Treex NLP Framework

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Outline

Applications

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multi-purpose
NLP framework
Treex

Architecture

Treebanks

Applications

lemmatization

tagging

parsing

deep parsing

machine translation
TectoMT

online interface
Treex::Web

named entity r.

coreference

alignment

SMT preproc.

multi-purpose NLP framework
Treex

Applications: analysis tools

lemmatization	base forms of words (linguistically adequate, finer than stemming)
tagging	part-of-speech tags, morphological analysis, disambiguation
parsing	dependency or constituency (phrase-based) trees
deep parsing	tectogrammatical trees, meaning of a sentence

English

Czech

German | Arabic | Spanish | French | Tamil

Russian | Hindi | Esperanto | Polish | Vietnamese

Urdu | Finish | Latin | Greek | etc.

Applications: TectoMT

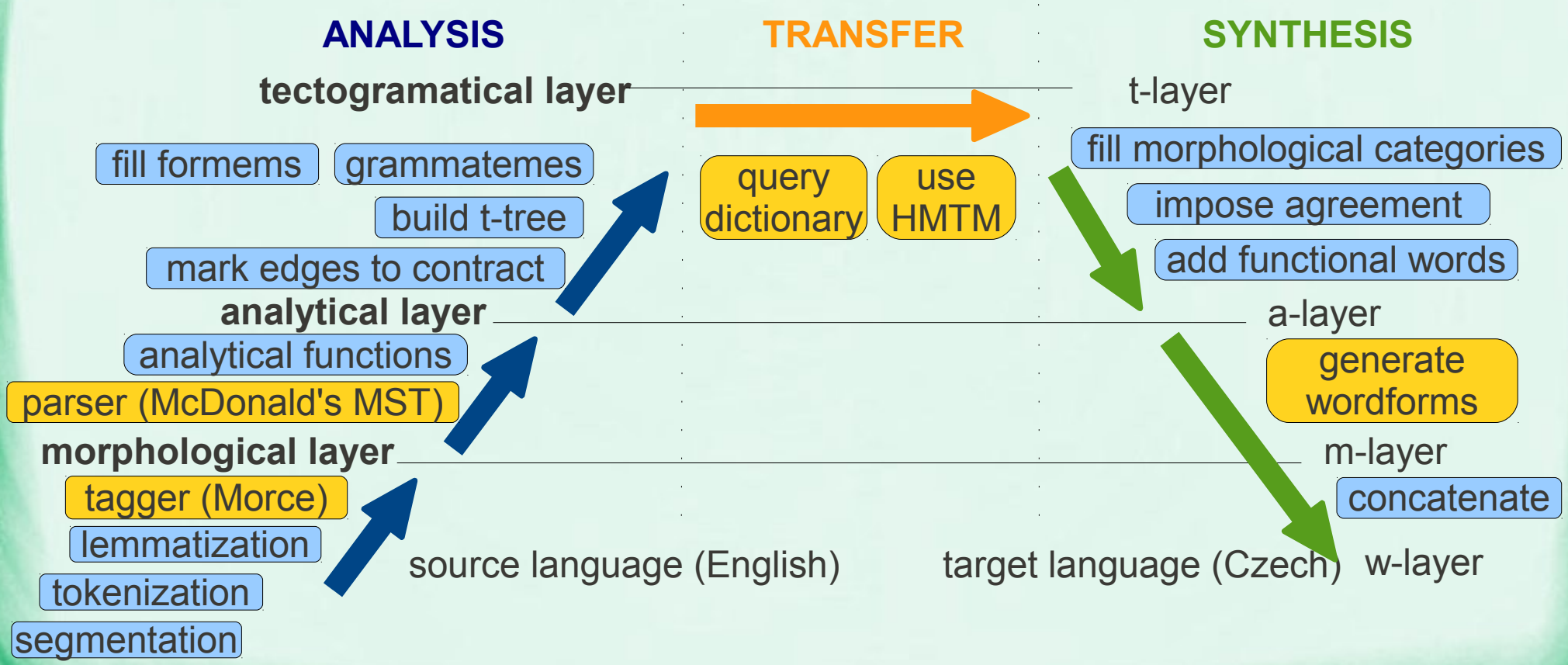
TectoMT

machine translation
TectoMT

- linguistically motivated machine translation
- developed since 2005 at ÚFAL by Zdeněk Žabokrtský et al.
- so far only English to Czech
- WMT 2012: evaluated as equally good as Moses system
- WMT 2013: in combination with Moses better than Google Translate
- speed: 0.8 seconds per sentence (after loading models)
- parallelization support (SGE with 100 cores, 68 M sentences, 10 days)

Applications: TectoMT

- deep-syntactic (tectogrammatical) transfer
- translation process divided to more than 140 “blocks“
- combining statistical and rule based blocks



Applications: TectoMT

TectoMT

MORPHOLOGY:
ResegmentSentences
Tokenize
NormalizeForms
FixTokenization
TagMorce
FixTags
Lemmatize

NAMED ENTITIES:
StanfordNamedEntities
DistinguishPersonalNames

A-LAYER:
MarkChunks
ParseMST
SetIsMemberFromDeprel
RehangConllToPdtStyle
FixNominalGroups
FixIsMember
FixAtree
FixMultiwordPrepAndConj
FixDicendiVerbs
SetAfunAuxCPCoord
SetAfun

T-LAYER:
MarkEdgesToCollapse
MarkEdgesToCollapseNeg
BuildTtree
SetIsMember
MoveAuxFromCoordToMembers
FixTlemmas
SetCoapFunctors
FixEitherOr
FixIsMember
MarkClauseHeads
MarkPassive
SetFunctors
MarkInfin
MarkRelClauseHeads
MarkRelClauseCoref
MarkDspRoot
MarkParentheses
SetNodetype
SetGrammatemes
SetFormeme
RehangSharedAttr
SetVoice
FixImperatives
SetIsNameOfPerson
SetGenderOfPerson
AddCorAct
FindTextCoref

TRANSFER:
CopyTtree
TrLFPhrases
TrLFJointStatic
DeleteSuperfluousTnodes
TrFTryRules
TrFAddVariants
TrFRerank
TrLTryRules
TrLAddVariants
TrLFNumeralsByRules
TrLFilterAspect
TransformPassiveConstructions
PrunePersonalNameVariants
RemoveUnpassivizableVariants
TrLFCompounds
CutVariants
RehangToEffParents
TrLFTreeViterbi
RehangToOrigParents
CutVariants
FixTransferChoices
ReplaceVerbWithAdj
DeletePossPronBeforeVlastni
TrLFemaleSurnames
AddNounGender
MarkNewRelClauses
AddRelpronBelowRc
ChangeCorToPersPron
AddPersPronBelowVfin
AddVerbAspect
FixDateTime
FixGrammatemesAfterTransfer
FixNegation
MoveAdjsBeforeNouns
MoveGenitivesRight
MoveRelClauseRight
MoveDicendiCloserToDsp
MovePersPronNextToVerb
MoveEnoughBeforeAdj
MoveJesteBeforeVerb
FixMoney
OverridePpWithPhraseTr
FindGramCorefForReflPron
NeutPersPronGenderFromAntec
ValencyRelatedRules
SetClauseNumber
TurnTextCorefToGramCoref

