Moses

Machine Translation with Open Source Software

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1 November 2012

Outline

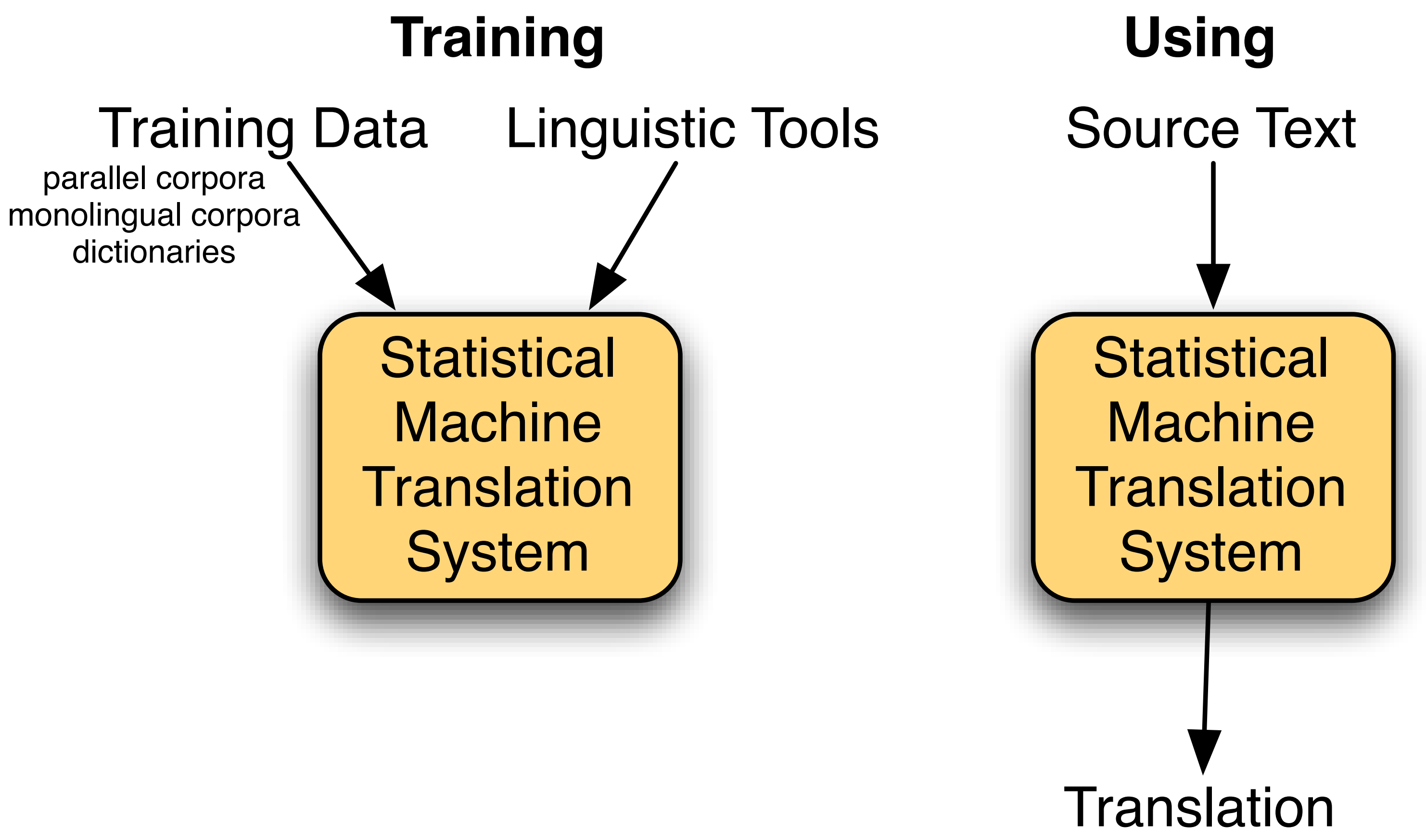
09:30-10:00 **Introduction**

10:00-11:00 **Hands-on Session** — you will need a laptop

11:00-11:30 Break

11:30-12:30 **Advanced Topics**

Basic Idea


Training
Using
Training Data
parallel corpora
monolingual corpora
dictionaries
Linguistic Tools
Statistical Machine Translation System
Source Text
Statistical Machine Translation System
Translation

Statistical Machine Translation History

around 1990

Pioneering work at IBM, inspired by success in speech recognition

1990s

Dominance of IBM's word-based models, support technologies

early 2000s

Phrase-based models

late 2000s

Tree-based models

Moses History

2002 Pharaoh decoder, precursor to Moses (phrase-based models)

2005 Moses started by Hieu Hoang and Philipp Koehn (factored models)

2006 JHU workshop extends Moses significantly

since late 2006 Funding by EU projects EuroMatrix, EuroMatrixPlus

2009 Tree-based models implemented in Moses

2012 MosesCore project. Full-time staff to maintain and enhance Moses

Moses in Academia

- Built by academics, for academics

- Reference implementation of state of the art
  - researchers develop new methods on top of Moses
  - developers re-implement published methods
  - used by other researchers as black box

- Baseline to beat
  - researchers compare their method against Moses

Developer Community

- Main development at University of Edinburgh, but also:
  - Fondazione Bruno Kessler (Italy)
  - Charles University (Czech Republic)
  - DFKI (Germany)
  - RWTH Aachen (Germany)
  - others...
- Code shared on github.com
- Main forum: support and developer mailing lists
- Main event: Machine Translation Marathon (next: September 2011, Trento)
  - annual open source convention
  - presentation of new open source tools
  - hands-on work on new open source projects
  - summer school for statistical machine translation

Open Source Components

- Moses distribution uses external open source tools
  - word alignment: GIZA++, Berkeley aligner
  - language model: SRILM, IRSTLM, RANDLM
  - scoring: BLEU, TER, METEOR

- Other useful tools
  - sentence aligner
  - syntactic parsers
  - part-of-speech taggers
  - morphological analyzers

Other Open Source MT Systems

- **Joshua** — Johns Hopkins University
  `http://joshua.sourceforge.net/`
- **CDec** — University of Maryland
  `http://cdec-decoder.org/`
- **Jane** — RWTH Aachen
  `http://www-i6.informatik.rwth-aachen.de/jane/`
- Very similar technology
  - Joshua implemented in Java, others in C++
  - Joshua and Jane support only tree-based models
  - Phrasal supports only phrase-based models
- Open sourcing tools increasing trend in NLP research

Moses in Industry

- Distributed with LGPL — free to use
- Competitive with commercial SMT solutions
  (Language Weaver, Google, ...)
- But:
  - not easy to use
  - requires significant expertise for optimal performance
  - integration into existing workflow not straight-forward

Case Studies

European Commission —
uses Moses in-house to aid human translators

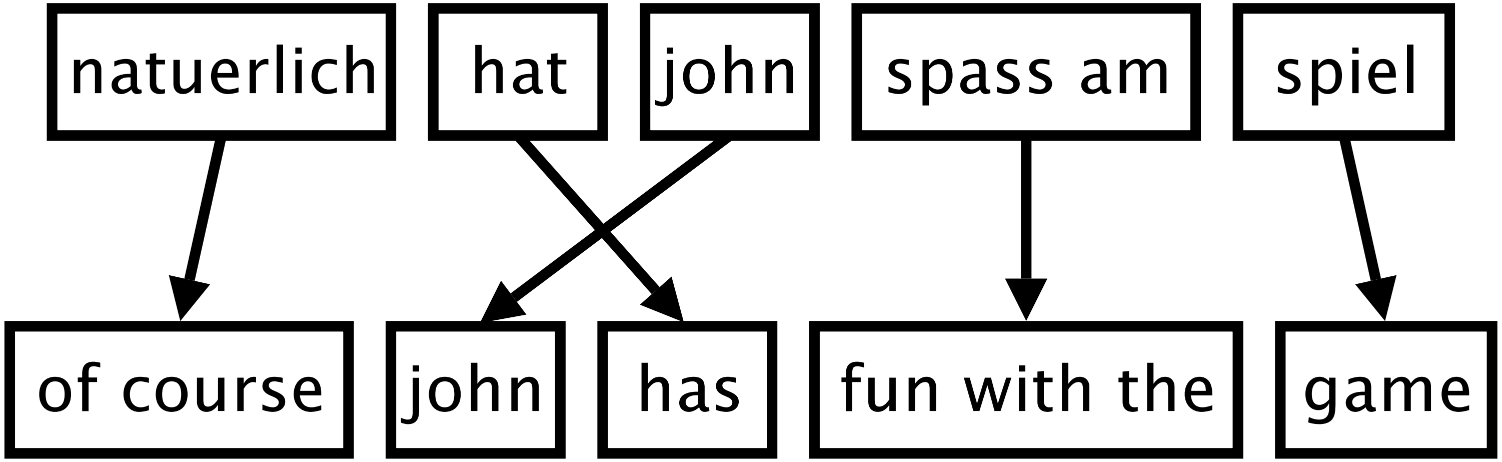
Autodesk —
showed productivity increases in translating manuals when post-editing output from a custom-build Moses system

Systran —
developed statistical post-editing using Moses

Asia Online —
offers translation technology and services based on Moses

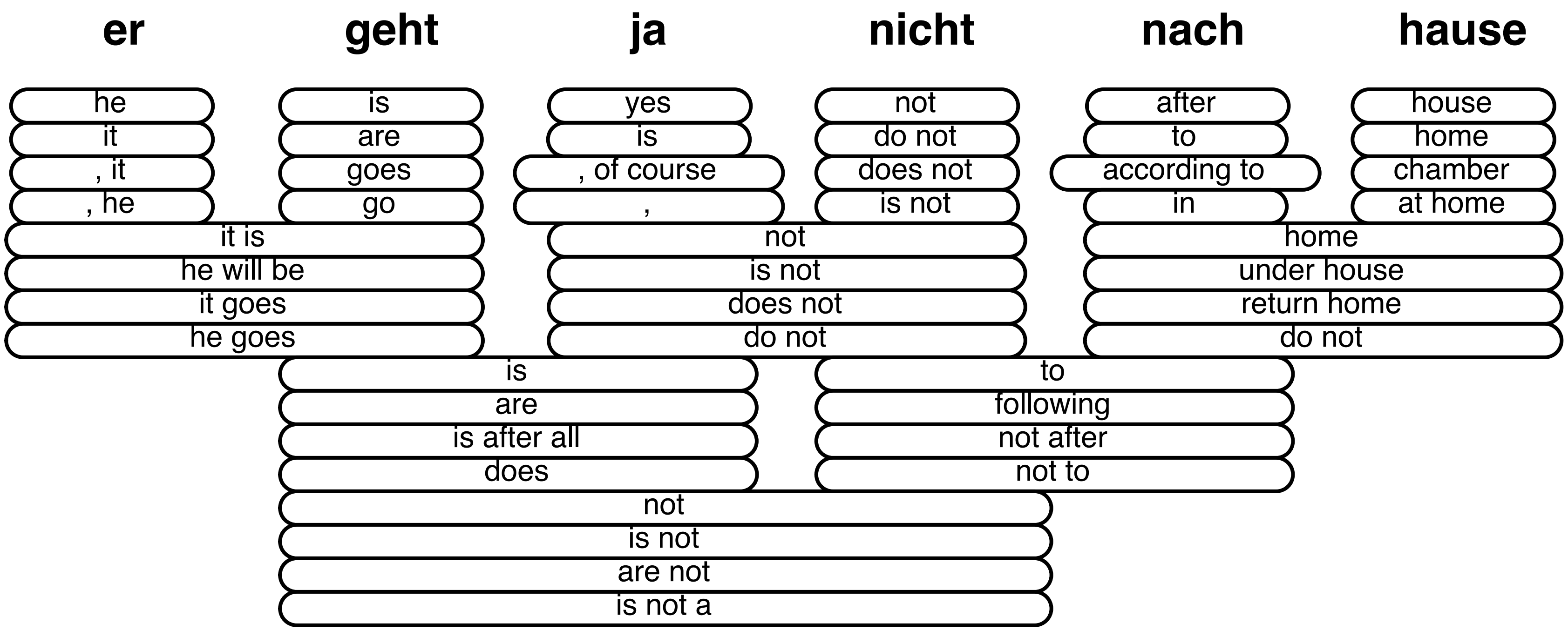
Many others... World Trade Organisation, Adobe, Symantec, WIPO, Sybase

Phrase-Based Model



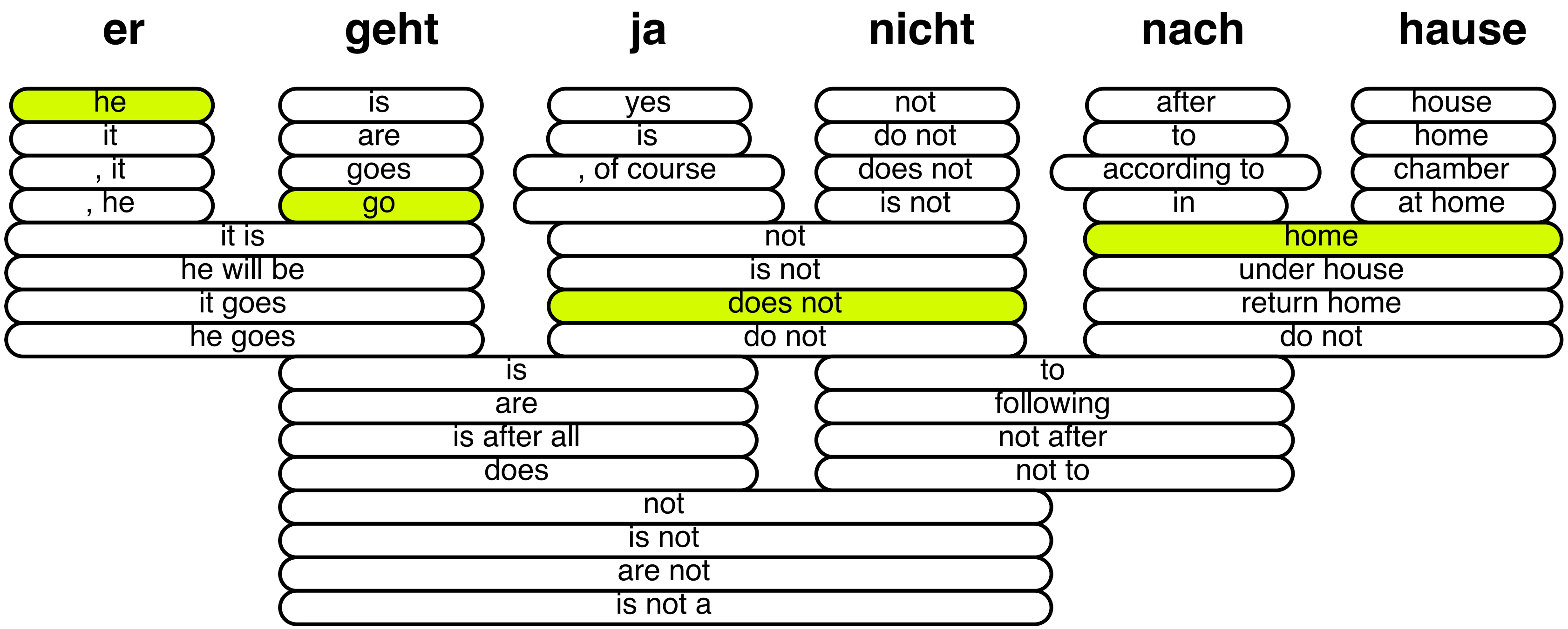
- Foreign input is segmented in phrases
- Each phrase is translated into English
- Phrases are reordered

