Empirical Dependency-Based Head Finalization for Statistical Chinese-, English-, and French-to-Myanmar (Burmese) Machine Translation

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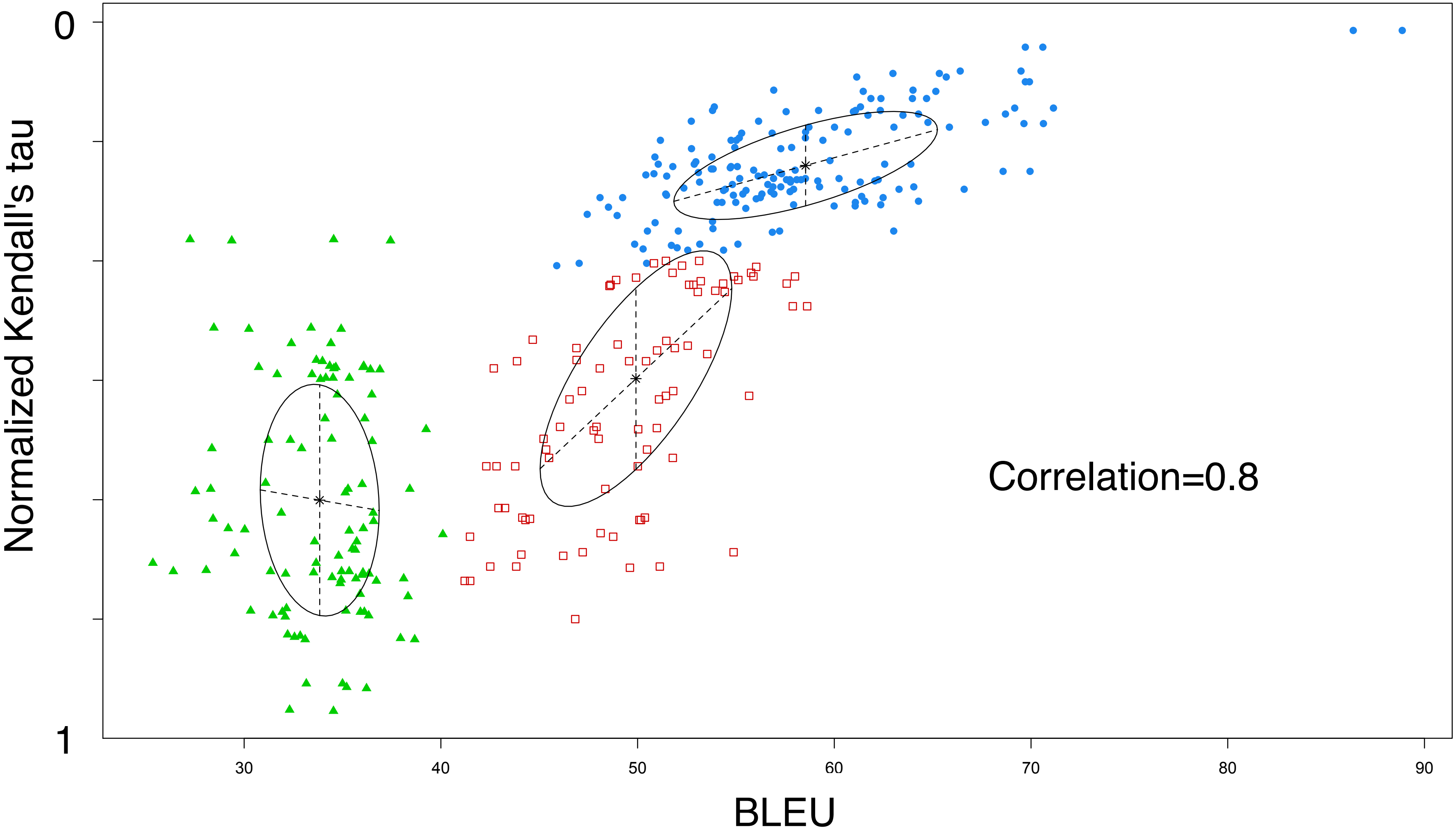
Normalized Kendall’s Tau

- Often used to measure differences in word order between languages
- Related to the number of crossing word alignments
- Calculated from word aligned data
- In the range from 0 to 1
    - 0 indicating identical word order

