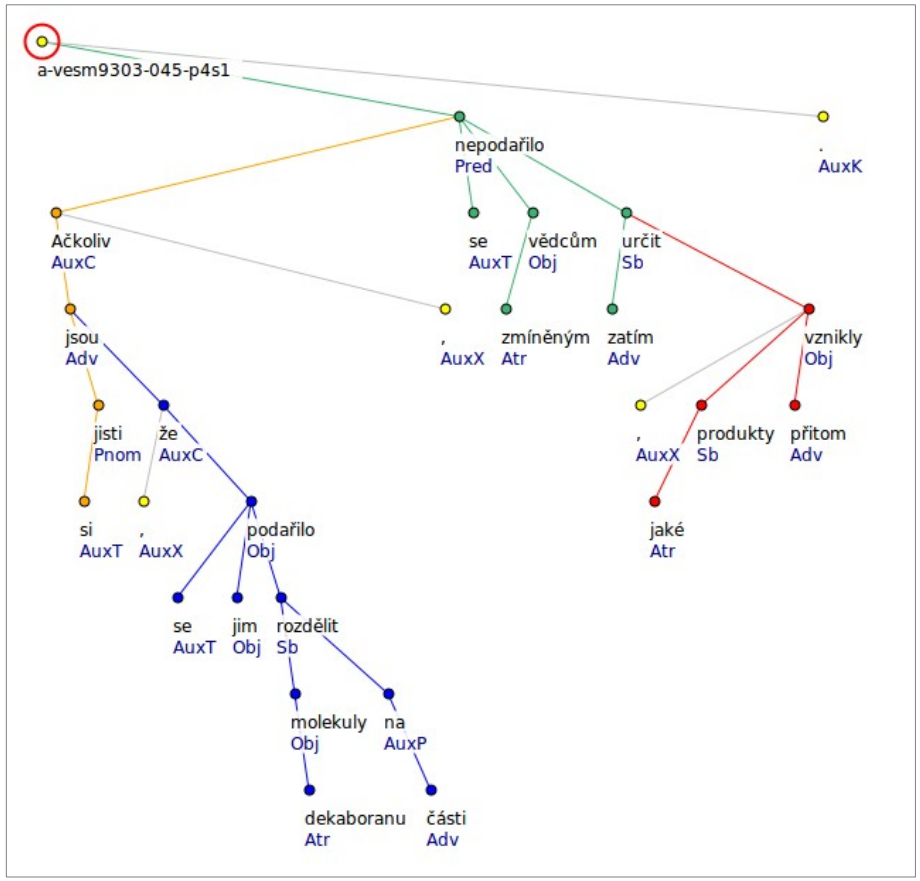

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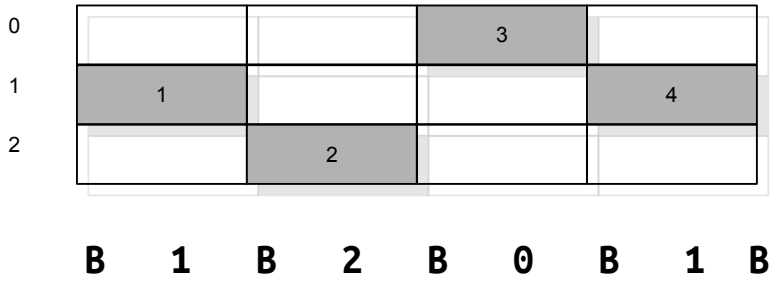