SYNTHESIS TO A-LAYER:
CopyTtree
DistinguishHomonymous.
ReverseNumberNounDep.
InitMorphcat
FixPossessiveAdjs
MarkSubject
ImposePronZAgr
ImposeRelPronAgr
ImposeSubjpredAgr
ImposeAttrAgr
ImposeComplAgr
DropSubjPersProns
AddPrepos
AddSubconjs
AddReflexParticles
AddAuxVerbCompoundPassive
AddAuxVerbModal
AddAuxVerbCompoundFuture
AddAuxVerbConditional
AddAuxVerbCompoundPast
AddClausalExpletivePronouns
ResolveVerbs
ProjectClauseNumber
AddParentheses
AddSentFinalPunct
AddSubordClausePunct
AddCoordPunct
AddAppositionPunct
ChooseMlemmaForPersPron
GenerateWordforms
MoveCliticsToWackernagel
DeleteSuperfluousPrepos
DeleteEmptyNouns
VocalizePrepos
CapitalizeSentStart
CapitalizeNamedEntities.
FillTagFromMorphcat

SYNTHESIS TO TEXT:
ConcatenateTokens
ApplySubstitutions
DetokenizeUsingRules
RemoveRepeatedTokens
NormalizePunctuationForWMT

Applications: Treex::Web

online interface

quest.ms.mff.cuni.cz/treex-web/result/180u77gRxPyo6x0oKYx

Treex::Web | Home | Run Treex | Results | Scenarios | Logout

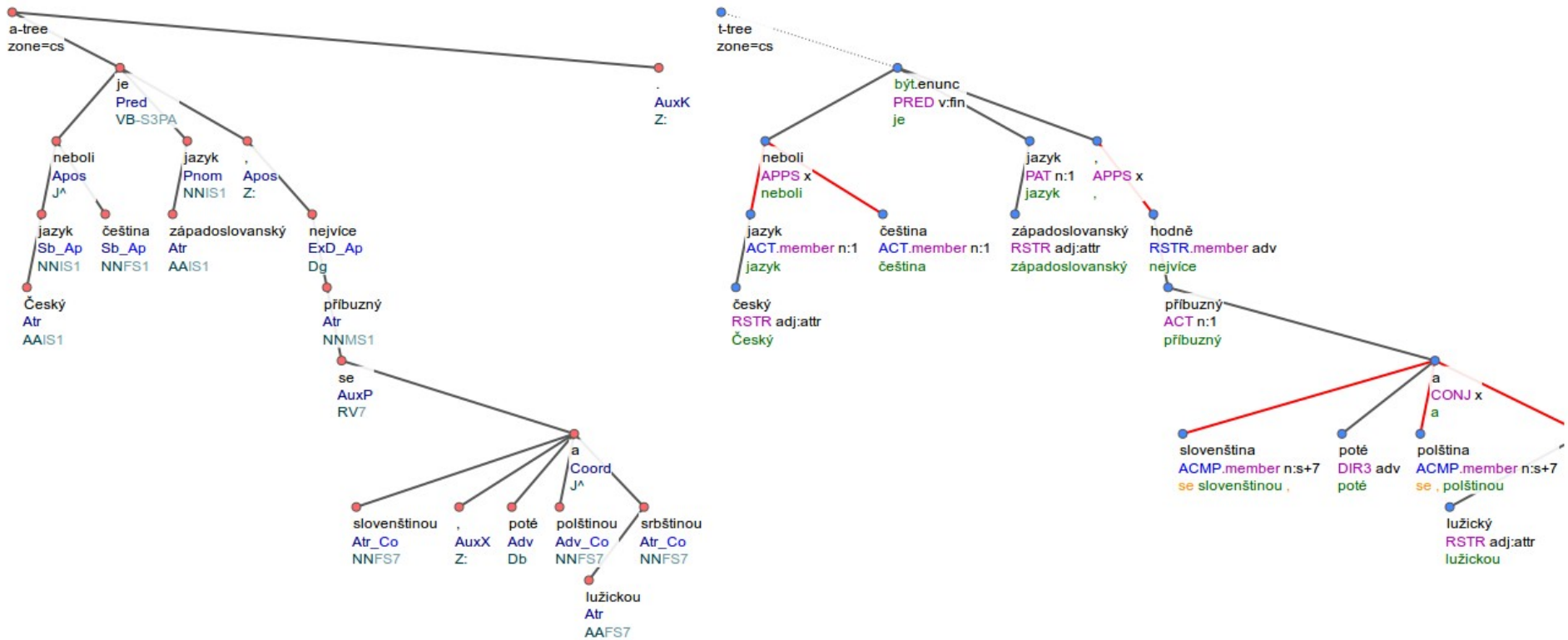
Treex Result

« Go back to all results

Download result | Download all | Run again

Previous | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Next

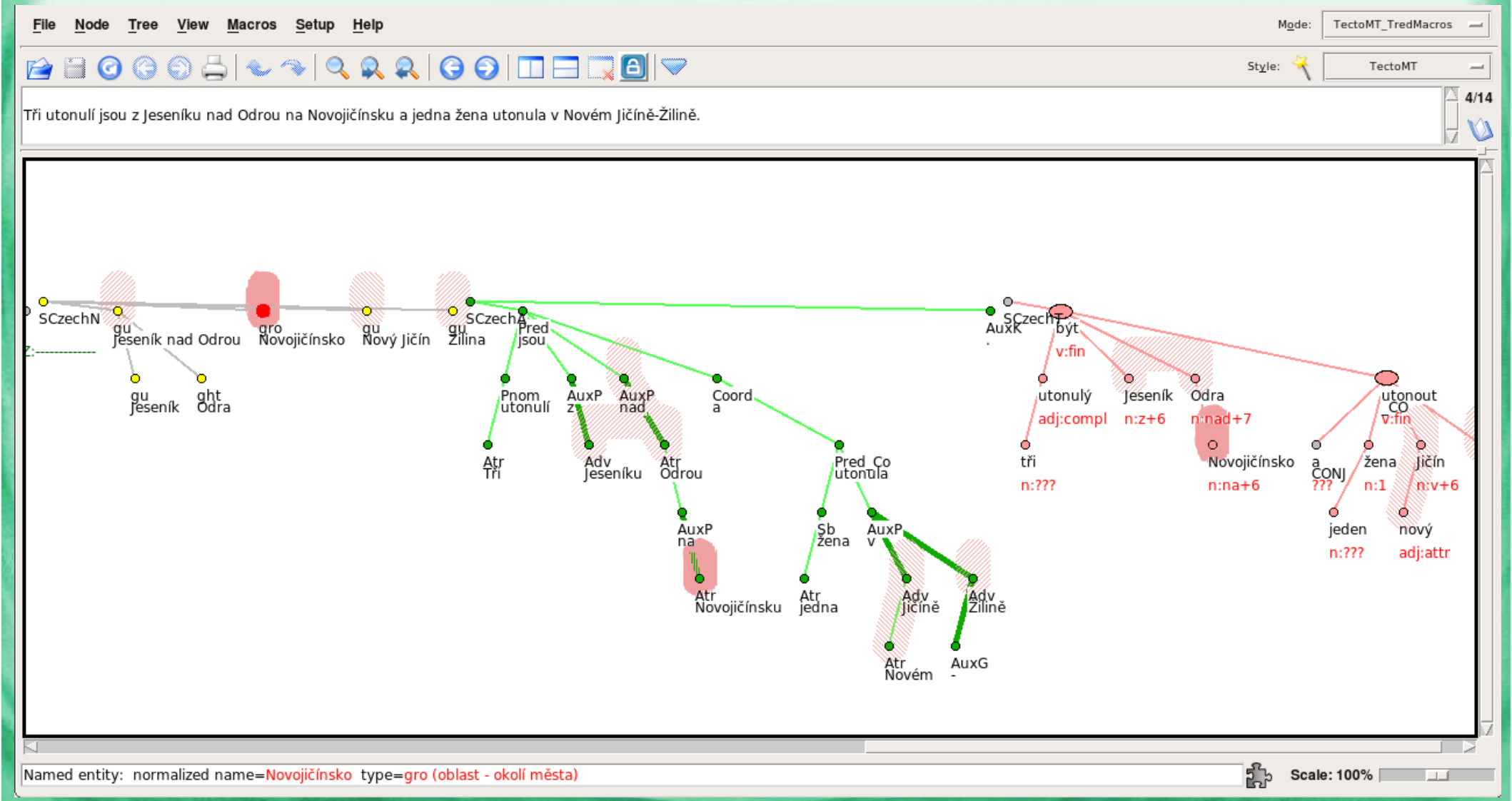
[cs] Český jazyk neboli čeština je západoslovanský jazyk, nejvíce příbuzný se slovenštinou, poté polštinou a lužickou srbštinou.



