A treebank for everyone

Milena Hnátková, Petr Jäger, Tomáš Jelínek,
Vladimír Petkevič, Alexandr Rosen, Hana Skoumalová

Ústav teoretické a komputační lingvistiky
Filozofická fakulta Univerzity Karlovy v Praze

Institute of Theoretical and Computational Linguistics
Faculty of Arts, Charles University, Prague

Zespół Lingwistyki Korpusowej Języków Słowiańskich
Instytut Slawistyki Zachodniej i Południowej
Uniwersytet Warszawski
19 czerwca 2012

Outline of the talk

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About treebanks

- Treebank = a corpus annotated with syntactic structure
- Probably first major project: Penn Treebank (release v. 0.5, 1992)
- Now: 74 treebanks in about 40 languages (Wikipedia)
- Different in:
  - size
  - linguistic background
  - format
  - level of detail
  - depth of analysis
  - ways they are built
- Parallel treebanks, semantic annotation, ...

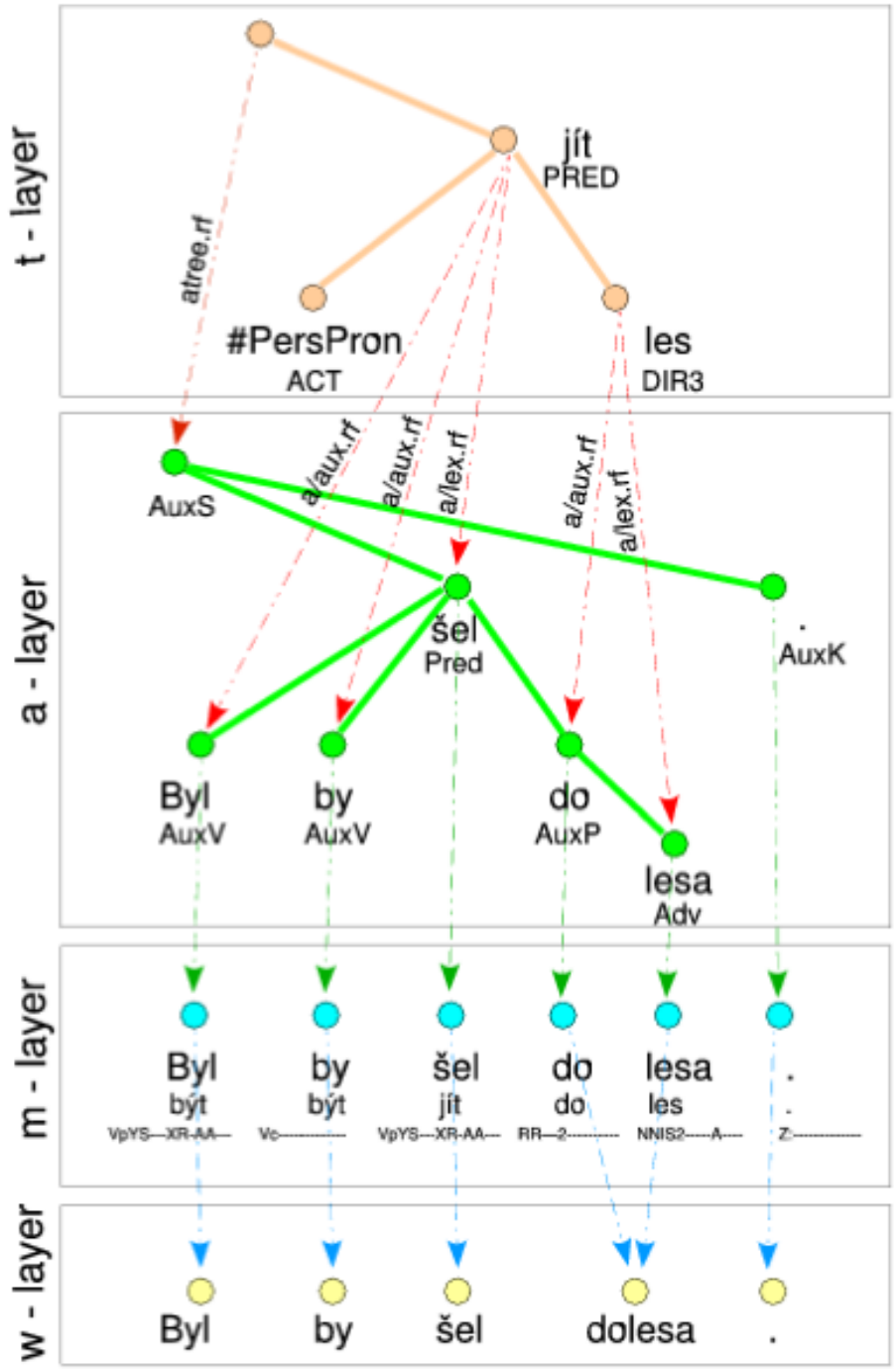
Why are treebanks useful?

- Explicit markup of syntactic relations (constituents; heads and dependents)
- – easier to identify semantic relations (predicates/functors and arguments)
- – simplifies some queries
- – simplifies extraction of lexical properties (valency) or syntactic rules
- – support for grammar development

Treebanks of Czech

Prague Dependency Treebank

- Dependency syntax, close to the Prague theory of Functional Generative Description [Sgall et al.(1986)]
- 3 annotation levels: morphology, surface syntax, deep syntax
- PDT 0.5 – 1998, 0.5M tokens
- PDT 1 – 2000, 1.5M tokens
- PDT 2 – 2004, deep syntax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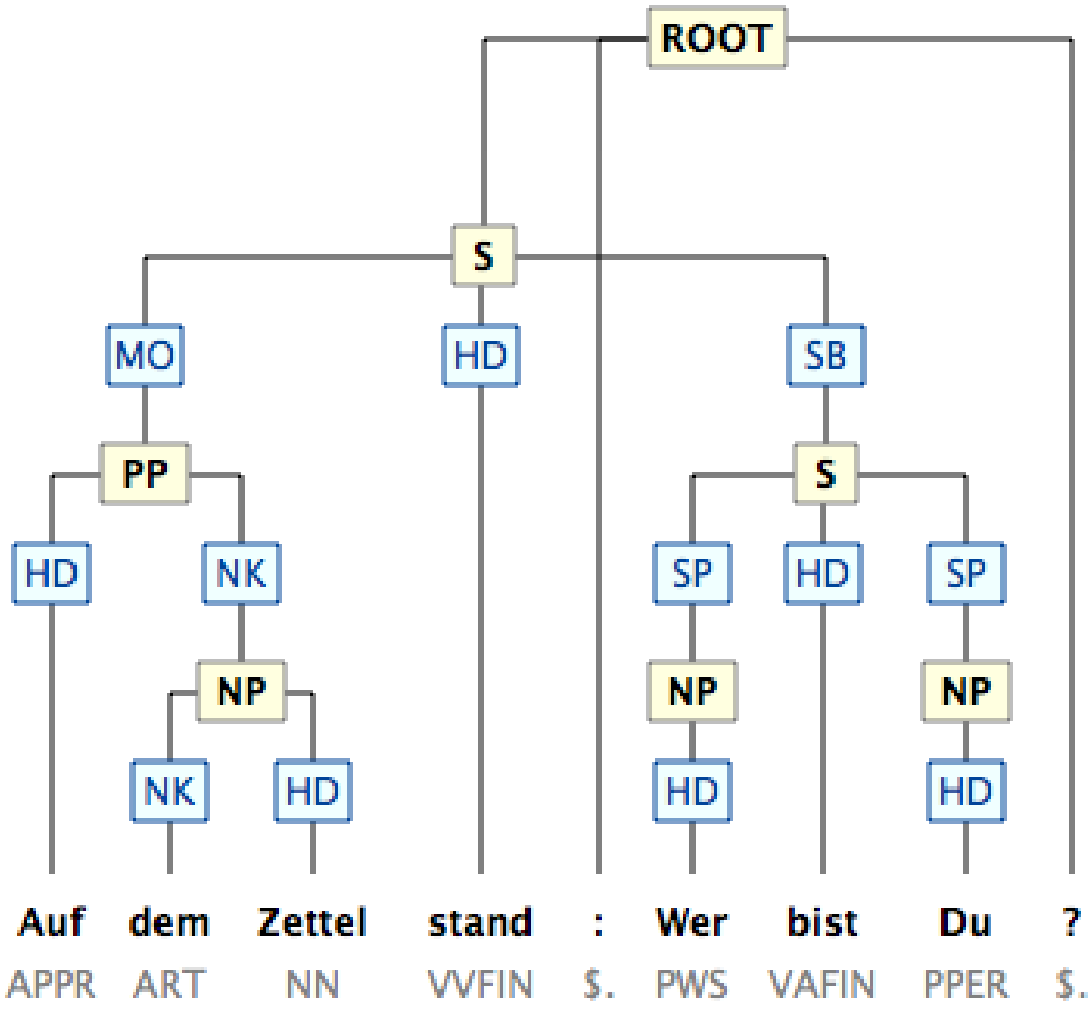
Some other treebanks

