A Tookit for Visualizing the Coherence of Tree-based Reordering with Word Alignments

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Big Picture: Motivation

- Improving SMT:
  - Better models
  - Better learning methods and decoding

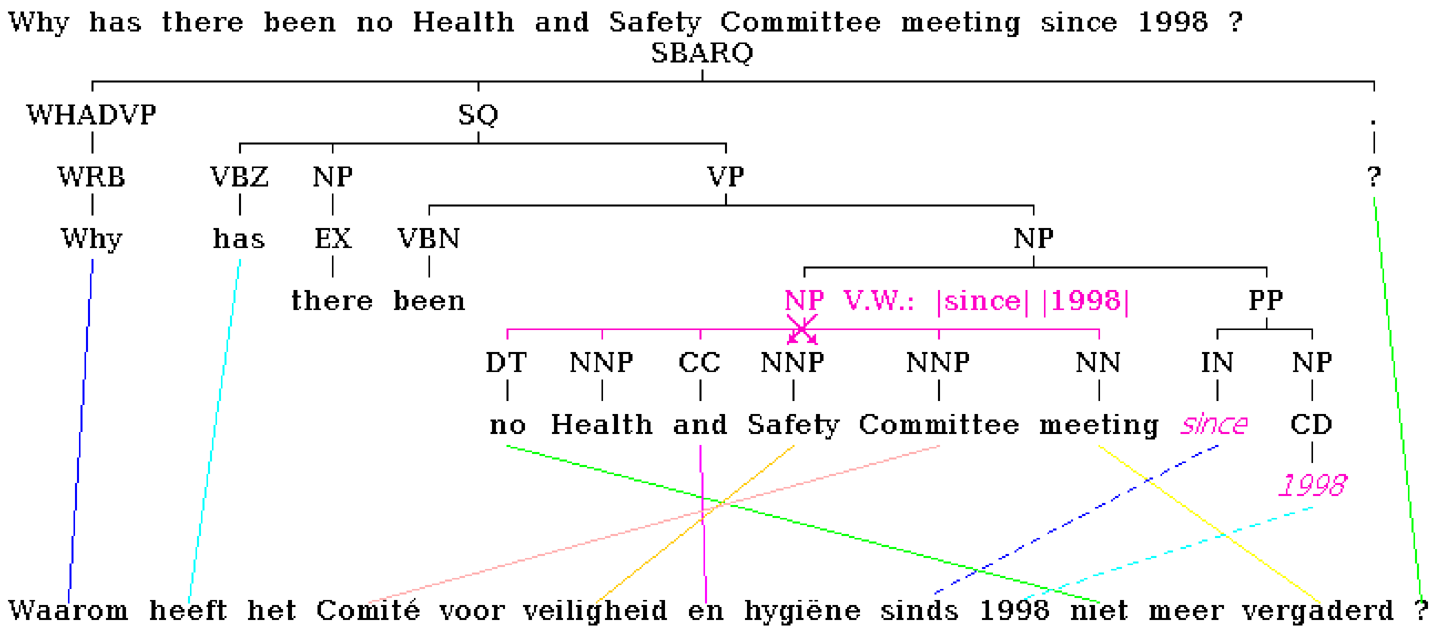
- Better models:
  - More sensible alignments
  - Explicit language-specific reordering models
  - Adding all sorts of extra information

- This work: support search better models

- Data visualization facilitates SMT research

Motivating Example

- Tree Structures: basis **syntactic SMT**
- ***Un-cohesiveness*** resulting from negation

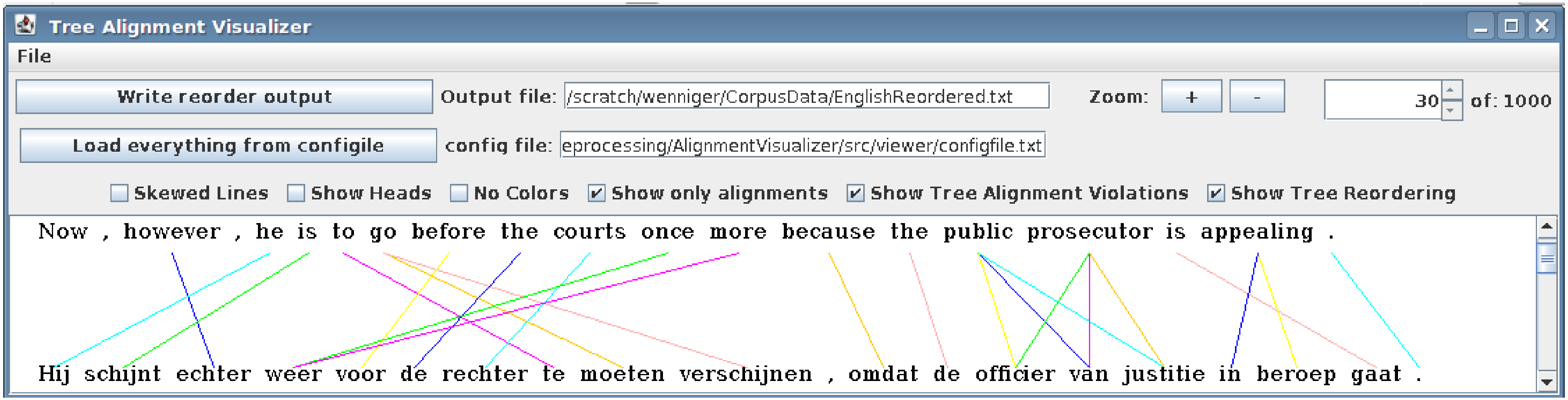


Why has there been no Health and Safety Committee meeting since 1998 ?
SBARQ
WHADVP
SQ
.
WRB
VBZ
NP
VP
?
Why
has
EX
VBN
NP
there
been
NP V.W.: |since| |1998|
PP
DT
NNP
CC
NNP
NNP
NN
IN
NP
no
Health
and
Safety
Committee
meeting
since
CD
1998
Waarom heeft het Comité voor veiligheid en hygiëne sinds 1998 niet meer vergaderd ?

