

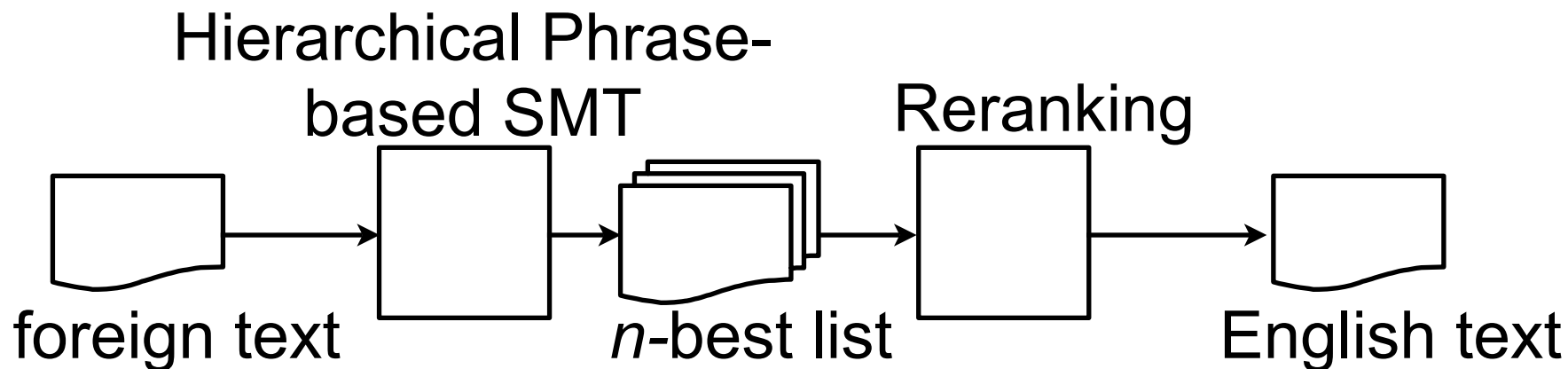
NTT Statistical Machine Translation for IWSLT 2006

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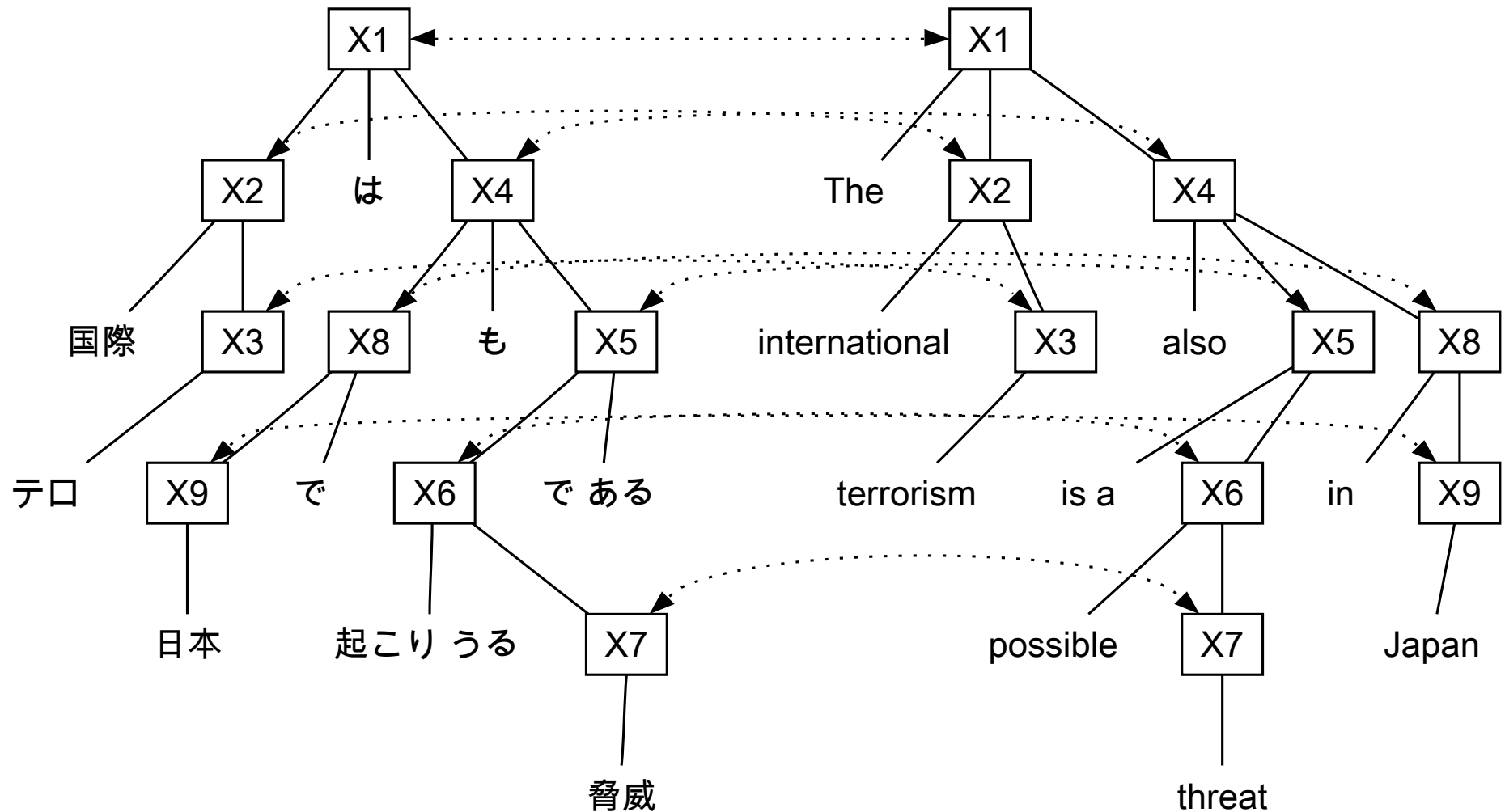
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Overview