Phrase Translation Options



- Many translation options to choose from

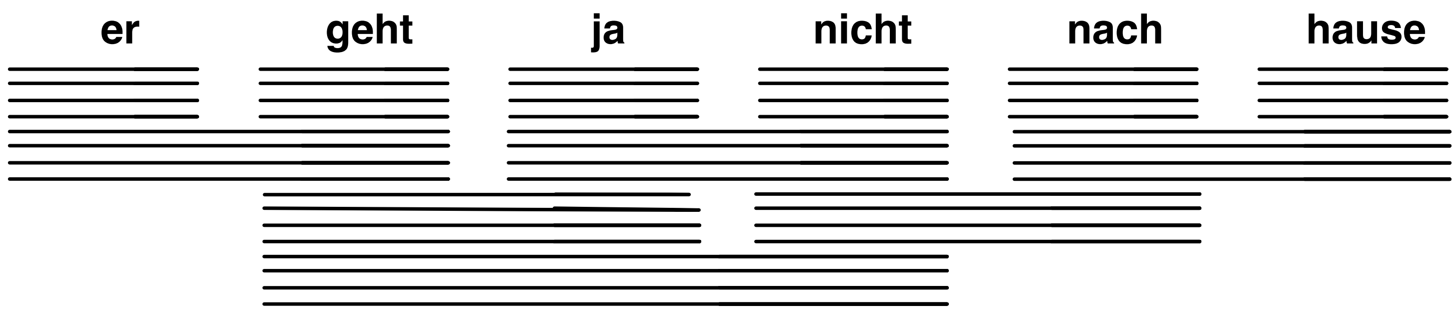
Phrase Translation Options



- The machine translation decoder does not know the right answer
  - picking the right translation options
  - arranging them in the right order

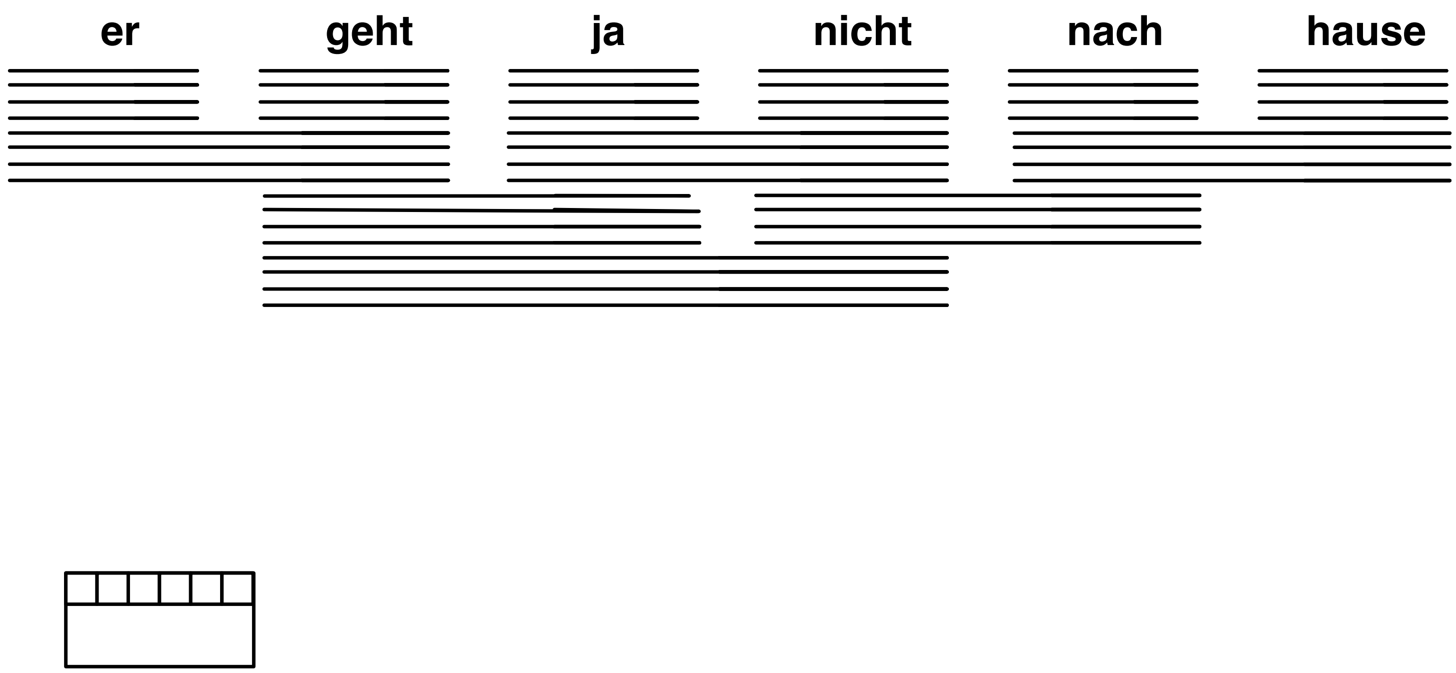
→ Search problem solved by heuristic beam search

Decoding: Precompute Translation Options



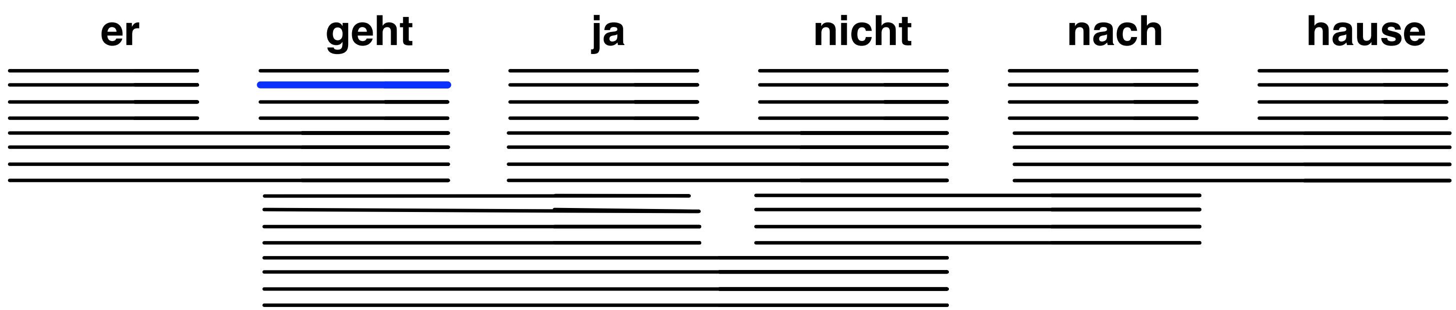
consult phrase translation table for all input phrases

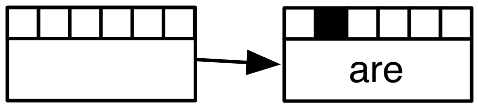
Decoding: Start with Initial Hypothesis



initial hypothesis: no input words covered, no output produced

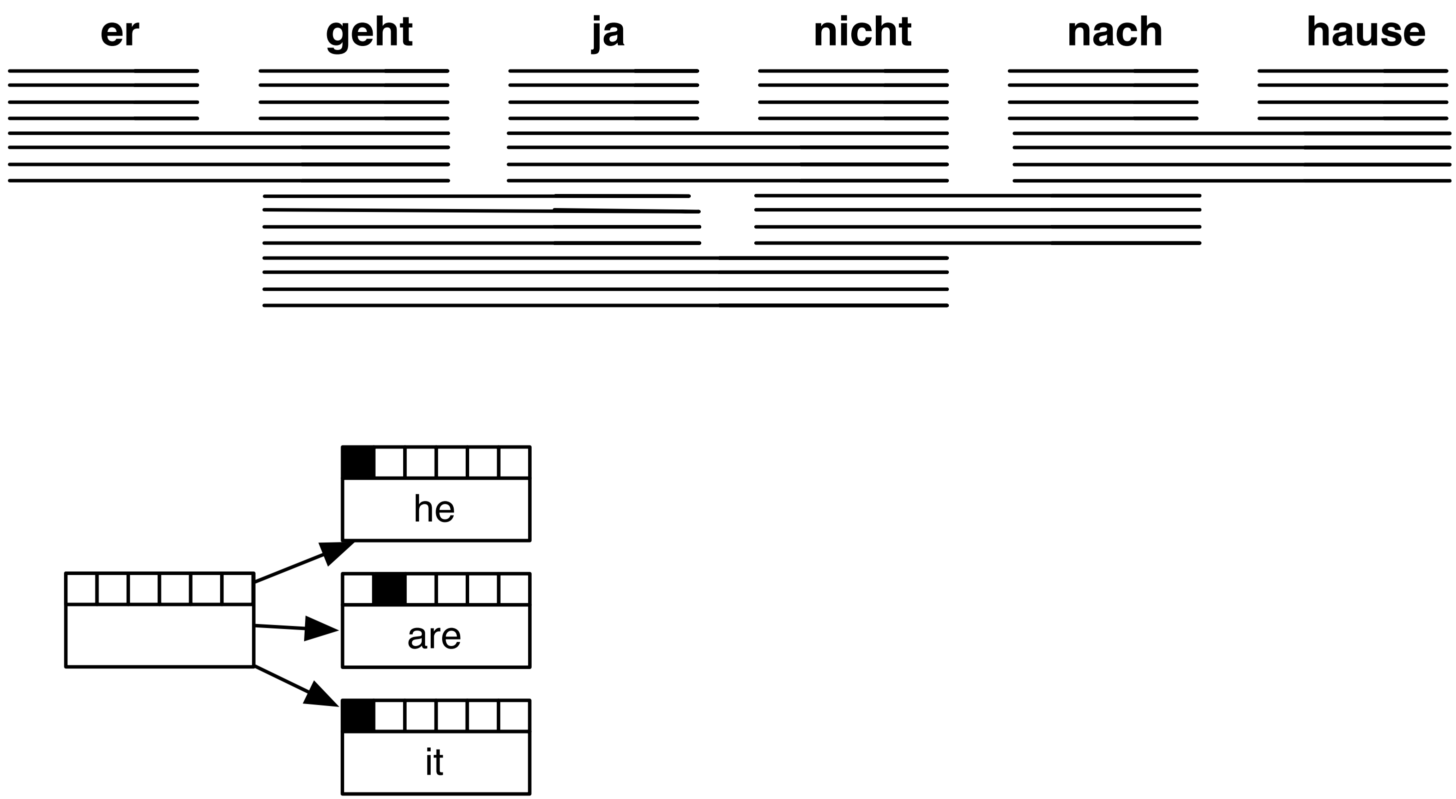
Decoding: Hypothesis Expansion





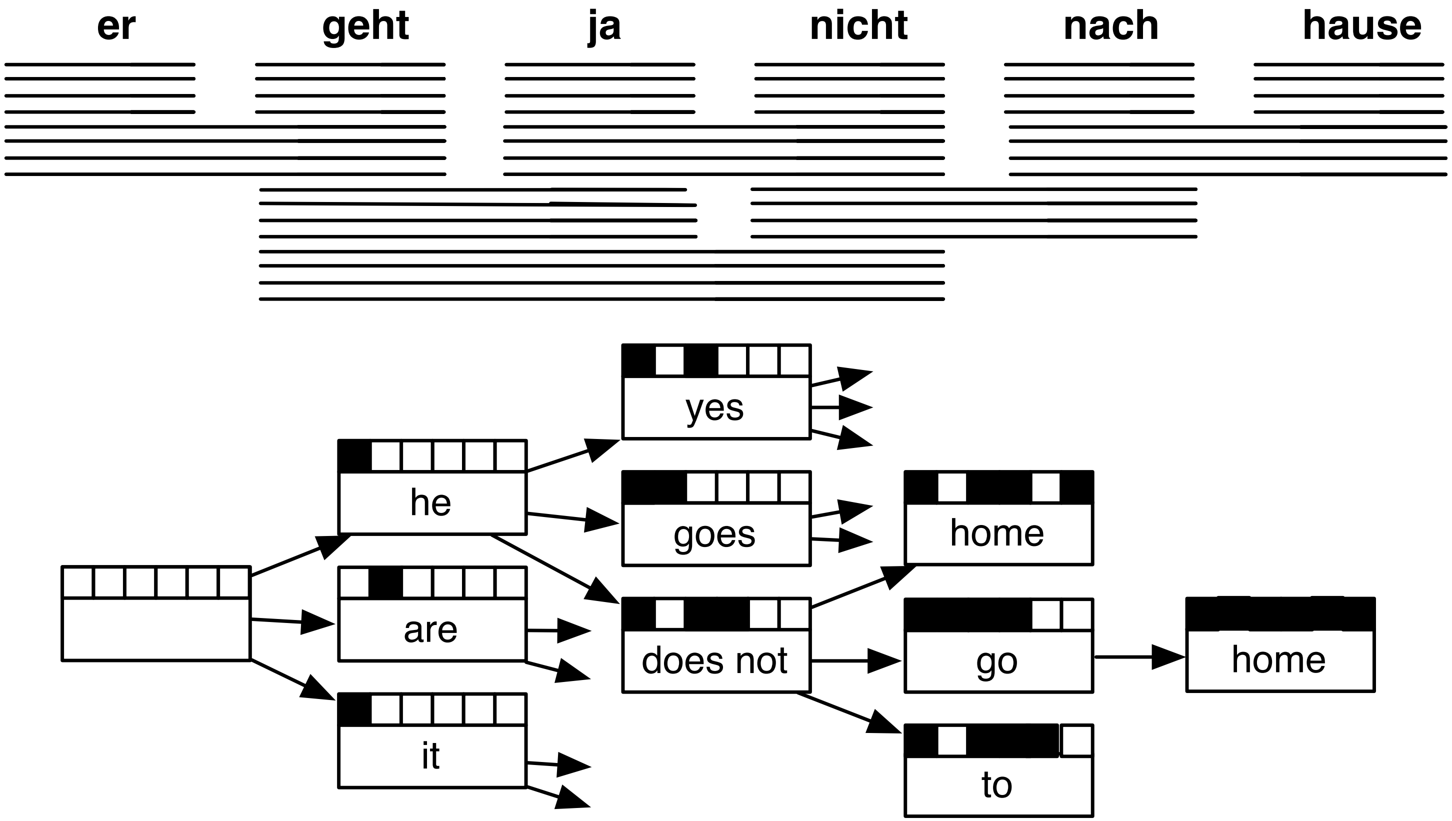
pick any translation option, create new hypothesis

Decoding: Hypothesis Expansion



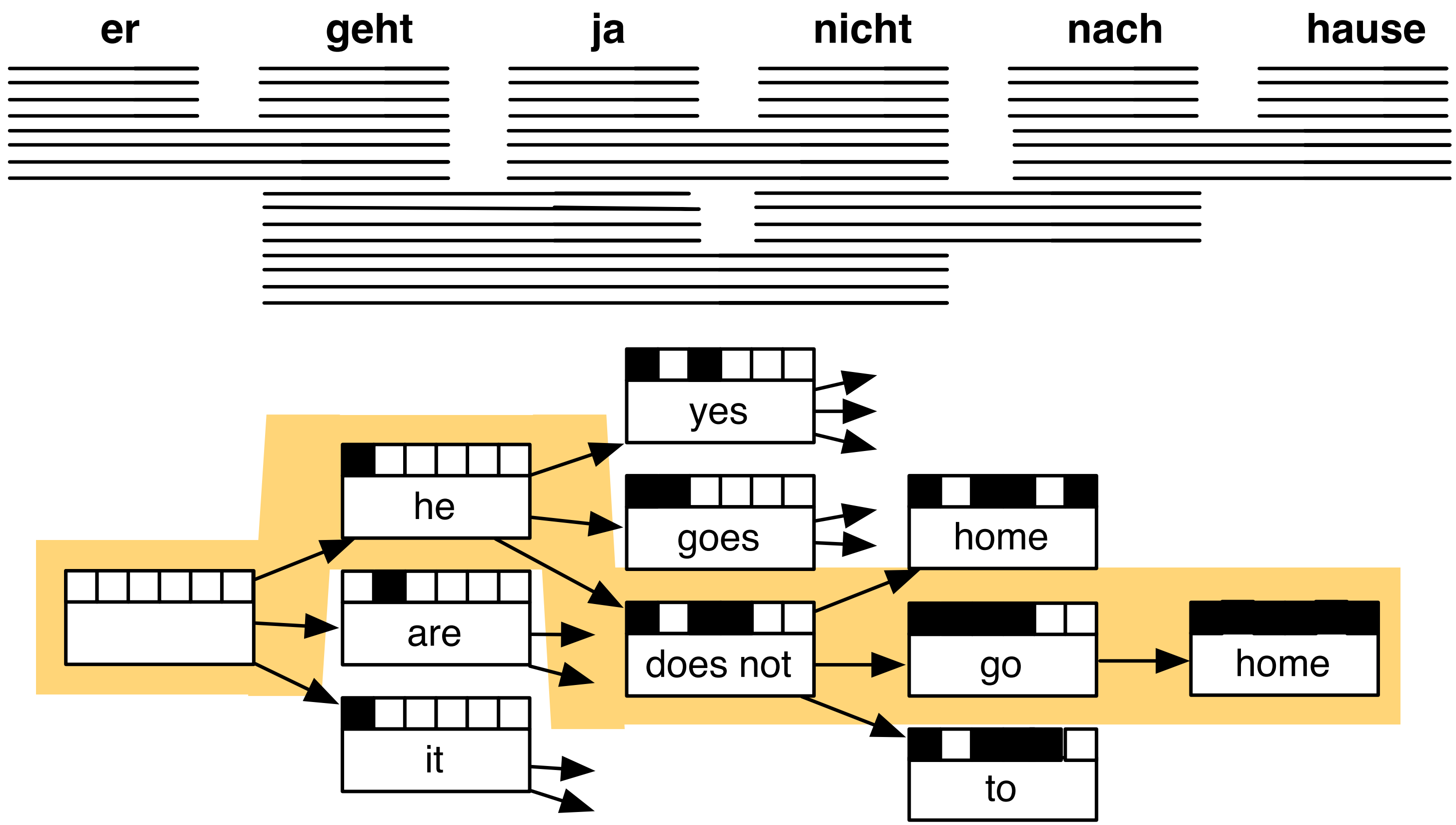
create hypotheses for all other translation options