- Is this big NP subtree appropriate?
  - For translation?
  - For reordering?
- Insight in **coherence** trees and alignments

Basic Alignment Visualization

- Alignment between source and target sentence
  - General: m-to-n mappings between words



Output file: /scratch/wenniger/CorpusData/EnglishReordered.txt

config file: eprocessing/AlignmentVisualizer/src/viewer/configfile.txt

30 of: 1000

□ Skewed Lines □ Show Heads □ No Colors ☑ Show only alignments ☑ Show Tree Alignment Violations ☑ Show Tree Reordering

Now , however , he is to go before the courts once more because the public prosecutor is appealing .

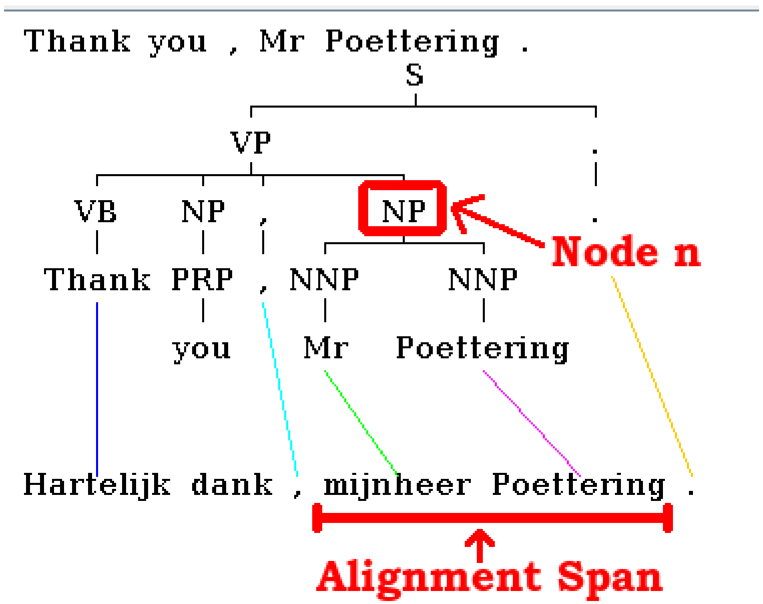
Hij schijnt echter weer voor de rechter te moeten verschijnen , omdat de officier van justitie in beroep gaat .

Alignment Span of Nodes

- Alignment mapping function

$$A(n) \rightarrow \{1, \cdots, m\}^*$$

- Span of target positions covered by subtree rooted at node **n**


Thank you , Mr Poettering .
S
VP
.
VB
NP
,
NP
Node n
Thank
PRP
,
NNP
NNP
you
Mr
Poettering
Hartelijk dank , mijnheer Poettering .
Alignment Span

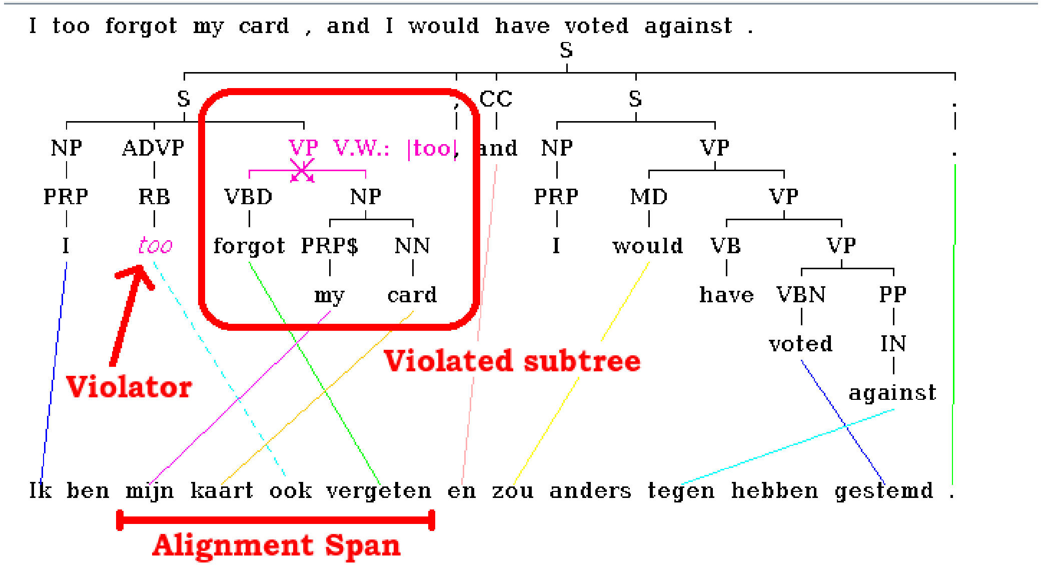
Definition 2.1 (Alignment Span)
AlignmentSpan(n) :=

$$[a_{n_{min}}, a_{n_{max}}] = \left[\min_{x \in \mathrm{LeafNodes}(n)} \left(\min_{a_{x'} \in A(x)} a_{x'} \right), \max_{y \in \mathrm{LeafNodes}(n)} \left(\max_{a_{y'} \in A(y)} a_{y'} \right) \right]$$