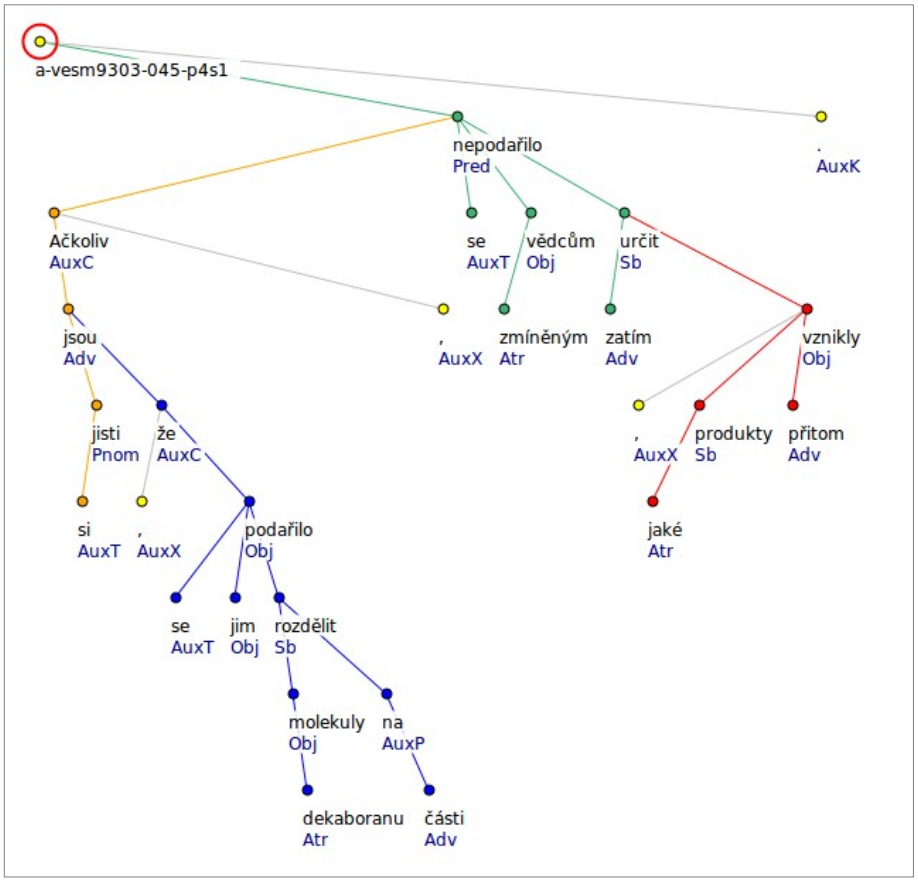

Clause Charts

- **exploring clause charts**

Clause Charts

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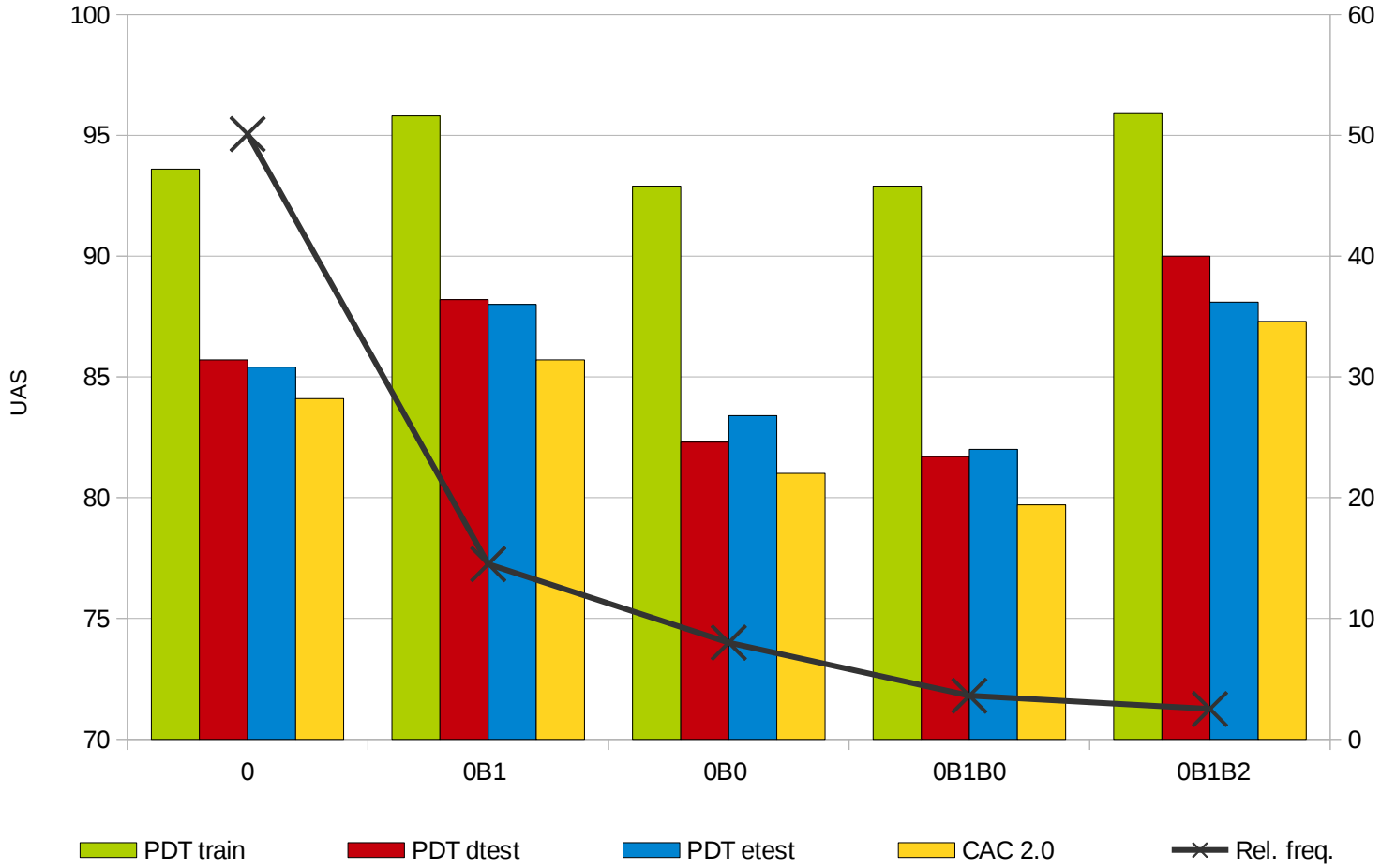


Clause Charts

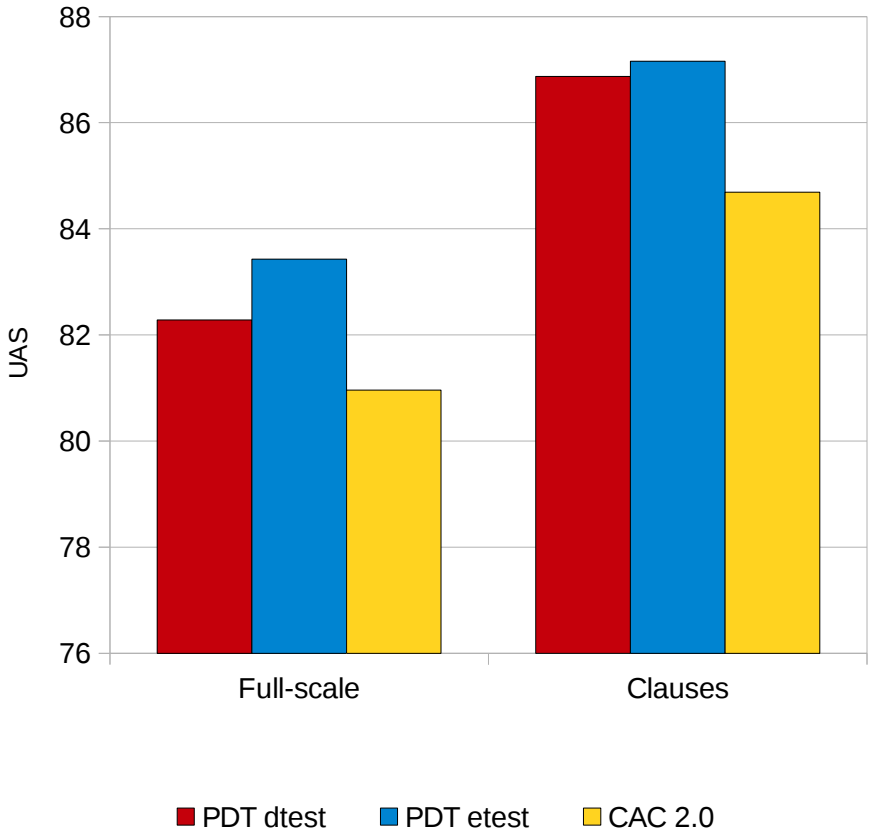
- **exploring clause charts**
  - sentence with 36 clauses
  - sentence with 7 layers of embedding
    - 0B1B2B3B4B5B6

Clause Chart Parsing

- **new method for dependency parsing**
  - exploit an existing dependency parser
    - trained on complete sentences
  - exploit gold-standard clause charts
  - Kríž Vincent, Hladká Barbora: Improving Dependency Parsing Using Sentence Clause Charts. In: Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics – Student Research Workshop
- **two specific strategies**
  - parsing coordinated clauses
  - parsing subordinated clauses

Clause Chart Parsing

- **parsing coordinated clauses**
  - let's explore the most simple sentences with coordinated clauses – **0B0**
  - how good is the full-scale parser on individual clauses from 0B0?