- Polish Constituency Treebank
- BulTreeBank
- Iness Treebanking Infrastructure
- Lingo Redwoods
- Tiger
- LASSY
- ...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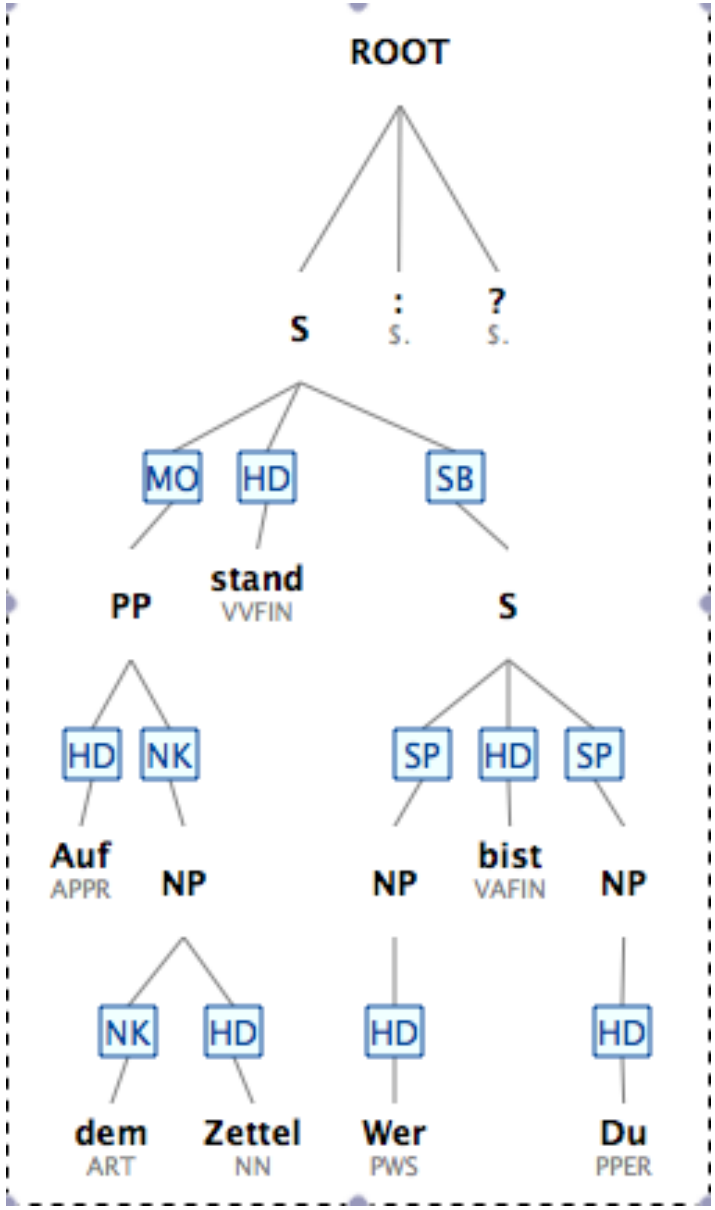
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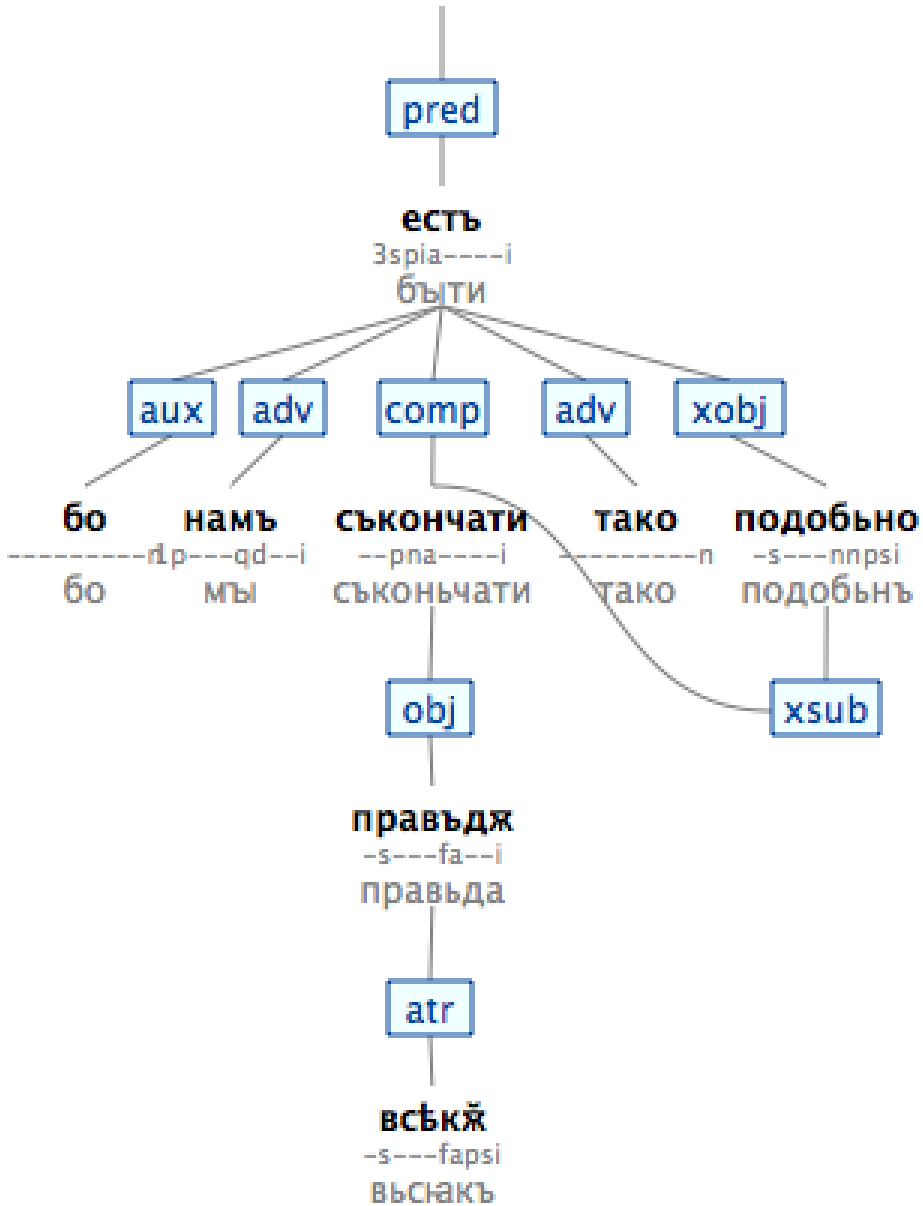
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Why isn't PDT good enough?

- Too small for investigating less frequent forms and phenomena
- Theoretical bias — distracts some people used to constituency structure

How to build a large treebank?

- Treebanks built with human assistance,
  even semi-automatically, are too small.
- They can be built by a stochastic parser.
- Or by a rule-based parser,
  with the advantage of correspondence to the grammar

Can a single core annotation be viewed in different ways?

- Theory-specific representations have different appearances but share a large part of content: constituency/dependency, morphosyntactic categories, even the spirit of analyses of many phenomena
- A treebank offering different views of a sufficiently expressive annotation scheme is a realistic goal
- Additional benefit: relating linguistic theories

A larger treebank with customizable visualization?

A project (2010—2012) aiming at:

- Syntactic annotation of the Czech National Corpus (1.3 billion words) using a stochastic parser, followed by a rule-based correction module
- Robust and expressive core annotation format, potentially underspecified
- Customizable query, visualization and export interface, offering multiple options to view syntactic structure
- Accessible to lay users and satisfying experts at the same time

Hopefully a follow-up project (2013–2015) aiming at:

- Development of a corpus-based grammar
- Options for queries, visualization and export:
  - ready-made, tailored to specific theories, or
  - definable by the user
- Improvements of the correction module

A corpus grammar?

- to bridge the gap between the empirical and the theoretical
- for grammar development
- for checking consistency
- for adding more info
- for assisting the treebank user
- to help converting the data onto other formats more easily

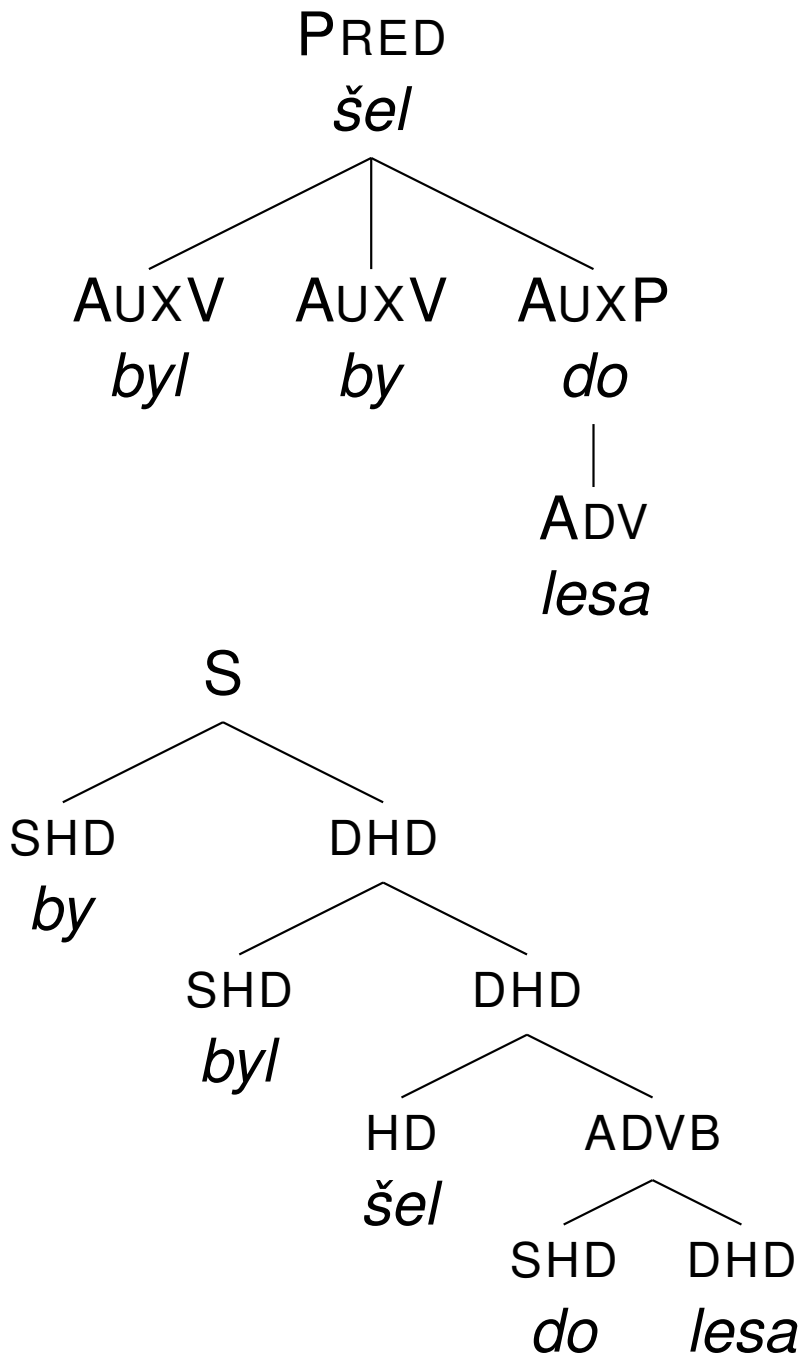
A corpus grammar can be:

- hand-crafted
- extracted from corpus
- hand-crafted but verified against the corpus data
  advantage: incremental development

Outline of the talk

Syntactic structure

- Internal skeleton structures: constituency-based, with a combination of **binary** and **flat** branching
- Interpretable as **constituency** or **dependency** trees, according to users' specification, visualized with an arbitrary amount of detail, not necessarily by tree graphs
- Surface and deep structure encoded within a single structure: constituents are labelled as **syntactic functions** including **head** as a special function
- Heads are further specified as **deep** or **surface**
  - **Deep head**: deep syntactic governor: *bylo by se to **povedlo***
  - **Surface head**: can be identical to the deep head or different: auxiliary, prepositions, subordinate conjunctions, numerals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Three levels

- Word order and syntactic structure as distinct dimensions, each sentence is represented at three inter-linked levels:
  - **graphemics** (orthographic words, contractions)
  - **morphology** (syntactic words, including haplologized items)
  - **syntax** (trees, no nodes for pro-dropped subjects)

Annotation of syntactic phenomena

- Agreement of various types
- Compound periphrastic verbal forms (passives, conditional structures, future...)
- Grammatical co-reference (grammatical control, relative/reflexive pronouns, predicative complements)
- Multi-word units (collocations)

Expressive power

- Expressive enough to accommodate analyses of arbitrary granularity
- Ambiguous or undecidable phenomena represented by underspecification and distributive disjunction
- Annotation of any kind can be missing, a sentence may be a mere list of words

Specifications

- Annotation must be licensed by a formal grammar. Words and constituents have their appropriate (potentially underspecified) sets of features
- Lexicons are used to index forms, syntactic words and compound forms
- Customizable visualizations are enabled by formal definitions

Representation layers:

- text
- morphology
- syntactic structure

Lexicons:

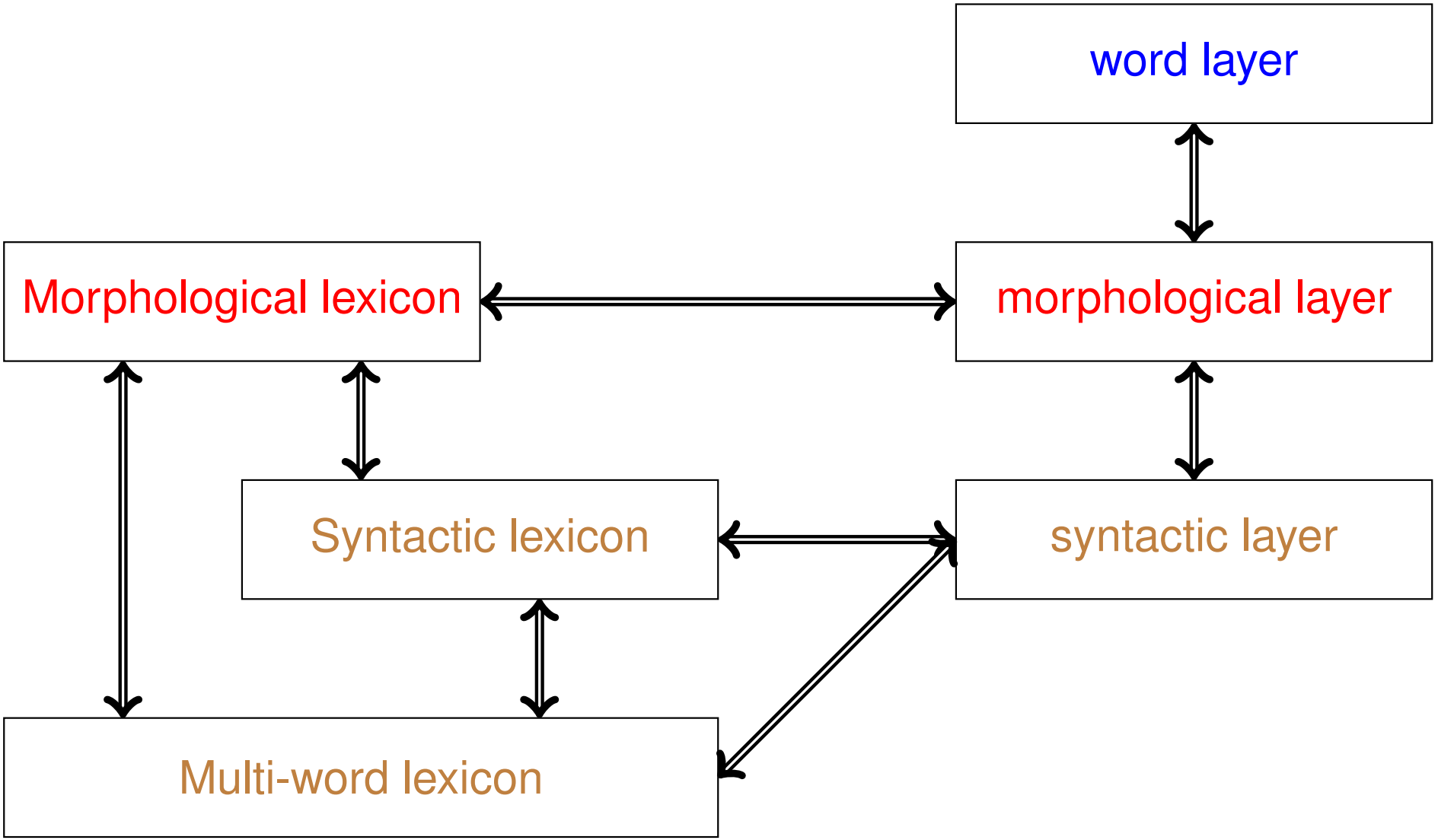
- morphological
- syntactic
- multi-word expressions

Two-way links between layers, and between layers and lexicons

- to link information across the layers
- to provide lexeme-specific information
- to identify multi-word expressions, including periphrastic forms

Links within a tree

- Agreement
- Compound (multi-word) verbal predicates
- Grammatical coreference
- ...


word layer
Morphological lexicon
morphological layer
Syntactic lexicon
syntactic layer
Multi-word lexicon

Word layer

- tokenized, including punctuation and MWE: *česko-slovenský*
- contractions left intact (not interpreted): *očs, ses*

Morphological layer

- morphological analysis and lemmatization of all forms
- contractions split (i.e. interpreted): *očs* → *o co jsi*
- some punctuation marks glued back with word forms: *atd.*, *česko-*

Syntactic layer

- **constituency-based structure**, representable according to user's options/specifications
- punctuation omitted

Syntactic structure

- each nonterminal node is assigned a construction type and a syntactic function
- each terminal node is assigned a syntactic function

Hierarchy of construction types

- **Headed**
- **UnHeaded**
  - **Coord** – coordination
  - **Adord** – adordination
  - **Unspec** – unspecified (for collocations and other)

Function for **UnHeaded** structures:

- **Memb** – a member

Syntactic functions for **Headed**

- **SurfHead** – surface head: auxiliary *být/bývat*, prepositions, subordinate conjunctions, numerals in quantified expressions: *pět dětí*
- **DeepHead** – in case it differs from SurfHead (head nouns in PPs, autosemantic verbs in analytical predicates...)
- **Head** – both **SurfHead** and **DeepHead**

Other syntactic functions for **Headed**

- **Subj** – subject
- **Attr** – attribute
- **Obj-Advb**
  - **Obj**
  - **Advb**
- **VbAttr** – predicative complement
- **ReflTant** – reflexive element (*si*, *se*) for inherent reflexives
- **Deagent** – deagentive reflexive
- **Apos** – apposition
- **InDep** – independent syntactic element (parenthesis, vocative syntactic noun...)

Morphological lexicon

- List of lemmas with inflection paradigms
- A lemma is introduced if two words differ in morphological paradigms – not only in syntactic properties or in semantics:
  - *travička* 'little grass'/'female poisoner' has only **one lemma**,
  - *člen* 'member' has two lemmas, as it is either **masculine animate** or **masculine inanimate**.