Cohesiveness

- Alignment ***Cohesive*** nodes: source side syntactic phrase pair

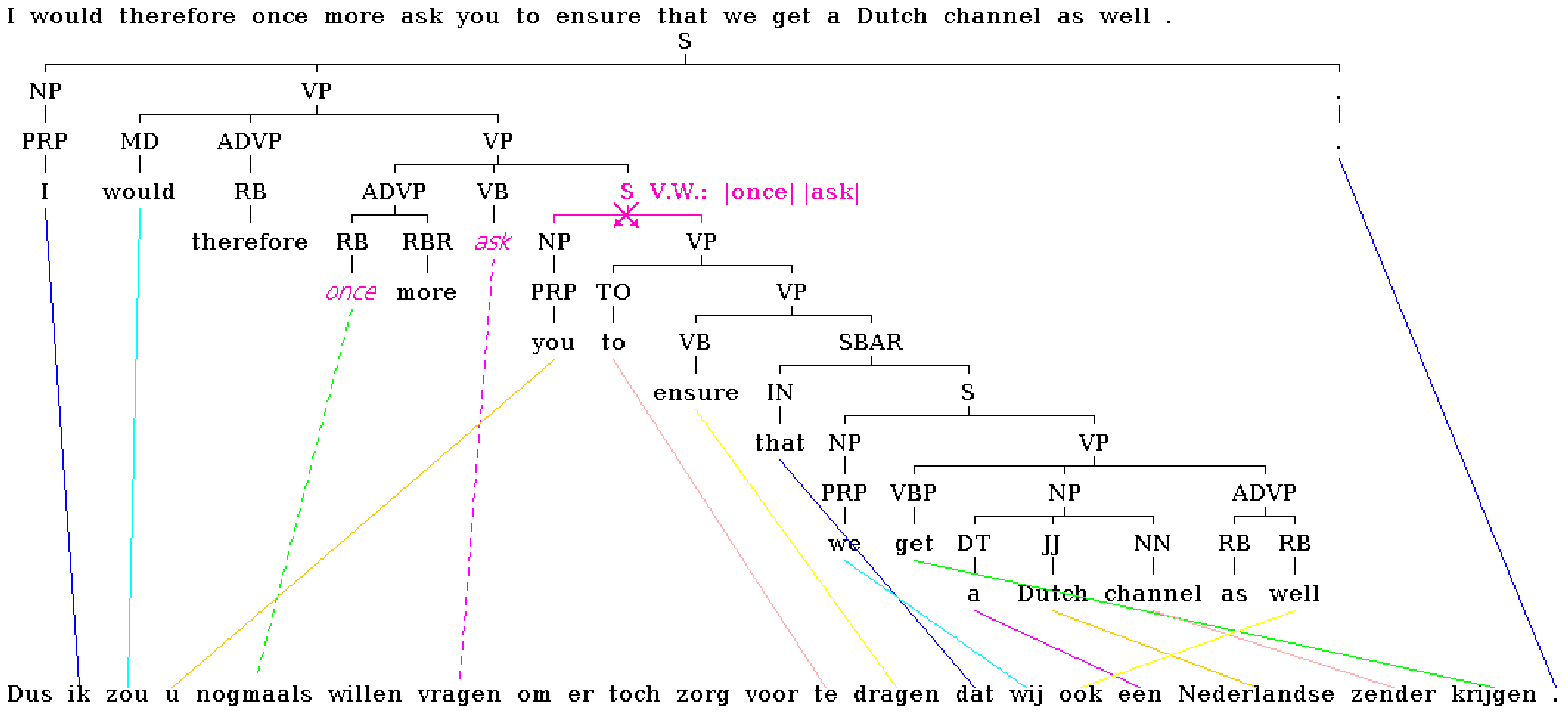
- Un-cohesive / **Alignment Violation**: Two distinct subtrees align within same target range



Definition 2.2 (Alignment Violation)

$$violates(n', n) := terminal(n') \land n' \notin \text{descendants}(n) \land$$
$$(\text{AlignmentSpan}(n) = [a_{n_{min}}, a_{n_{max}}]) \land$$
$$(a_{n_{min}} \leq A(n') \leq a_{n_{max}})$$

(Un)-Cohesiveness Example


I would therefore once more ask you to ensure that we get a Dutch channel as well .
S
NP
VP
.
PRP
MD
ADVP
VP
.
I
would
RB
ADVP
VB
S V.W.: |once| |ask|
therefore
RB
RBR
ask
NP
VP
once
more
PRP
TO
VP
you
to
VB
SBAR
ensure
IN
S
that
NP
VP
PRP
VBP
NP
ADVP
we
get
DT
JJ
NN
RB
RB
a
Dutch
channel
as
well
Dus ik zou u nogmaals willen vragen om er toch zorg voor te dragen dat wij ook een Nederlandse zender krijgen .

- ***Ask*** and ***once*** violate the alignment span of the S subtree

Reordering with ITG Constraints

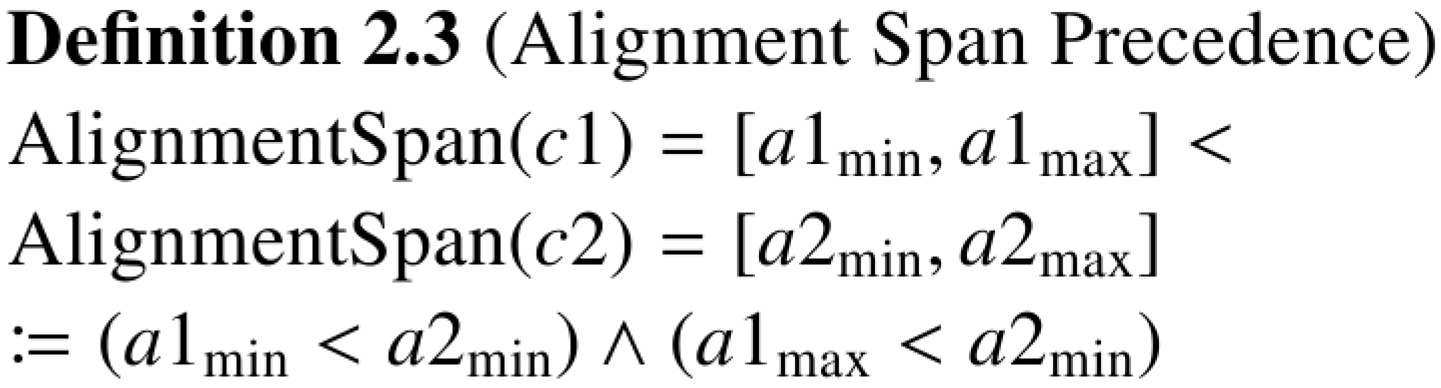
- Origin:
  Inversion Transduction Grammars (Wu, 1997):
  Bilingual Parsing

- Application   for Reordering:
  - Basic: child nodes binary tree may be inverted
  - General tree: permute child nodes arbitrarily
  - Restriction to constituency parse