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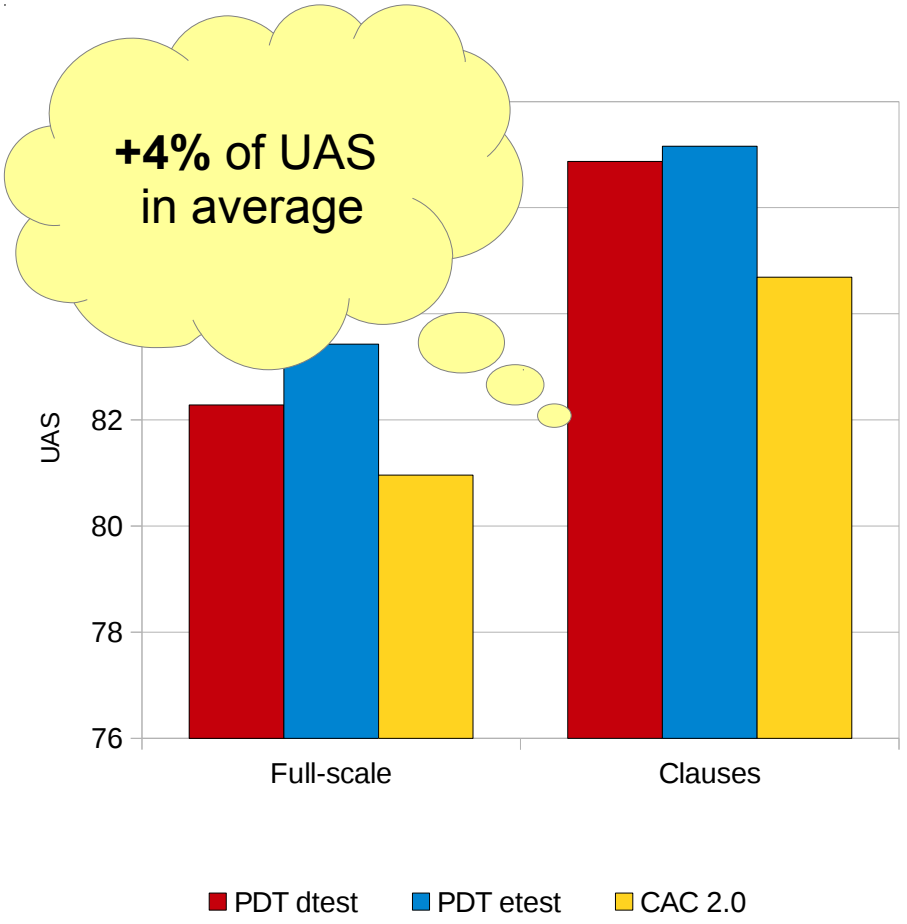


Clause Chart Parsing

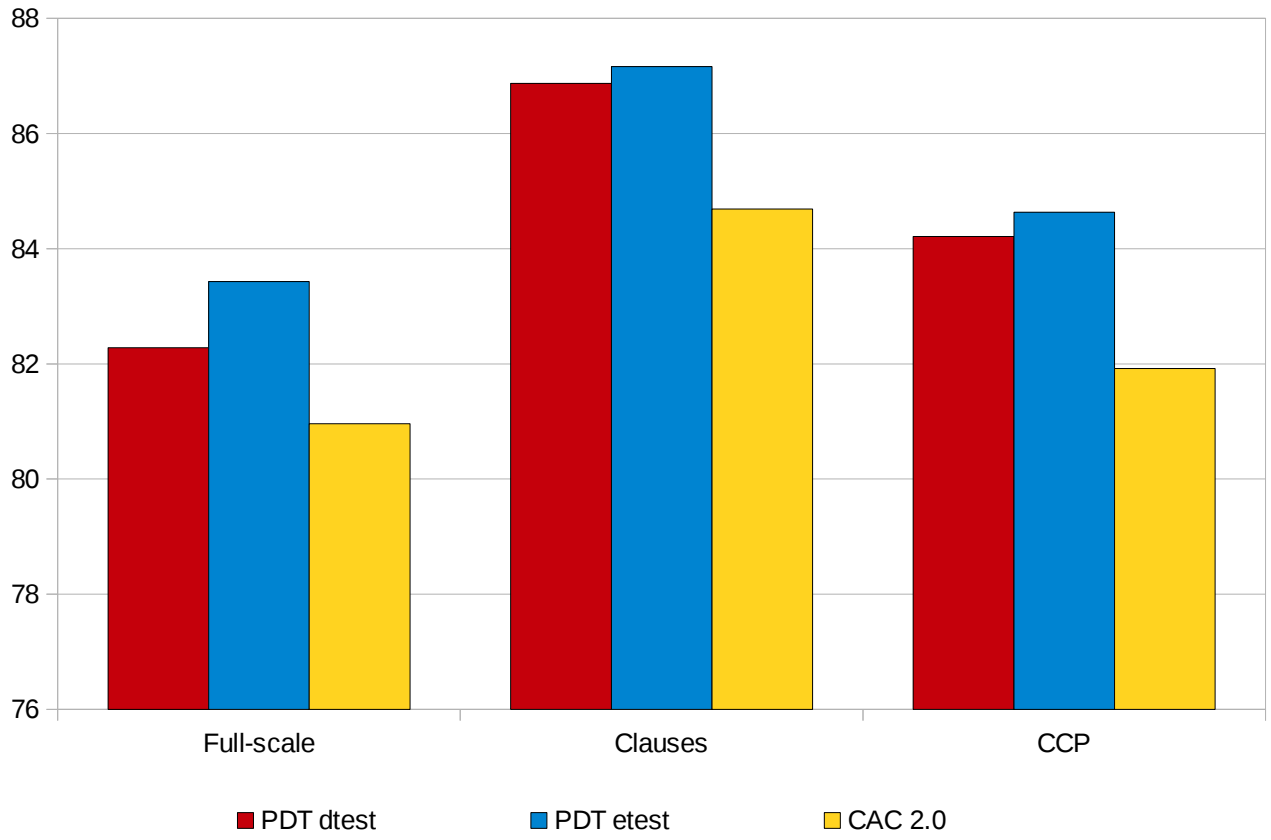
- **parsing coordinated clauses**
  - $C_1, C_2, \ldots, C_n$
    - neighboring coordinated clauses
    - on the same layer
  - parse C_i individually
    obtain dependency tree T_i with root node r_i
  - create a sequence of tokens
    $S = r_1\ B_{1,2}\ r_2\ B_{2,3}\ \ldots\ r_n$
  - parse S, obtain T_s
  - build a final dependency tree using T_i and T_s