Syntactic lexicon

- list of lemmas with their syntactic properties
- inherent reflexives have separate entries – *rozhodnout* and *rozhodnout se* 'decide',
  vidět 'see' is one entry
- **valency frame** entries
- different valency frames listed under one lemma

Multi-word lexicon

- collocations: *křížem krážem* ‘in all directions’
  nechat na holičkách ‘leave in the lurch’
- types of analytical verb forms: *bych byl přišel* ‘(I) would have come’, *jsi přišel* ‘(you) have come’
- inherent reflexives: *usmíváš se* ‘(you) smile’;
  rozhodne se ‘(he) decides’
- (reflexive) deagentive construction: *jde se* ‘let’s go’
- reflexive passives: *bábovka se peče* ‘the cake is baking/being baked’
- analytical passives: *je čten* ‘is read’
- nominal predicates: *je velký* ‘is big’
- agreement patterns:
  Lucie ho viděla opilého ‘Lucie saw him drunk’

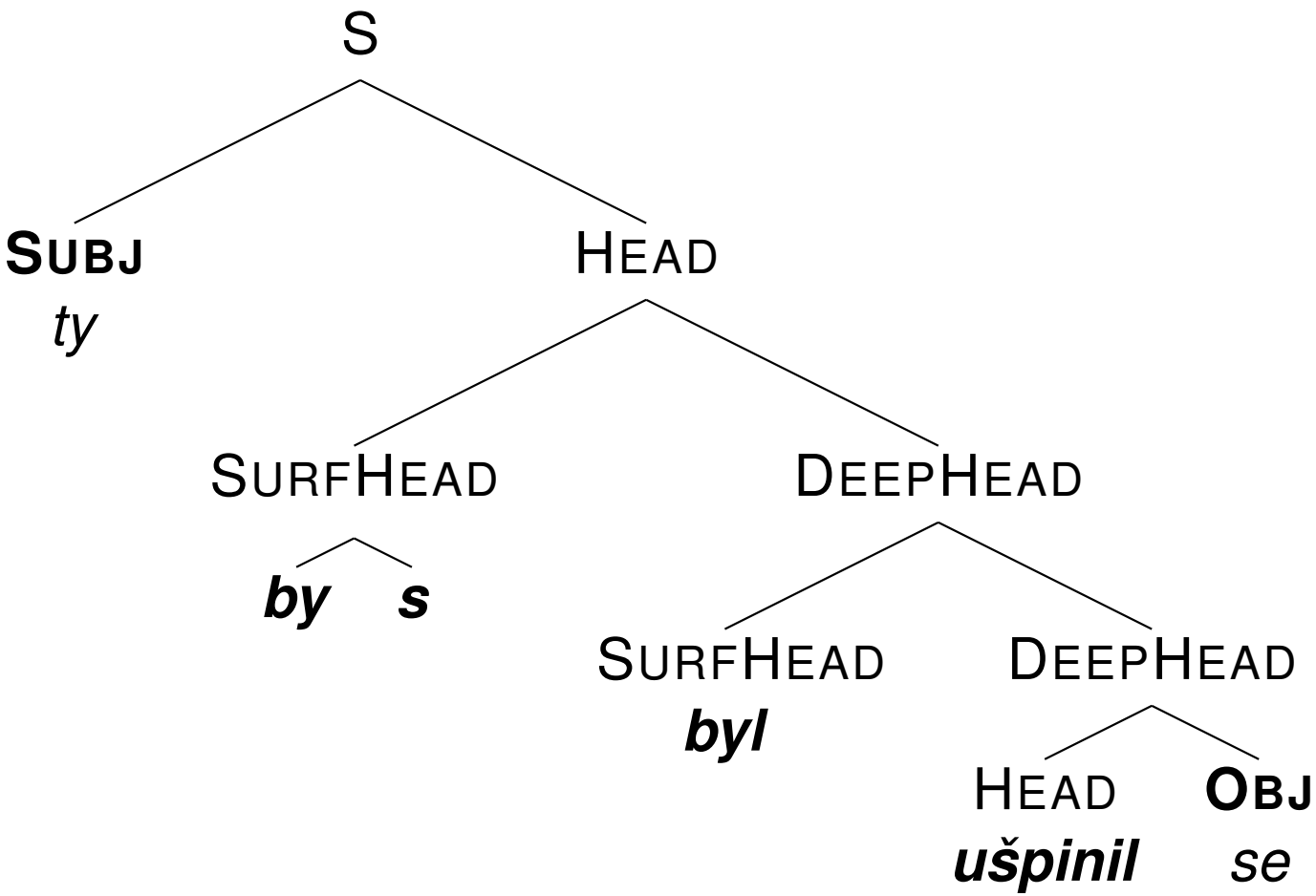
Outline of the talk

Treating contractions

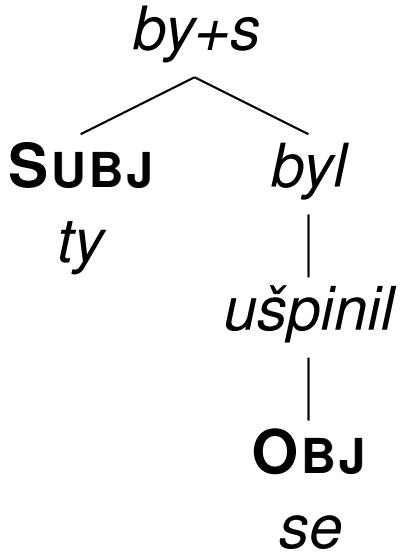
(1) **Ty** by *se*s byl ušpinil.
you would REFL+AUX$_{2nd,sg}$ be$_{pple}$ get dirty$_{pple}$
'You would have got dirty.'

Ty by ses byl ušpinil.

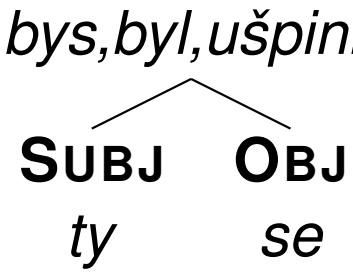
(2)



(3) **Surface dependency structure** derived from (2)



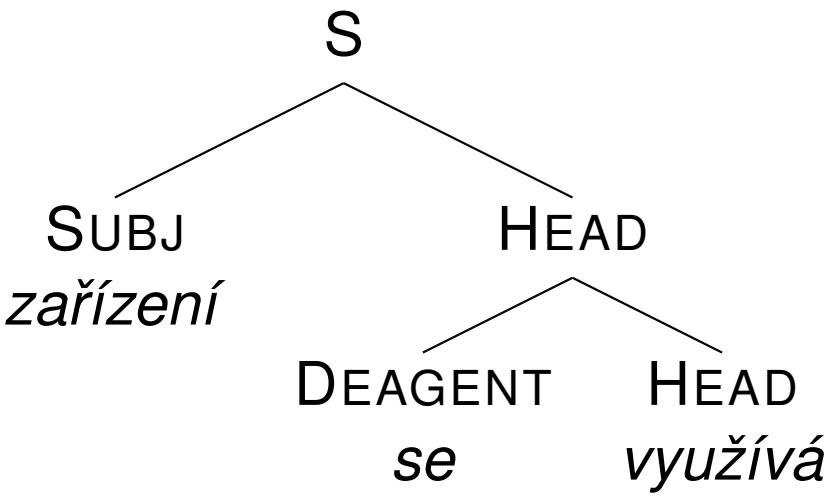
(4) **Deep dependency structure** derived from (2)

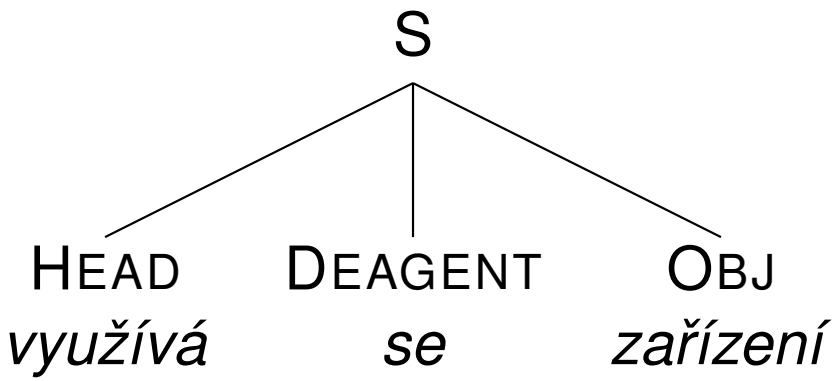


Subject/object ambiguity

Reflexive passive:

(5) Zařízení$_{Nom/Gen}$ se využívá.
device REFL uses
'The device is being used.'