Applications: NER

named entity recognition

- Support for nested named entities (“Jeseník nad Odrou”: city vs. river)
- Hierarchical classes (g=geographical entity, gr=region, gu=city, gs=street,...)



Background

PDT layers of annotation

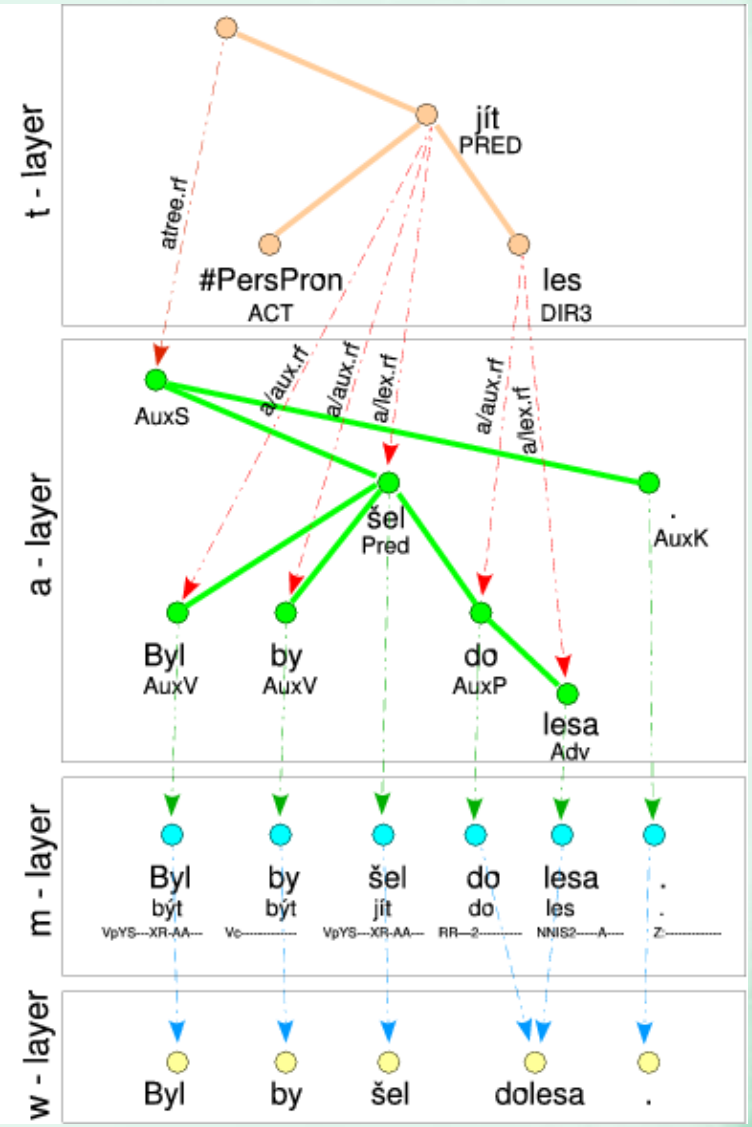
multi-purpose NLP framework *Treex*

Prague Markup Language

PDT layers of language description

implemented in Prague Dependency Treebank

- **tectogrammatical layer**
  deep-syntactic dependency trees
- **analytical layer**
  surface-syntactic dependency trees, labeled edges
- **morphological layer**
  lemma & POS tag for each word
- word layer
  raw (tokenized) text



PDT layers of language description

implemented in Prague Dependency Treebank

- **tectogrammatical layer**
  deep-syntactic dependency trees

- abstraction from many language-specific phenomena

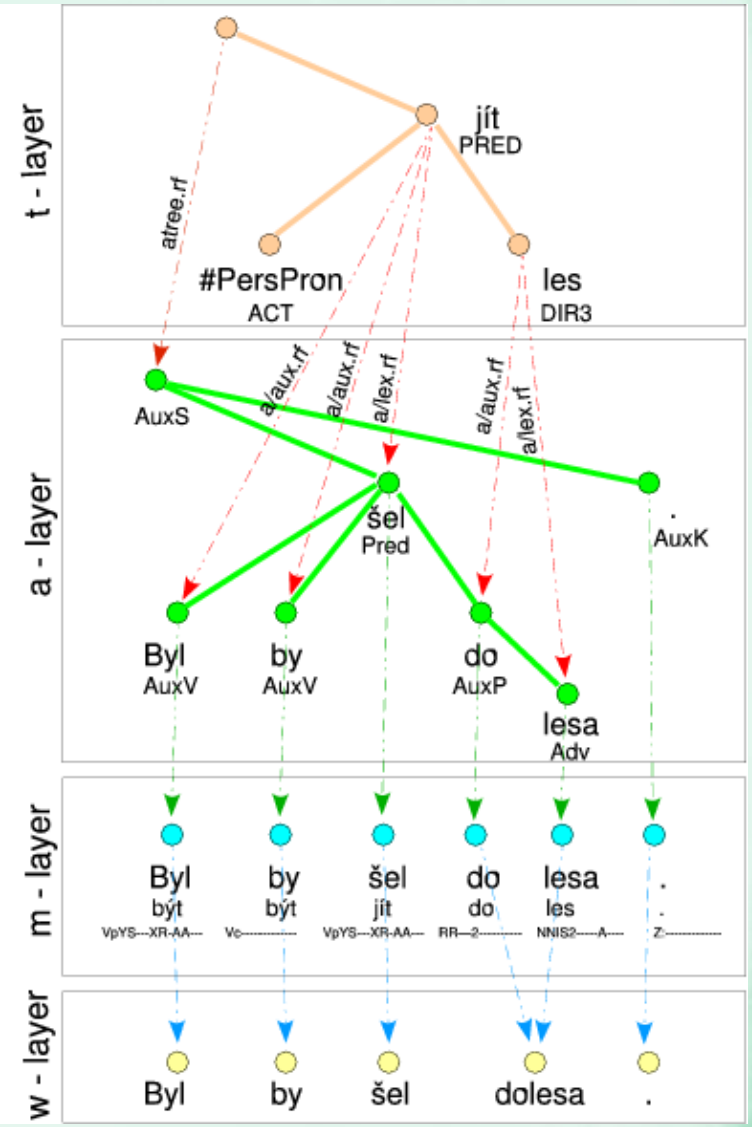
- autosemantic (meaningful) words
  ~ **nodes**

- functional words (prepositions, auxiliaries)
  ~ **attributes**

- syntactic-semantic relations (dependecies)
  ~ **edges**

- added nodes (e.g. because of pro-drop)

- ...



layers of language description
implemented in Treex

- Mostly backward compatible adaptations (adding attributes)
  - **formeme** (n:2, n:k+3, v:že+vfin, v:rc, adj:attr)
  - attributes for clauses, is_passive (→ diathesis),...