Kendall’s Tau for Myanmar

Language Pair	**Normalized Kendall’s Tau**
Engish-Myanmar	0.538
French-Myanmar	0.487
Chinese-Myanmar	0.315
Korean-Myanmar	0.156
Japanese Myanmar	0.123

Importance of re-ordering



Pre-ordering

- Long distance word re-ordering is a problem for SMT
- Pre-ordering approaches have been successful in SVO-to-SOV translation
    - Re-order the source in a pre-processing step
    - Use re-ordering heuristics in combination with a high-precision parser
    - Efficient

Exploiting the Head Final Property

- Languages such as Japanese, have the property that the head word typically follows its dependent words
- Parse the source with a head-driven phrase structure grammar (HPSG)
  - Pre-order with rules operating on the parse tree

- English-to-Japanese : [Isozaki+ 2012]
- Chinese-to-Japanese : [Han+ 2012]

Other approaches

- HPSG parsers not available for all languages
  - [Xu+ 2009] proposed using a dependency parser
- Statistical approaches are also possible, e.g. LADER (Neubig+ 2012)
- Myanmar (Burmese) is a typical SOV language

→ Head-finalization should work

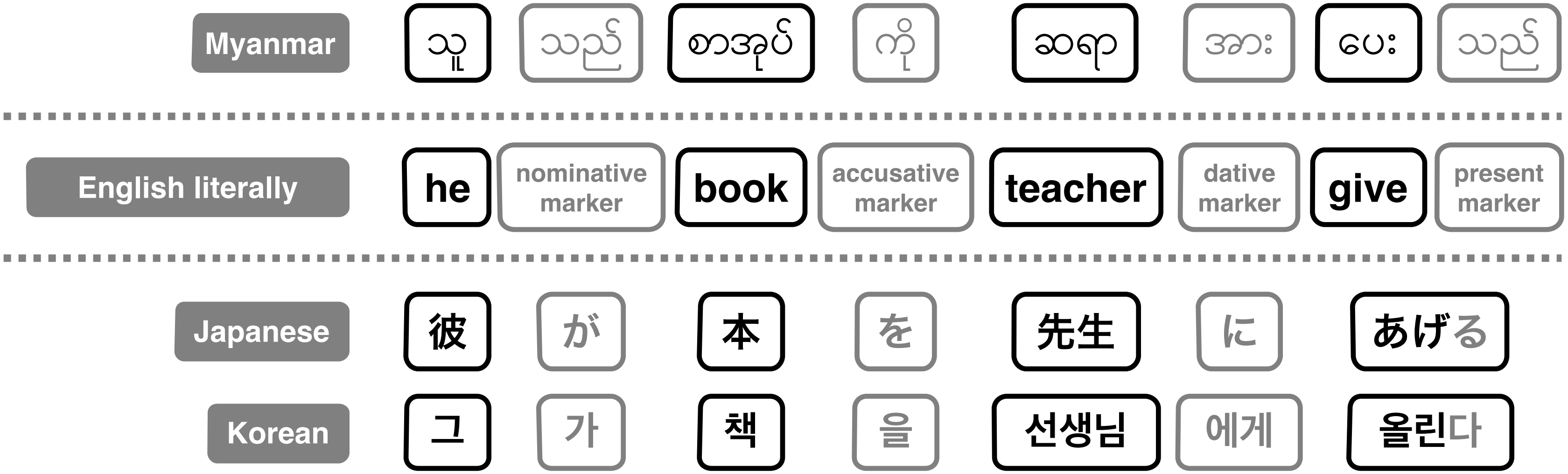
Myanmar Language

- SOV language
  - Consistently head-final
  - Similar to Japanese and Korean
  - Function morphemes succeed content morphemes
  - Unlike Japanese and Korean, Myanmar is analytic (morphemes are non-inflected syllables)

Pre-ordering for English-, Chinese-, French-to-Myanmar SMT

- Myanmar (Burmese) Language
  - – Similar syntax to Japanese/Korean

    → Transfer techniques used for JA/KO to MY



Myanmar	သူ	သည်	စာအုပ်	ကို	ဆရာ	အား	ပေး	သည်
English literally	he	nominative marker	book	accusative marker	teacher	dative marker	give	present marker
Japanese	彼	が	本	を	先生	に	あげる	
Korean	그	가	책	을	선생님	에게	올린다	

(Content morphemes in black, function morphemes in grey)