Tree Constrained Reordering

- ***Monotonization:*** Reorder source to match target order

- Formal definition precedence used

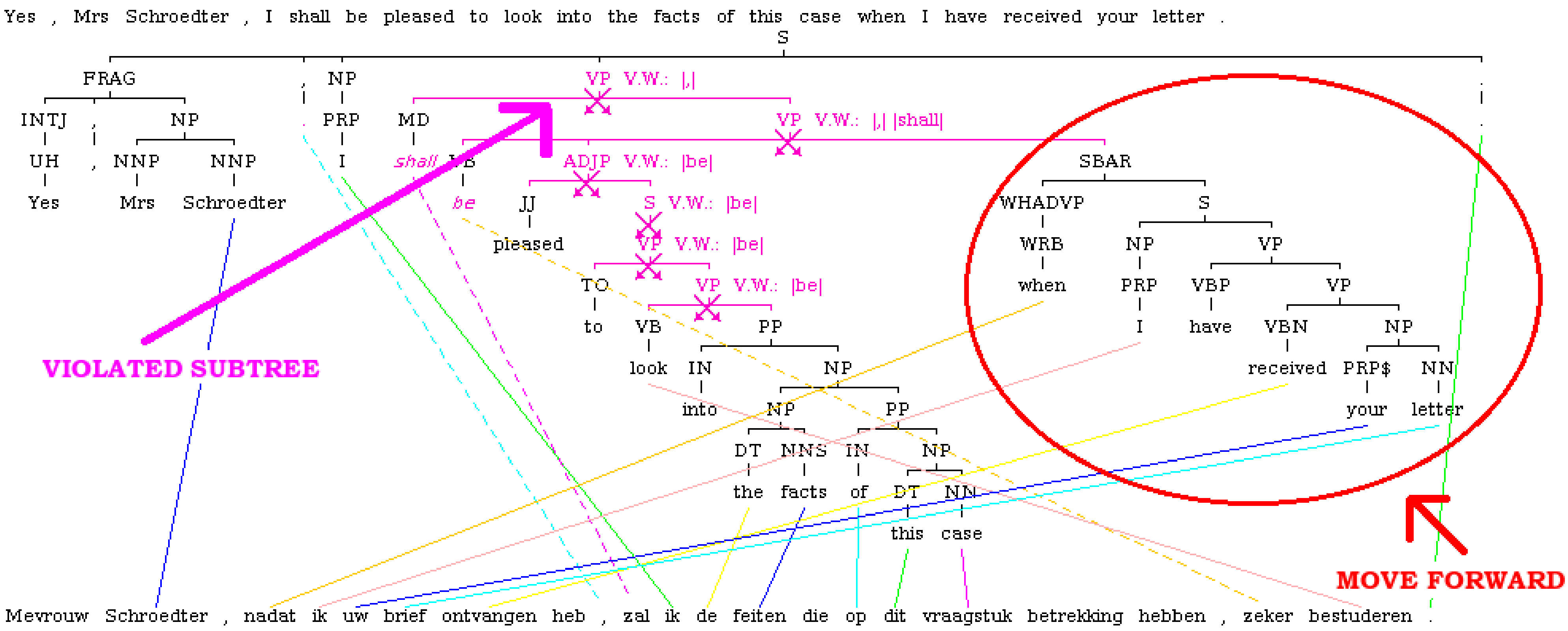


Definition 2.3 (Alignment Span Precedence)
$\text{AlignmentSpan}(c1) = [a1_{\min}, a1_{\max}] <$
$\text{AlignmentSpan}(c2) = [a2_{\min}, a2_{\max}]$
$:= (a1_{\min} < a2_{\min}) \wedge (a1_{\max} < a2_{\min})$

- All positions covered by *c1* strictly precede those covered by *c2*

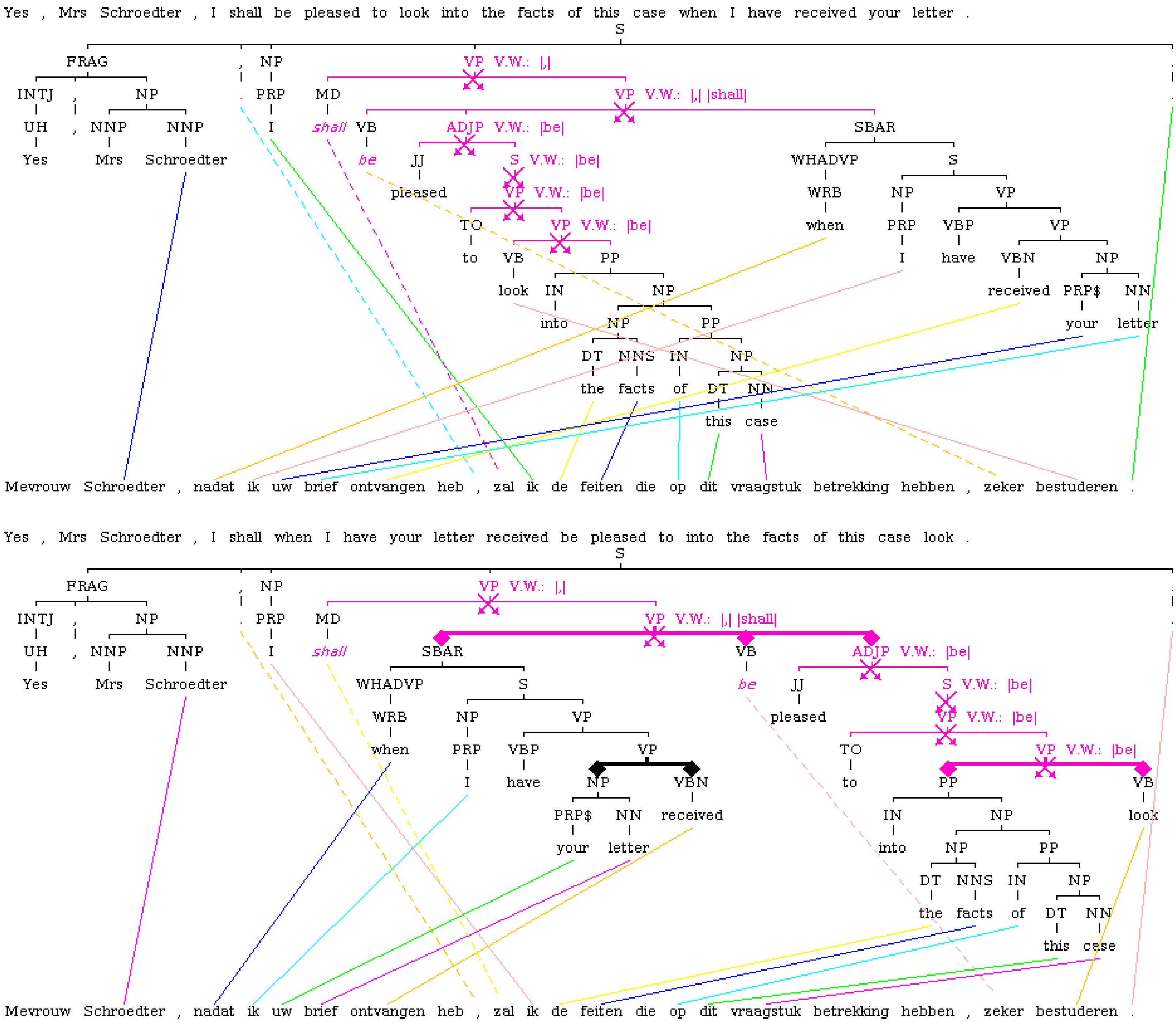
- ***Un-cohesiveness*** causes order problems