Clause Chart Parsing

- **parsing coordinated clauses**
  - *John loves Mary and Linda hates Peter.*
  - C_1 = {John loves Mary}, C_2 = {Linda hates Peter}
  - parse individual clauses
    - $C_1 \rightarrow T_1$, r_1 = loves
    - $C_2 \rightarrow T_2$, r_2 = hates
  - create a sequence of tokens
    S = {loves and hates}
  - parse $S \rightarrow T_s$
  - build a final dependency tree

Clause Chart Parsing

- **parsing coordinated clauses**



Clause Chart Parsing

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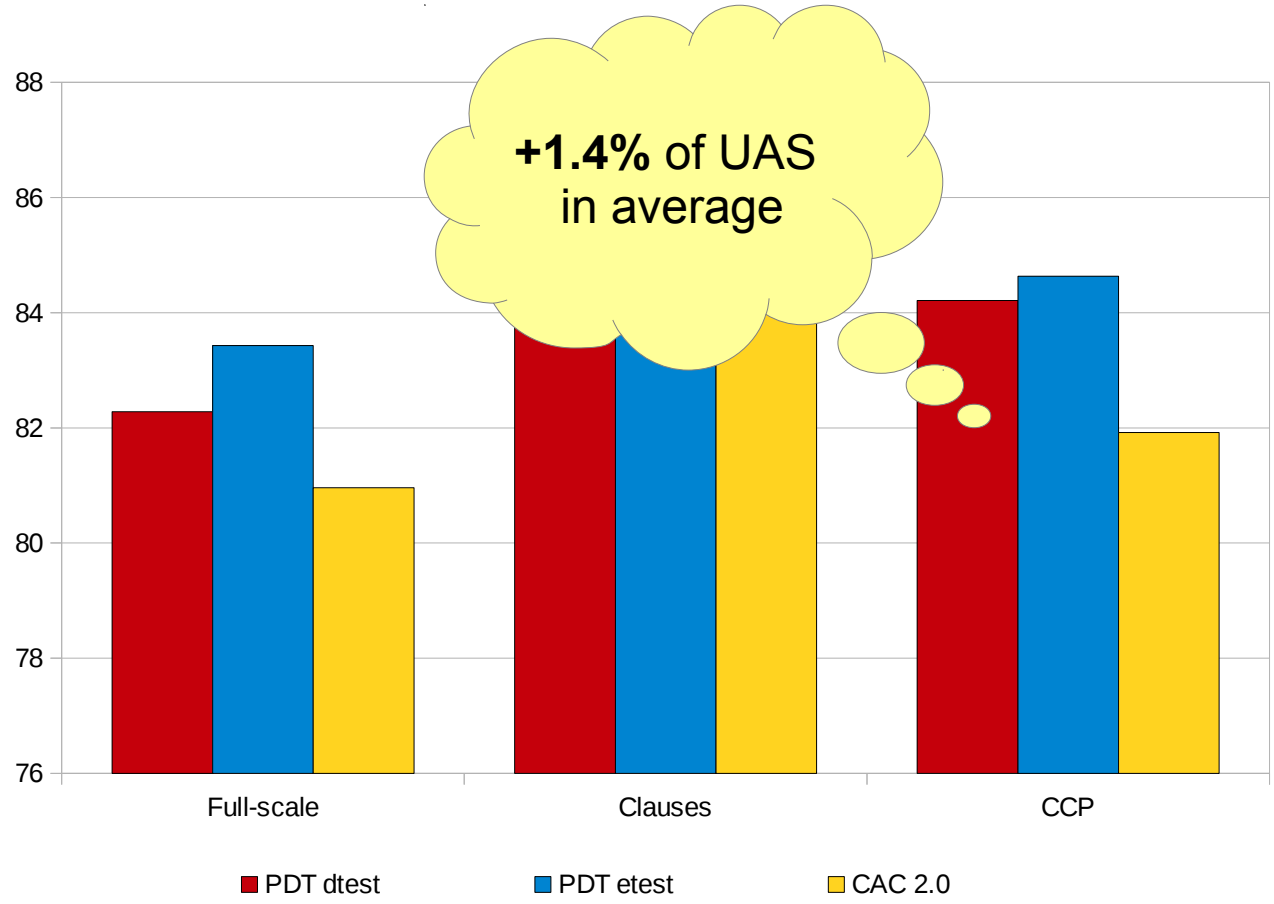
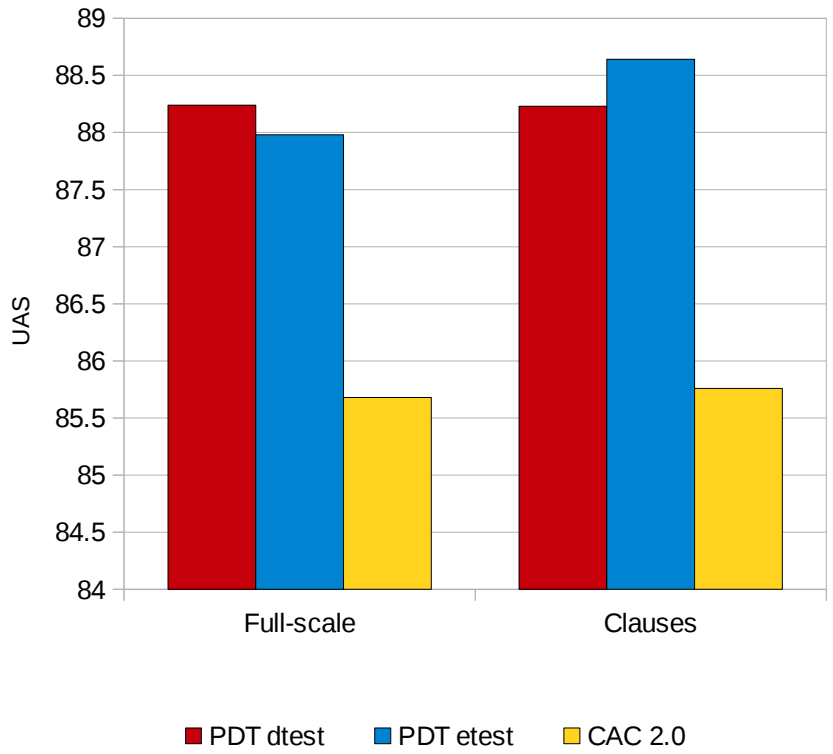