- Hierarchical Phrase-based SMT achieved by:
 - Target normalized form
 - Earley-style top-down parsing
- Reranking via voted perceptron

Hierarchical Phrase-based SMT

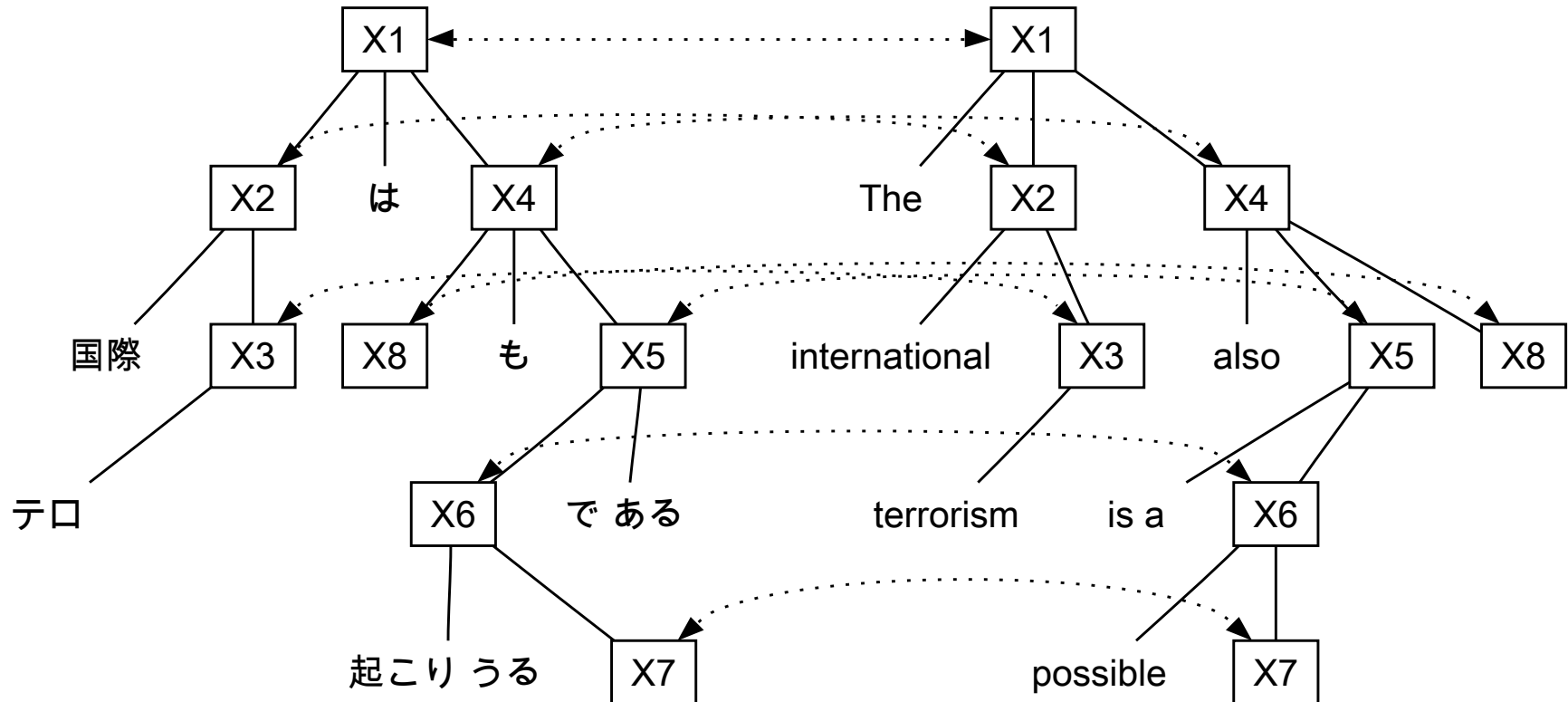


Simplified Grammar

X_1 份子		members of X_1
定将 X_1		decided to X_1
X_1 是 X_2		is X_1 X_2
X_1 不再 X_2		no longer X_1 X_2
X_2 一个最 X_1		One of the most X_1 X_2
X_2 的 X_1 表示哀悼		condolences to the X_1 X_2

- Target normalized form
- Phrase-prefixed structure for target-side (GNF-like structure)
- Arbitrary structure for source-side
- Constrained rule-extraction

Decoding by Top-down parsing



- Earley-style parsing on source-side
 - Straight-forward intersection with ngram
- Similar to a phrase-based decoding algorithm

Log-linear Approach

$$\hat{e}_1^I = \operatorname{argmax}_{e_1^I} \frac{\exp\left(\sum_{m=1}^M \lambda_m h_m(e_1^I, f_1^J)\right)}{\sum_{e_1^{I'}} \exp\left(\sum_{m=1}^M \lambda_m h_m(e_1^{I'}, f_1^J)\right)}$$

- Mixed-case 5-gram
- Rule translation probabilities
- Lexical weights
- Insertion/deletion penalties
- Backtrack penalties
- # of words/# of rules

Reranking by Voted Perceptron

- Ranking Voted Perceptron with BLEU-based updates
- Features
 - SC: Scores from the baseline decoder
 - AL: Word-pairs from IBM Model Viterbi alignment
 - RU: Rules & Rule pattern