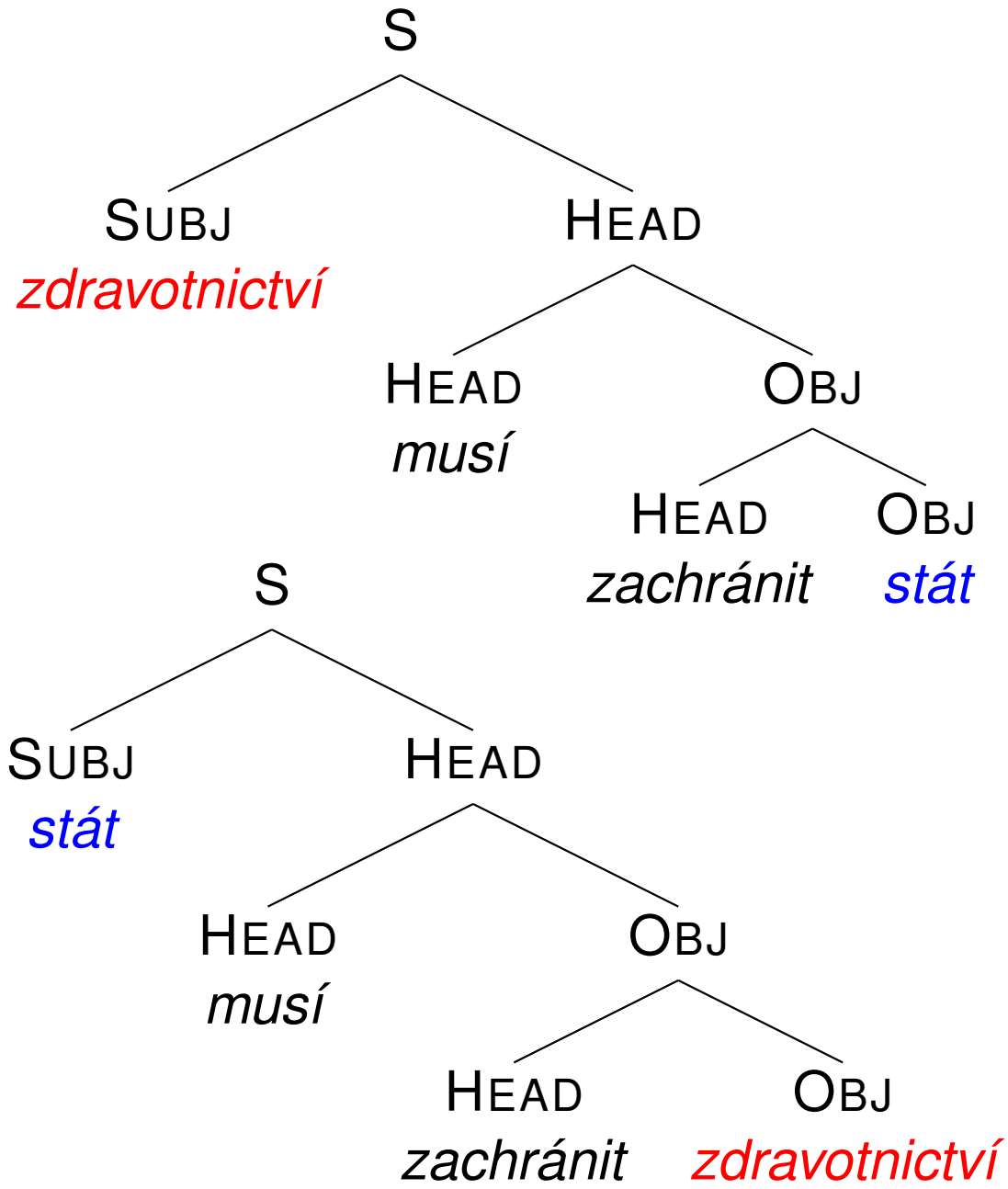


Another type of subject/object ambiguity

(6) Zdravotnictví musí zachránit stát.
health service$_{nom/acc}$ must save state$_{nom/acc}$

Two different readings:

- #1 Health service must save the State.
- #2 Health service must be saved by the government.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Morphological analysis of (6) with some values unspecified:

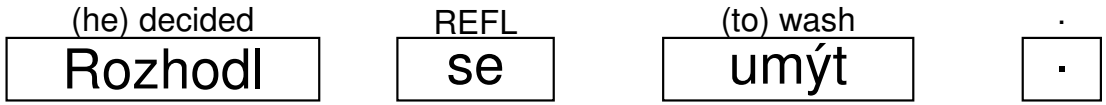
1	zdravotnictví	*noun*, CASE=*X*, NUM=*sg*, GEND=*n*
2	musí	*verbfin*, PERS=*3*, NUM=*sg*
3	zachránit	*verbinf*
4	stát	*noun*, CASE=*Y*, NUM=*sg*, GEND=*m*

Constituents in one of the two possible syntactic structures of (6), some boxed numbers refer to the forms above:

5 [3zachránit 4stát]
6 [2musí 5]
7 [1zdravotnictví 6]

Two possible structures with constraints on category values and overriding clauses:

#1 = 7, *X*=*nom*, *Y*=*acc*
#2 = 7, *X*=*acc*, *Y*=*nom*, 1 → 4, 4 → 1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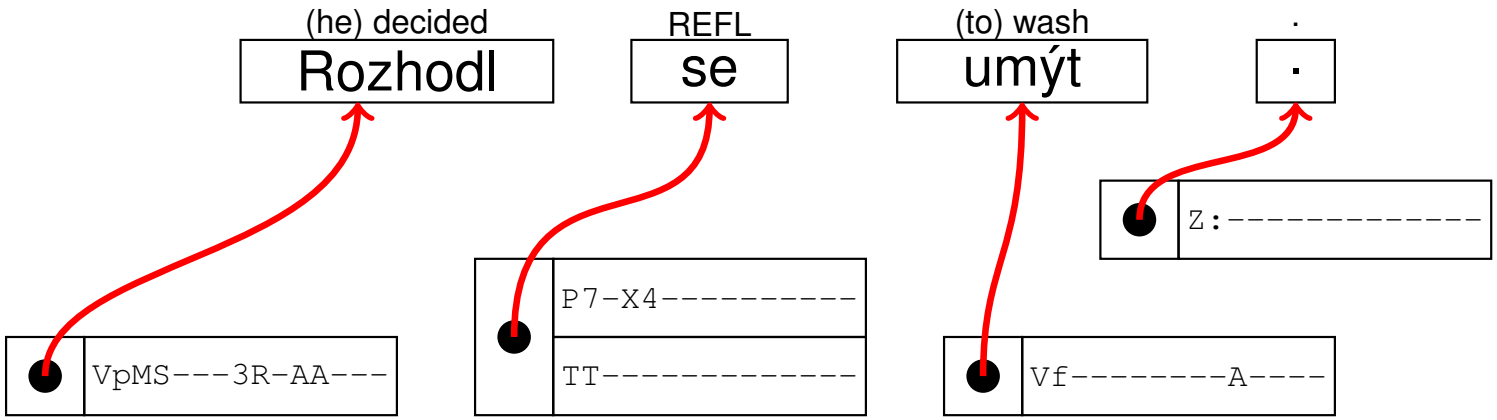
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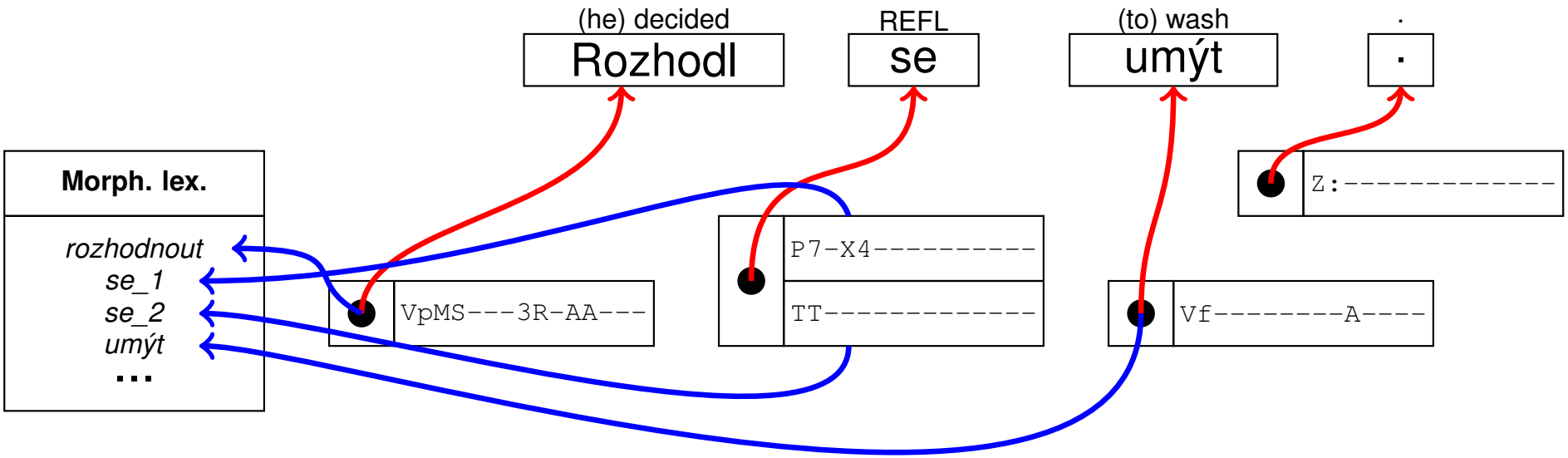
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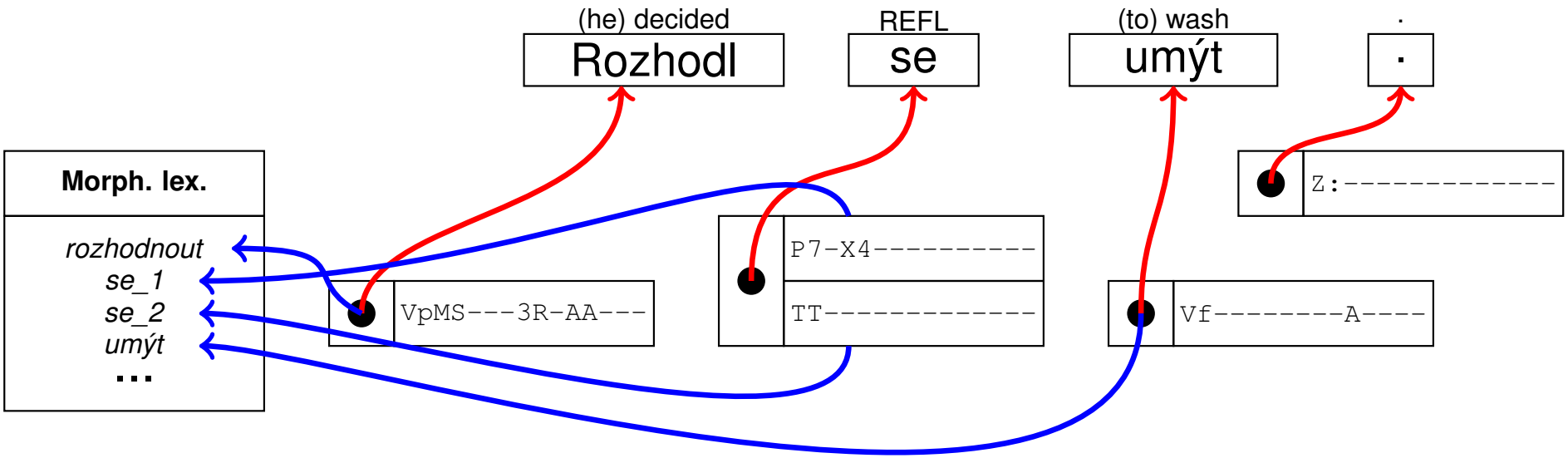
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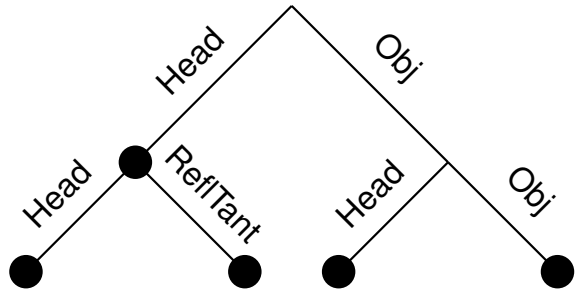
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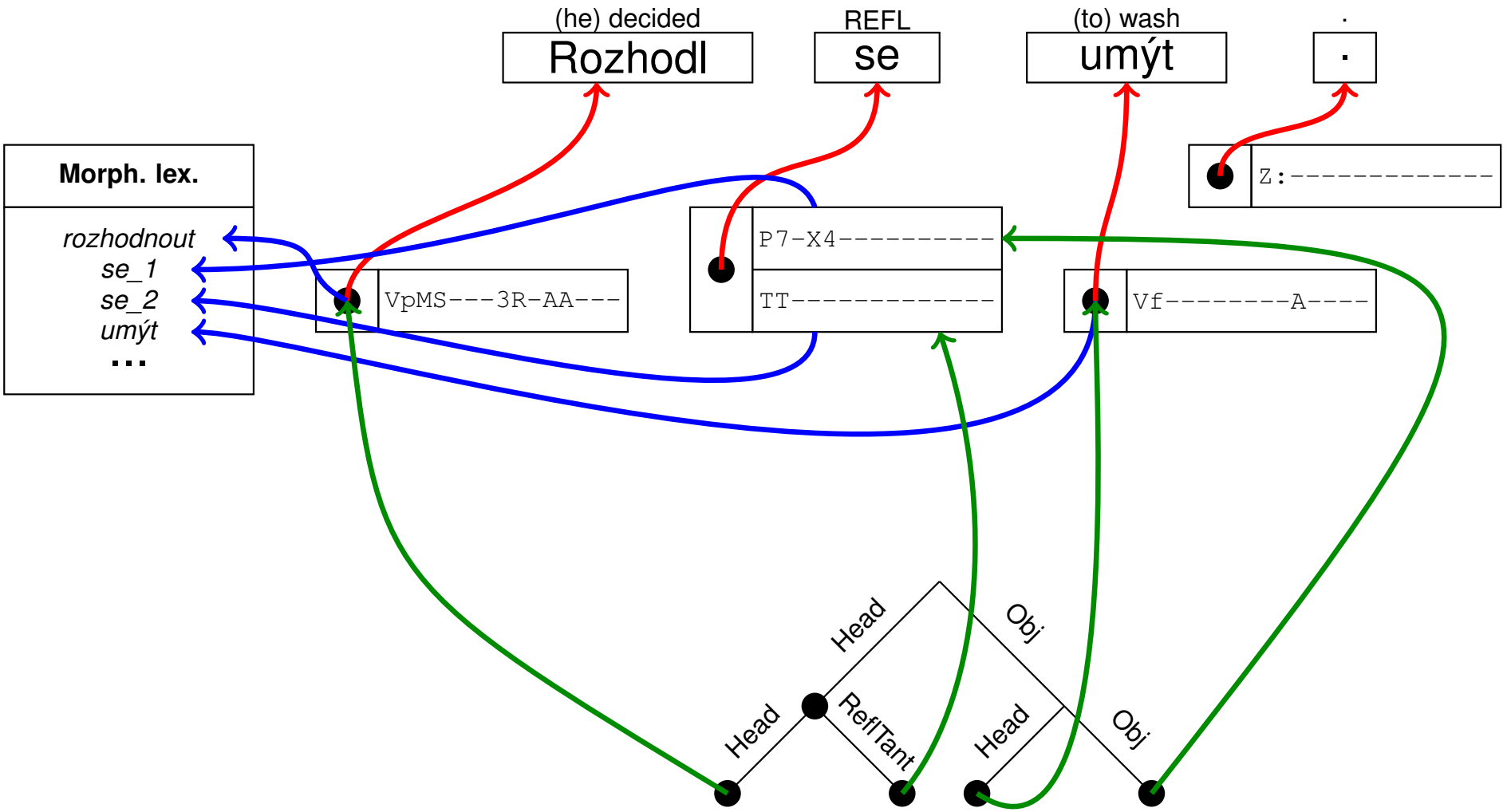
