Step-by-Step

Hieu Hoang
Matthias Huck

December 2014

SMT Pipeline

Preprocessing
- tokenizer
- lowercase

Alignment

Phrase extraction

Tuning

Decoding

Postprocessing
- recasing
- detokenizer

Scoring
- BLEU score

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Tokenize and Lowercase

Original

Madam President, on a point of order.

Tokenized

Madam President , on a point of order .

Lowercased

madam president , on a point of order .

Tokenization

- Language-specific
  - Moses tokenizer
    - Basic
    - Supports 22 languages
  - Use external tokenizer
    - MADA for Arabic etc.
- Compound splitter
- Preserve ambiguity
  - Lattice/Confusion network

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Tokenization

Lattice

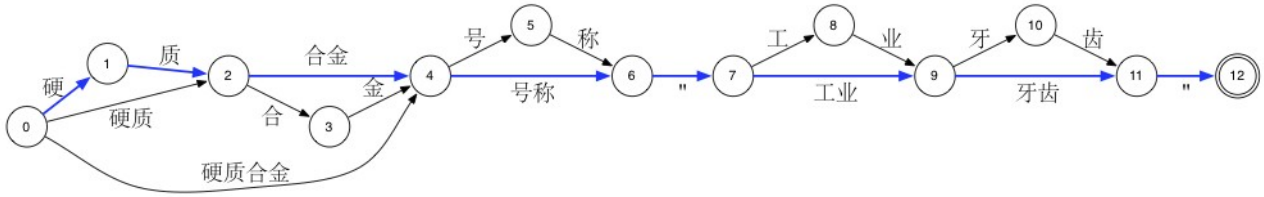
Unsegmented

硬质合金号称”工业牙齿"

One segmentation

硬质 合 金 号称 " 工 业牙 齿 "

Lattice



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Casing

- Lowercase / Recase
- Truecase
- Recase

Word Alignment

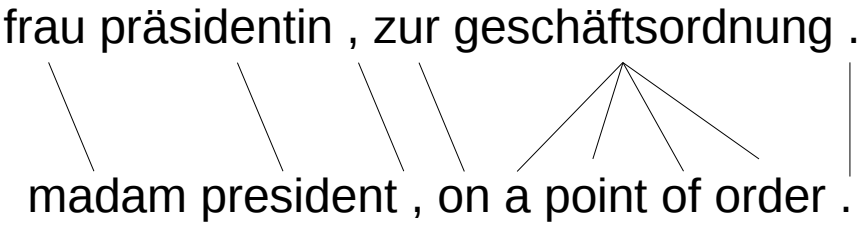
Input

frau präsidentin , zur geschäftsordnung .

madam president , on a point of order .

Output

0-0 1-1 2-2 3-3 4-4 4-5 4-6 4-7 5-8



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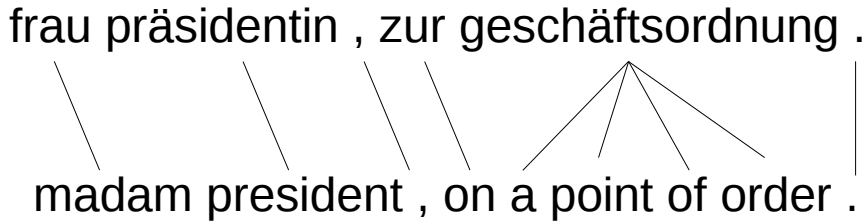
Phrase Extraction

Input



Output

frau ||| madam ||| 0-0
präsidentin ||| president ||| 0-0
frau präsidentin ||| madam president ||| 0-0 1-1
…..

Phrase-Table Creation

Input

frau ||| madam ||| 0-0
präsidentin ||| president ||| 0-0
frau präsidentin ||| madam president ||| 0-0 1-1
…..

Output

frau ||| madam ||| 0.89719 0.852604 0.364141 0.331687 ||| 0-0 ||| 21992 54185 19731 ||| |||
frau ||| her ||| 0.00210656 0.0042994 0.000442927 0.0007843 ||| 0-0 ||| 11393 54185 24
….
präsidentin ||| president ||| 0.163569 0.117671 0.969559 0.865753 ||| 0-0 ||| 89962 15177 14715 ||| |||
präsidentin ||| presided ||| 0.00122554 0.0066225 4.84499e-06 3.74e-05 ||| 0-0 ||| 60 15177 1 ||| |||
….
frau präsidentin ||| madam president ||| 0.874562 0.100327 0.884875 0.287159 ||| 0-0 1-1 ||| 14844 14671 12982 ||| |||
frau präsidentin ||| madam chairman ||| 0.933333 0.00801738 0.000954263 0.000359383 ||| 0-0 1-1 ||| 15 14671 14 ||| |||
...