Decoding: Hypothesis Expansion



also create hypotheses from created partial hypothesis

Decoding: Find Best Path



backtrack from highest scoring complete hypothesis

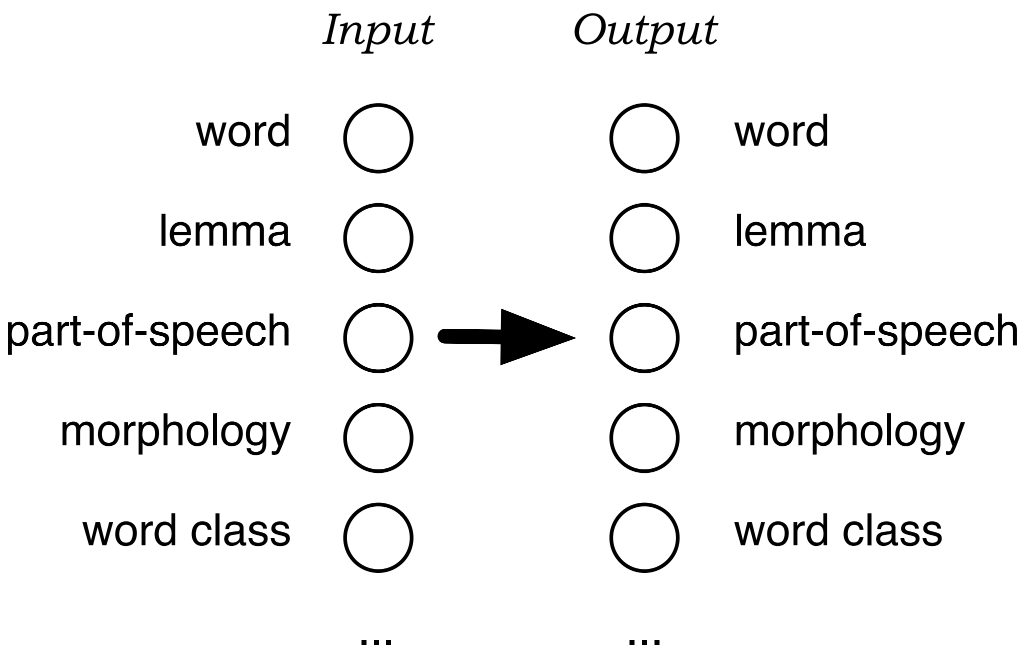
Computational Complexity

- The suggested process creates exponential number of hypothesis
- Reduction of search space: pruning

$\rightarrow$ Decoder may not find the model-best translation

Factored Represention

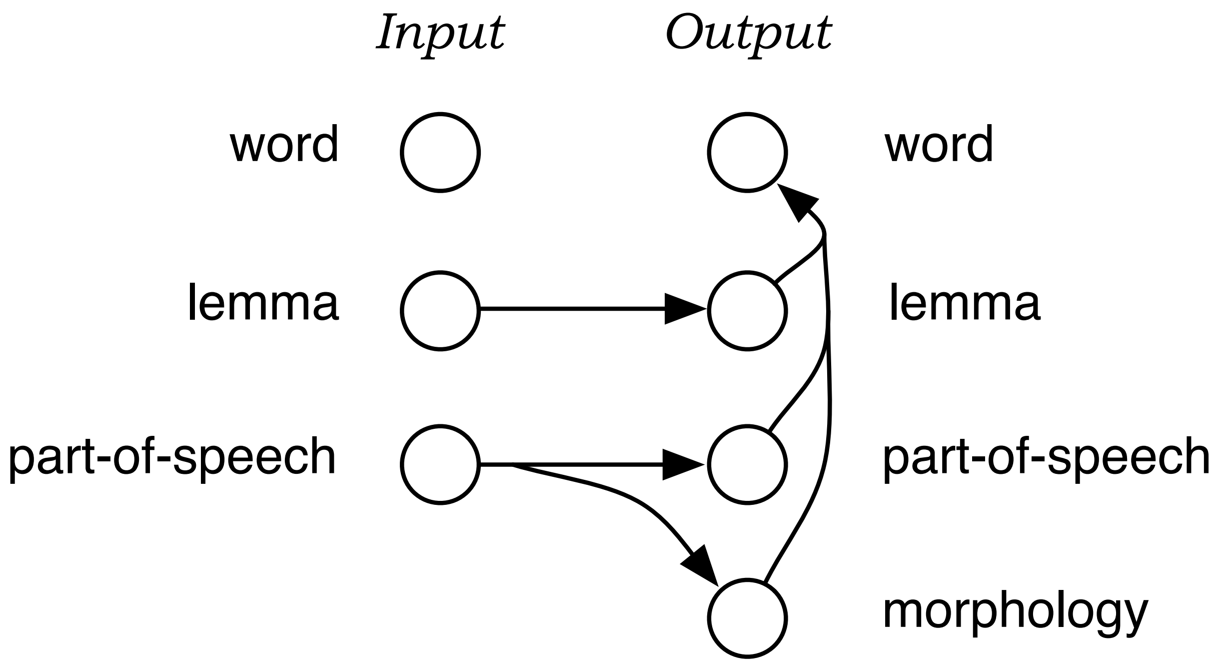
- Factored represention of words



- Goals
  - generalization, e.g. by translating lemmas, not surface forms
  - richer model, e.g. using syntax for reordering, language modeling)

Factored Model

Example:



Decomposing the translation step
Translating lemma and morphological information more robust

Syntax Models

String to String

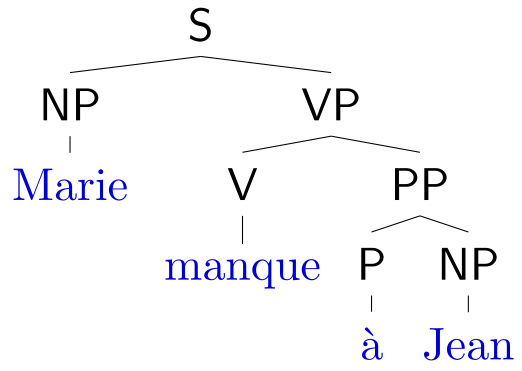
John misses Mary

⇒ Marie manque à Jean

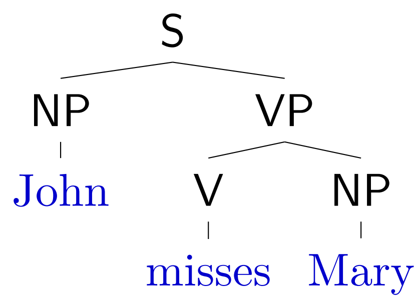
String to Tree

John misses Mary

⇒

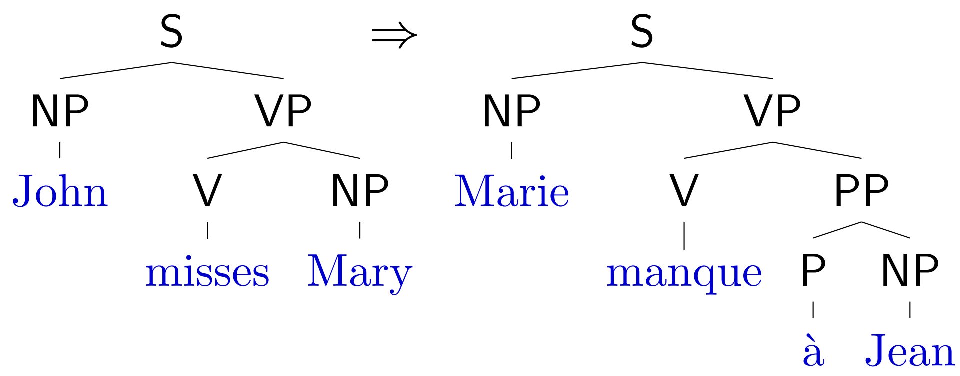


Tree to String

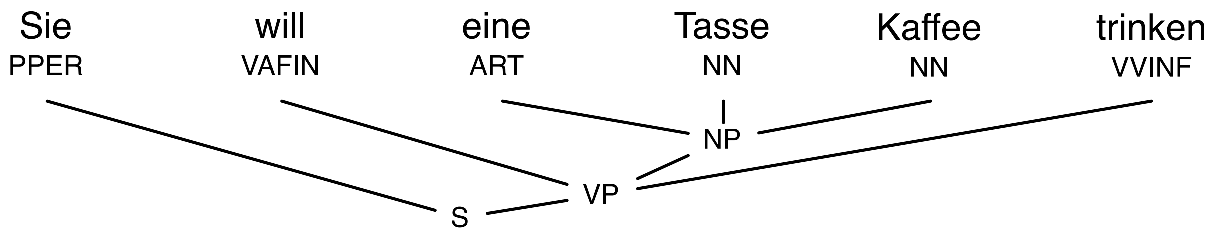


⇒ Marie manque à Jean

Tree to Tree



Syntax Decoding



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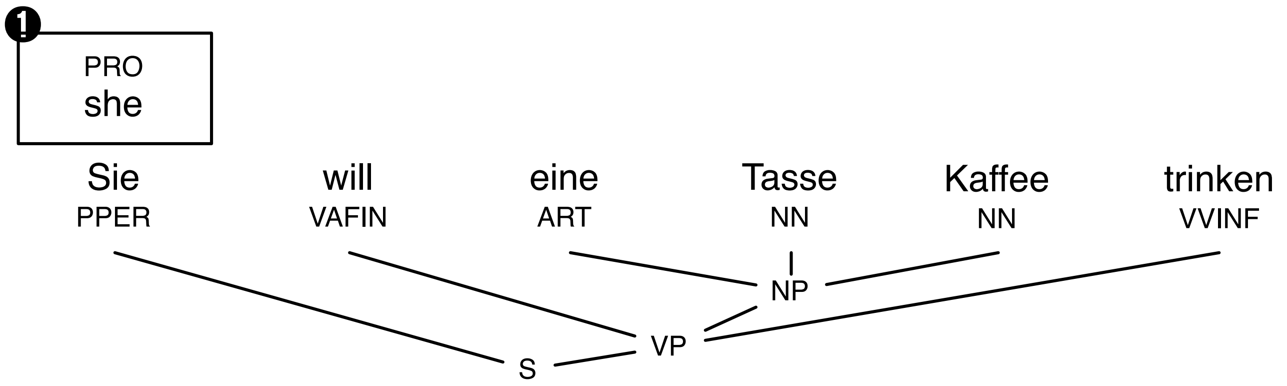
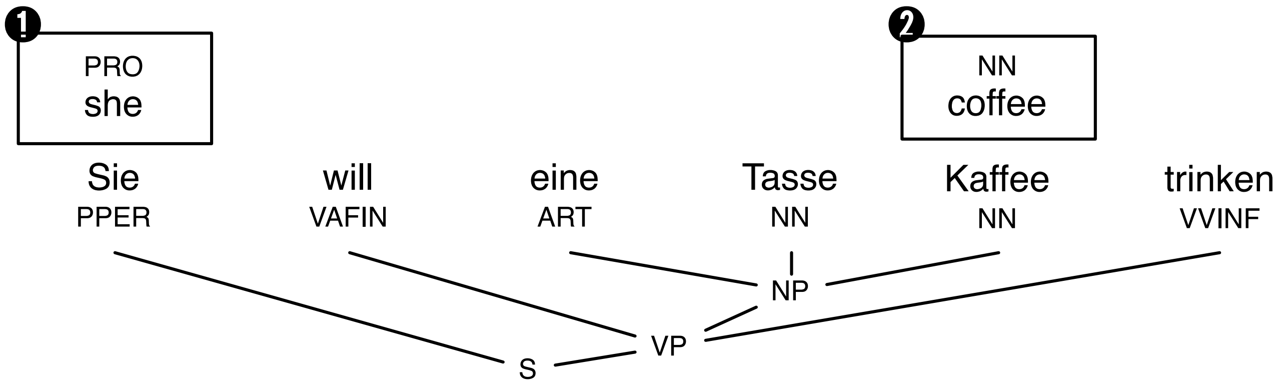
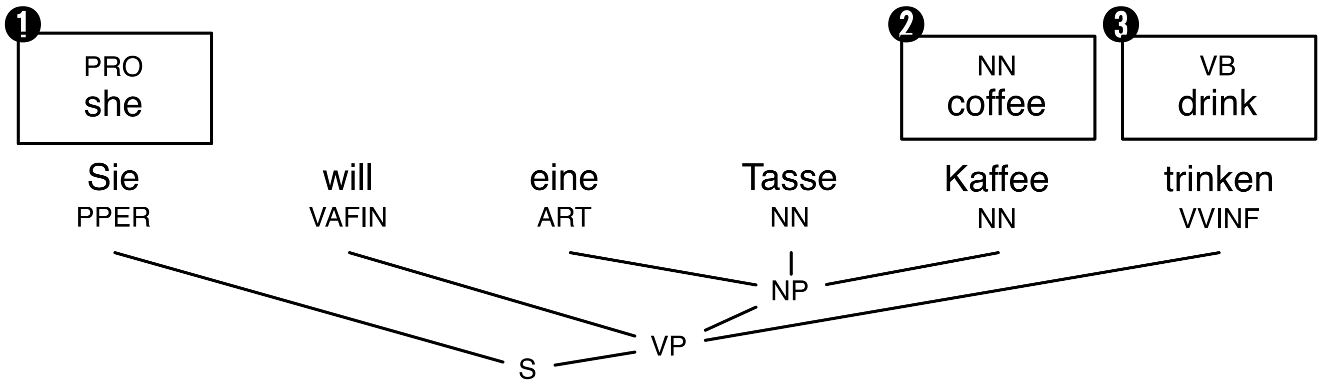