Our Head-Finalization

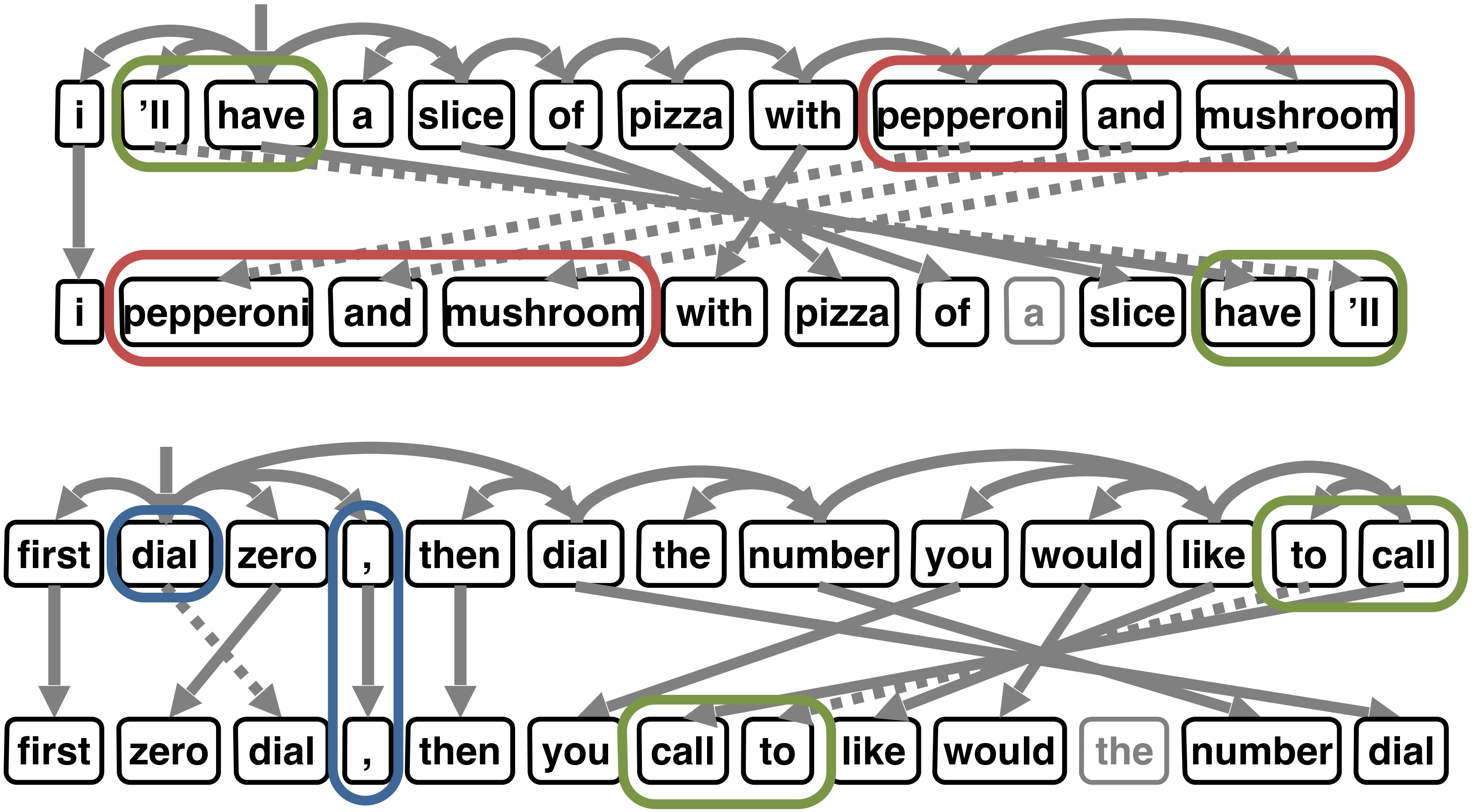
- Dependency-based head-finalization
  - A combination of [Isozaki+ 2012] and [Xu+ 2009]
- Available for more source languages
- Just move the head after modifiers
  - Simple
  - With several exceptions
    - → Examples

Head finalization for Myanmar

Our rules follow 3 basic principles:

- Do not break a coordination structure
  - *English: conj, cc*
- Do not reorder across punctuation
  - *English: punct*
- Auxiliary verbs are placed after their head verb
  - English: *aux, auxpass, cop*