Tree-Constrained Reordering



- Right subtree moved forward, violated subtree not touched

Tree-Constrained Reordering



Yes , Mrs Schroedter , I shall be pleased to look into the facts of this case when I have received your letter .

Mevrouw Schroedter , nadat ik uw brief ontvangen heb , zal ik de feiten die op dit vraagstuk betrekking hebben , zeker bestuderen .

Yes , Mrs Schroedter , I shall when I have your letter received be pleased to into the facts of this case look .

Mevrouw Schroedter , nadat ik uw brief ontvangen heb , zal ik de feiten die op dit vraagstuk betrekking hebben , zeker bestuderen .

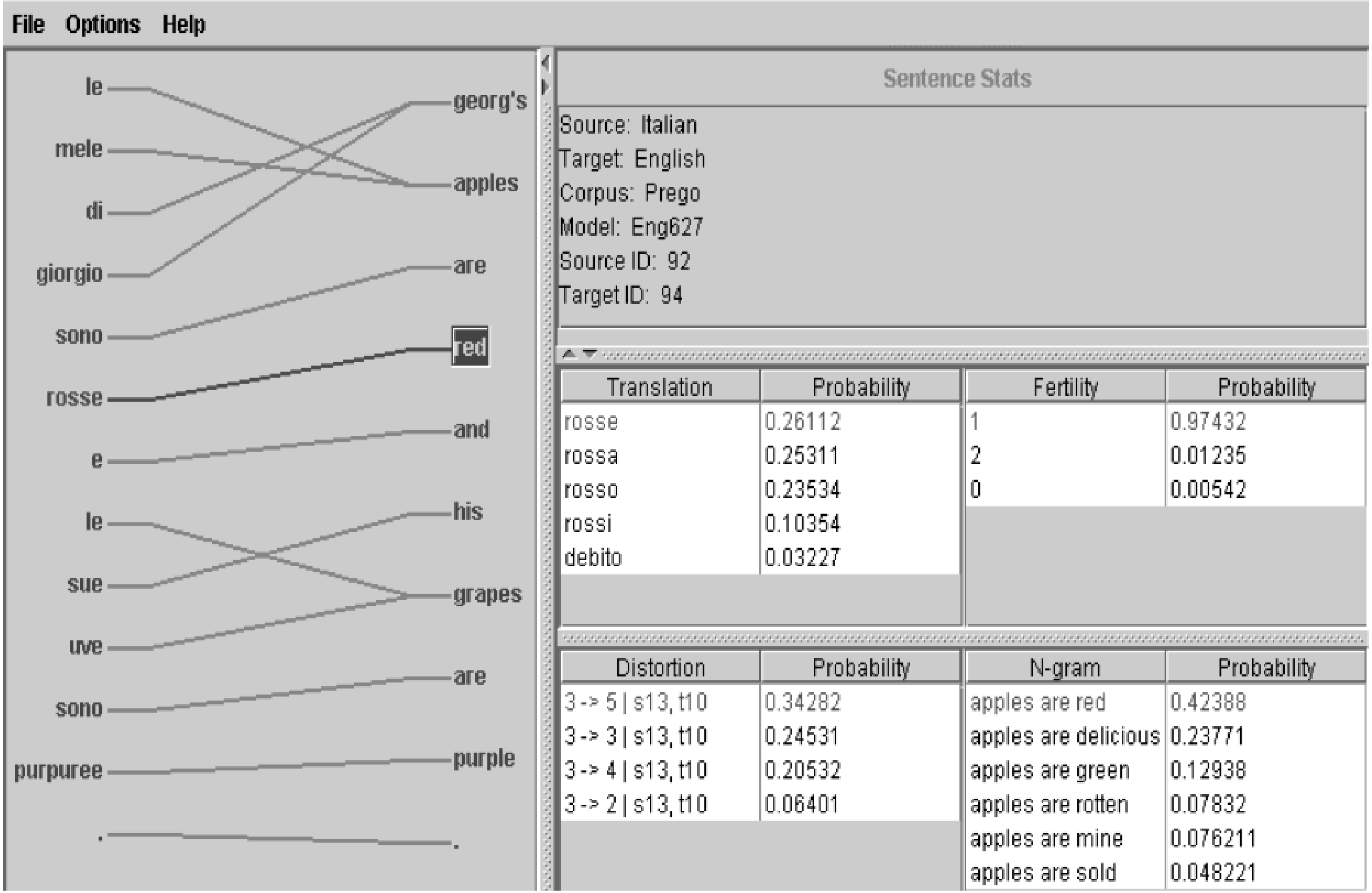
Usability

- Browsing through aligned sentences
- Insight into alignment mapping sub-trees
- Assess quality reordering tree-constrained ITG
- Get ideas for new tree-transduction operations

Related Work

- Visualization tools
  - *Cairo* (Smith and Jahr, 2000)
  - *Yawat* (Germann, 2008)
  - *Stockholm Tree Aligner (STA)* (Volk et al., 2007)

Cairo: IBM model visualization



Source: Italian
Target: English
Corpus: Prego
Model: Eng627
Source ID: 92
Target ID: 94

Translation	Probability
rosse	0.26112
rossa	0.25311
rosso	0.23534
rossi	0.10354
debito	0.03227