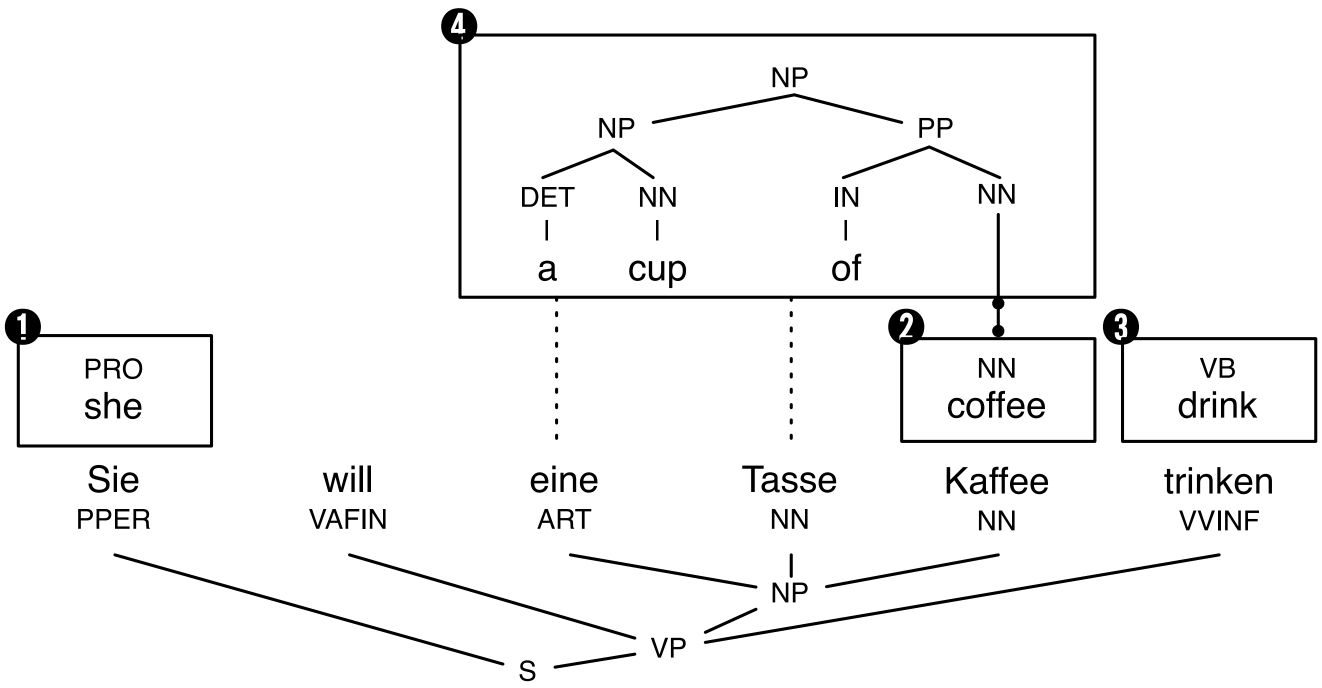
Syntax Decoding



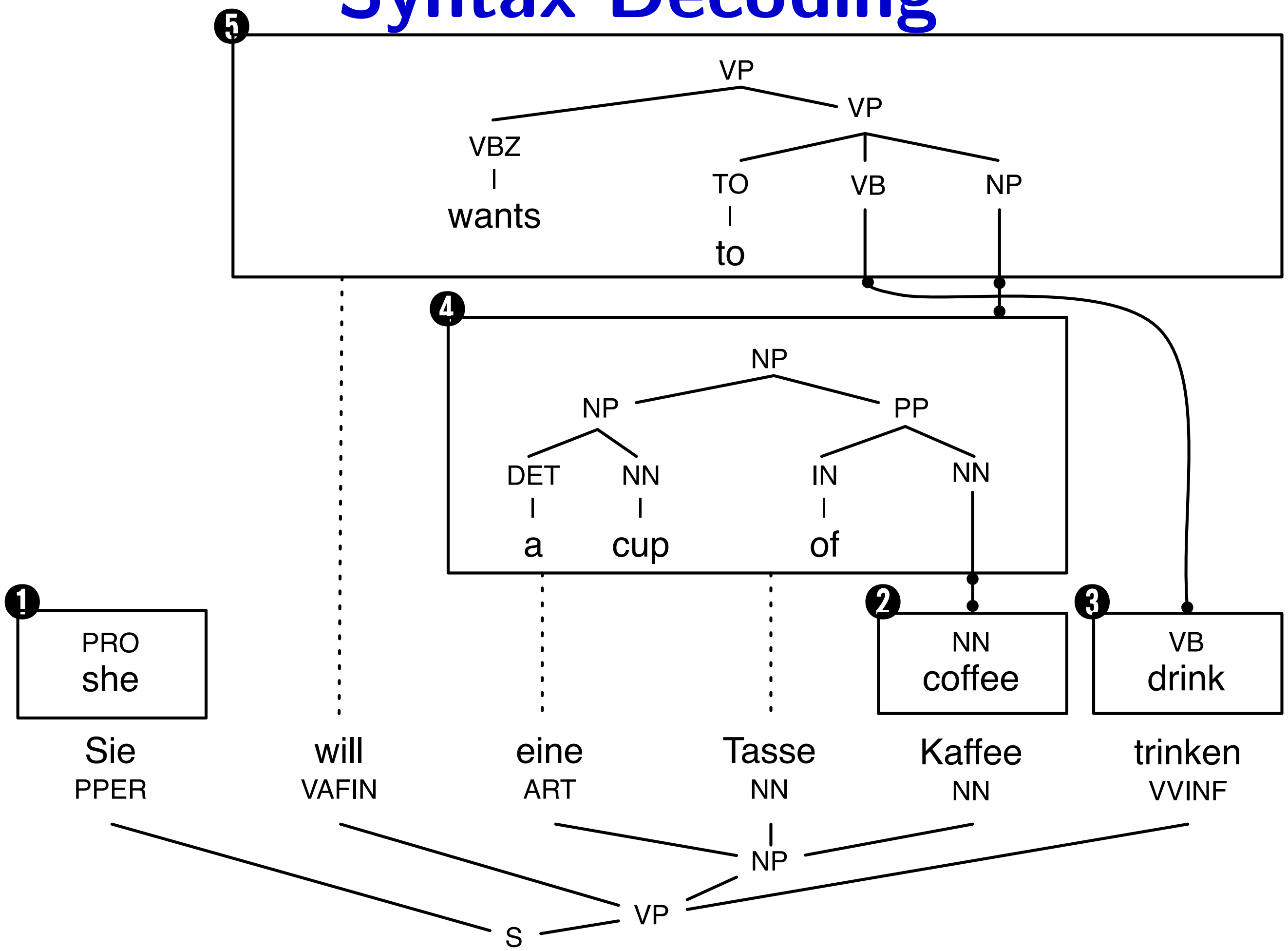
Syntax Decoding

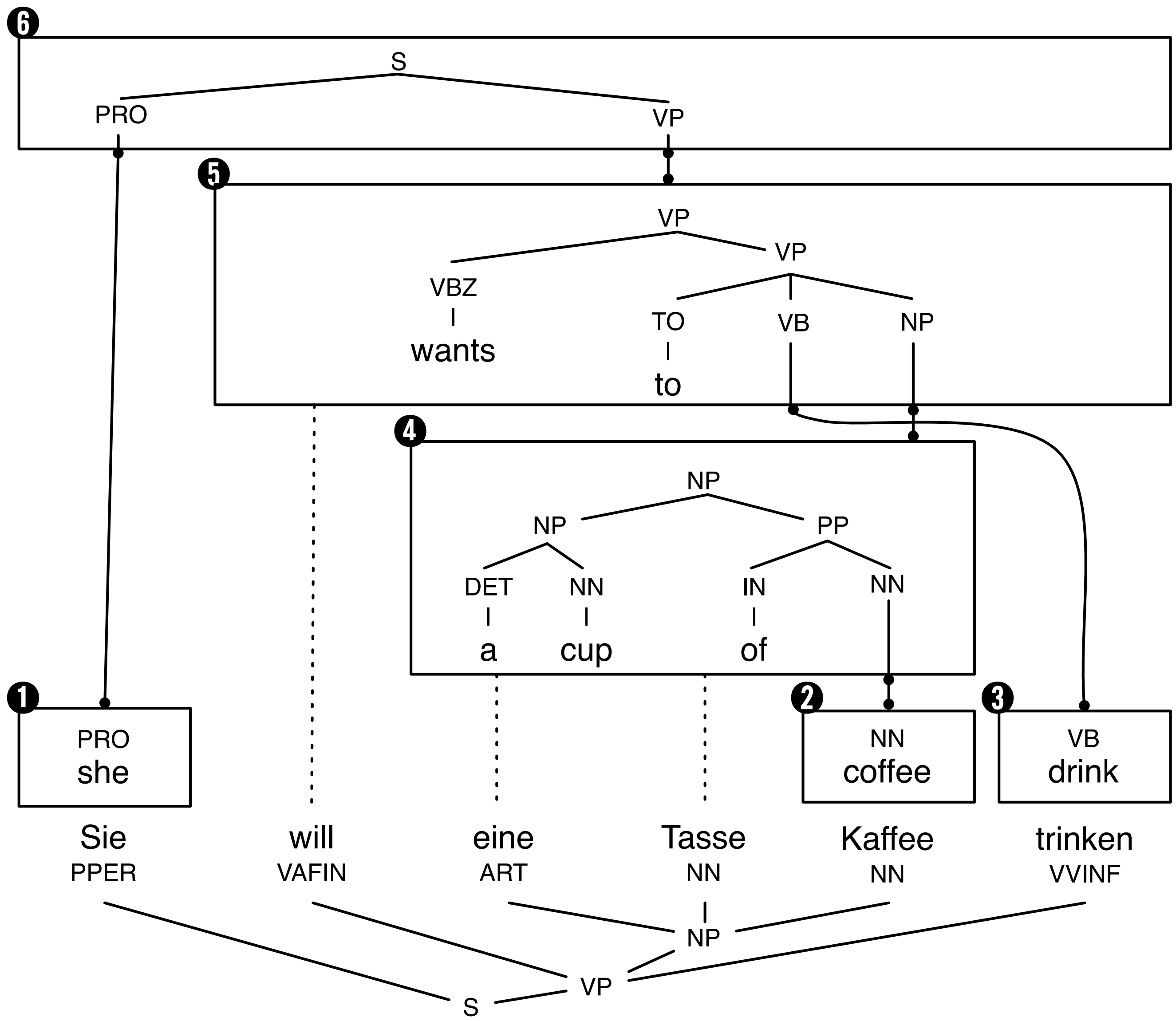


Syntax Decoding



Syntax Decoding

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Advanced Topics

- Data and domain adaptation
- Speed vs. quality
- Speed vs. memory use
- Language models
- Instructions to decoder
- Input formats
- Output formats
- Minimum Bayes risk decoding
- Translation models
- Experiment management system

Hands-On Session

Advanced Topics

Advanced Features

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Data

- Parallel corpora → translation model
  - sentence-aligned translated texts
  - translation memories are parallel corpora
  - dictionaries are parallel corpora

- Monolingual corpora → language model
  - text in the target language
  - billions of words easy to handle

Domain Adaptation

- The more data, the better
- The more in-domain data, the better
  (even in-domain monolingual data very valuable)
- Multiple models
  - train a translation model for each domain corpus
  - train a language model for each domain corpus
  - use all, tune weights for each model
  - alternative: interpolate language model
- Always tune towards target domain

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Speed

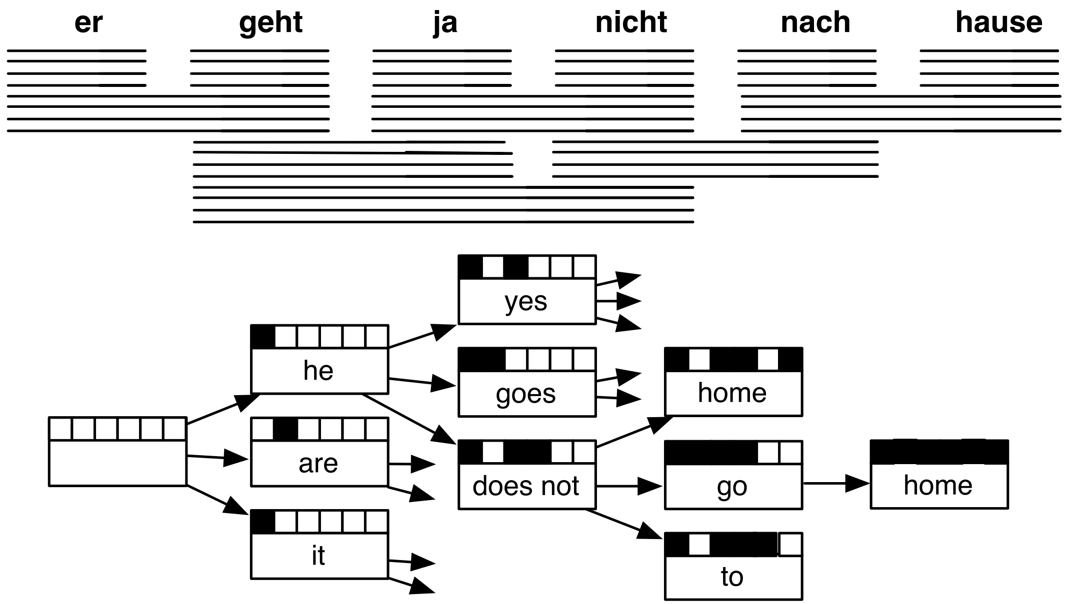
- Easy speed-up: multi-threaded decoding

```
--threads NUM
```

- Requires boost library

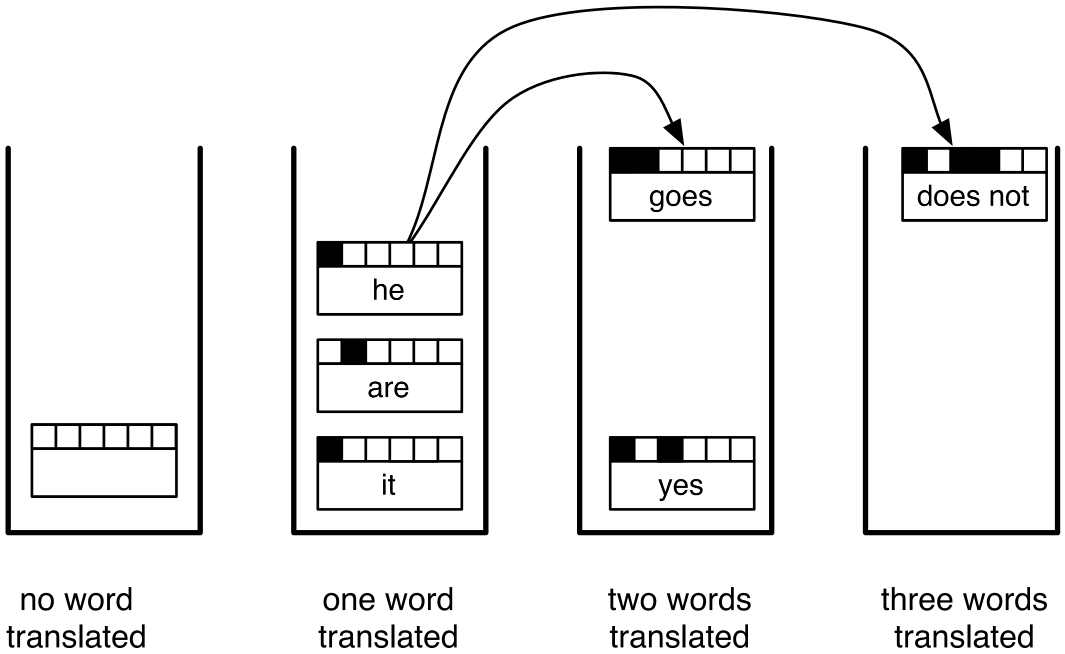
- Does not currently work for:
  - syntax-based decoding
  - IRSTLM
  - randLM

Speed vs. Quality



- Decoder search creates very large number of partial translations ("hypotheses")
- Decoding time $\sim$ number of hypotheses created
- Translation quality $\sim$ number of hypothesis created