Pre-reordering Examples


i 'll have a slice of pizza with pepperoni and mushroom
i pepperoni and mushroom with pizza of a slice have 'll
first dial zero , then dial the number you would like to call
first zero dial , then you call to like would the number dial

Myanmar Oriented Process

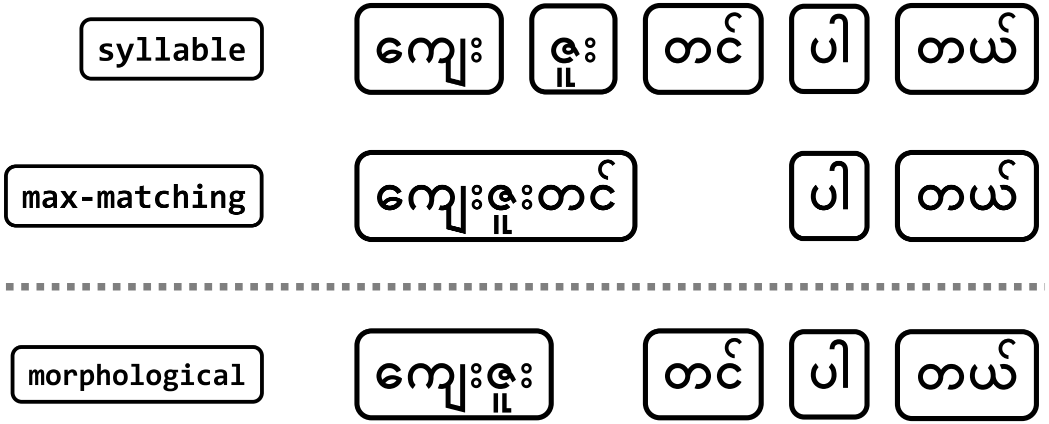
- In [Isozaki+, 2012] topic, nominative, and accusative markers are inserted on the source side
  - In Myanmar these are typically omitted, unless there is ambiguity
- We handle negation in Myanmar
  - Negation prefix and suffix (“ma … buu” like “ne … pas” in French)
  - Place negation word immediately before verb, and “neg” maker immediately after
- Source side articles are deleted

Experimental Methodology

- Chinese-, English-, French-to-Myanmar
  - On BTEC corpus
    - Train: 155,121 sentence pairs
    - Dev. : 5,000 sentence pairs
    - Test : 2,000 sentence pairs
- For dependency parsing
  - Chinese : Stanford parser
  - English : Stanford parser
  - French : Stanford tagger (CC set) + MALT parser
- Statistical approach for comparison
  - LADER

Myanmar Segmentation

- 2 approaches
  - Syllable segmentation (Fr-My)
  - Maximum matching (Ch-My, En-My)