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Phrase-Table Format

frau ||| madam ||| 0.89719 0.852604 0.364141 0.331687 ||| 0-0 ||| 21992 54185 19731

1. Source
2. Target
3. Scores
4. Word Alignment
5. Counts
   - Not used during decoding
   - Debugging information
6. Sparse scores
   - Key-value pairs
     - eg. VB 1 NP 2
7. Key-value properties
   - {{Key Values}}
     - eg. {{NonTermContext 1 0 23 32 24 51 0.0685714}}

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Language Model

Output

Standard ARPA format

```
\data\
ngram  1=     92951
ngram  2=    3010080
ngram  3=   14418108
ngram  4=   29762375
ngram  5=   40770370


\1-grams:
-6.49179        <s>     -1.59127
-4.76751        resumption      -0.696029
….
\2-grams:
-5.79014        <s> <s> -0.366199
-3.99848        <s> resumption  -1.76034
….
\3-grams:
-0.279408       <s> <s> <s>     0.114419
-1.35467        <s> <s> resumption      2.14638
….
```

moses.ini

Decoder configuration file

```
# input factors
[input-factors]
0

# mapping steps
[mapping]
0 T 0

[distortion-limit]
6

# feature functions
[feature]
UnknownWordPenalty
WordPenalty
PhrasePenalty
PhraseDictionaryMemory name=TranslationModel0 num-features=4 path=.../phrase-table.1 input-factor=0 output-factor=0
LexicalReordering name=LexicalReordering0 num-features=6 type=wbe-msd-bidirectional-fe-allff input-factor=0 output-factor=0 path=...
Distortion
KENLM lazyken=1 name=LM0 factor=0 path=.../europarl.binlm.1 order=5

# dense weights for feature functions
[weight]
UnknownWordPenalty0= 1
WordPenalty0= -1
PhrasePenalty0= 0.2
TranslationModel0= 0.2 0.2 0.2 0.2
LexicalReordering0= 0.3 0.3 0.3 0.3 0.3 0.3
Distortion0= 0.3
LM0= 0.5
```

No factors

1 phrase-table (phrase-table 0)

Maximum distortion = 6 words

Feature functions

weights

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Running the decoder

- Basic

  moses -f moses.ini [< input]

- Override moses.ini parameters

  moses -f moses.ini -distortion-limit 0

- Short cuts

  moses -f moses.ini -dl 0

Hierarchical model

Decoder configuration file

```
# input factors
[input-factors]
0

[search-algorithm]
3

# mapping steps
[mapping]
0 T 0
1 T 1

[cube-pruning-pop-limit]
1000

[non-terminals]
X

[max-chart-span]
20
1000
```

0=standard pb. 1=cube pruning. 3=CYK+

2 phrase-tables. Regular phrase-table + 'glue rules'

Number hypotheses created per stack/cell

LHS label for rules of unknown words

Max span of rules in each phrase table.
20 for regular phrase-table
1000 for glue rules

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Hierarchical model

Decoder configuration file

```
# feature functions
[feature]
UnknownWordPenalty
WordPenalty
PhrasePenalty
PhraseDictionaryMemory name=TranslationModel0 num-features=4 path=regular-phrase-table input-factor=0 output-factor=0
PhraseDictionaryMemory name=TranslationModel1 num-features=1 path=glue-grammar input-factor=0 output-factor=0
KENLM lazyken=1 name=LM0 factor=0 path=... order=5

# dense weights for feature functions
[weight]
UnknownWordPenalty0= 1
WordPenalty0= -1
PhrasePenalty0= 0.2
TranslationModel0= 0.2 0.2 0.2 0.2
TranslationModel1= 1.0
LM0= 0.5
```

Tuning

Untuned

[weight]
UnknownWordPenalty0= 1
WordPenalty0= -1
PhrasePenalty0= 0.2
TranslationModel0= 0.2 0.2 0.2 0.2
TranslationModel1= 1.0
LM0= 0.5

