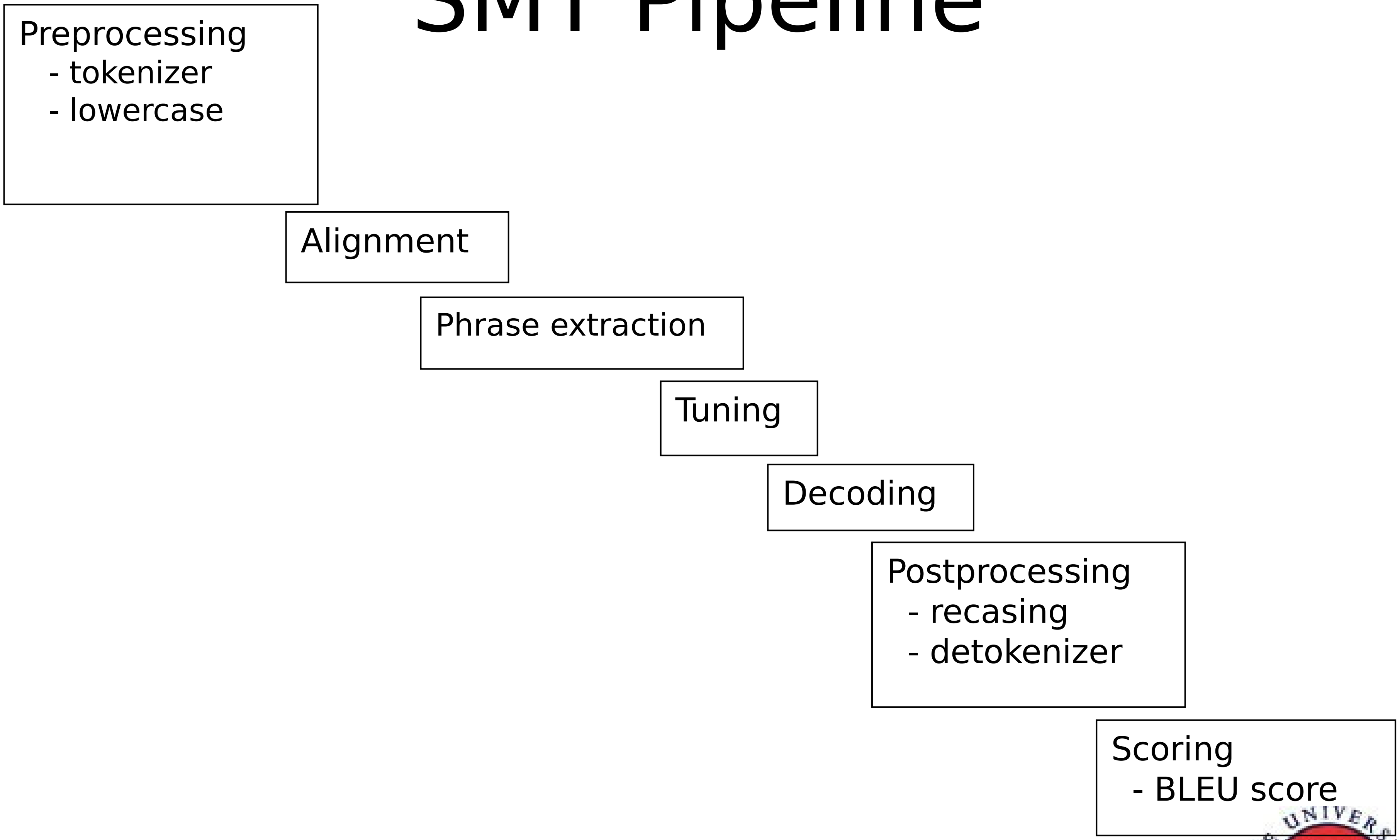
Step-by-Step

Hieu Hoang
Matthias Huck

December 2014

SMT Pipeline



Preprocessing
- tokenizer
- lowercase

Alignment

Phrase extraction

Tuning

Decoding

Postprocessing
- recasing
- detokenizer

Scoring
- BLEU score

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
  - eg. MADA for Arabic
- Text normalization
- Compound splitter

Casing

- Lowercase / Recase
- Truecase
  - Most common case for each word
- Real case
  - Don't do any case processing
- Dependent on data, language