syllable ကျေး ဇူး တင် ပါ တယ်

max-matching ကျေးဇူးတင် ပါ တယ်

morphological ကျေးဇူး တင် ပါ တယ်

Training LADER

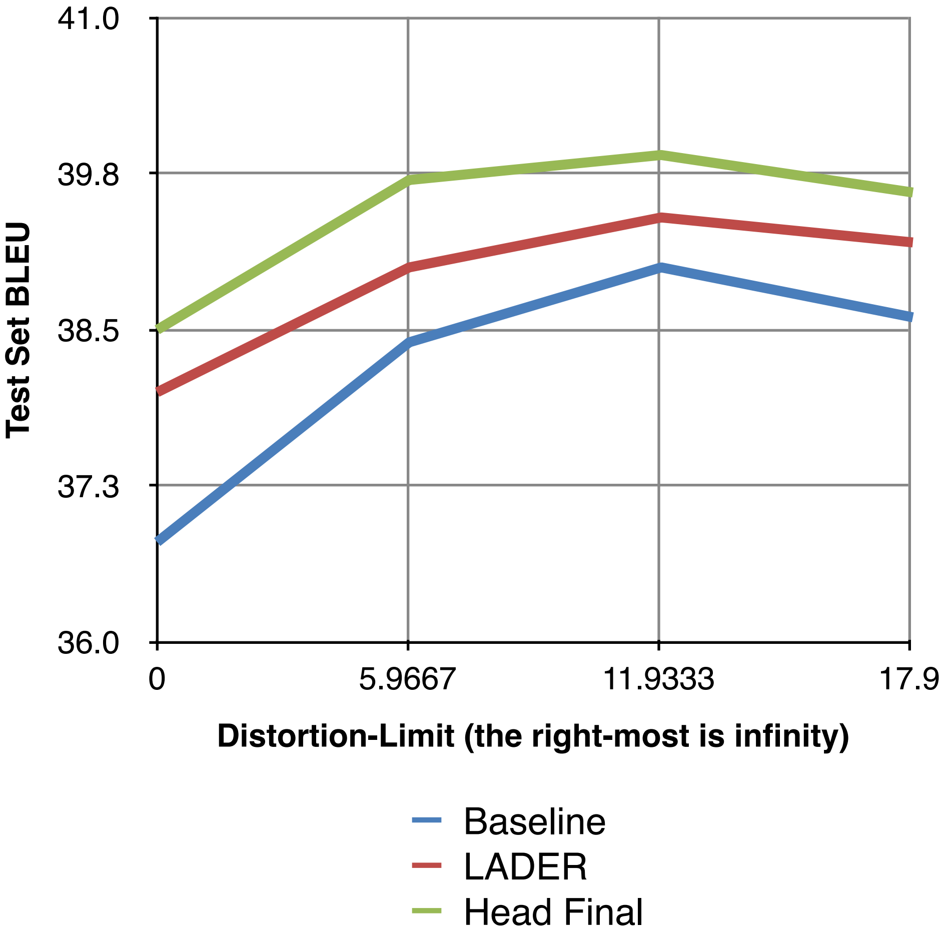
- 1000 sentences sampled randomly
    - Used automatic alignment since no manually-aligned data was available
- Using larger training data set sizes with automatic alignment gave only a small improvement in the original work [Neubig+ 2012].
- Long training times.

Evaluation

- Evaluated using BLEU (default MOSES)
- Also used RIBES
    - For distant language pairs, BLEU has been shown to correlate poorly with human judgements [Goto+ 2011]
    - RIBES was developed specifically to evaluate distant language pairs
- Results had similar characteristics with both metrics