Clause Chart Parsing

- **parsing subordinated clauses**
  - exploring 0B1 sentences
  - almost no improvement when parse individual clauses
  -



Clause Chart Parsing

- **parsing subordinated clauses**
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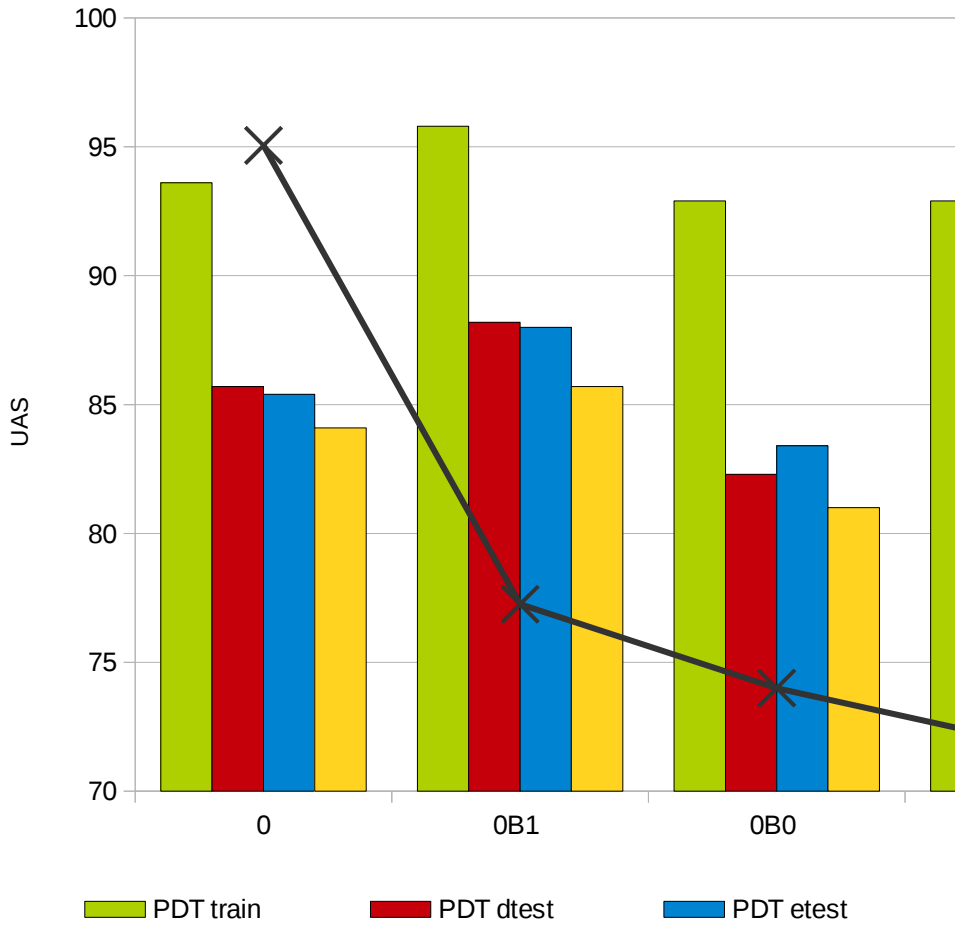
  - almost no improvement when parse individual clauses
  - UAS is significantly higher then overall UAS