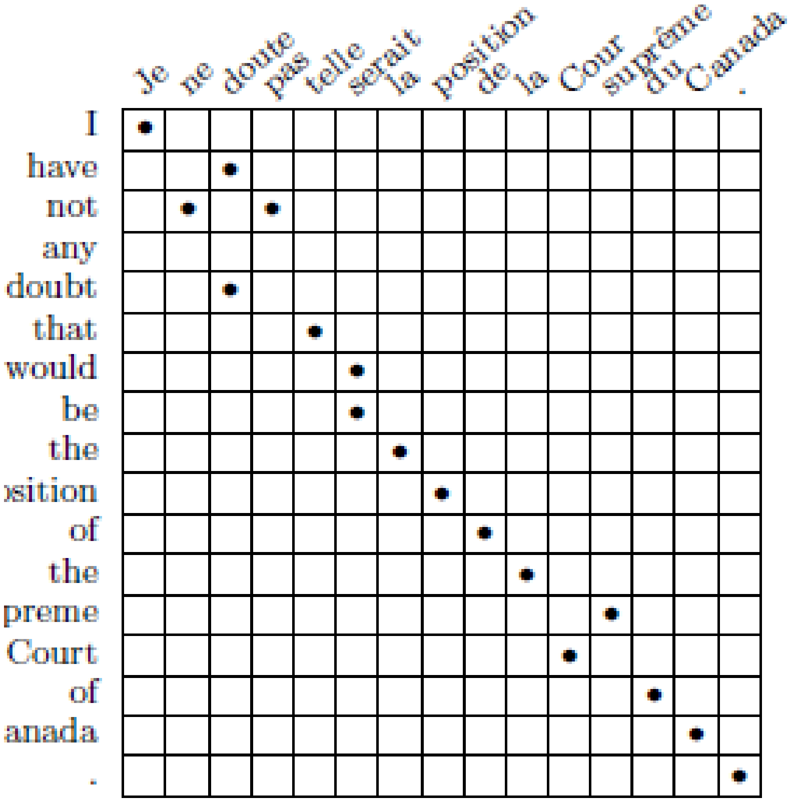
Fertility	Probability
1	0.97432
2	0.01235
0	0.00542

Distortion	Probability
3 -> 5 | s13, t10	0.34282
3 -> 3 | s13, t10	0.24531
3 -> 4 | s13, t10	0.20532
3 -> 2 | s13, t10	0.06401

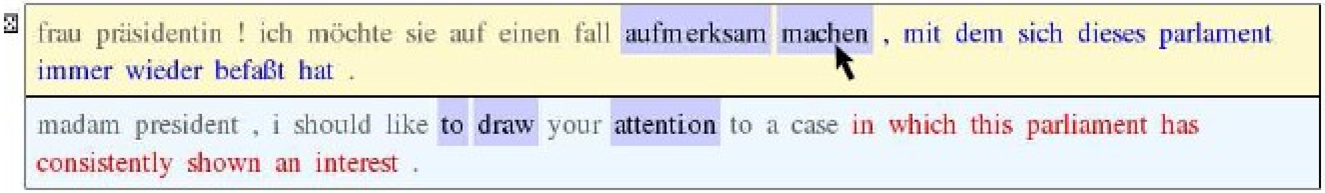
N-gram	Probability
apples are red	0.42388
apples are delicious	0.23771
apples are green	0.12938
apples are rotten	0.07832
apples are mine	0.076211
apples are sold	0.048221

Yawat: focus on clearity

- Visualization alignment matrix
- Support manual annotation
- Dynamic highlighting



	Je	ne	doute	pas	telle	serait	la	position	de	la	Cour	suprême	du	Canada	.
I	●														
have			●												
not		●		●											
any															
doubt			●												
that					●										
would						●									
be						●									
the							●								
osition								●							
of									●						
the										●					
preme												●			
Court											●				
of													●		
anada														●	
.															●

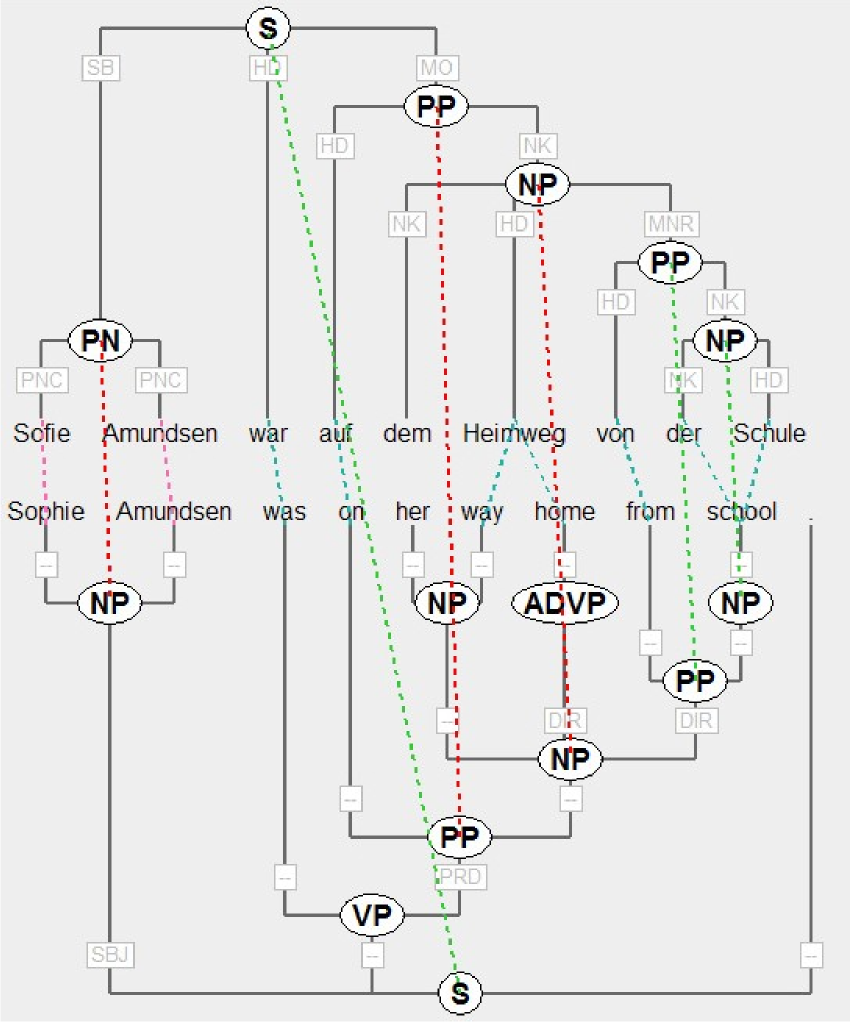


frau präsidentin ! ich möchte sie auf einen fall aufmerksam machen , mit dem sich dieses parlament immer wieder befaßt hat .

madam president , i should like to draw your attention to a case in which this parliament has consistently shown an interest .