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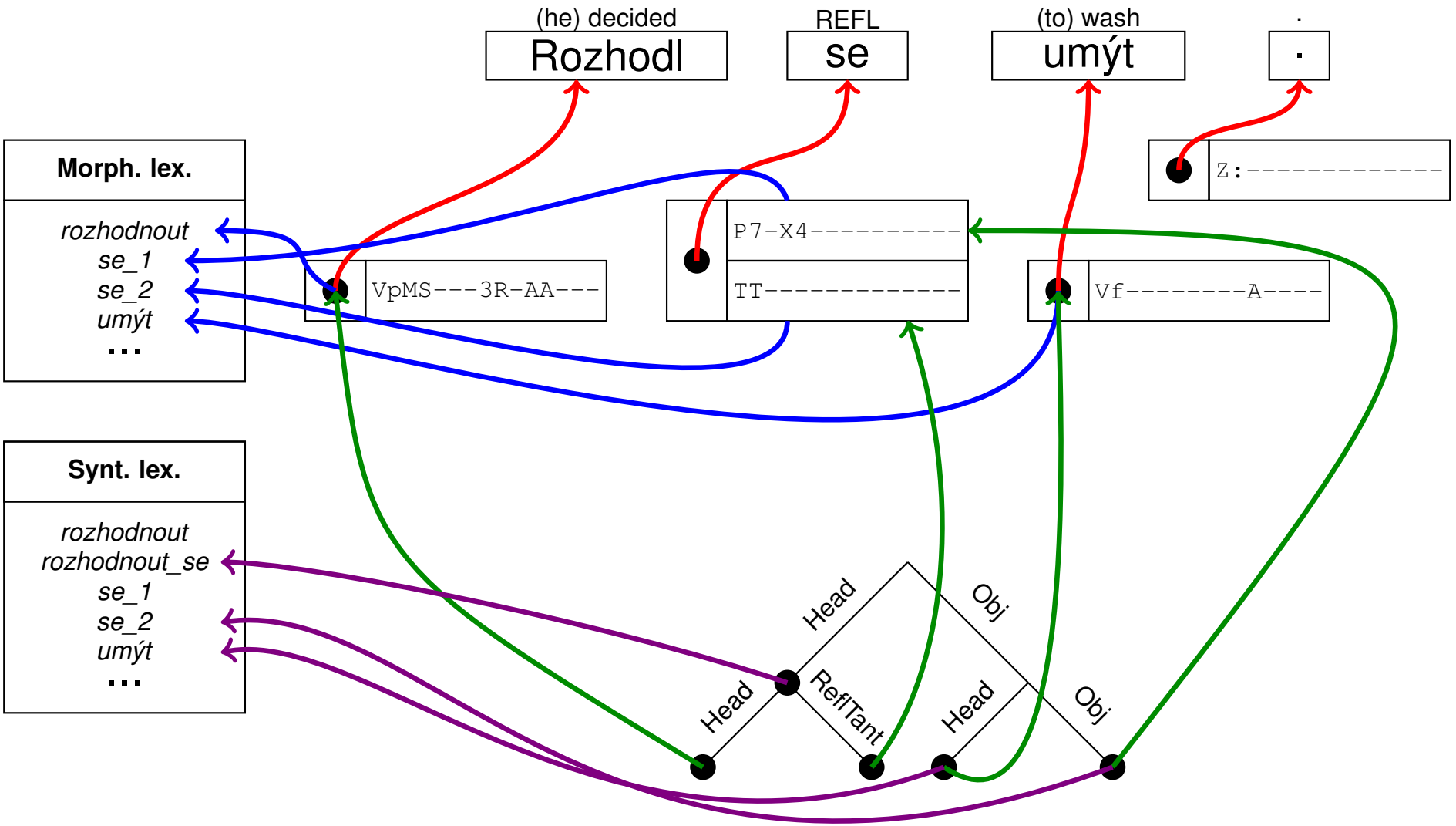
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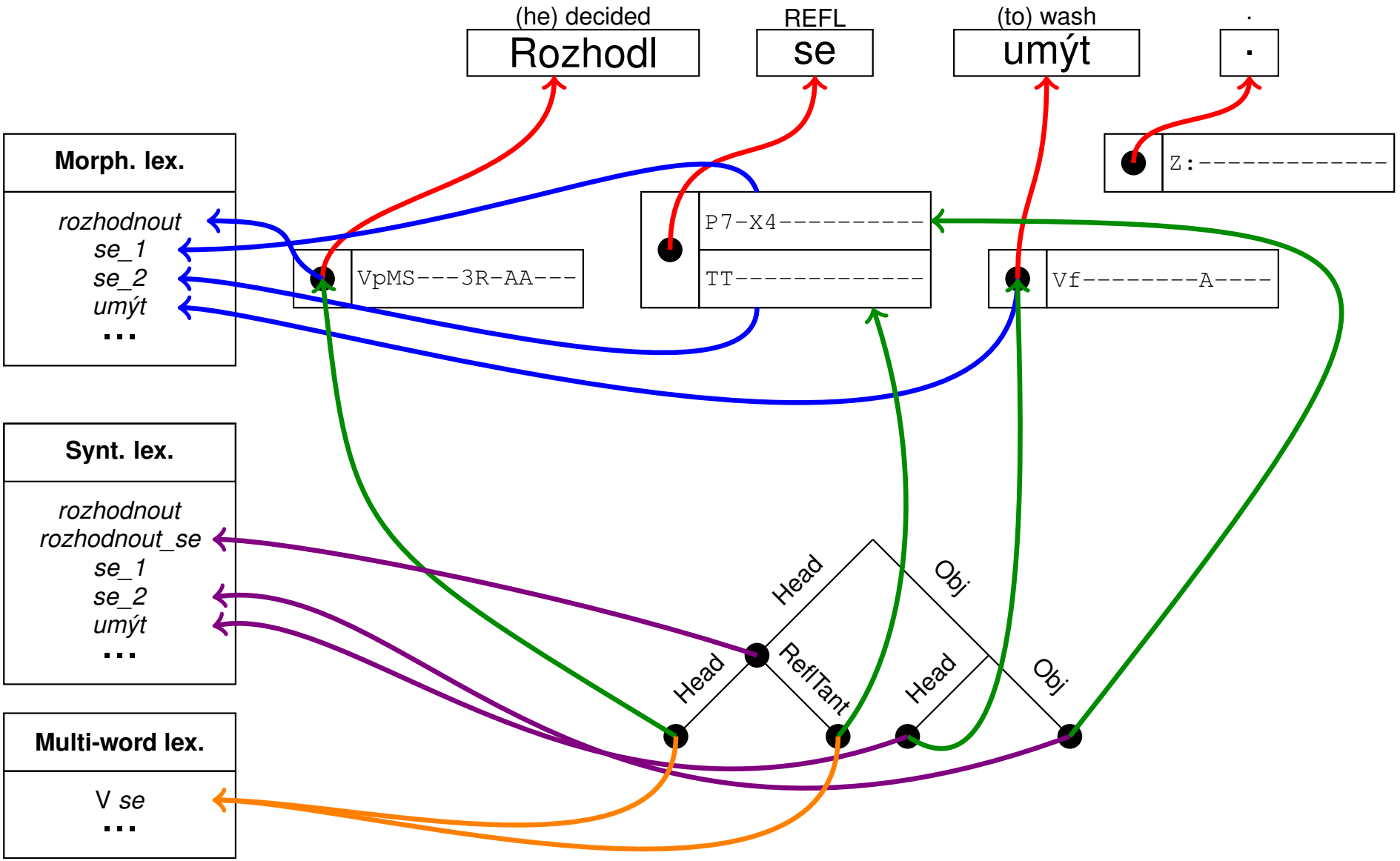
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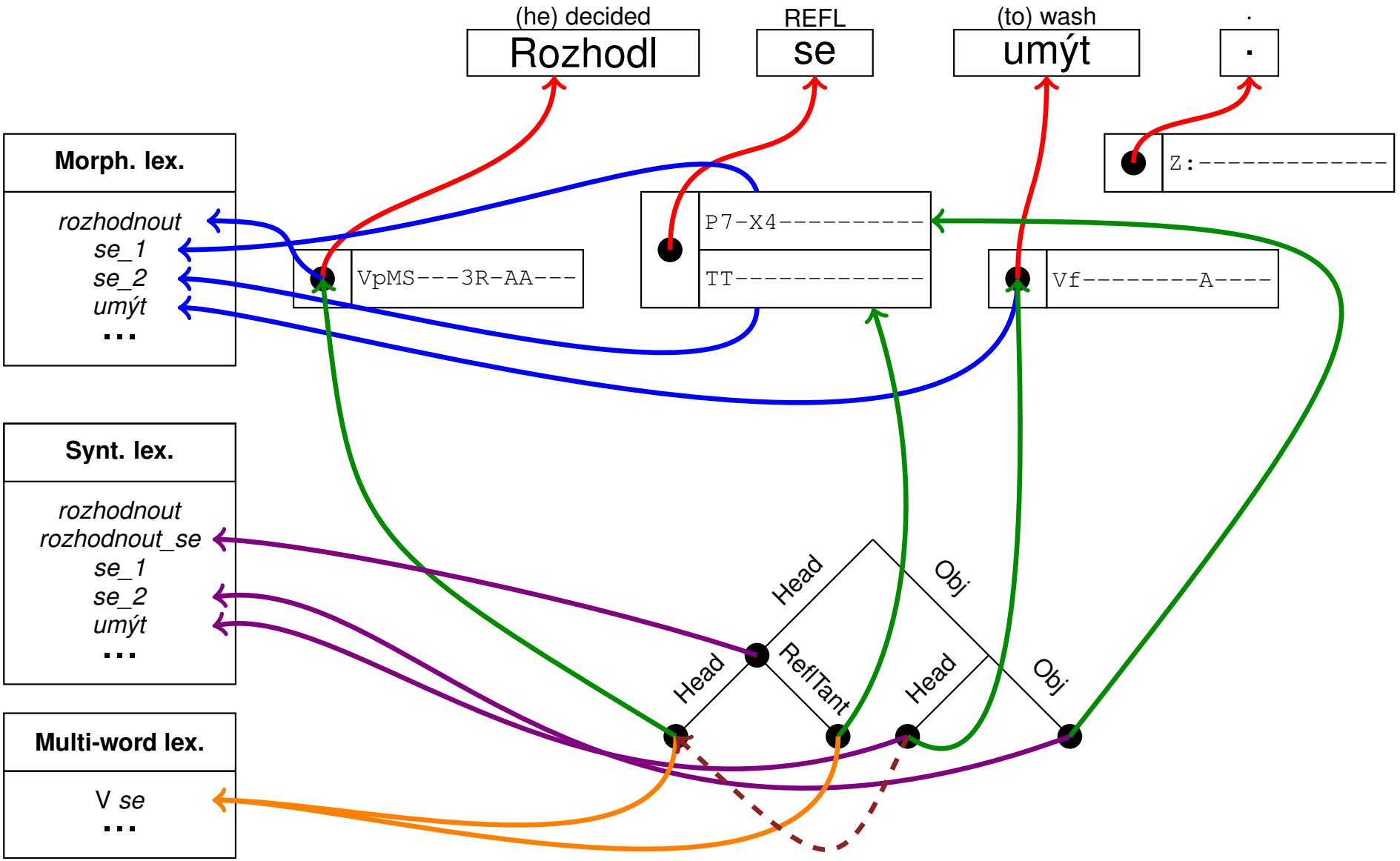
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Multi-word lex.
V se
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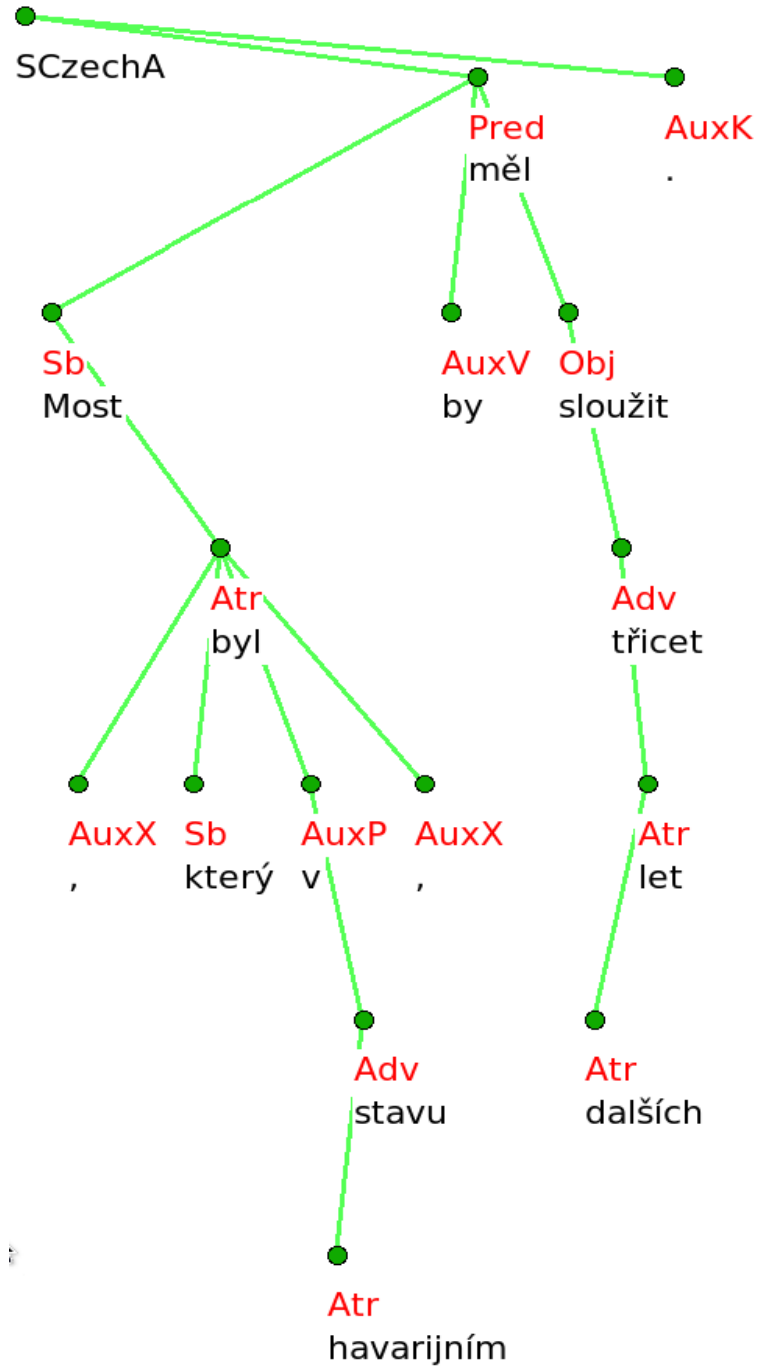
Outline of the talk