- All layers stored in **one file**
- A-layer and m-layer merged into one
- Two more layers:
  - P-layer phrase-structure trees
  - N-layer named entities

Prague Markup Language

- developed since 2005, used for PDT 2.0 (2006)
- many similarities with NIF: universal NLP,...
- XML-based (no RDF), PML Schema (→ Relax NG)
- special support for trees and roles
- one schema for each layer of PDT, one for Treex
- used in TrEd (tree editor) and PML-TQ (tree query)
- much less popular than simple CoNLL format
- too universal, too complex, only Perl implementation
- not enough advertising?
- standard: format vs. API?

Treebanks

multi-purpose
NLP framework
Treex

Czech-English
deep treebank
CzEng

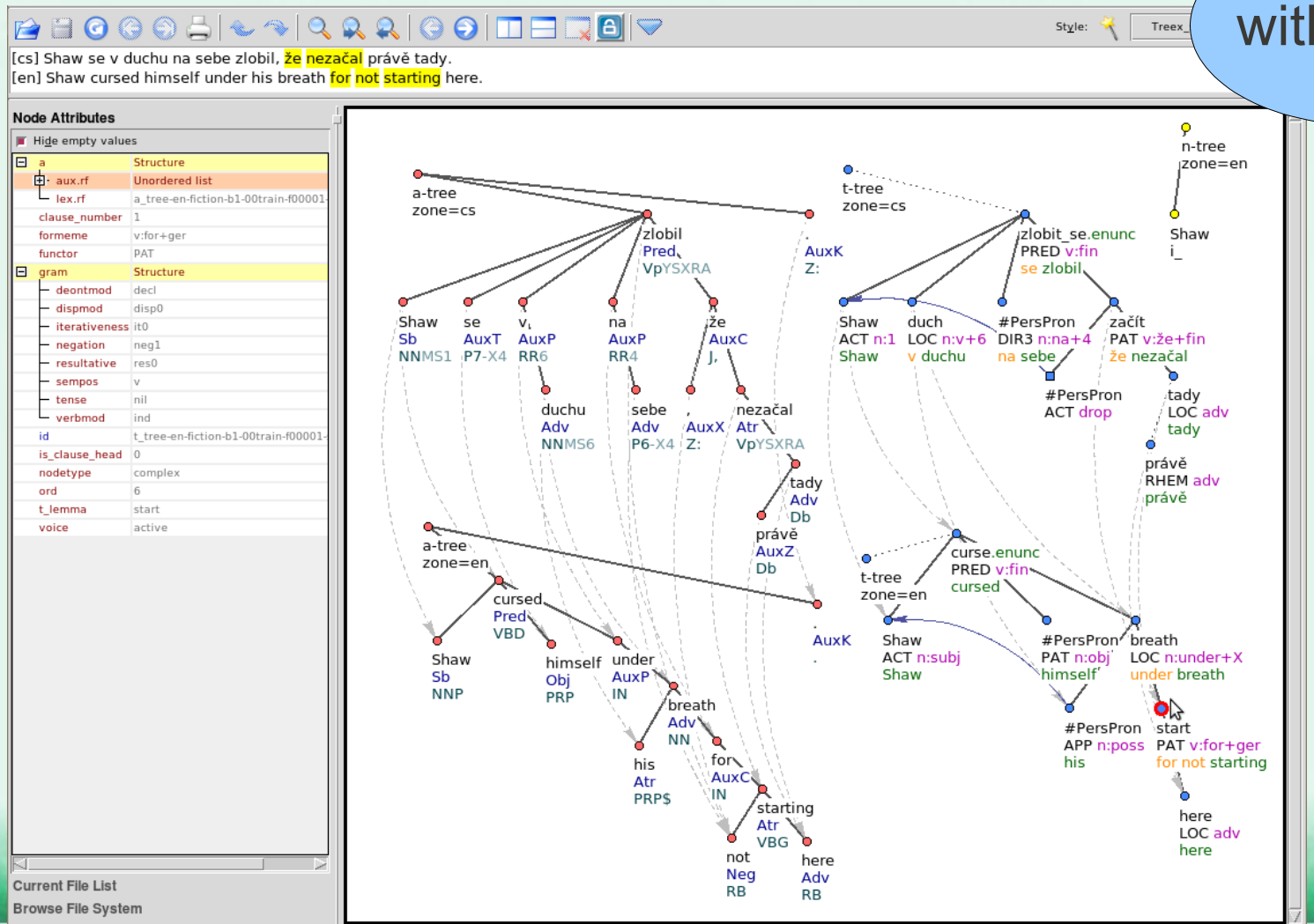
Czech-English
deep treebank
PCEDT

treebanks for
30 languages
HamleDT

CzEng
(Czech-English treebank)