Stockholm Tree Aligner (STA)

- Visualization parallel treebanks
- Focus on hand-annotated trees



Conclusions

- Toolkit targeted especially SMT people
- Focus on automatically generated resources and syntactic SMT
- Offers new functionality
- Goal: support SMT research

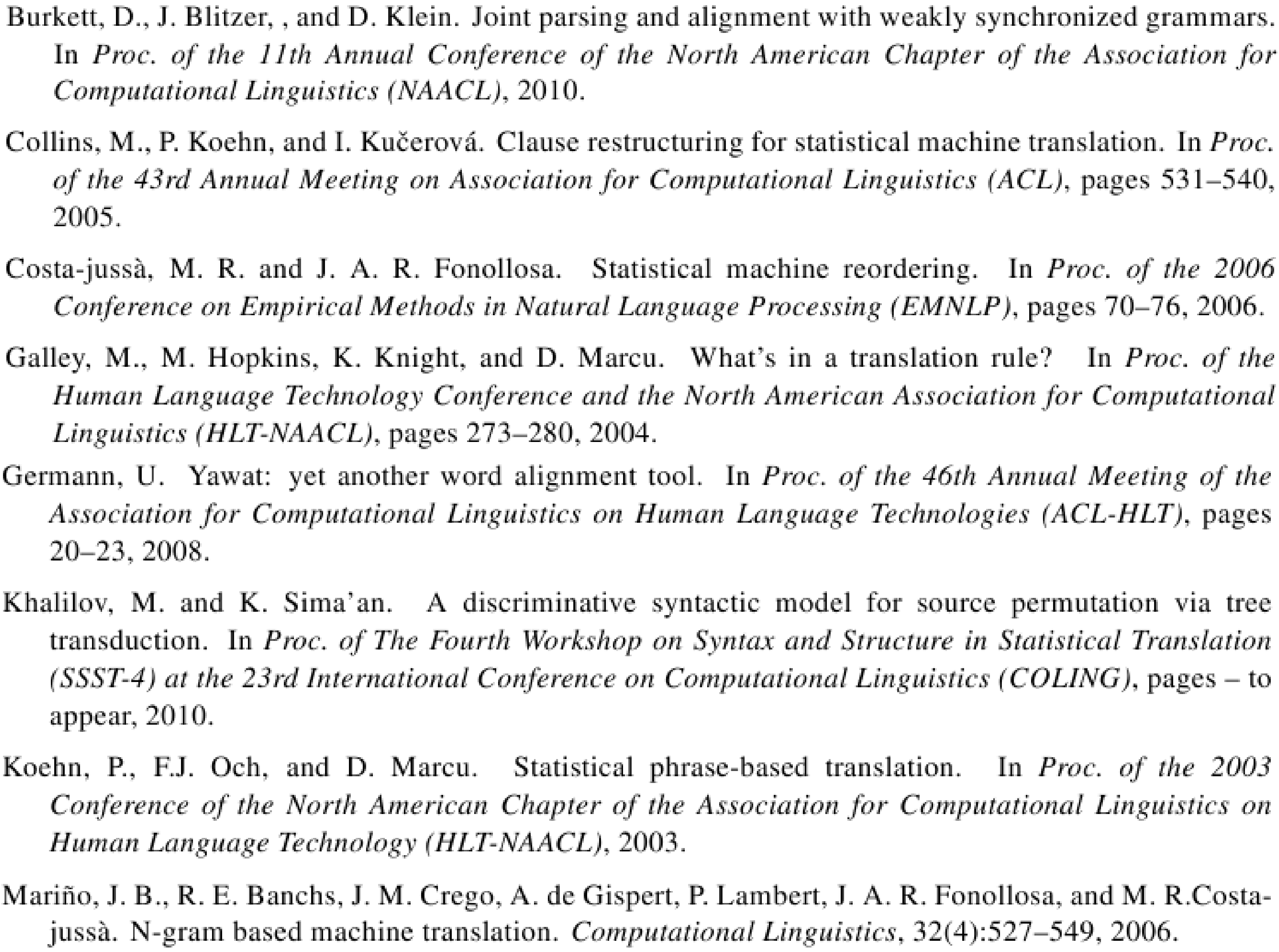
Future Work

- Heuristics in subtree reordering
- Tree modification
- Alignment refinement

Demo

Questions?

Bibliography(1/2)



Burkett, D., J. Blitzer, , and D. Klein. Joint parsing and alignment with weakly synchronized grammars. In *Proc. of the 11th Annual Conference of the North American Chapter of the Association for Computational Linguistics (NAACL)*, 2010.

Collins, M., P. Koehn, and I. Kučerová. Clause restructuring for statistical machine translation. In *Proc. of the 43rd Annual Meeting on Association for Computational Linguistics (ACL)*, pages 531–540, 2005.

Costa-jussà, M. R. and J. A. R. Fonollosa. Statistical machine reordering. In *Proc. of the 2006 Conference on Empirical Methods in Natural Language Processing (EMNLP)*, pages 70–76, 2006.

Galley, M., M. Hopkins, K. Knight, and D. Marcu. What's in a translation rule? In *Proc. of the Human Language Technology Conference and the North American Association for Computational Linguistics (HLT-NAACL)*, pages 273–280, 2004.