住所 を ここ に 書い て下さい $\langle X_1$ て下さい , Please X_1 \rangle
~~住所 を ここ に 書い て下さい~~ $\langle X_1$ 書い , write X_1 \rangle
~~住所 を ここ に 書い て下さい~~ $\langle X_1$ を X_2 , down X_1 X_2 \rangle
~~住所 を ここ に 書い て下さい~~ \langle 住所 , your address \rangle
Please write down your address here \langle ここ に , here \rangle

Reranking Algorithm

$D = \{D^1, \dots, D^M\}$: Development set

$C^m = \{c_1^m, \dots, c_N^m\}$: The original N -best list of D^m

$X^m = \{x_1^m, \dots, x_N^m\}$: (reordered) N -best list of D^m

$Ranking(W, C^m)$: returns N -best list of C^m reordered based on the score, $s_n^m = \langle W, \phi(c_n^m) \rangle$

for $t = 1, \dots, T$ **do**

for $m = 1, \dots, M$ **do**

$X^m \leftarrow Ranking(W, C^m)$

for $i = 1, \dots, |X^m|$ **do**

for $j = i + 1, \dots, |X^m|$ **do**

if $BLEU(x_j^m) > BLEU(x_i^m) \& WER(x_j^m) \leq WER(x_i^m)$ **then**

$W = W + (BLEU(x_j^m) - BLEU(x_i^m)) \times (\phi(x_j^m) - \phi(x_i^m))$

end if

end for

end for

$V_t = W$

end for

end for

Update all incorrect ranking pair
through pair-wise comparison

Approximated BLEU

- Very frequent updates required:
 - Computation of doc-set BLEU is impossible
- Sentence-wise BLEU?
 - Bad objective: 27.78 to 25.95 in MTEval 2006
- Approximated BLEU:
 - doc-set BLEU of 1-best
 - Compute difference for each segment