Hypothesis Stacks



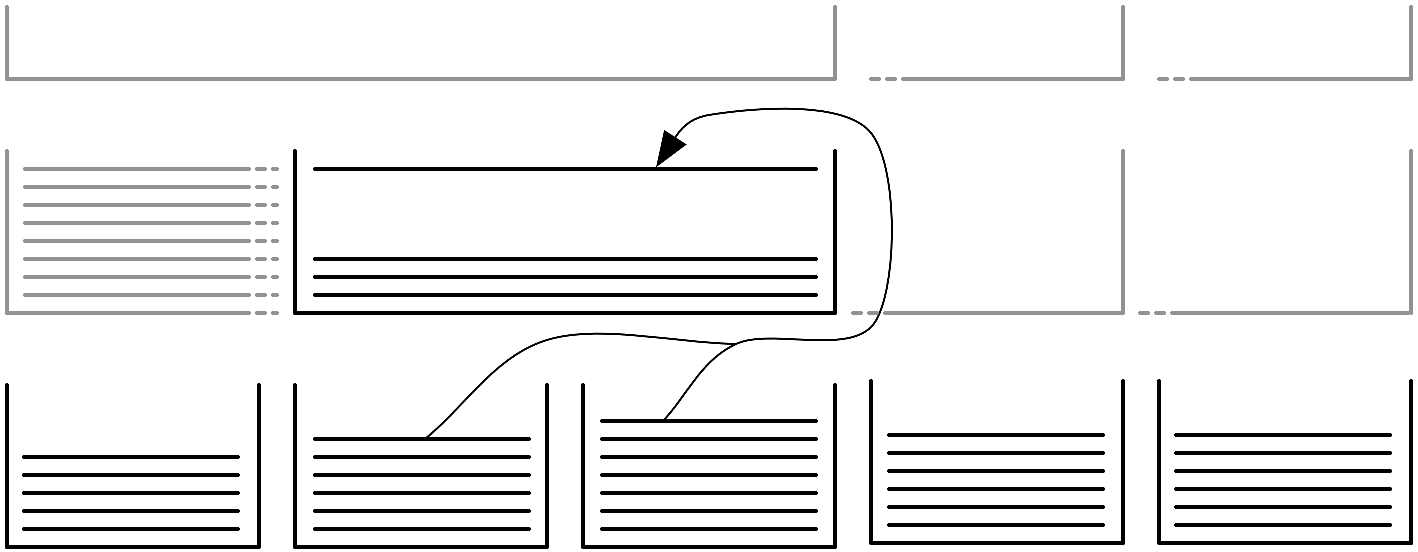
- Phrase-based: One stack per number of input words covered
- Number of hypothesis created = sentence length $\times$ stack size $\times$ applicable translation options

Pruning Parameters

- Regular beam search
  - `--stack NUM` max. number of hypotheses contained in each stack
  - `--ttable-limit NUM` max. num. of translation options per input phrase
  - search time roughly linear with respect to each number

- Cube pruning
  (fixed number of hypotheses are added to each stack)
  - `--search-algorithm 1` turns on cube pruning
  - `--cube-pruning-pop-limit NUM` number of hypotheses added to each stack
  - search time roughly linear with respect to pop limit
  - note: stack size and translation table limit have little impact in speed

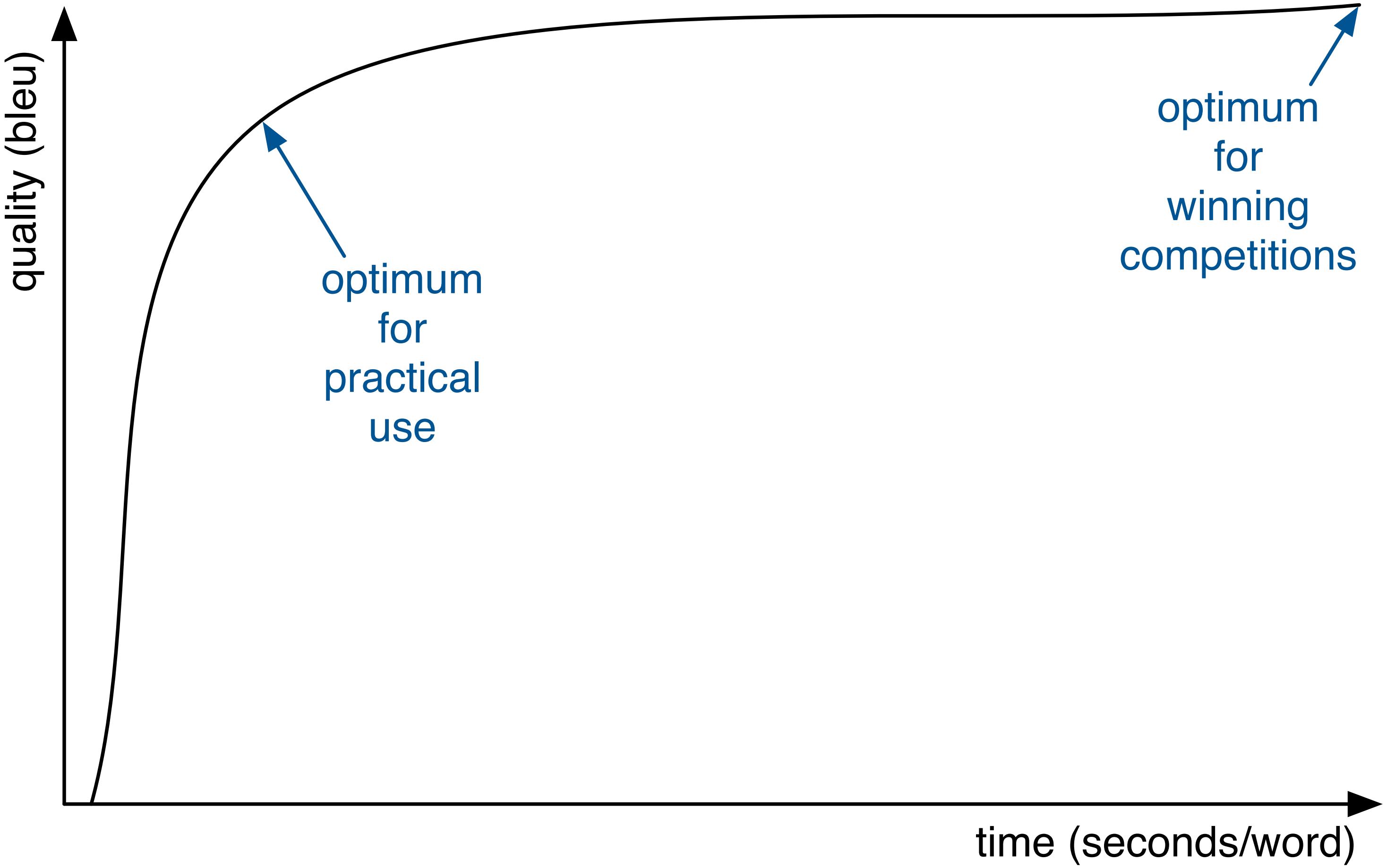
Syntax Hypothesis Stacks



- One stack per input word span
- Number of hypothesis created $=$
  sentence length^2 $\times$ number of hypotheses added to each stack

`--cube-pruning-pop-limit NUM` number of hypotheses added to each stack

Trade-Off Speed vs Quality



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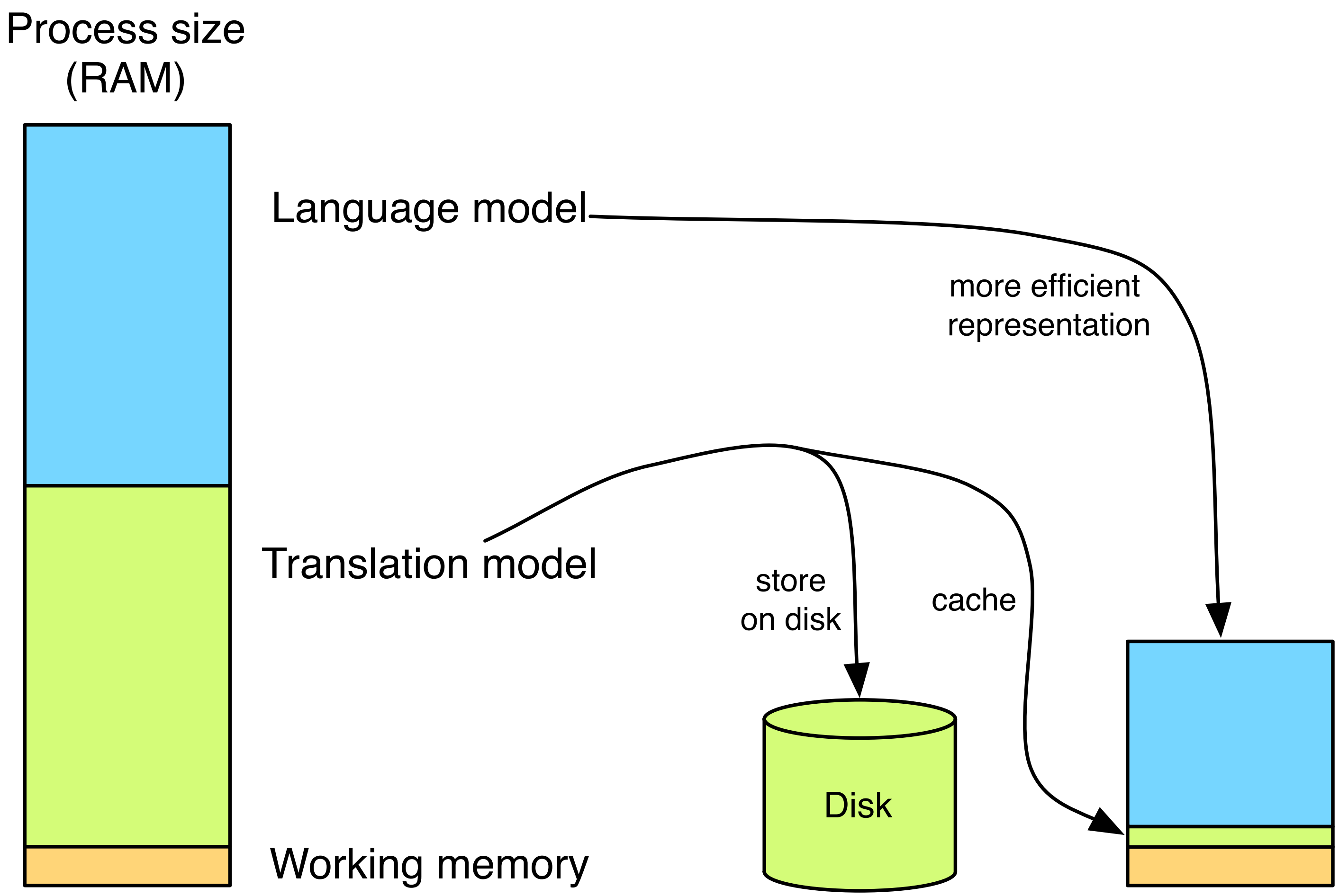
Speech vs. Memory Use

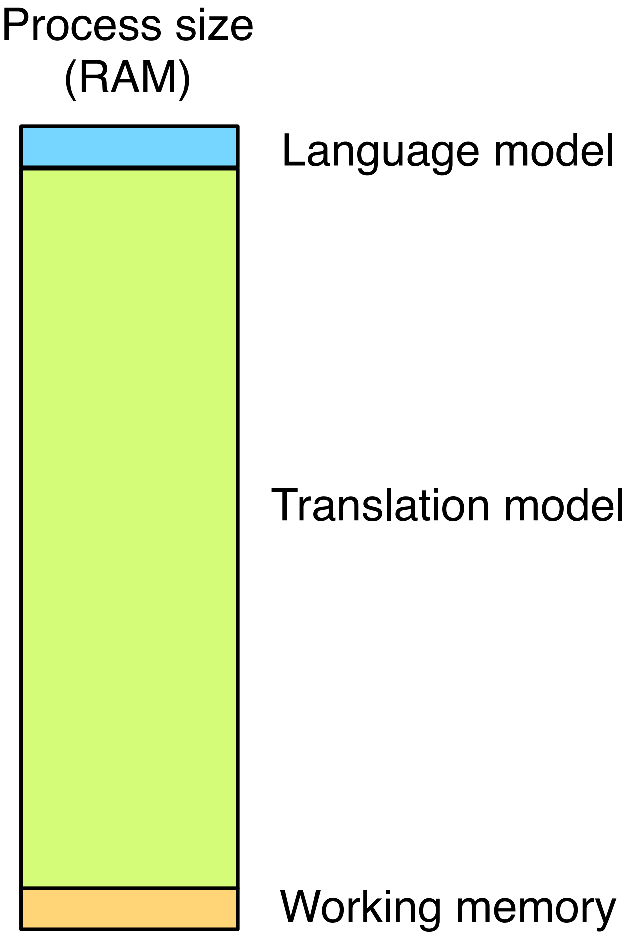


Speed vs. Memory Use

Typical Europarl file sizes:

- Language model
  - 170 MB (trigram)
  - 412 MB (5-gram)
- Phrase table
  - 11GB
- Lexicalized reordering
  - 9.4GB

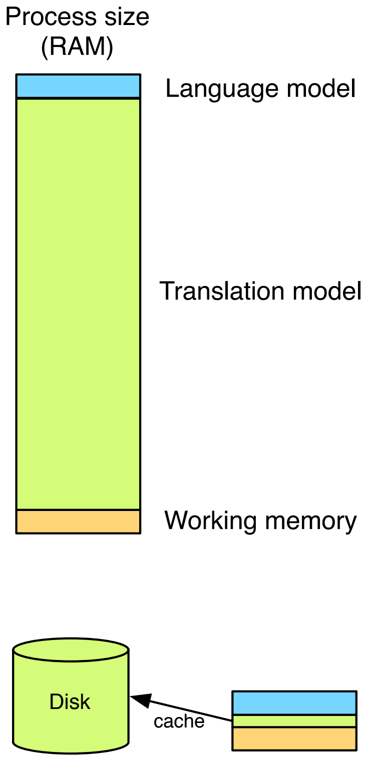
→ total = 20.8 GB



Speed vs. Memory Use

- Load into memory
  - fast decoding
  - large memory usage
  - large load time

- Load-on-demand
  - store indexed model on disk
  - binary format
  - minimal start-up time, memory usage
  - slower decoding



Speed vs. Memory Use

Phrase Table:

Phrase-based

```
export LC_ALL=C
cat pt.txt | sort | ./processPhraseTable -ttable 0 0 -  \
    -nscores 5 -out out.file
```

Hierarchical / Syntax

```
export LC_ALL=C
./CreateOnDiskPt 1 1 5 100 2 pt.txt out.folder
```

Lexical Reordering Table:

```
export LC_ALL=C
processLexicalTable -in r-t.txt -out out.file
```

Language Models (later)

Speed vs. Memory Use

Change ini file

Phrase-based

```
[ttable-file]
1 0 0 5 out.file
```

Hierarchical / Syntax

```
[ttable-file]
2 0 0 5 out.folder
```

Lexical Reordering Table

```
[distortion-file]
0-0 wbe-msd-bidirectional-fe-allff 6 out.file
```

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Language Models

- Probability of the output
- Very important in MT, for all SMT models → improve fluency
- Huge amount of training data easy to obtain
  - monolingual
  - can scrape from websites etc.
- But:
  - training takes a long time
  - large memory requirement during decoding
  - large load time
- IRSTLM and RandLM especially designed to tackle large data issues

IRSTLM

- Developed by FBK-irst, Trento, Italy
- Create a binary format which can be read from disk as needed
  - reduces memory but slower decoding
- Quantization of probabilities
  - reduces memory but lose accuracy
  - probability stored in 1 byte instead of 4 bytes

IRSTLM in Moses

- Compile the decoder with IRSTLM library

```
./configure --with-irstlm=[root dir of the IRSTLM toolkit]
```

- Change ini file to use IRSTLM implementation

```
[lmodel-file]
1 0 3 file/path
```

IRSTLM: Training

- Specialized training for large corpora
  - parallelization
  - reduce memory usage
- Training:

```
build-lm.sh -i "gunzip -c corpus.gz" -n 3
      -o train.irstlm.gz -k 10
```

  - `-n 3` = n-gram order
  - `-k 10` = split training procedure into 10 steps

IRSTLM: Binary Format

- Create binary format:

```
compile-lm language-model.srilm language-model.blm
```

- Load-on-demand:

```
rename file .mm
```

Randomized language model

- For huge corpora (e.g. 100 billion words)
- Lossy compression
  - Makes false positive mistakes
  - frequency of mistakes can be varied with a parameter
- Typically $\frac{1}{10}$ size of SRI / IRST language model
- Maybe use as secondary LM to complement conventional LM
  - out-of-domain data scraped from the web
  - high-order n-gram, eg. 6-7 gram

RandLM: Use in Moses

- Compile the decoder with RandLM library

```
./configure --with-randlm=[root dir of the RandLM toolkit]
```

- Change ini file to use RandLM implementation

```
[lmodel-file]
0 0 3 /path/to/file   # conventional lm
5 0 7 /path/to/file   # rand lm
```

RandLM: Training

- Train from text corpus

```
./buildlm -struct BloomMap -falsepos 8 -values 8 -order 3
   -output-prefix model
   < corpus.txt
```

- Convert SRILM language model

```
./buildlm -struct BloomMap -falsepos 8 -values 8 -order 3
   -output-prefix model
   -input-path lm.srilm -input-type arpa
```

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Specifying Translations with XML

- Translation tables for numbers?

f	e	$p(f\|e)$
2003	2003	0.7432
2003	2000	0.0421
2003	year	0.0212
2003	the	0.0175
2003	...	...