Processing of the input text:

- Word and sentence segmentation → sentence on the **graphemic level**
- Morphological analysis and disambiguation (rule-based disambiguation, stochastic tagger, collocation module) → sentence on the **morphological level**
- Stochastic parser applied to the disambiguated sentence
- Automatic correction of the parse
- Conversion of the corrected parse + modifications:
  - phenomena that require arbitrary decisions in a dependency tree: constructions with function words, coordinated constructions, lists
  - **disjunction** accounting for structural ambiguities expressed by "combined functions" **AttrAdv**, **ObjAdv**

Syntactic tree in the PDT and the new format

(7) Most, který byl v havarijním stavu, by měl sloužit
Bridge which was in emergency state should have$_{modal}$ serve
dalších třicet let.
next thirty years.
'The bridge, which was ramshackle, should serve for another thirty years.'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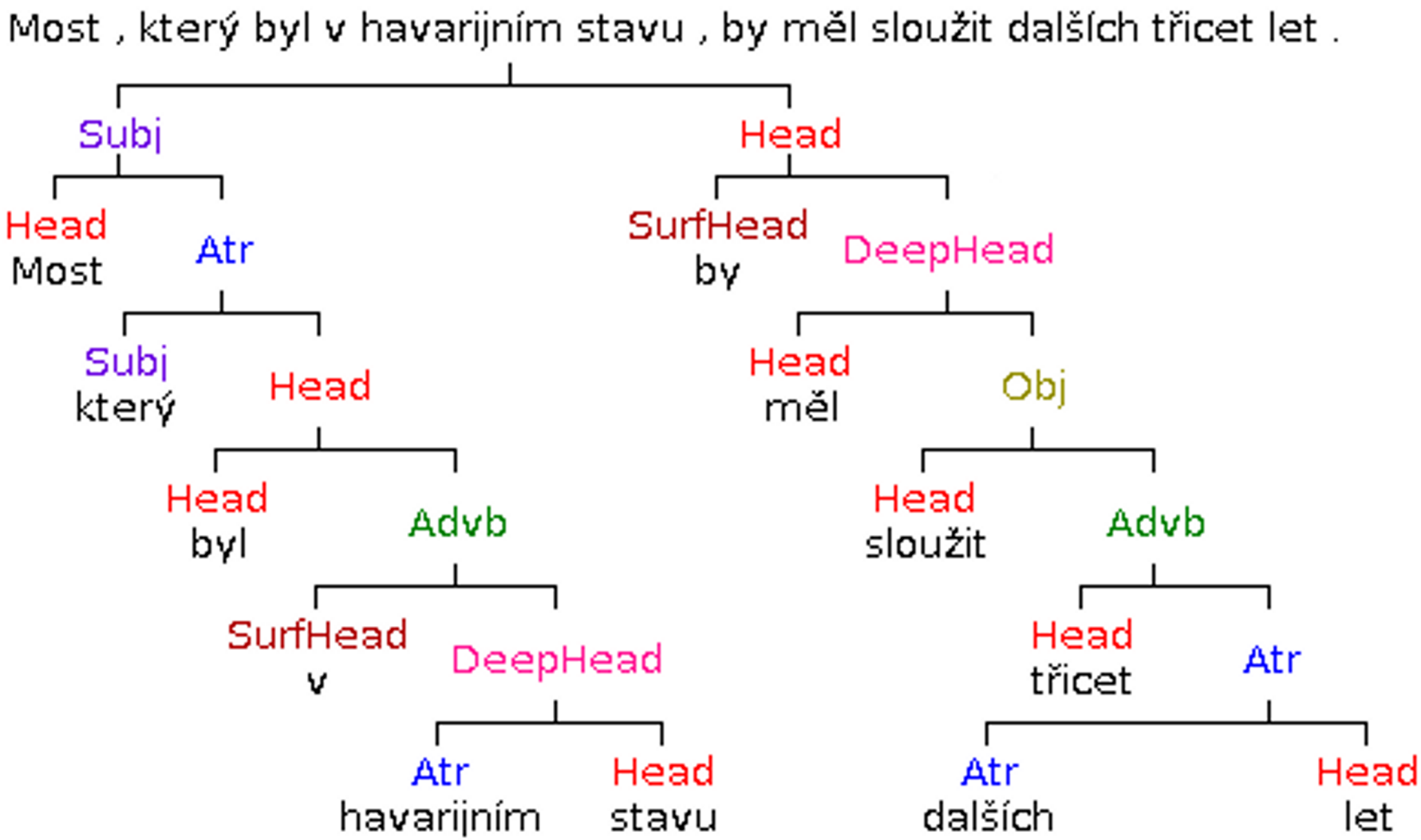
Most , který byl v havarijním stavu , by měl sloužit dalších třicet let .
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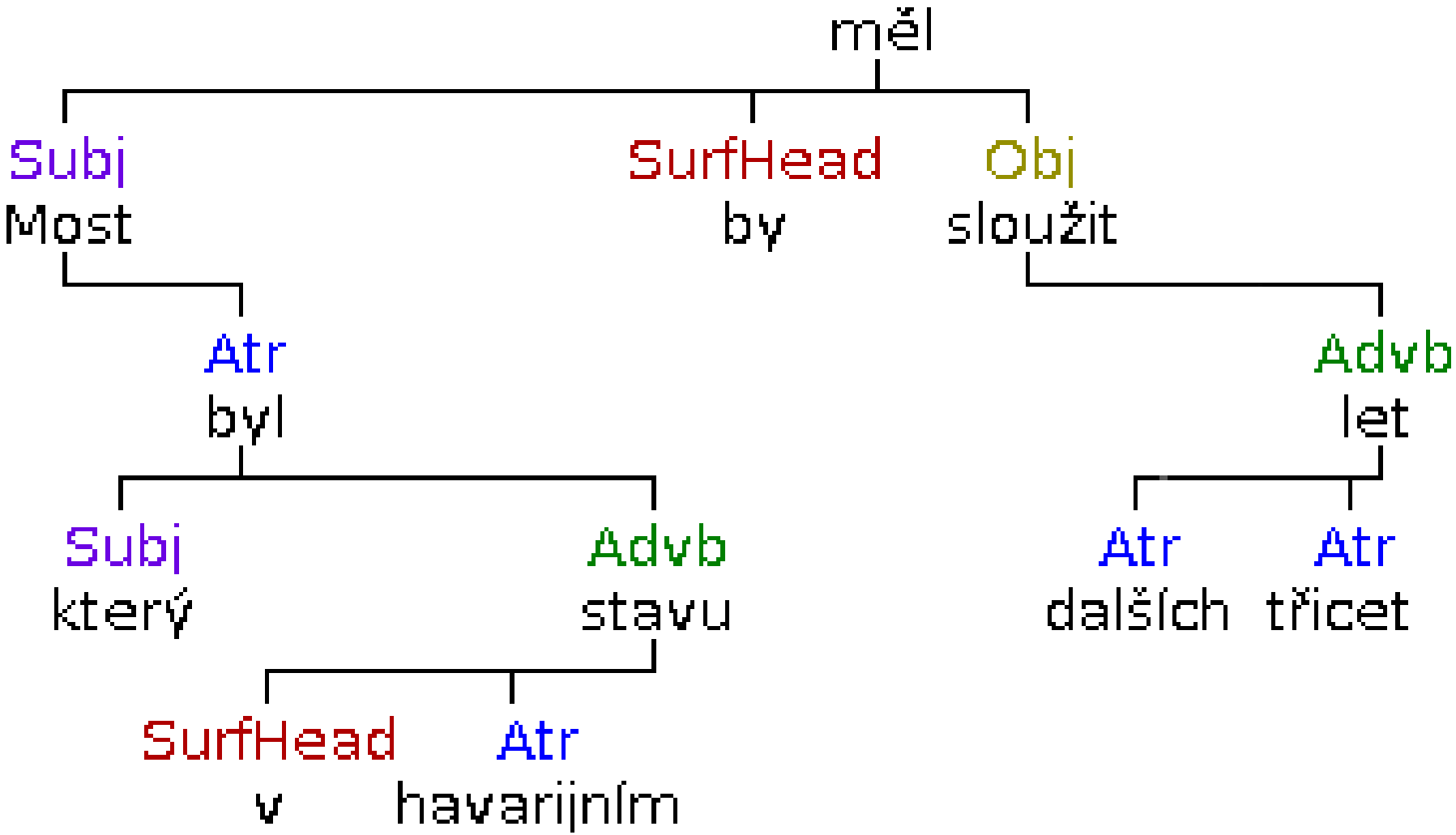
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dalších
Atr
třicet
SurfHead
v
Atr
havarijním

Correction module

- 30 correction rules so far
- for more frequent errors which can be reliably corrected
- such as noun in accusative as subject

Success rate of the correction modules

	rules	dependency	label	total
Clauses	6	1688	774	1744
NP	8	819	2066	2625
PP	9	834	7160	7722
Other	5	412	1390	1802
Total (ppm)		3753	11390	13893
Total (%)		0.38%	1.14%	1.39%

Outline of the talk

Conclusions and plans

Results

- 200M corpus parsed and corrected
- First version of a viewer with three modes of representation

Further work

- Manual tagging of a 2M training corpus for improvement of the tagger
- Manual parsing of sentences for improvement of the parser
- Detection of more errors made by the parser and their correction
- Creating a corpus with improved tools
- Enabling more modes of viewing the syntactic structure
- Grammar development

Acknowledgment

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Thank you for your attention!


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