- automatically parsed deep parallel treebank
- 15 M sentences; 200 M tokens

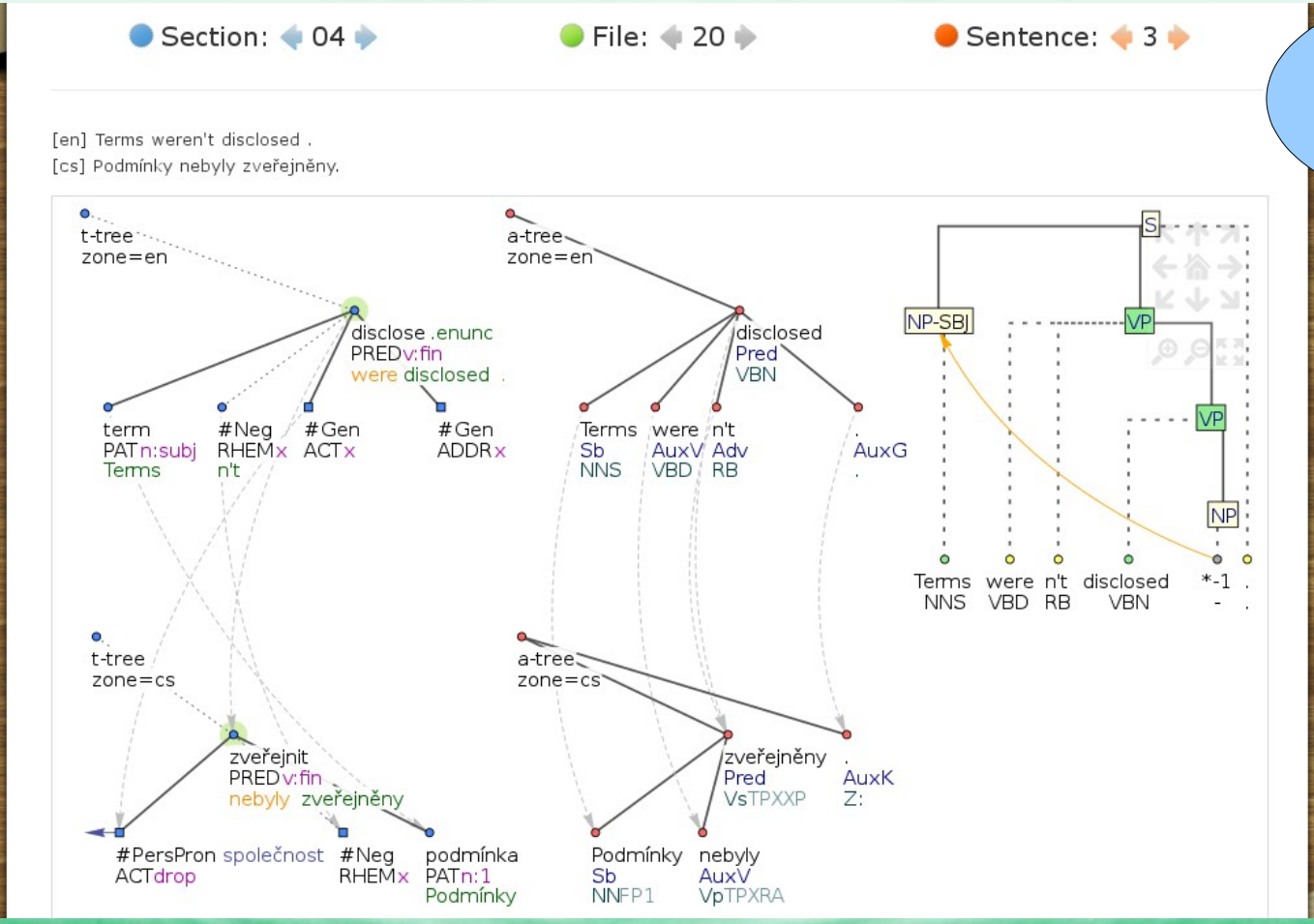
with Treex



PCEDT
(Prague Czech-English Dependency Treebank)

- manually parsed deep parallel treebank
- 50 k sentences; 1.2 M tokens

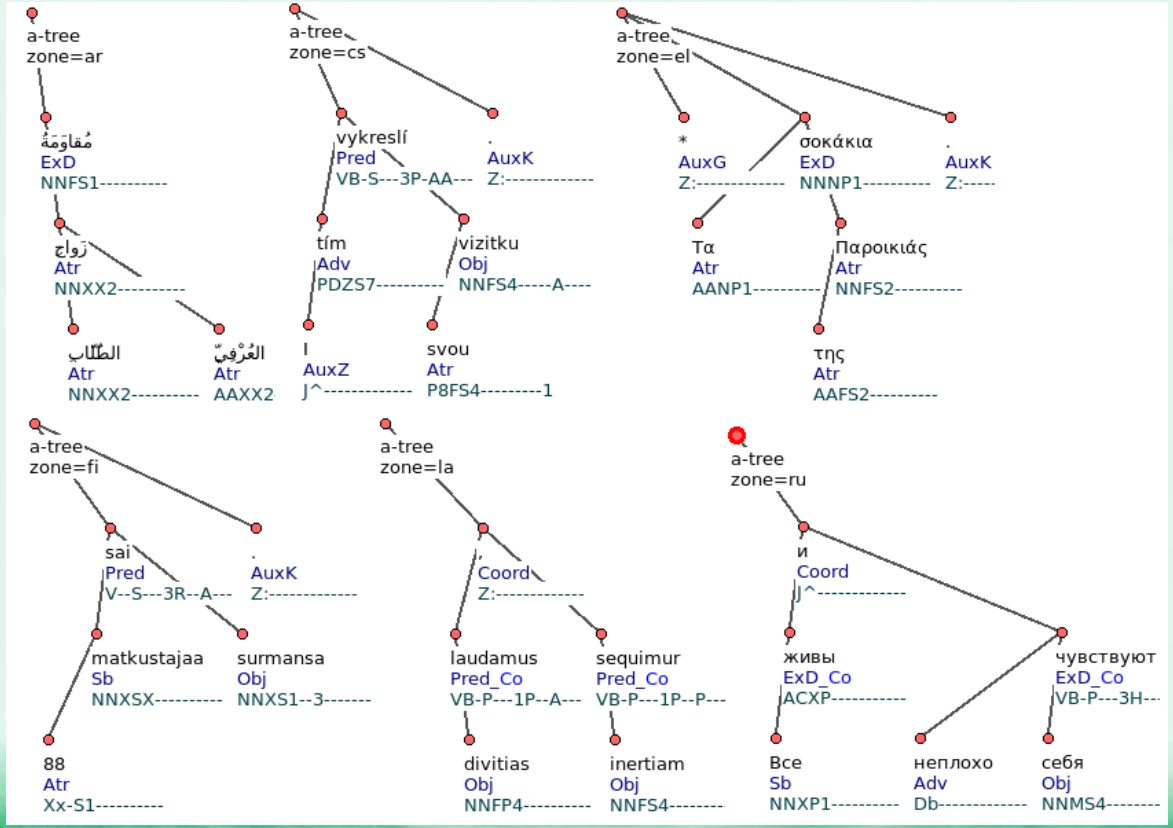
pre-annotated with Treex



HamleDT

- 30 manually annotated dependency treebanks
- 30 languages; 400 k sentences; 6 M tokens
- harmonized into a common style (guidelines)

using Treex



Treex architecture

multi-purpose
NLP framework
Treex

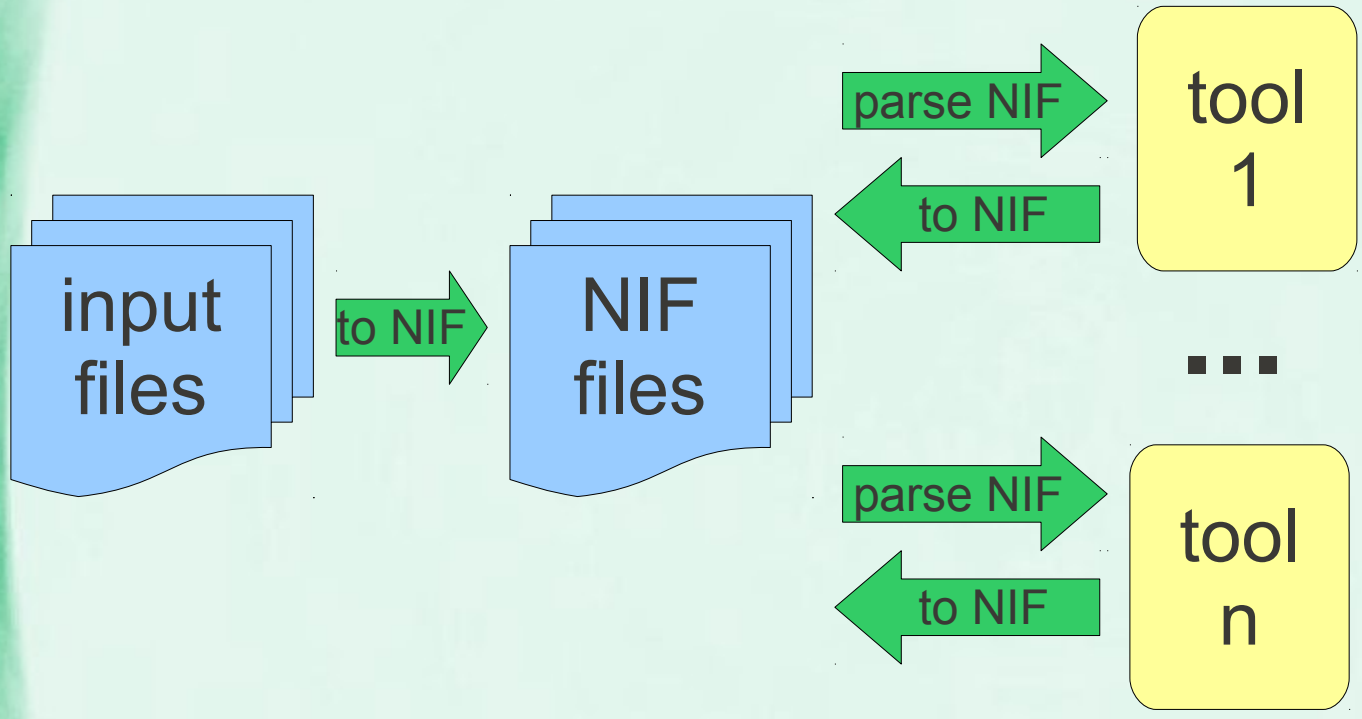
- motivation
- architecture
- internals
- examples