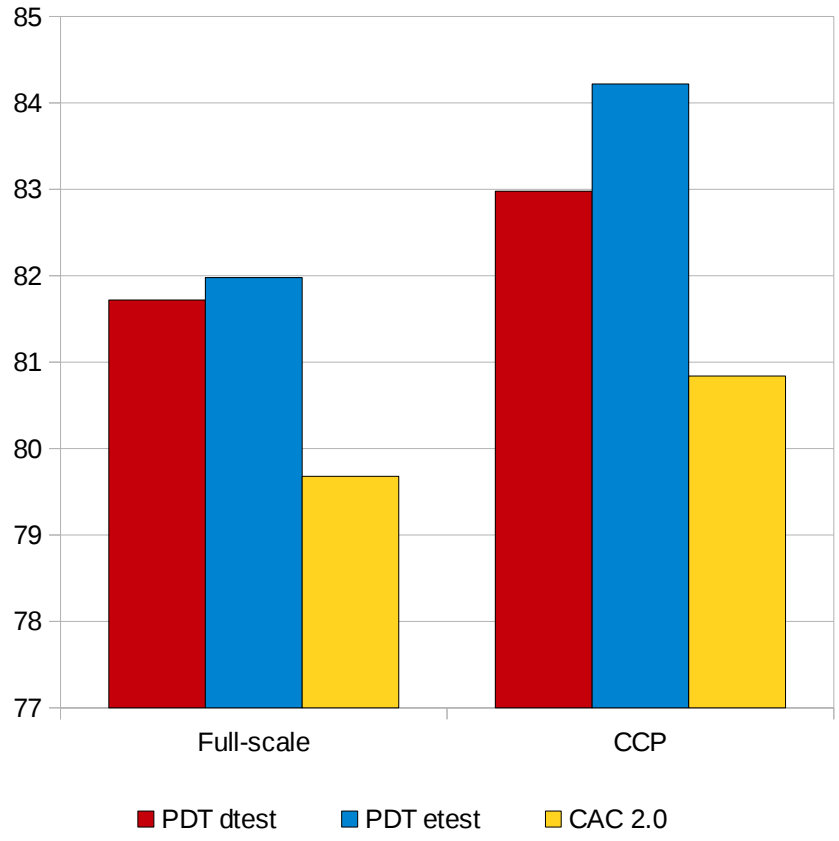


Clause Chart Parsing

- **parsing subordinated clauses**
  - $C_1, C_2, \ldots, C_n$
    - the longest sequence of neighboring subordinated clauses
    - $layer(C_{i+1}) = layer(C_i) + 1$
  - create a sequence of tokens
    $S = C_1\ B_{1,2}\ C_2\ B_{2,3}\ \ldots\ C_n$
  - parse S, obtain T_s

Clause Chart Parsing

- **parsing subordinated clauses**
  - evaluation on 0B1B0 sentences
    - parse 0B1
    - parse 0B0



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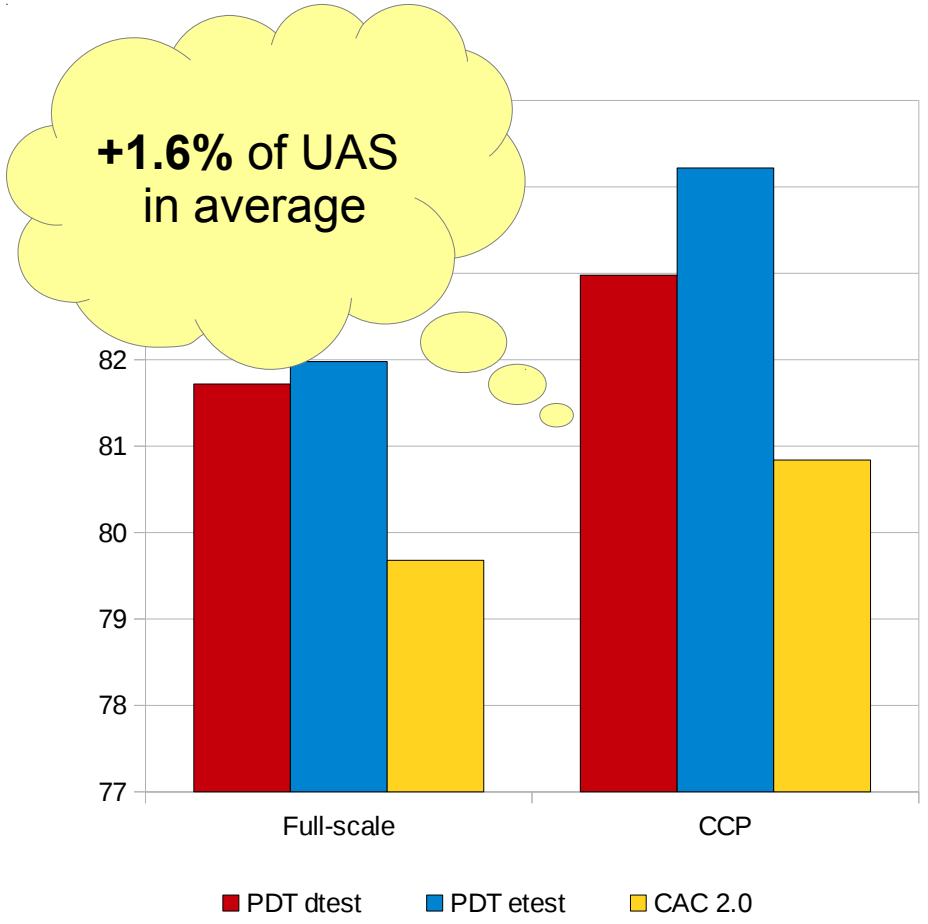
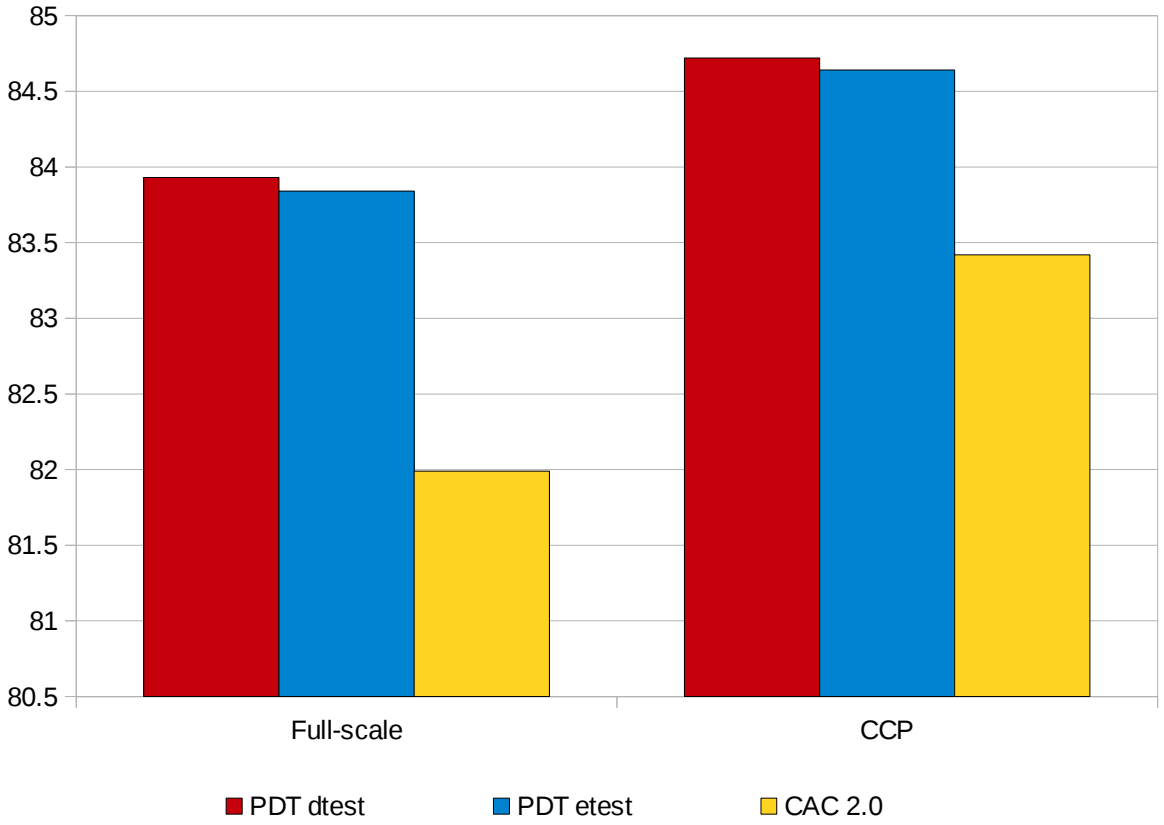