- Instruct the decoder with XML instruction

the revenue for <num translation="2003"> 2003 </num> is higher than ...

- Deal with different number formats

er erzielte <num translation="17.55"> 17,55 </num> Punkte .

Walls and Zones

- Specification of reordering constraints
- Zone

  sequence to be translated without reordering with outside material
- Wall

  hard reordering constraint, no words may be reordered across
- Local wall

  wall within a zone, not valid outside zone

Walls and Zones: Examples

- Requiring the translation of quoted material as a block

  He said `<zone>` " yes " `</zone>` .

- Hard reordering constraint

  Number 1 : `<wall/>` the beginning .

- Local hard reordering constraint within zone

  A new plan `<zone>` (`<wall/>` maybe not new `<wall/>`) `</zone>` emerged .

- Nesting

  The `<zone>` " new `<zone>` (old) `</zone>` " `</zone>` proposal .

Preserving Markup

- How do you translate this:

<h1>My Home Page</h1>
I really like to eat chicken!

- Solution 1: XML translations, walls and zones

```
<x translation="<h1>"/> <wall/> My Home Page <wall/>
<x translation="</h1>"/>
```

```
I really like to <zone><x translation="<b>"/> <wall/> eat <wall/>
<x translation="</b>"/> </zone> chicken !
```

(note: special XML characters like $<$ and $>$ need to be escaped)

Preserving Markup

- Solution 2: Handle markup externally
  - track word positions and their markup

I	really	like	to	eat	chicken	!
1	2	3	4	5	6	7
-	-	-	-		-	-

  - translate without markup

I really like to eat chicken !

  - keep word alignment to source

Ich	esse	wirklich	gerne	Hühnchen	!
1	5	2	3-4	6	7

  - re-insert markup

Ich esse wirklich gerne Hühnchen!

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Example: Misspelt Words

- Misspelt sentence:

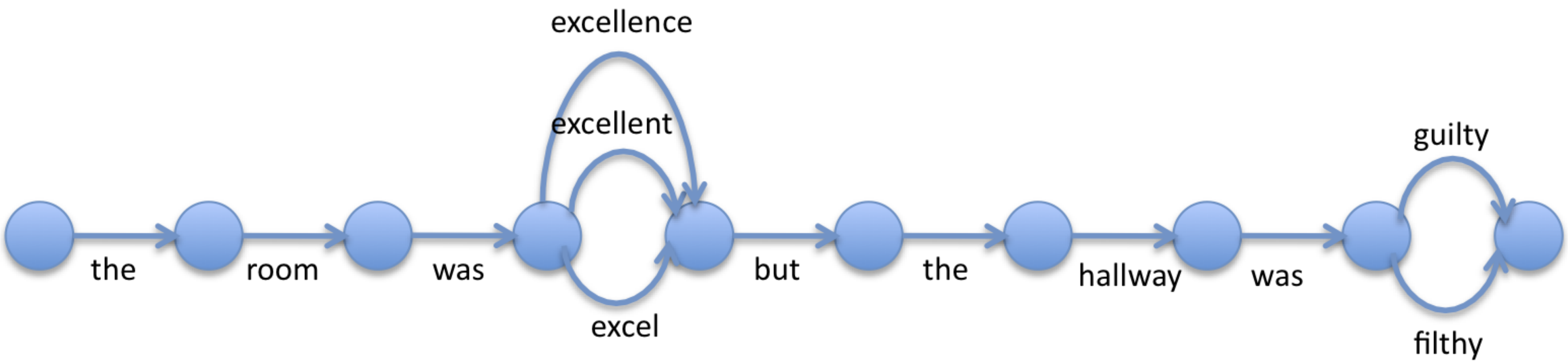
The room was *exellent but the hallway was *filty .

- Strategies for dealing with spelling errors:
  - Create correct sentence with correction
    × problem: if not corrected properly, adds more errors
  - Create many sentences with different corrections
    × problem: have to decode each sentence, slow

Confusion Network

The room was *exellent but the hallway was *filty .

Input to decoder:



Let the decoder decide

Example: Diacritics

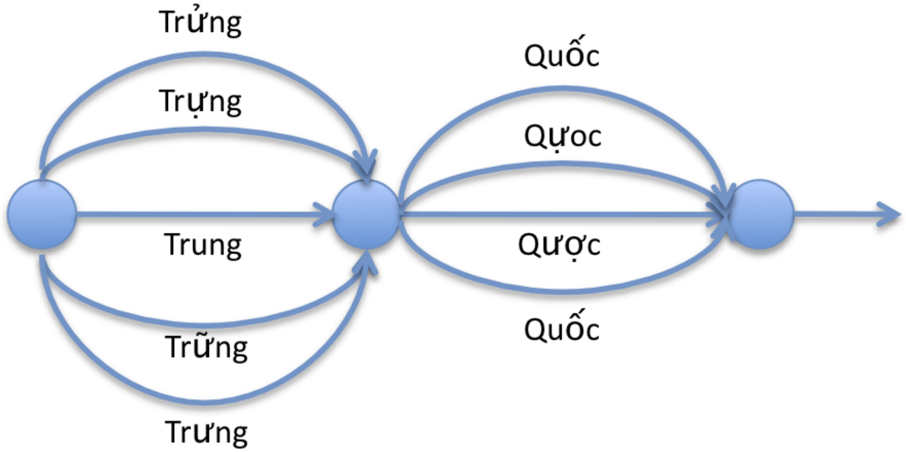
- Correct sentence

Trung Quốc cảnh báo Mỹ về luật tiền tệ

- Something a non-native person might type

Trung Quoc canh bao My ve luat tien te

- Confusion network



Confusion Network Specification

Argument on command line

```
./moses -inputtype 1
```

Input to moses

```
the 1.0
room 1.0
was 1.0
excel 0.33 excellent 0.33 excellence 0.33
but 1.0
the 1.0
hallway 1.0
was 1.0
guilty 0.5 filthy 0.5
```

Lattice

Example: Chinese Word Segmentation

- Unsegmented sentence

硬质合金号称”工业牙齿"

- Incorrect segmention

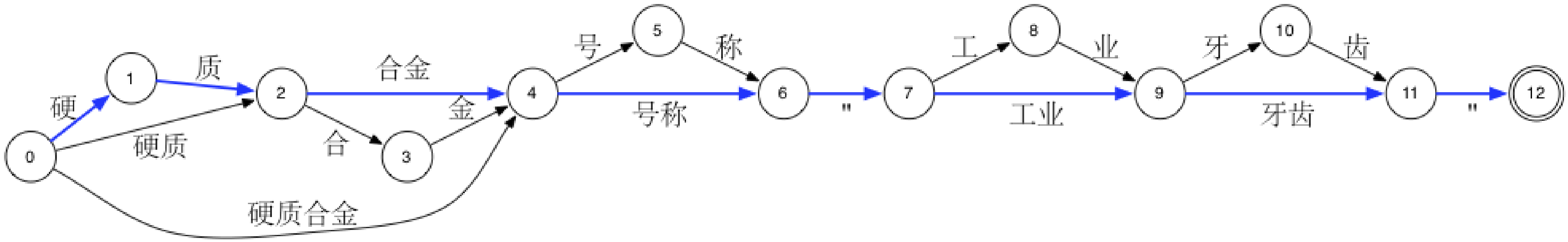
硬质 合 金 号称 " 工 业牙 齿 "

- Correct segmention

硬 质 合金 号称 " 工业 牙齿 "

Lattice

Input to decoder:



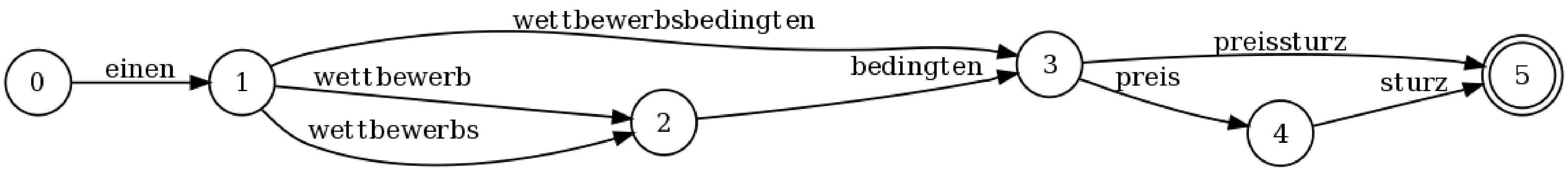
Let the decoder decide

Example: Compound Splitting

- Input sentence

einen wettbewerbsbedingten preissturz

- Different compound splits



- Let the decoder decide

Lattice Specification

Command line argument

```
./moses -inputtype 1
```

Input to Moses (PLF format - Python Lattice Format)

```
(
 (
  ('einen', 1.0, 1),
 ),
 (
  ('wettbewerbsbedingten', 0.5, 2),
  ('wettbewerbs', 0.25, 1),
  ('wettbewerb', 0.25, 1),
 ),
 (
  ('bedingten', 1.0, 1),
 ),
 (
  ('preissturz', 0.5, 2),
  ('preis', 0.5, 1),
 ),
 (
  ('sturz', 1.0, 1),
 ),
)
```

Advanced Features

- Data and domain adaptation
- Speed vs. quality
- Speed vs. memory use
- Language models
- Instructions to decoder
- Input formats
- **Output formats**
- Minimum Bayes risk decoding
- Translation models
- Experiment management system

N-Best List

- Input

es gibt verschiedene andere meinungen .

- Best Translation

there are various different opinions .

- Next nine best translations

there are various other opinions .
there are different different opinions .
there are other different opinions .
we are various different opinions .
there are various other opinions of .
it is various different opinions .
there are different other opinions .
it is various other opinions .
it is a different opinions .

Uses of N-Best Lists

- Let the translator choose from possible translations
- Reranker
  - add more knowledge sources
  - can take global view
  - coherency of whole sentence
  - coherency of document
- Used to tune component weights

N-Best Lists in Moses

Argument to command line

```
./moses -n-bestlist n-best.file.txt [distinct] 100
```

Output

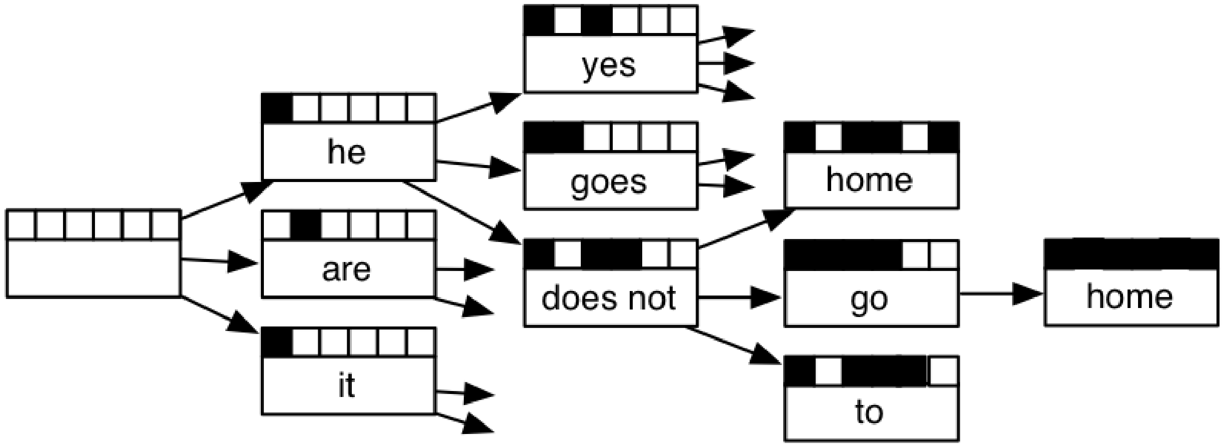
```
0 ||| there are various different opinions .  ||| d: 0 lm: -21.6664 w: -6 ...  ||| -113.734
0 ||| there are various other opinions .  ||| d: 0 lm: -25.3276 w: -6 ... ||| -114.004
0 ||| there are different different opinions .  ||| d: 0 lm: -27.8429 w: -6 ...  ||| -117.738
0 ||| there are other different opinions .  ||| d: -4 lm: -25.1666 w: -6 ...  ||| -118.007
0 ||| we are various different opinions .  ||| d: 0 lm: -28.1533 w: -6 ...  ||| -118.142
0 ||| there are various other opinions of .  ||| d: 0 lm: -33.7616 w: -7 ...  ||| -118.153
0 ||| it is various different opinions .  ||| d: 0 lm: -29.8191 w: -6  ... ||| -118.222
0 ||| there are different other opinions .  ||| d: 0 lm: -30.426 w: -6 ...  ||| -118.236
0 ||| it is various other opinions .  ||| d: 0 lm: -32.6824 w: -6 ... ||| -118.395
0 ||| it is a different opinions .  ||| d: 0 lm: -20.1611 w: -6 ...  ||| -118.434
```

Search Graph

- Input

er geht ja nicht nach hause

- Return internal structure from the decoder



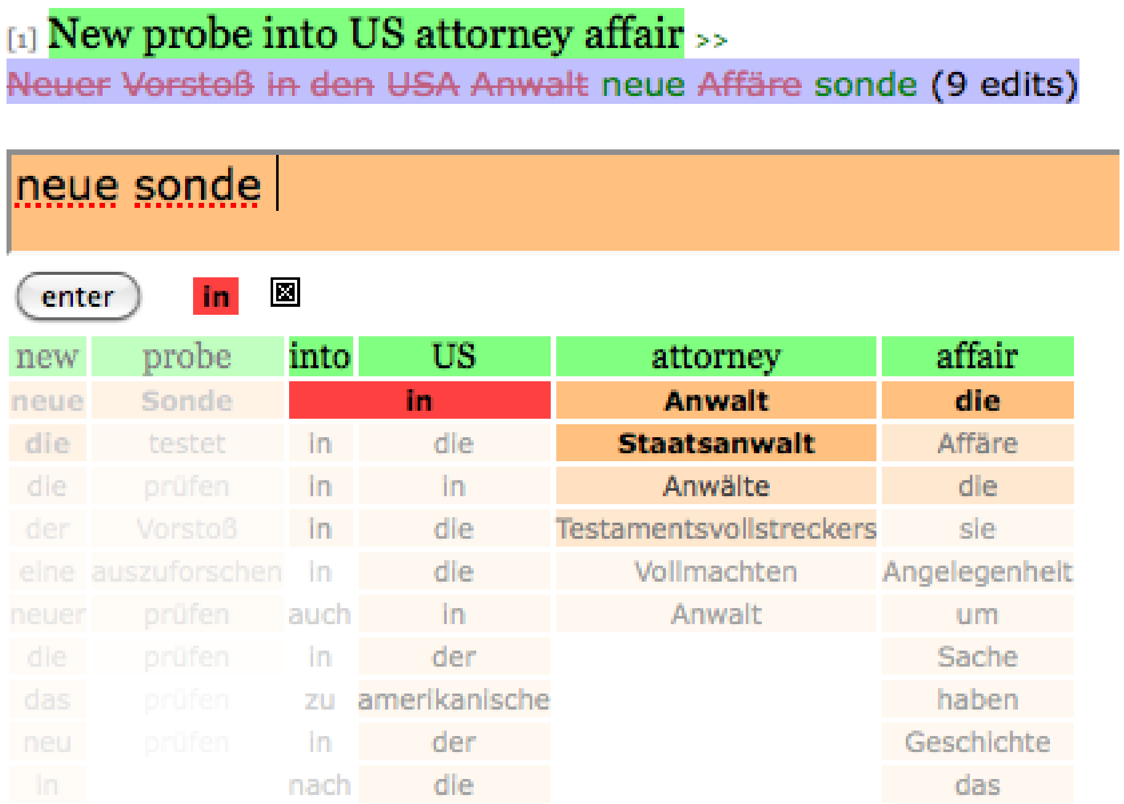
- Encode millions of other possible translations
  (every path through the graph = 1 translation)