Motivation

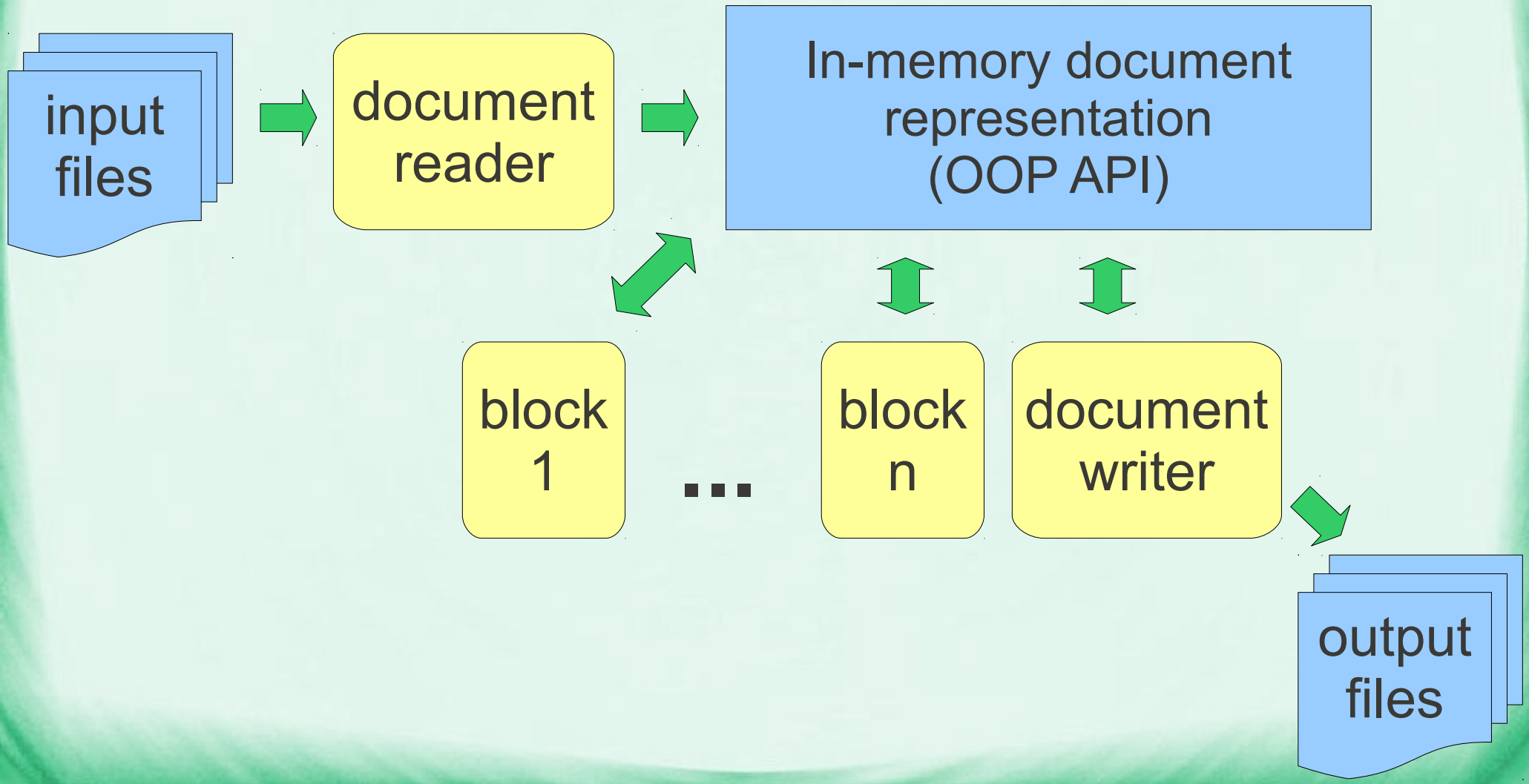
Goals of Treex

- elegant integration of in-house and third-party NLP tools
- modularity, reusability, cooperation, efficient development
- ability to easily modify and add code in a full-fledged programming language (Perl)
- unified object-oriented interface for accessing data structures

My idea about NIF pipeline



Treex architecture



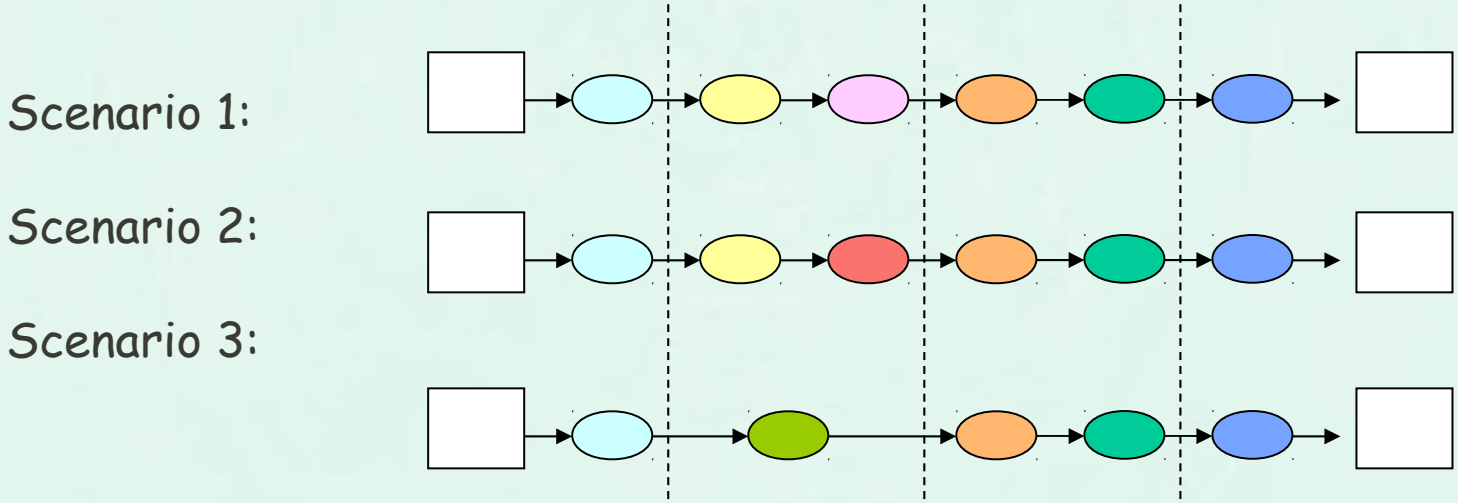
Treex architecture processing units

- **block** – elementary processing unit in Treex
  - corresponding to a given NLP subtask
  - one Perl class, saved in one file
- **scenario** – a sequence of blocks
  - saved in plain text files
  - just a list of the blocks' names and their parameters
- **application** – represents an end-to-end NLP task
  - described by a scenario that
    - starts with a **reader** (input conversion)
    - ends with a **writer** (output conversion)
  - Readers can split the input file into more in-memory docs.
  - There are readers&writers for a number of popular formats: plain text, CoNLL, PDT PML, Penn MRG, Tiger...