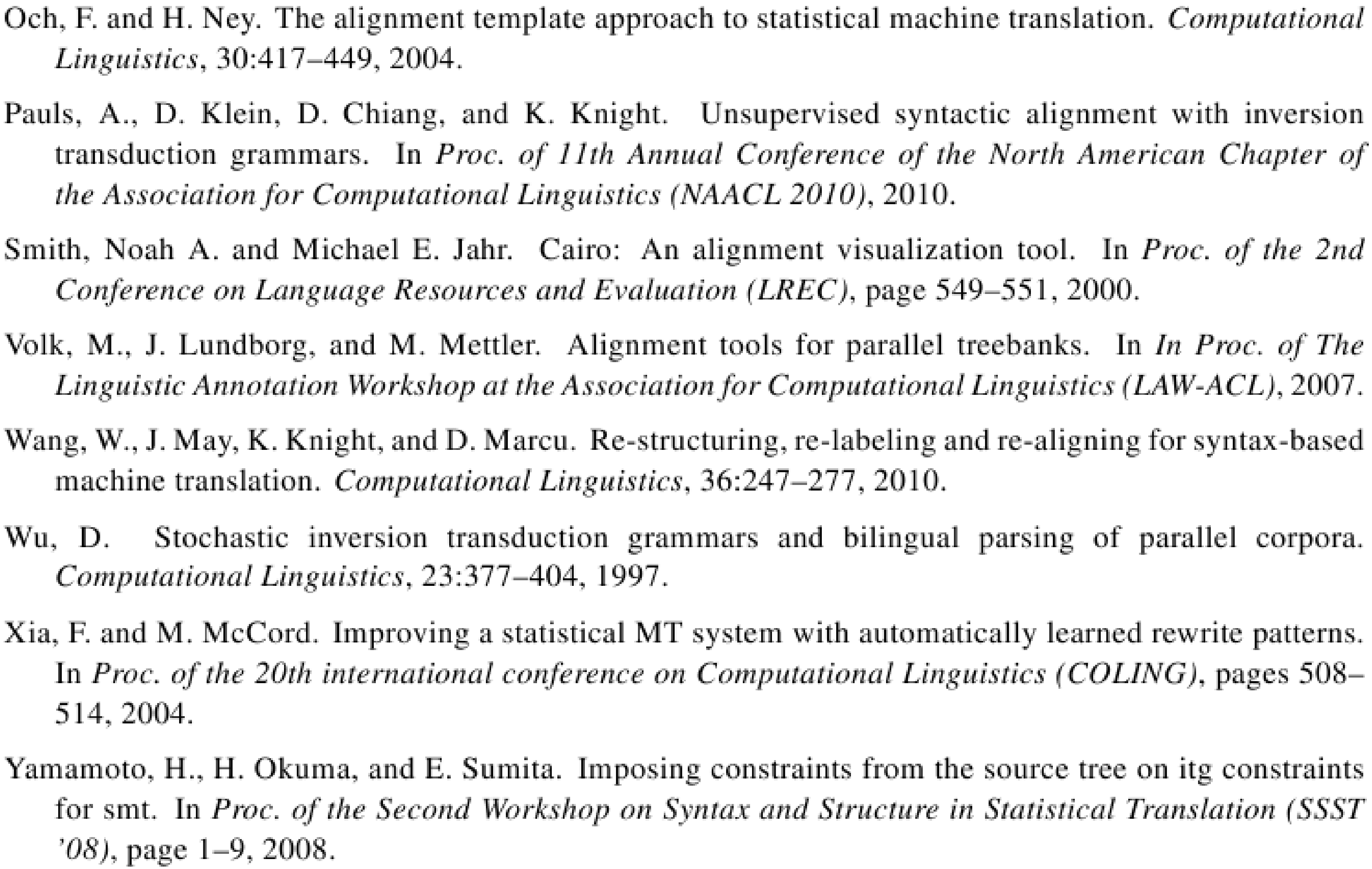
Germann, U. Yawat: yet another word alignment tool. In *Proc. of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies (ACL-HLT)*, pages 20–23, 2008.

Khalilov, M. and K. Sima'an. A discriminative syntactic model for source permutation via tree transduction. In *Proc. of The Fourth Workshop on Syntax and Structure in Statistical Translation (SSST-4) at the 23rd International Conference on Computational Linguistics (COLING)*, pages – to appear, 2010.

Koehn, P., F.J. Och, and D. Marcu. Statistical phrase-based translation. In *Proc. of the 2003 Conference of the North American Chapter of the Association for Computational Linguistics on Human Language Technology (HLT-NAACL)*, 2003.

Mariño, J. B., R. E. Banchs, J. M. Crego, A. de Gispert, P. Lambert, J. A. R. Fonollosa, and M. R.Costa-jussà. N-gram based machine translation. *Computational Linguistics*, 32(4):527–549, 2006.

Bibliography(2/2)



Och, F. and H. Ney. The alignment template approach to statistical machine translation. *Computational Linguistics*, 30:417–449, 2004.

Pauls, A., D. Klein, D. Chiang, and K. Knight. Unsupervised syntactic alignment with inversion transduction grammars. In *Proc. of 11th Annual Conference of the North American Chapter of the Association for Computational Linguistics (NAACL 2010)*, 2010.

Smith, Noah A. and Michael E. Jahr. Cairo: An alignment visualization tool. In *Proc. of the 2nd Conference on Language Resources and Evaluation (LREC)*, page 549–551, 2000.

Volk, M., J. Lundborg, and M. Mettler. Alignment tools for parallel treebanks. In *In Proc. of The Linguistic Annotation Workshop at the Association for Computational Linguistics (LAW-ACL)*, 2007.

Wang, W., J. May, K. Knight, and D. Marcu. Re-structuring, re-labeling and re-aligning for syntax-based machine translation. *Computational Linguistics*, 36:247–277, 2010.

Wu, D. Stochastic inversion transduction grammars and bilingual parsing of parallel corpora. *Computational Linguistics*, 23:377–404, 1997.

Xia, F. and M. McCord. Improving a statistical MT system with automatically learned rewrite patterns. In *Proc. of the 20th international conference on Computational Linguistics (COLING)*, pages 508–514, 2004.

Yamamoto, H., H. Okuma, and E. Sumita. Imposing constraints from the source tree on itg constraints for smt. In *Proc. of the Second Workshop on Syntax and Structure in Statistical Translation (SSST '08)*, page 1–9, 2008.