Tasks

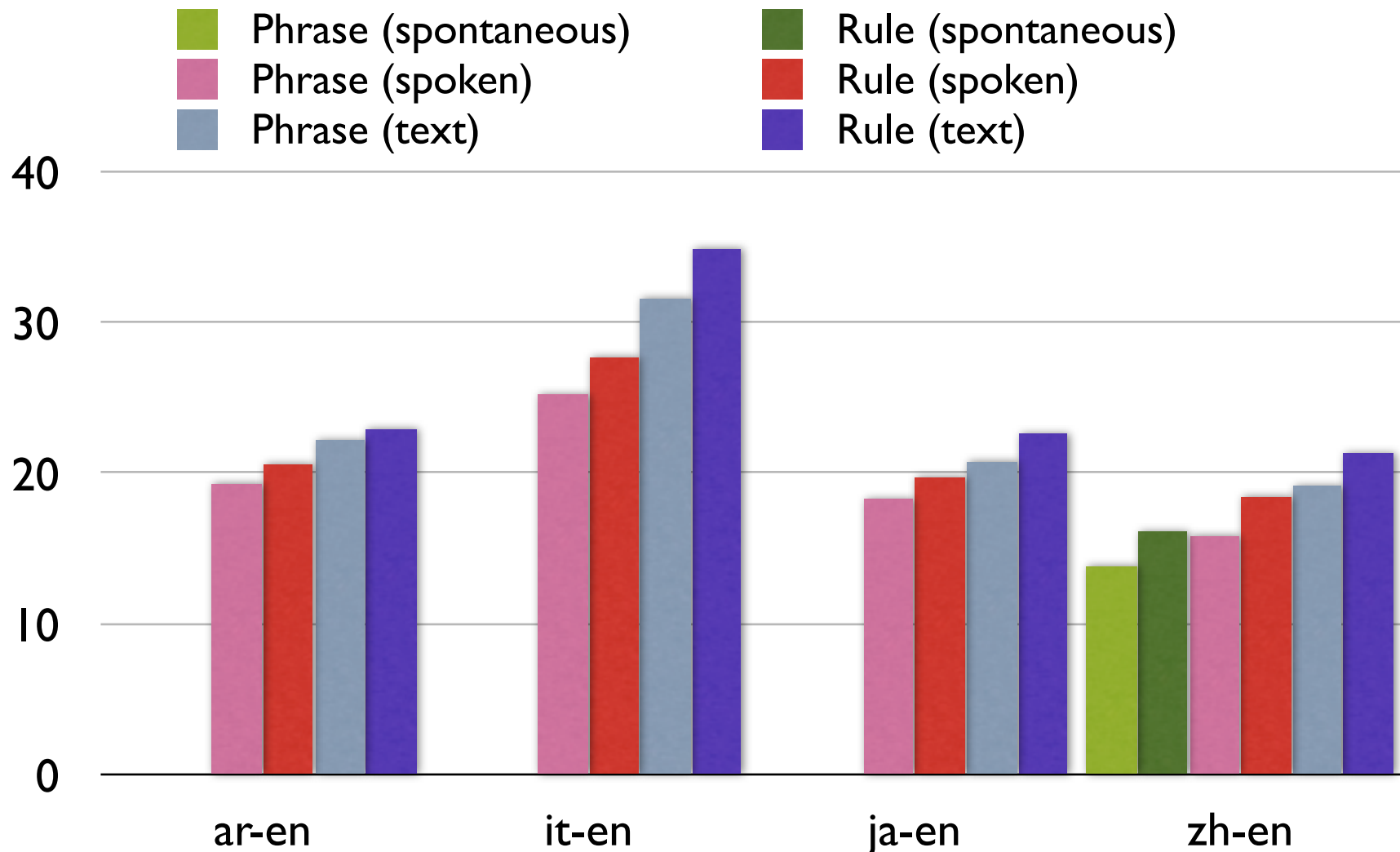
- ASR's I-best translation
- Case-restoration/punctuation-insertion required
- Preprocessing:
 - Case/punctuation-preserved English-side + lower-cased/punctuation-removed source-side
 - Induce multiple alignments from differently preprocessed corpora (punct-removed, etc.)
 - Aggregate rules from differently aligned corpora