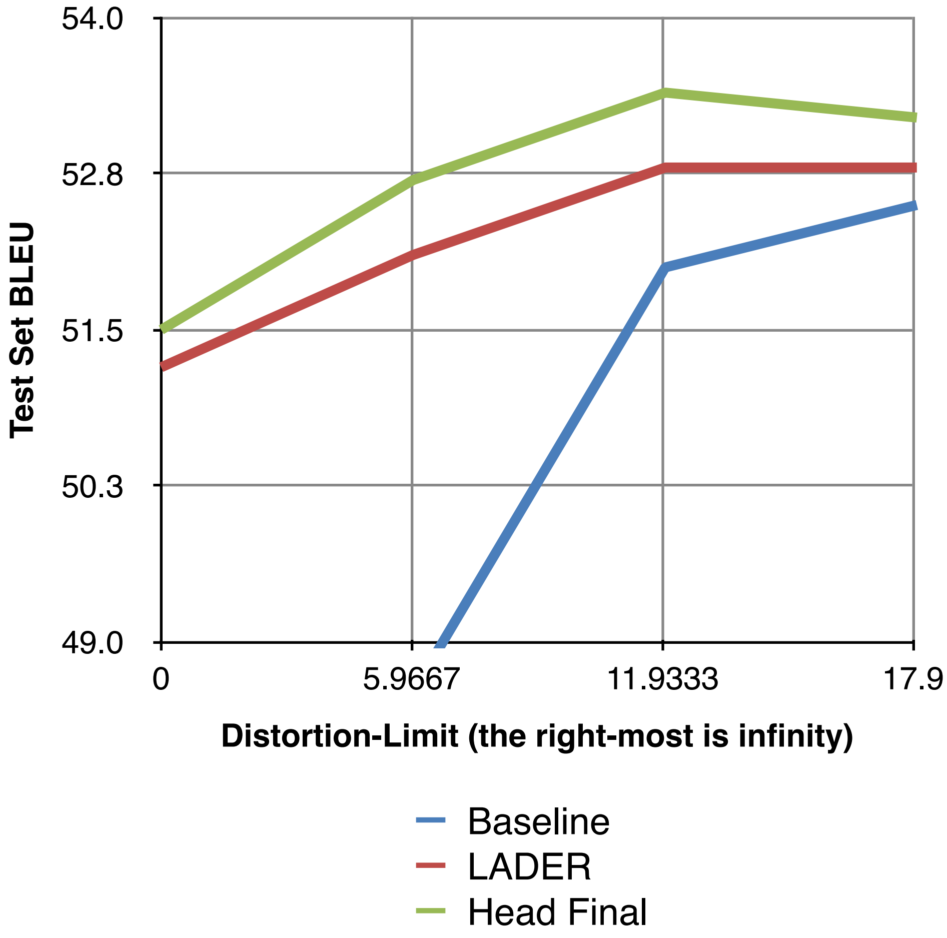
Results of Chinese-to-Myanmar

- Average Kendall’s τ
  - Baseline : 0.31
  - LADER : 0.20
  - Head Final : 0.17
- Maximum matching segmentation



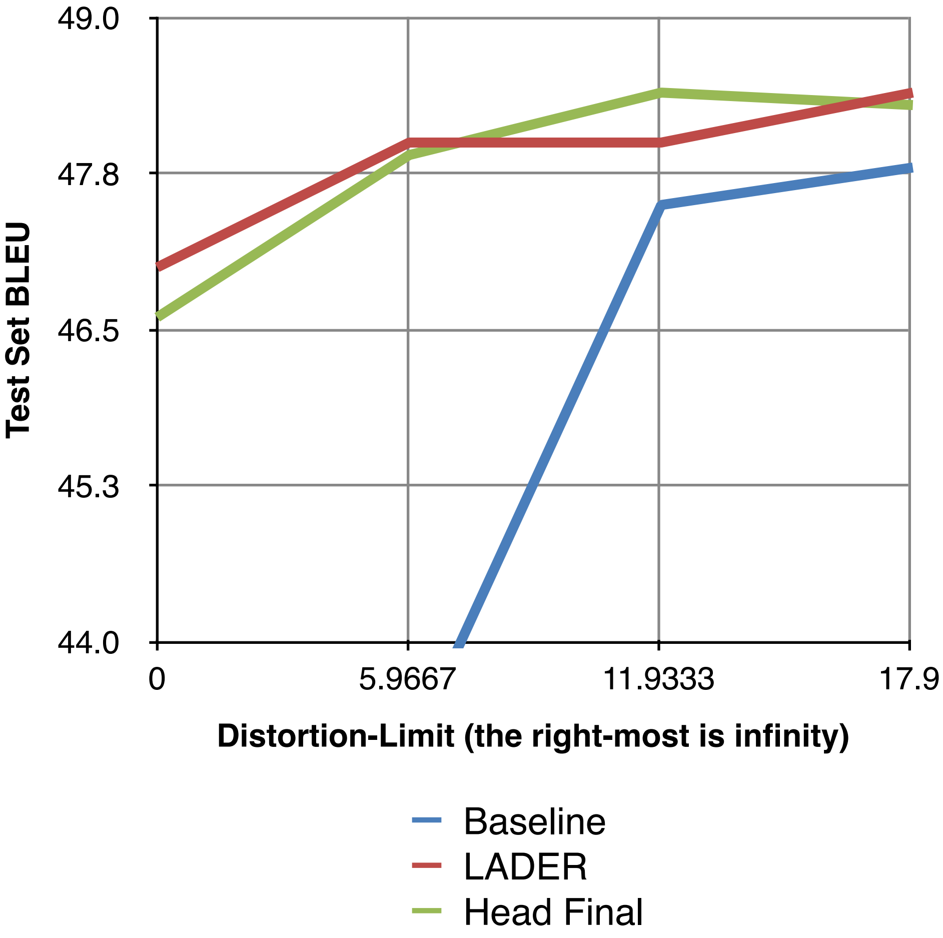
Results of English-to-Myanmar

- Average Kendall's τ
  - Baseline : 0.47
  - LADER : 0.21
  - Head Final : 0.21
- Maximum matching segmentation



Results of French-to-Myanmar

- Average Kendall's τ
  - Baseline : 0.46
  - LADER : 0.24
  - Head Final : 0.24
- Maximum matching segmentation



Summary

- Head-final approach works on distant languages to Myanmar SMT
  - Can use dependency structure
  - Simple set of rules

- Future work
  - Experiment on larger corpora
  - Experiment on longer sentences

Thank you very much for listening!