Word Alignment

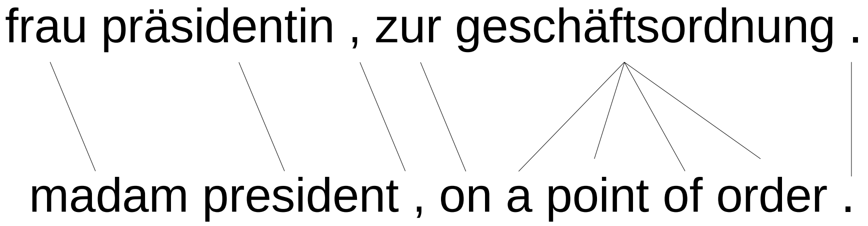
Input

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
```

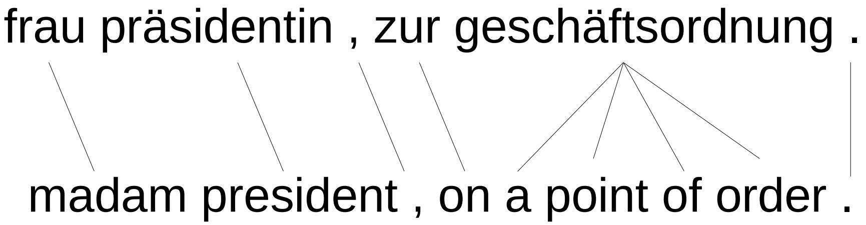


frau präsidentin , zur geschäftsordnung .

madam president , on a point of order .

Phrase Extraction

Input



frau präsidentin , zur geschäftsordnung .

madam president , on a point of order .

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 ||| |||
...
```

Probabilities

1. p(source | target)
2. p(source | target) per word
3. p(target | source)
4. p(target | source) per word

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}}

Language Model

Input

Monolingual target text

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
```

No factors

```
# mapping steps
[mapping]
0 T 0
```

1 phrase-table (phrase-table 0)

```
[distortion-limit]
6
```

Maximum distortion = 6 words

```
# 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
```

Feature functions

```
# 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
```

weights

MOSES CORE

THE UNIVERSITY OF EDINBURGH

Running the decoder

- Basic command line

```
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
```

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

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

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

```
[cube-pruning-pop-limit]
1000
```

Number hypotheses created per stack/cell

```
[non-terminals]
X
```

LHS label for rules of unknown words

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

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

Hierarchical model

Decoder configuration file

```
# feature functions
[feature]
UnknownWordPenalty
WordPenalty
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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
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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

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

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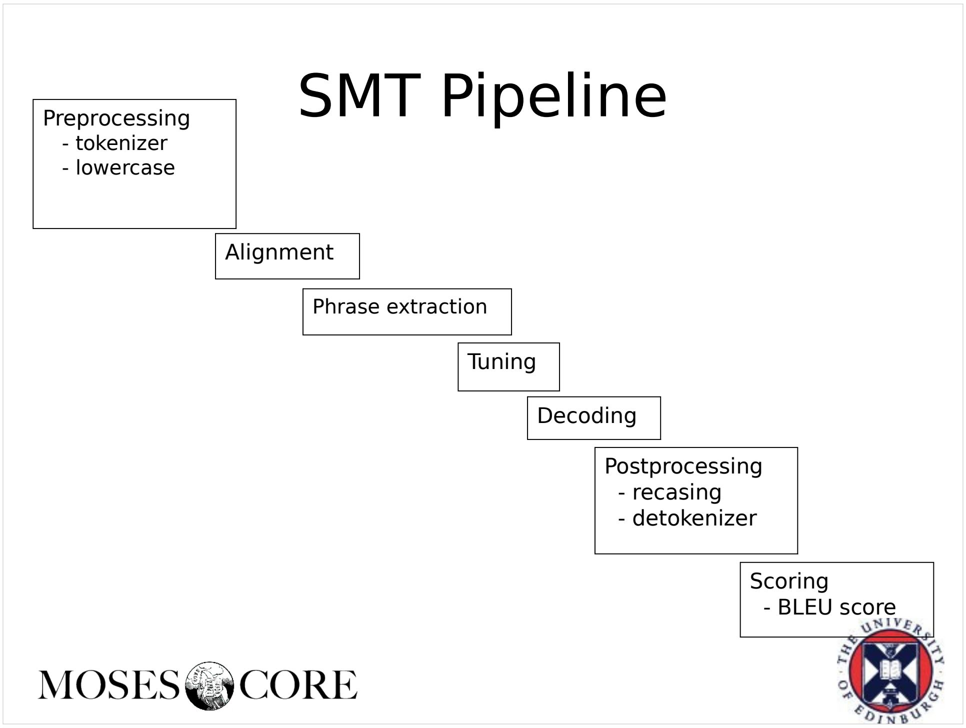
Thanks for inviting me to come

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



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MOSES CORE

What is this feature function framework?

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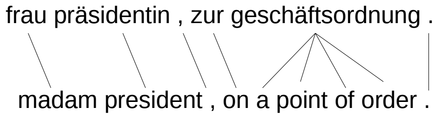
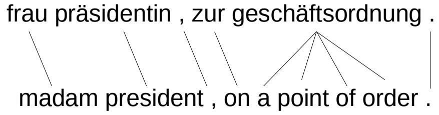


Phrase Extraction

Input



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