Uses of Search Graphs

- Let the translator choose
  - Individual words or phrases
  - 'Suggest' next phrase

- Reranker

- Used to tune component weights
  - More difficult than with n-best list



Search Graphs in Moses

Argument to command line

```
./moses -output-search-graph search-graph.file.txt
```

Argument to command line

```
0 hyp=0 stack=0 forward=36 fscore=-113.734
0 hyp=75 stack=1 back=0 score=-104.943 ... covered=5-5 out=.
0 hyp=72 stack=1 back=0 score=-8.846 ... covered=4-4 out=opinions
0 hyp=73 stack=1 back=0 score=-10.661 ... covered=4-4 out=opinions of
```

- hyp - hypothesis id
- stack - how many words have been translated
- score - total weighted score
- covered - which words were translated by this hypothesis
- out - target phrase

Advanced Features

- Data and domain adaptation
- Speed vs. quality
- Speed vs. memory use
- Language models
- Instructions to decoder
- Input formats
- Output formats
- **Minimum Bayes risk decoding**
- Translation models
- Experiment management system

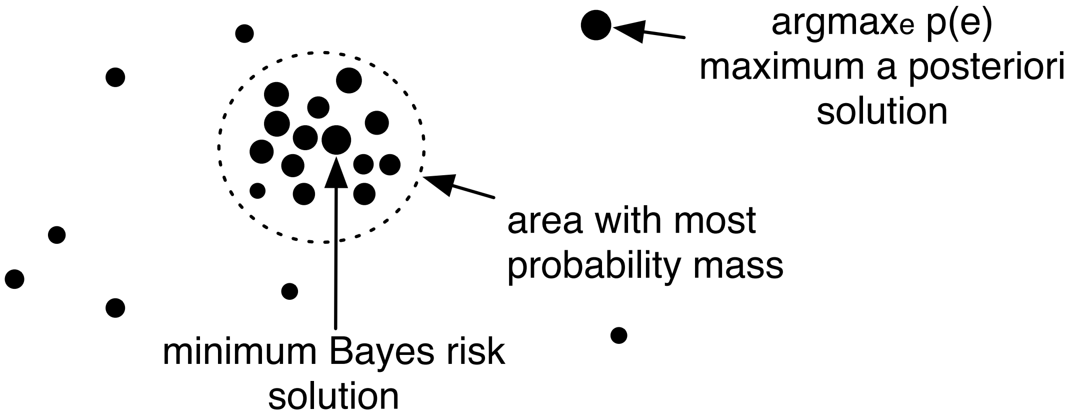
Minimum Bayes Risk Decoding

- Normal (MAP) decoding:

$$\hat{t} = argmax_t \; p(t|s)$$

- MBR decoding:

$$\hat{t} = argmax_t \sum_{t' \in T} p(t'|s) \times bleu(t', t)$$



Minimum Bayes Risk Decoding

- Set of translations $t' \in T$

$$\hat{t} = argmax_t \sum_{t' \in T} p(t'|s) \times bleu(t', t)$$

- Using n-best list:

```
moses -f moses.ini -i in.txt -mbr
```

- Using lattice:

```
lmbrgrid ... -f moses.ini -i input.txt
```

Advanced Features

- Data and domain adaptation
- Speed vs. quality
- Speed vs. memory use
- Language models
- Instructions to decoder
- Input formats
- Output formats
- Minimum Bayes risk decoding
- **Translation models**
- Experiment management system

Phrase-Based Model

- Advantages
  - fast: under half a second per sentence for fast configuration
  - low-memory requirement
    - 200-300MB for lowest configuration
    - suitable for netbooks and mobile devices
  - outperform more complicated models for many language pairs
    - especially for related languages pairs

- Command line

```
./moses -f moses.ini -i in.txt > out.txt
```

- Output

```
there are various different opinions .
```

Hierarchical Models

Advantages

- able to model non-contiguous phrases
  - ne..pas $\longrightarrow$ not
- low-memory requirement
  - 200-300MB for lowest configuration
  - suitable for netbooks and mobile devices
- outperform phrase-based models when translating between widely different languages
  - Chinese-English consistently better with hierarchical model
  - better at medium range re-ordering
- Linguistically motivated

Disadvantages

- slower
  - 0.5 - 2 sec for fastest configuration
- more memory requirement
  - 1-2GB ram
- more disk usage
  - translation model $\times$10 larger than phrase-based

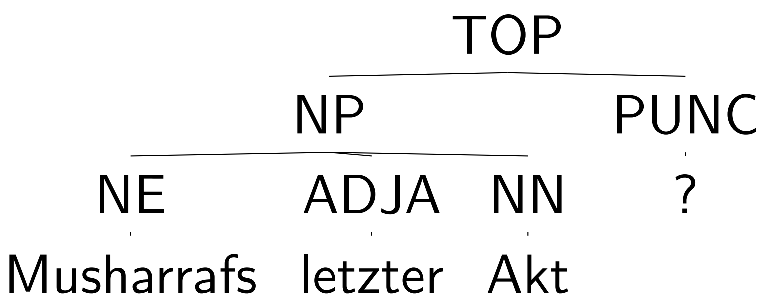
Command line

```
./moses-chart -f moses.ini -i in.txt > out.txt
```

Syntax Models

- Hierarchical model + use of syntactic information (constituency parser, chunkers)
- Advantage
  - Can use outside linguistic information
  - promises to solve important problems in SMT, eg. long-range reordering
- Disadvantages
  - difficult to get right
  - for many language pairs still worse than phrase-based and hierarchical models
  - need syntactic parse information
    * unreliable
    * available only for some languages
    * not designed for machine translation

Moses Tree Representation




```
– <tree label="TOP">
  – <tree label="NP">
      <tree label="NE"> Musharrafs </tree>
      <tree label="ADJA"> letzter </tree>
      <tree label="NN"> Akt </tree>
    </tree>
    <tree label="PUNC"> ? </tree>
  </tree>
```

Phrase-Based Model Training

- Command line

```
train-model.perl ...
```

- Model

```
Bndnisse ||| alliances ||| 1 1 1 1 2.718 ||| ||| 1 1
General Musharraf betrat am ||| general Musharraf appeared on ||| 1 1 1 1 2.718 ||| ||| 1 1
```

Hierarchical Model Training

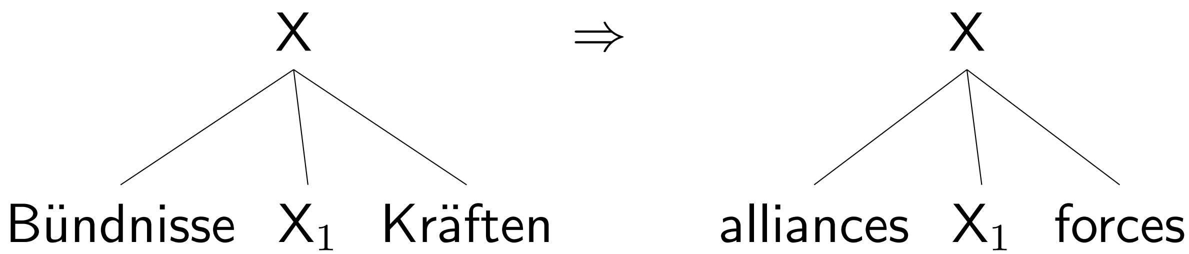
- Command line

```
train-model.perl ... -hierarchical
```

- Example rule from model

```
Bündnisse [X][X] Kräften [X] ||| alliances [X][X] forces [X] ||| 1 1 1 1 2.718 ||| 1-1 ||| 0.0526316 0.0526316
```

- Visualization of rule



Tree-to-String Model Training

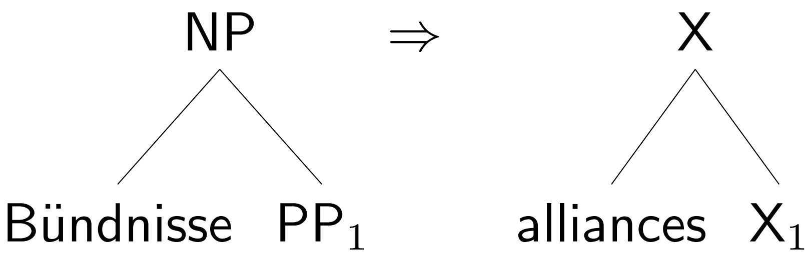
- Command line

```
train-model.perl ... -source-syntax
```

- Example rule from model

```
Bündnisse [PP][X] [NP] ||| alliances [PP][X] [X] ||| 1 1 1 1 2.718 ||| 1-1 ||| 1 1
```

- Visualization of rule



String to Tree Model Training

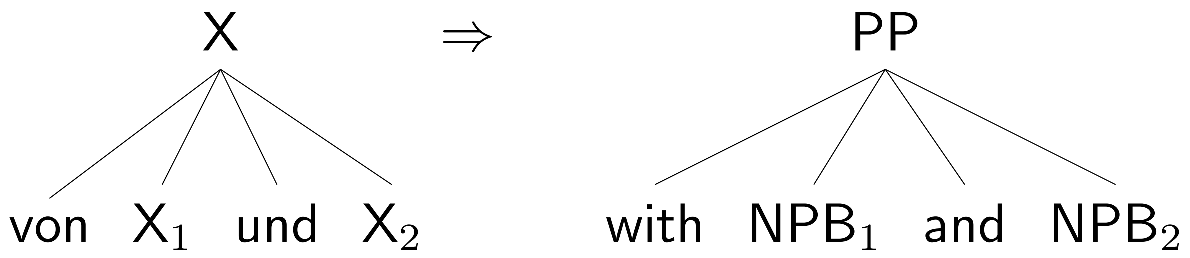
- Command line

```
train-model.perl ... -target-syntax
```

- Example rule from model

```
von [X][NPB] und [X][NPB] [X] ||| with [X][NPB] and [X][NPB] [PP] ||| ...
```

- Visualization of rule



Tree-to-Tree Model Training

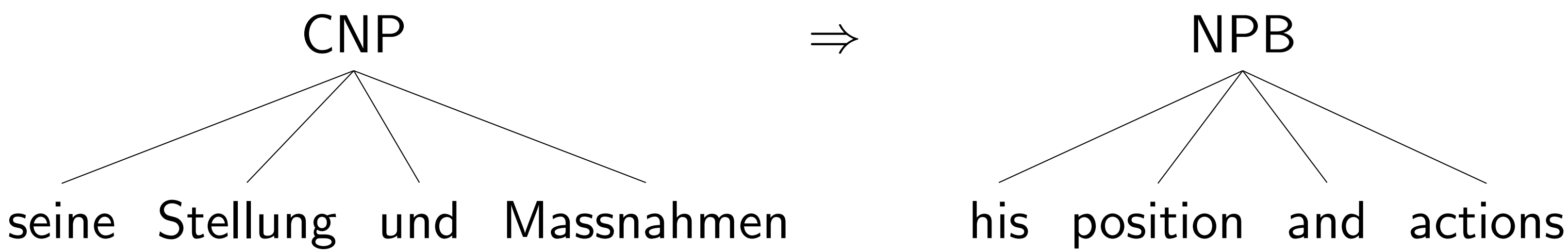
- Command line

```
train-model.perl ... -source-syntax -target-syntax
```

- Example rule from model

```
seine Stellung und Manahmen [CNP] ||| his position and actions [NPB] ||| ...
```

- Visualization of rule



Syntax Models Decoding in Moses

- String-to-string (hierarchical) or string-to-tree

```
./moses-chart -f moses.ini -i in.txt > out.txt
```

- Tree-to-string or tree-to-tree

```
./moses-chart -f moses.ini -i in.txt -inputtype 3 > out.txt
```

Advanced Features

- Data and domain adaptation
- Speed vs. quality
- Speed vs. memory use
- Language models
- Instructions to decoder
- Input formats
- Output formats
- Minimum Bayes risk decoding
- Translation models
- **Experiment management system**

Running Experiments

Execute a lot of scripts

```
tokenize < corpus.en > corpus.en.tok
lowercase < corpus.en.tok > corpus.en.lc
...
mert.perl ....
moses ...
mteval-v13.pl ...
```

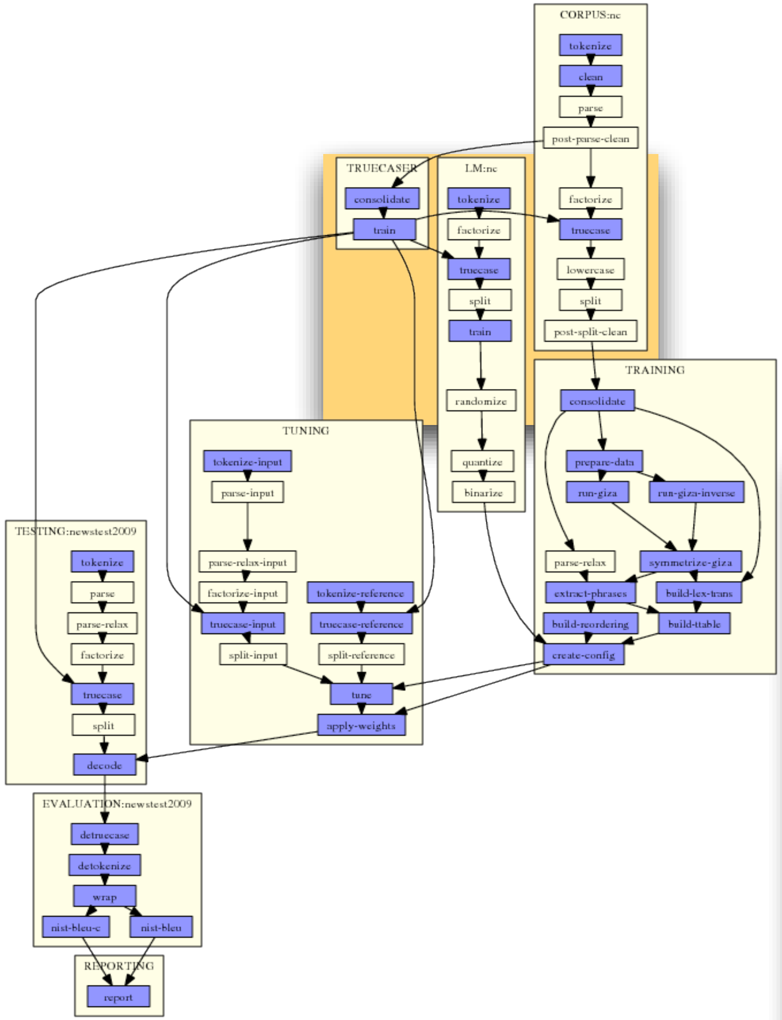
Change a part of the process, execute everything again

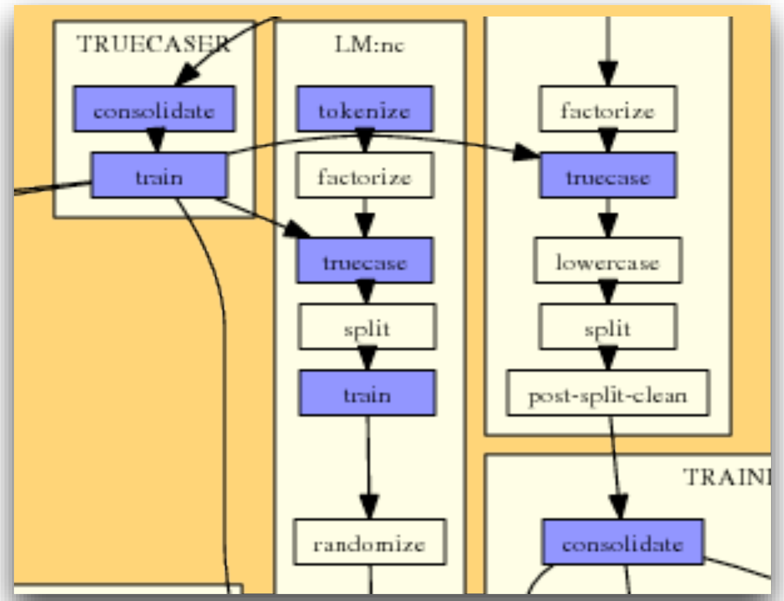
```
tokenize < corpus.en > corpus.en.tok
lowercase < corpus.en.tok > corpus.en.lc
...
mert.perl ....
moses ...
mteval-v13.pl ...
```

Experiment Management System

- One configuration file for all settings: record of all experimental details
- Scheduler of individual steps in pipeline
  - automatically keeps track of dependencies
  - on single machine, multi-core machines, GridEngine clusters
  - parallel execution
  - crash detection
  - automatic re-use of prior results
- Fast to use
  - set up a new experiments in minutes
  - set up a variation of an experiment in seconds

Workflow automatically generated by experiment.perl





How does it work?