Tuned

[weight]
UnknownWordPenalty0= 1
WordPenalty0= -0.336804
PhrasePenalty0= -0.0855363
TranslationModel0= 0.0739741 0.0212178 0.139777 0.0393687
TranslationModel1= 0.17723
LM0= 0.126092

- Multiple algorithms
- MERT
  - Original. Best?
  - Not good for sparse feature
- PRO
- MIRA
  - Batch MIRA
- Iterative process
  - Repeatedly run decoder with different settings
  - Decode held-out tuning data (with reference)
    - 1000-2000 sentences
- Tune on in-domain data

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Evaluation

- Decode test set
  - 1000-2000 sentences (minimum)
  - With references
    - Multiple references
- Multiple decode set
- Many metrics
  - BLEU
    - Nist-BLEU
    - IBM BLEU
    - Multi-BLEU
  - Meteor
  - TER

  ....

Step-by-Step

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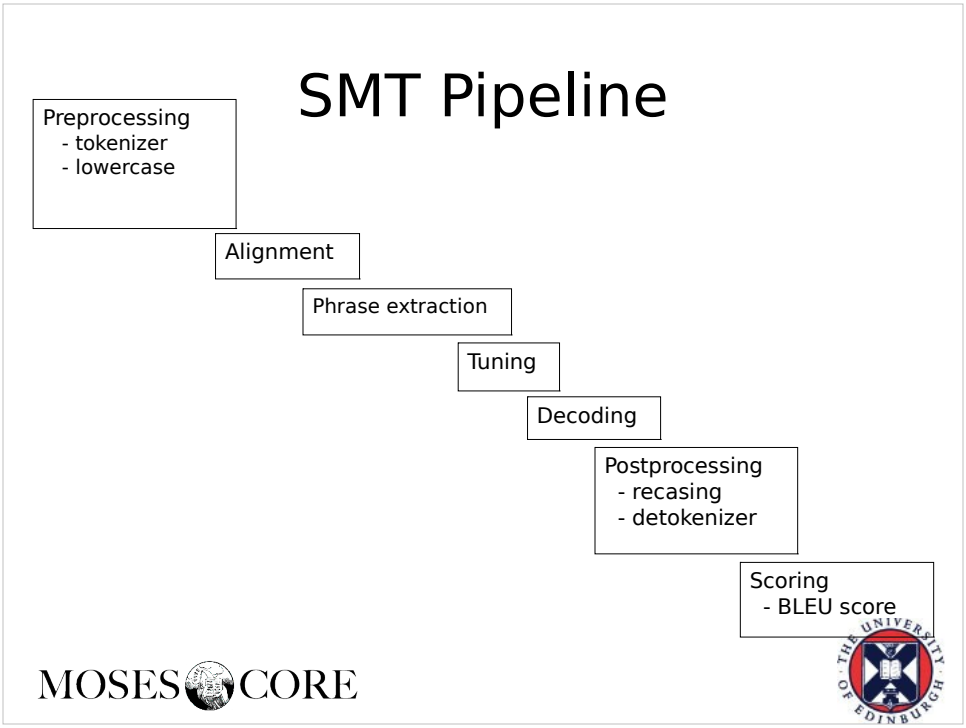
Matthias Huck

December 2014

Thanks for inviting me to come

Here to tell you a little about the things I've been doing to Moses
- over the past 2 years
- mainly concentrate of the past year
  - but will quickly tell you about things I did prior to that



What is this feature function framework?

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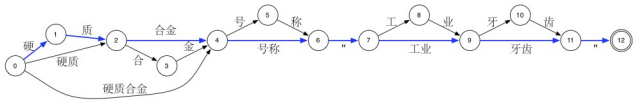

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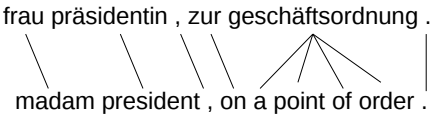

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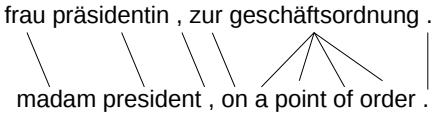
Phrase Extraction

Input



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Phrase-Table Creation

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Running the decoder

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MOSES CORE

Hierarchical model

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