`*.treex.gz`

Treex architecture processing units

Blocks can be easily substituted with an alternative solution.



Treex architecture processing units

Blocks can be easily substituted with an alternative solution.

Scenario A

```
W2A::EN::Segment
W2A::EN::Tokenize
W2A::EN::TagMorce
W2A::EN::Lemmatize
W2A::EN::ParseMST
```

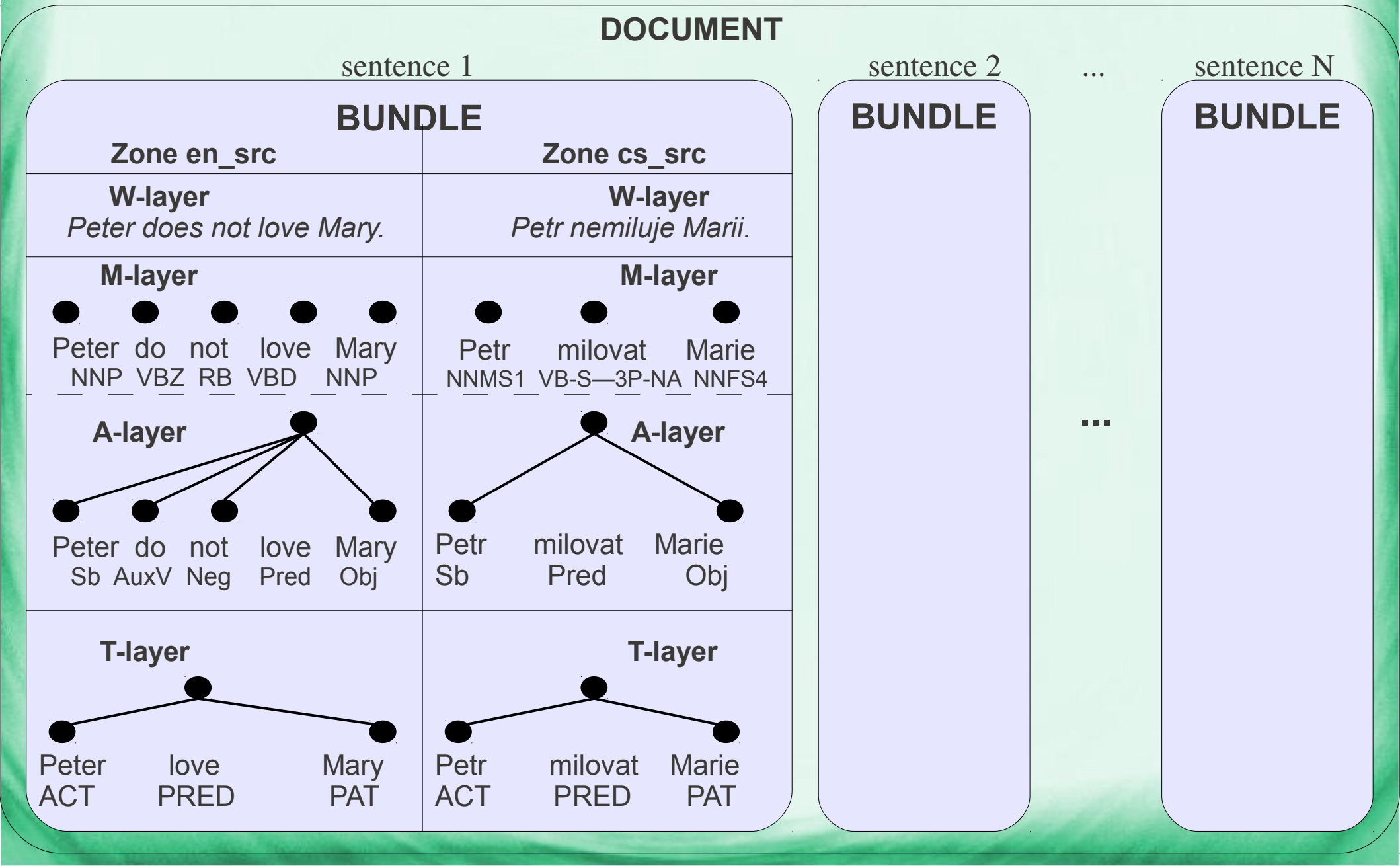
Scenario B

```
W2A::SegmentOnNewlines
W2A::EN::TagLinguaEn
W2A::EN::Lemmatize
W2A::EN::ParseMalt
```

Treex architecture
data units

- **Document**
  - stored in one file
  - sequence of sentences
- **Bundle** (“bundle of trees”)
  - corresponds to one sentence
- **Zone**
  - one for each language (Arabic, Czech, English,...)
  - and optionally a variant (“selectors” src, trg, ref,...)
- **Tree**
  - layer of language description: A, T (plus P, N)
  - m-layer is stored with the a-layer in one tree