Clause Chart Parsing

- **CCP as full-scale parsing**
  - work in cycles
  - check the deepest layer
    - if there are coordinated clauses → apply 0B0 strategy
    - otherwise identify the longest sequence of subordinated clauses → apply 0B1 strategy
  - use standard full-scale parsing as a fall-back

Clause Chart Parsing

- **final evaluation (excl. 0 sentences)**



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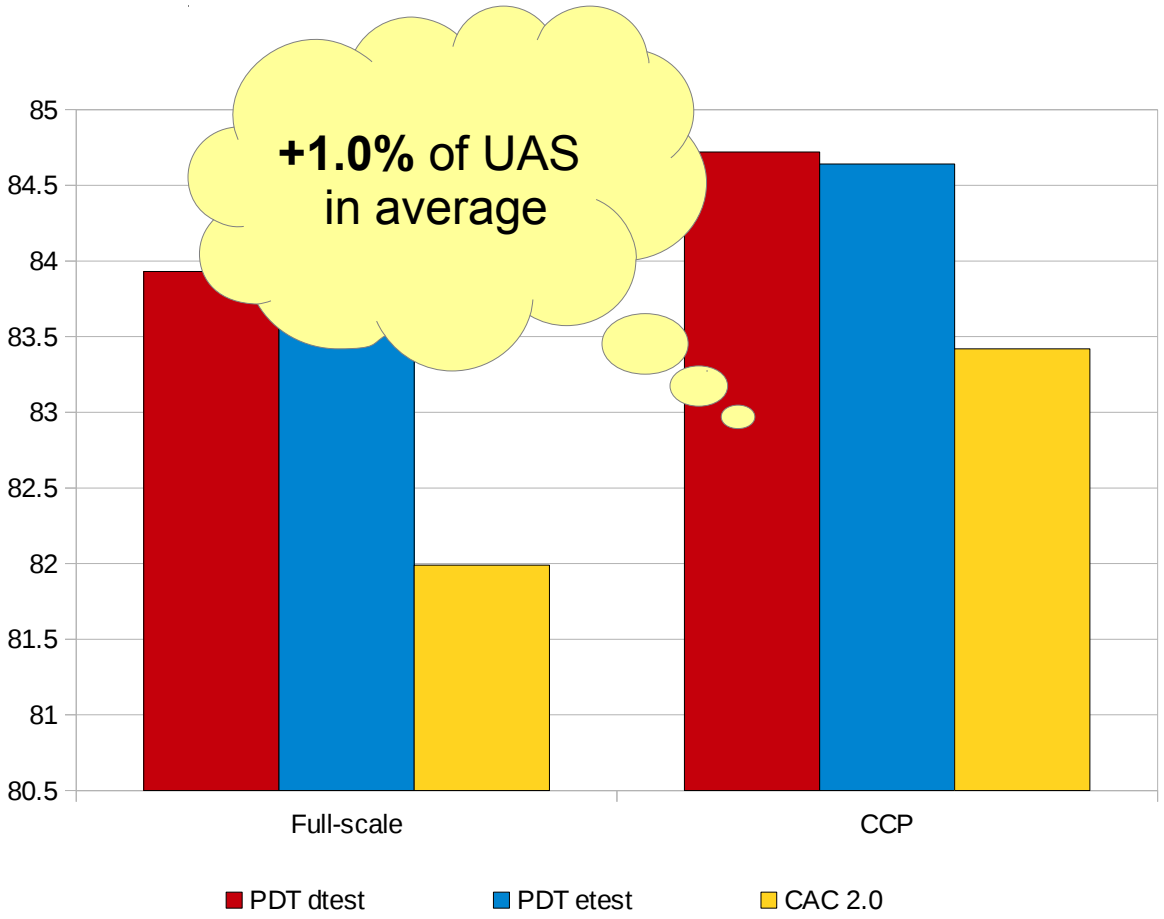