- Write a configuration file (typically by adapting an existing file)

- Execute:

```
experiment.perl -config config
```

Web Interface

All Experimental Setups

ID	User	Task	Directory
97	pkoehn	Acquis Truecased	/group/project/statmt2/pkoehn/acquis-truecase
96	pkoehn	Chinese-English AGILE 2008	/group/project/statmt2/pkoehn/agile08-chinese
95	miles	Randlm testing	/group/project/statmt7/miles/experiments /ep-enfr/work
94	joseph	Proj2008 Impl.Adapted experiment(fr-en)for News Comm.	/group/project/statmt2/joseph/experimentJo/task6
93	joseph	Proj2008 Impl.Baseline experiment(fr-en)for News Comm.	/group/project/statmt2/joseph/experimentJo/task5
92	jschroe1	FR-EN System Combination Components	/group/project/statmt9/josh/experiments /fr-syscomb/work

List of experiments

List of Runs

Task: WMT10 German-English (pkoehn)

Wiki Notes | Overview of experiments | /fs/bragi2/pkoehn-experiment/wmt10-de-en

compare	ID	start	end	avg	newstest2009		newstest2010	
cfg|par|img	[1042-16] 11+analysis	16 May	16 May	BLEU-c: 21.74 BLEU: 22.91	21.03 (1.002) 22.30 (1.002)	Ⓐ	22.45 (1.041) 23.51 (1.041)	Ⓐ
cfg|par|img	[1042-15] 11+Internal emplus test set	21 Apr	crashed	-	-		-	
cfg|par|img	[1042-14] 9+interpolated-tm.lm-weighted	21 Feb	21 Feb 9: 0.239258 -> 0.239296	-	20.81 (1.003) 22.06 (1.003)	Ⓐ	-	
cfg|par|img	[1042-13] 9+only-ep	21 Feb	21 Feb 13: 0.235046 -> 0.235053	-	20.42 (1.002) 21.69 (1.002)	Ⓐ	-	
cfg|par|img	[1042-12] 9+only-nc	21 Feb	21 Feb 7: 0.222237 ->	-	18.96 (1.002) 20.16	Ⓐ	-	

Analysis: Basic Statistics

Coverage

	model	corpus
0	2047 (3.1%)	1708 (2.6%)
1	738 (1.1%)	518 (0.8%)
2-5	1483 (2.2%)	818 (1.2%)
6+	61745 (93.5%)	62969 (95.4%)

by token / by type / details

Phrase Segmentation

	1	2	3	4+
1 to	26897 (40.7%)	2145 (3.2%)	278 (0.4%)	90 (0.1%)
2 to	4144 (6.3%)	14414 (21.8%)	2518 (3.8%)	432 (0.7%)
3 to	639 (1.0%)	3522 (5.3%)	4821 (7.3%)	1272 (1.9%)
4+ to	158 (0.2%)	855 (1.3%)	1693 (2.6%)	2135 (3.2%)

by word / by phrase

- Basic statistics
  - n-gram precision
  - evaluation metrics
  - coverage of the input in corpus and translation model
  - phrase segmentations used

Analysis: Unknown Words

grouped by frequency in test set

unknown words

18 Eatonville
16 Hurston
12 Barrick
12 Hema
12 Stewards
11 Gebrselassie
10 Flamenco
10 Mango
9 Glitter
9 ÚOHS
9 ČTÚ
8 Coles
8 Deka
8 Garci
8 ITV

4: Eatonvilles, Együtt, Garver, Harmadik, Hurstons, Jobb, Jol, Jos, Jövőért, Kovalev, Krever, Lados, Mercandelli, Stehplätze, Tauro, Tórtola, Zenobia, fon, Évezredért, Ózd

3: Anmil, Atlasz, BR23C, BSA, Bayón, Biztos, Bt., Butch, Casado, Dal, Embraer, FT, Faymann, Fiatal, Gregg, Gélineau, HSV, Hanzelka, Illhäusern, Iván, Jansen, Jančura, Joanne, Kemrová, Kid, Llamazares, Loafs, Mangas, Medikamentes, Mobil.cz, Mutual,

2: Abfertigungen, Albums, Alondra, Andoh, Anm., Armiñon, Ashford, BZÖ, Baloldal, Bani, Baugesellschaften, Bedienkomfort, Bento, Bentos, Bingleys, Bojen, Bowens, Bowery, Boyd, Bringley, Browser, Bělohlávek, CBGB, Carci, Cera, Charts, Chemical, Chigi, Cineast, Comics, Commerzbank, Coppola, Corker, Cowon, DF, Dinkins, Download, Drehbewegung, Drzewiecki, Drápal, Düsseldorfer, Ella,

1: -Ach, -Minister, -Pakets, -weiss, .docx, .pptx, .xlsx, 1,45, 1.106,55, 1.983,73, 10.365,45, 10.579, 10.809,25, 106,85, 11,9, 11.743,61, 12.595.75, 14,2, 14,7, 145.29, 16,8, 17.9, 18,6, 18.286,90, 1802, 1834, 1880ern, 1920ern, 1925, 19252008, 199,61, 2,178, 2,37, 2.400, 26,3, 270.000, 29,2, 3,30, 3,632, 3,827, 3.0.0, 4,161, 4,357, 42,2, 43,4, 499, 49sten, 5.839, 506,43, 6,98, 684,81, 729,700, 75,5, 777,68, 8,25, 8,81, 9,14, 99.80, AAC, ADQ, ART, Aareal, Abbremsens, Abhöraktion, Absenzen, Abwesenheiten, Abwiegen, Abwärtssog, Achronot, Actor, AdSense, AdWords, Aday, Adobe, Adressverzeichnisses, Adwards, Adélard, Agazio, Akku, Akron, Aktuálně.cz, Alameda, Alatriste, Alcolock, Aleš, Alhambra, Alleinregierer, Amazonengebiet, Amil, Aminei, Amministrazione, Amway, Andalusierin, Andik, Android, Anděl, Angeklagtem, Ansa, Anthologie, Antiasthmatika, Apnoe, Aquel, Arabija, Arbeiternehmers, Arcandor, Arriaga, Asiana, Askale, Astronomen, Aufeislegen, Augäpfel, Ausdrückstärke, Ausführungs-, Ausgeruhter, Ausscheidungsspiele,

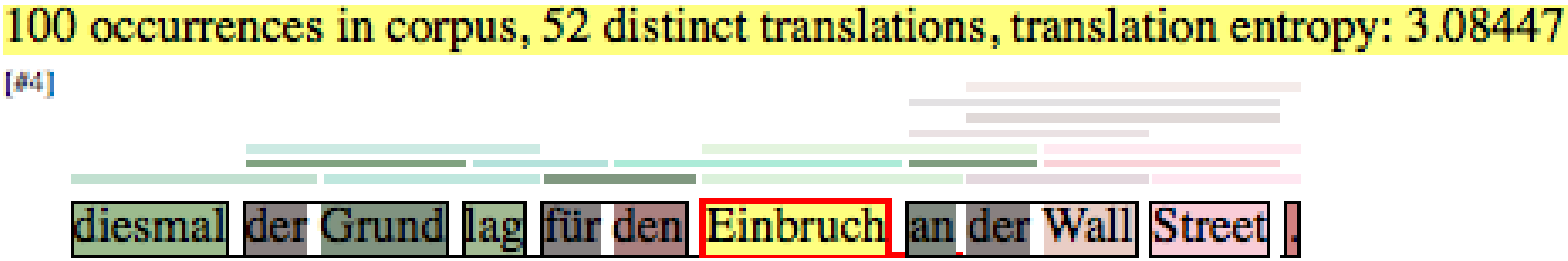
Analysis: Output Annotation

[0.2152] This time was the reason for the collapse on Wall Street .
[ref] This time the fall in stocks on Wall Street is responsible for the drop .

Color highlighting to indicate n-gram overlap with reference translation

darker bleu = word is part of larger n-gram match

Analysis: Input Annotation



- For each word and phrase, color coding and stats on
  - number of occurrences in training corpus
  - number of distinct translations in translation model
  - entropy of conditional translation probability distribution $\phi(e|f)$ (normalized)

Analysis: Bilingual Concordancer

entre autres(560/1554)

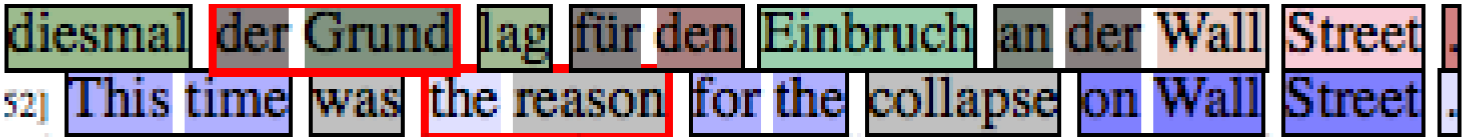
...d and made recommendations , " **inter alia** " , with respect to the follow...	...� des recommandations concernant , **entre autres** , les questions spécifiques suiva...
...on (EC) No 1995 / 2000 imposing , **inter alia** , a definitive anti @-@ dumping dut...	...995 / 2000 du Conseil instituant , **entre autres** , un droit antidumping définitif ...
...ervices . this increase , arising , **inter alia** , as a result of economic growth , ...	...nsports . cette augmentation , due **entre autres** facteurs à la croissance économi...
...of paragraph 1 the Commission may , **inter alia** , bring forward :	...aragraphe 1 , la Commission peut , **entre autres** , présenter :
... of stocks of obsolete pesticides , **inter alia** , by supporting projects aimed at s...	...r les stocks de vieux pesticides , **entre autres** en soutenant des projets à cet ef...
...wn rules of procedure which shall , **inter alia** , contain provisions for convening ...	...lement intérieur , qui contient , **entre autres** dispositions , les modalités de c...
...uch specific agreements may cover , **inter alia** , financing provisions , assignment...	...ords spécifiques peuvent porter , **entre autres** , sur les mécanismes financiers s...
...he internal market and concerning , **inter alia** , health and environmental protecti...	...hé intérieur et qui concernent , **entre autres** , la santé et la protection de l&...
...e product concerned) originating , **inter alia** , in Belarus and Russia (the count...	...it concerné ") originaire , **entre autres** , du Belarus et de Russie (ci @-@ ...
...e product concerned) originating , **inter alia** , in India .	...t concerné ") originaires , **entre autres** , de l ' Inde .

notamment(447/1554)

... the EU budget by addressing " **inter alia** " the problems of accountabili...	...get de l' Union , ce qui passe **notamment** par la résolution du problème de r...
...ates , the Commission has adopted , **inter alia** , Decision 2003 / 526 / EC (3) wh...	...es États membres , la Commission a **notamment** arrêté la décision 2003 / 526 / C...
...d equitable development involving , **inter alia** , access to productive resources , ...	... durable et équitable , impliquant **notamment** l' accès aux ressources produc...
...ertain products which could be used **inter alia** , as equipment on board ships but w...	...usceptibles d' être utilisés **notamment** comme équipements mis à bord , mai...
...nexes , taking into consideration , **inter alia** , available scientific , technical ...	...ion et à ses annexes , compte tenu **notamment** des informations scientifiques , tec...
...w that it is absolutely necessary , **inter alia** , because of enlargement , to find ...	...os; il est absolument nécessaire , **notamment** en raison de l' élargissement ...
...paragraphs 1 and 2 as appropriate , **inter alia** , by conducting studies and compili...	...ragraphes 1 et 2 le cas échéant , **notamment** en menant des études et en compilan...
...liability and efficiency , caused , **inter alia** , by insufficient technical and adm...	... et d' efficacité en raison , **notamment** , d' une interopérabilité tec...
...in the Programme shall be pursued , **inter alia** , by the following means :	...nis dans le programme , il convient **notamment** de mettre en oeuvre les moyens ci @-...

translation of input phrase in training data context

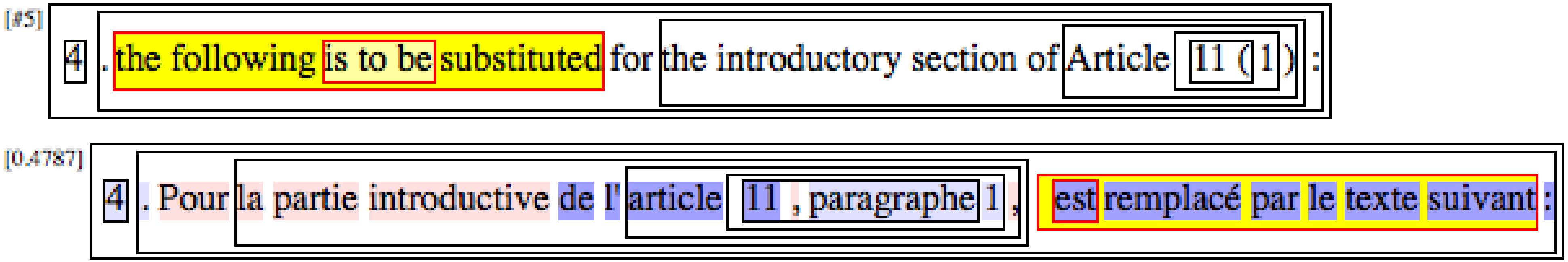
Analysis: Alignment



Phrase alignment of the decoding process

(red border, interactive)

Analysis: Tree Alignment



Uses nested boxes to indicate tree structure

(red border, yellow shaded spans in focus, interactive)

for syntax model, non-terminals are also shown

Analysis: Comparison of 2 Runs

annotated sentences

sorted by order order worse display fullscreen showing 5 more all

identical	same	better	worse
2348	51	57	69
93%	2%	2%	3%

[2143:0.2974] In Austria , Haider and Co. are ready to govern to prevent a red and black coalition .
[2143:0.1754] In Austria , Haider and Co. are prepared to rule to prevent a red and black coalition .
[ref] Haider and his party are ready to govern Austria in order to avoid red @-@ black coalition .

[2165:0.3174] The SPÖ wants to show that the cooperation of both parties is possible - in some countries and in the social partnership that is already the case .
[2165:0.2061] The SPÖ wants to show that a cooperation of both parties is possible - in some countries and in the social partnership that is already the case .
[ref] SPÖ would like to show that the cooperation of the two parties is possible - it does exist in some of the provinces as well as in social partnership .

Different words are highlighted

sortable by most improvement, deterioration

Acknowledgements

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Hieu Hoang	H. Leal Fontes	Holger Schwenk	Josh Schroeder
Jean-Baptiste Fouet	Joern Wuebker	Jorge Civera	Konrad Rawlik
Abby Levenberg	Alexandra Birch	Bo Fu	M.J.Bellino-Machado
Mauro Cettolo	Marcello Federico	Michael Auli	John Joseph Morgan
Mark Fishel	Gabriele Antonio Musillo	Miles Osborne	Nadi Tomeh
Nicola Bertoldi	Oliver Wilson	Pascual Martinez	Philipp Koehn
Phil Williams	Bruno Pouliquen	Raphael Payen	Chris Dyer
Joao Lus Rosas	Rico Sennrich	Herve Saint-Amand	Felipe Sanchez Martinez
Sara Stymne	Steven B. Parks	Steven Buraje Poggel	Andre Lynum
Yizhao Ni	David Kolovratnak	Sergio Penkale	Stephan
Suzy Howlett	Wade Shen	Yang Gao	Tsuyoshi Okita
Alexander Fraser	Richard Zens		