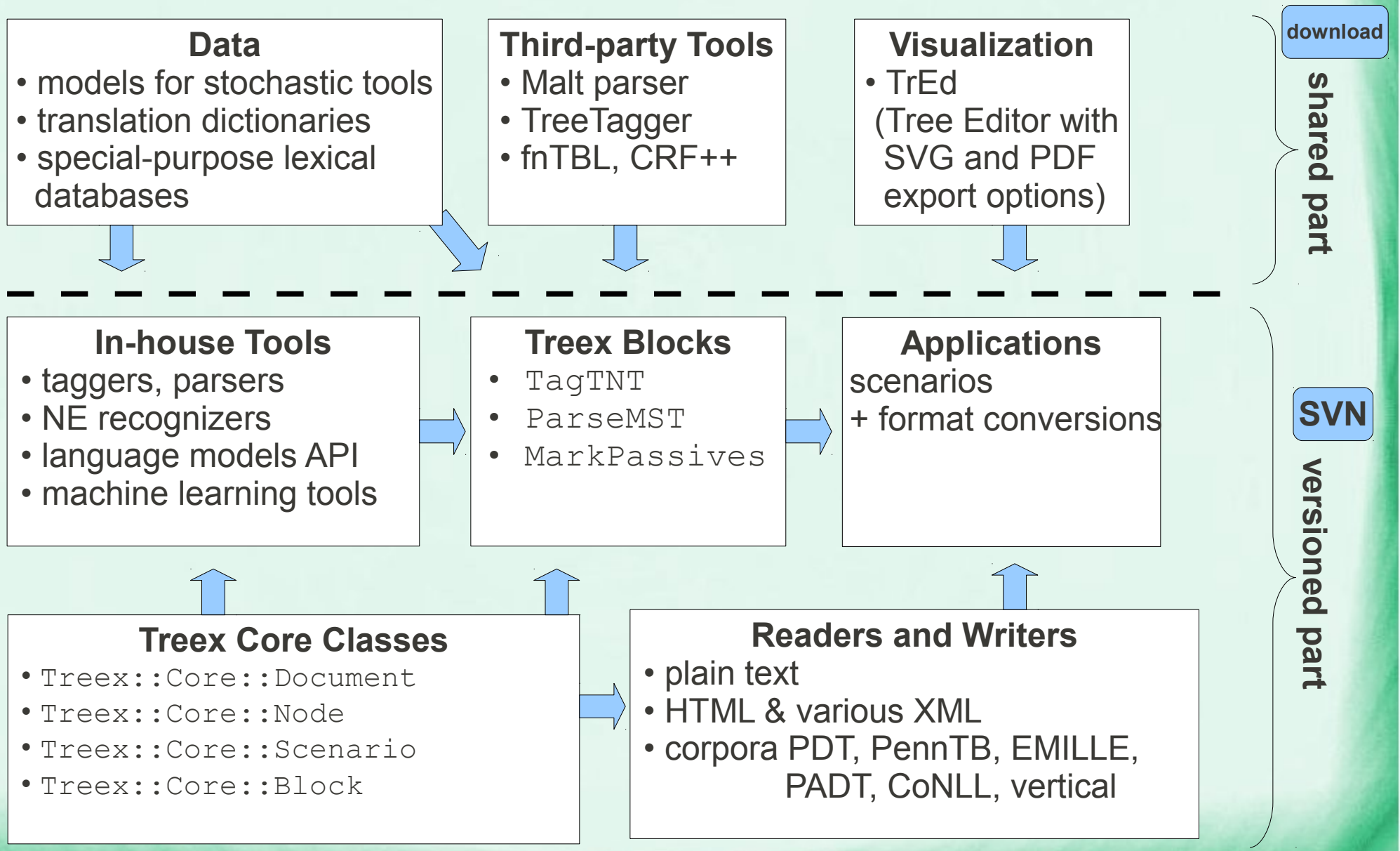
Treex architecture
data units



Internals – Design decisions

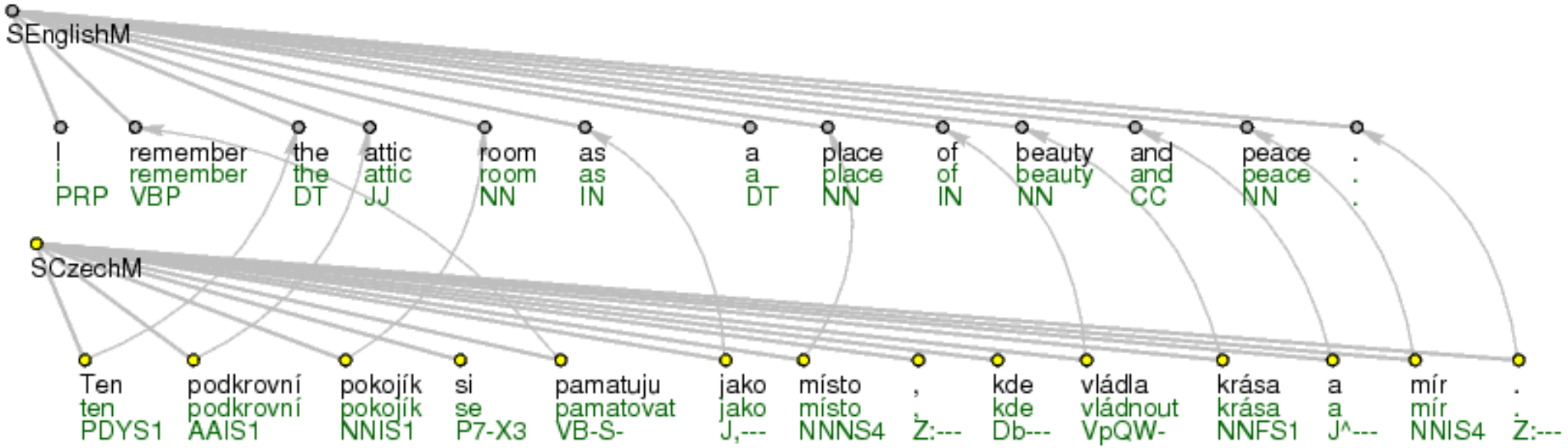
- Perl (wrappers for binaries, Java,...)
- Linux (some applications platform-independent)
- OOP (Moose)
- Open source (GNU GPL for the versioned part)
- Neutral w.r.t. methodology (statistical, rule-based)
- Multilingual
- Open standards (Unicode, XML)

Internals – Components



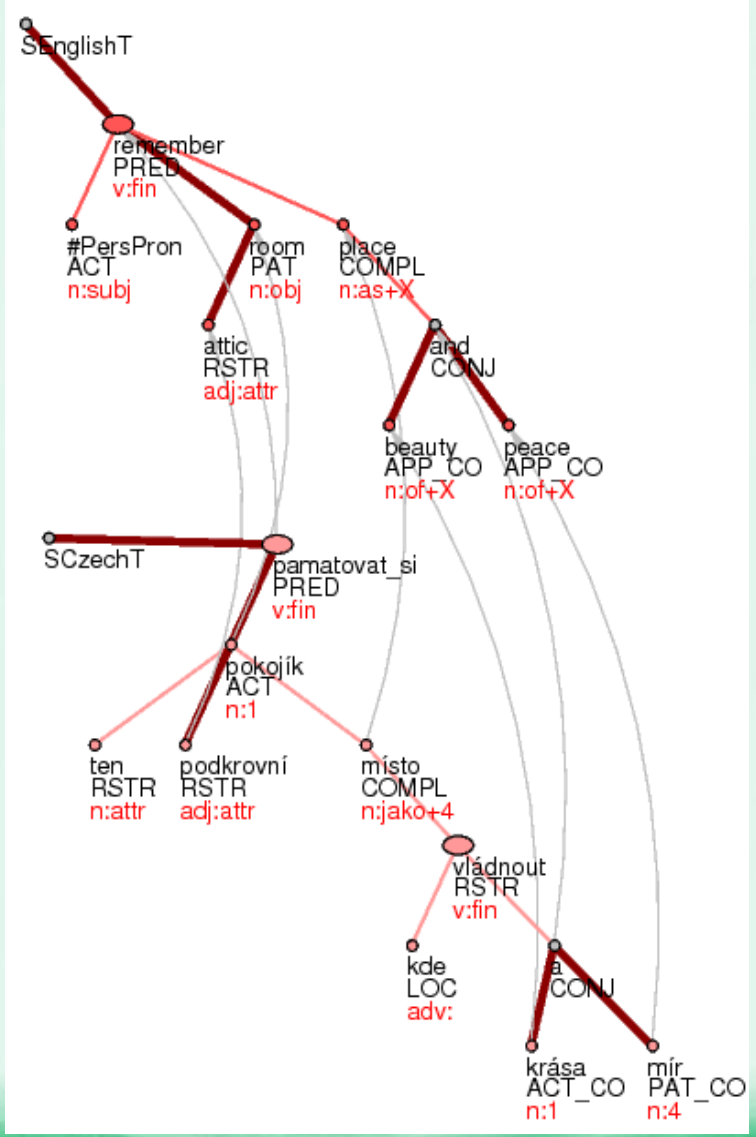
TrEd visualization

word alignment on the morphological layer



TrEd visualization

word alignment on the tectogrammatical layer



Block example – SVO to SOV code

```
package Tutorial::Svo2SovSolution;
use Moose;
use Treex::Core::Common;
extends 'Treex::Core::Block';

sub process_anode {
  my ( $self, $a_node ) = @_;
  if ( $a_node->tag =~ /^V/ ) {        # verb found
    foreach my $child ( $a_node->get_echildren() ) {
      if ( $child->afun eq 'Obj' ) {    # object found
        # Move the object and its subtree so it precedes the verb
        $child->shift_before_node($a_node);
      }
    }
  }
  return;
}
1;
```

Treex core
Treex convention
Perl keyword/convention

John loves Mary more than cherry.
SUBJ VERB OBJECT

John Mary loves more than cherry.
SUBJ OBJECT VERB

SVO → SOV

Thank you

Cooperation is welcomed.

http://ufal.mff.cuni.cz/treex

References

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PML-TQ