Clause Chart Parsing

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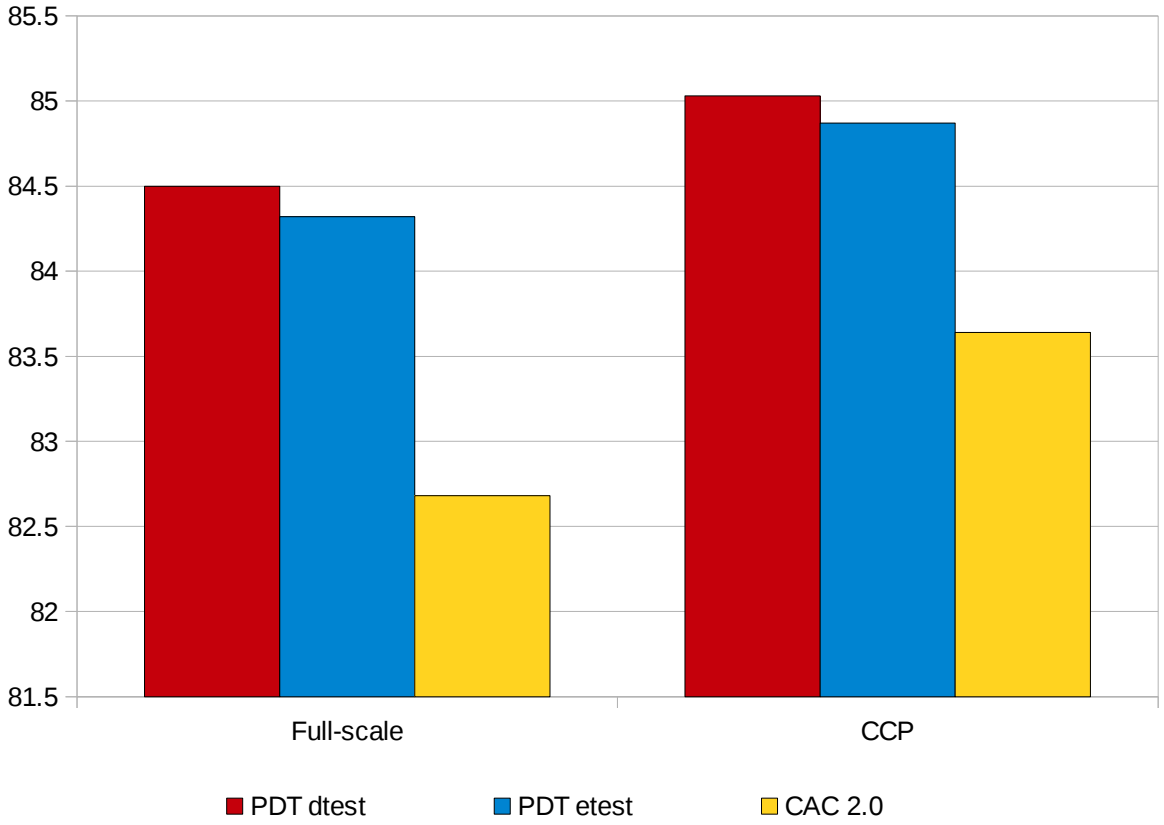

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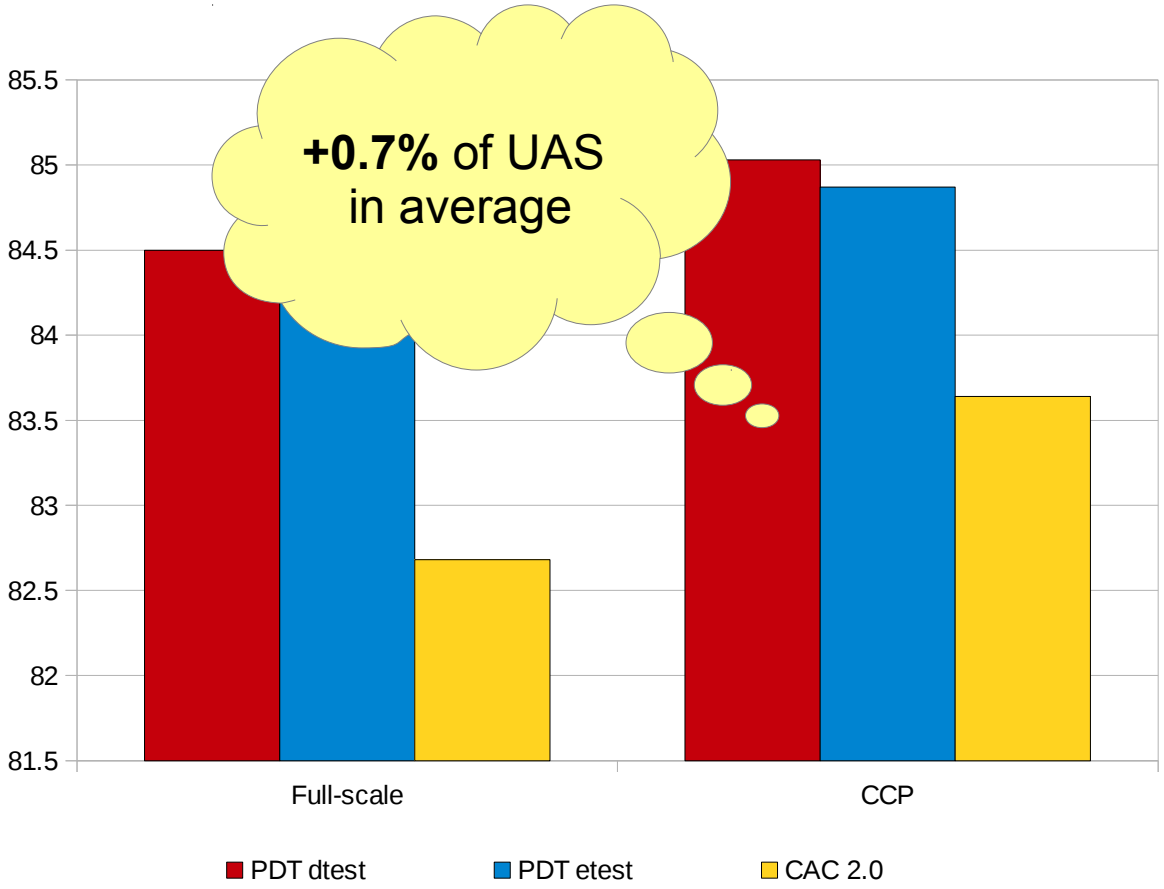

Future Work

- **evaluation**
  - Czech Legal Text Treebank 1.0
  - relation extraction in RExtractor
- **clause charts**
  - extraction from plain-text
- **special parsers**
  - train on individual clauses

Conclusion

- sentence clause structure helps with dependency parsing
- 1% increase of UAS on complex sentences

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in the real parsing task, automatically detected clause structures must be used, not gold-standard

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we can train specialized clause-parsers – for main clauses, subordinated clauses, merge clauses, …

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- sentence clause structure helps with dependency parsing
- 1% increase of UAS on complex sentences

in the real parsing task, automatically detected clause structures must be used, not gold-standard

we can train specialized clause-parsers – for main clauses, subordinated clauses, merge clauses, …

we can find out better strategies for parsing sequences of subordinated clauses