Official Results

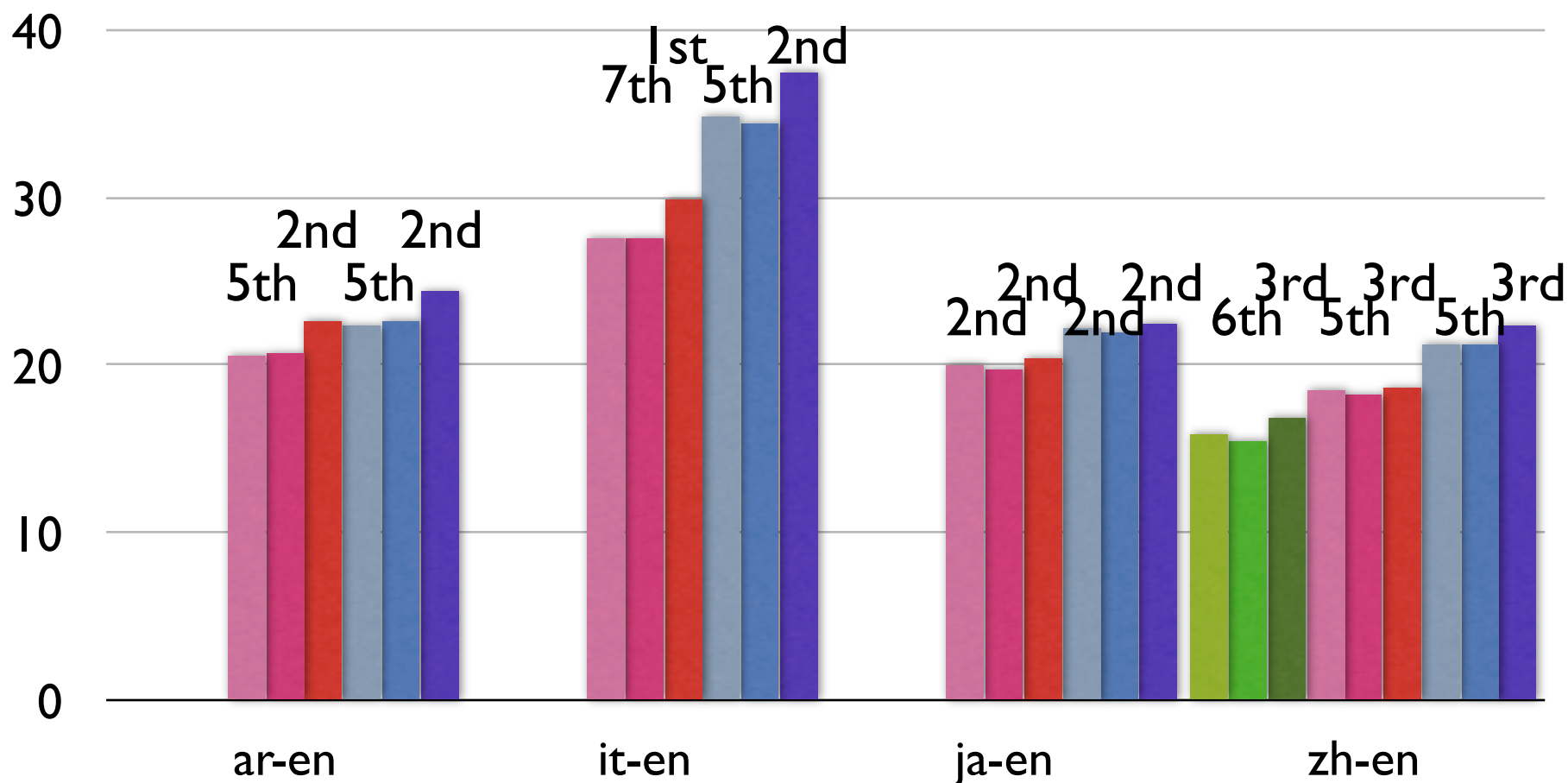
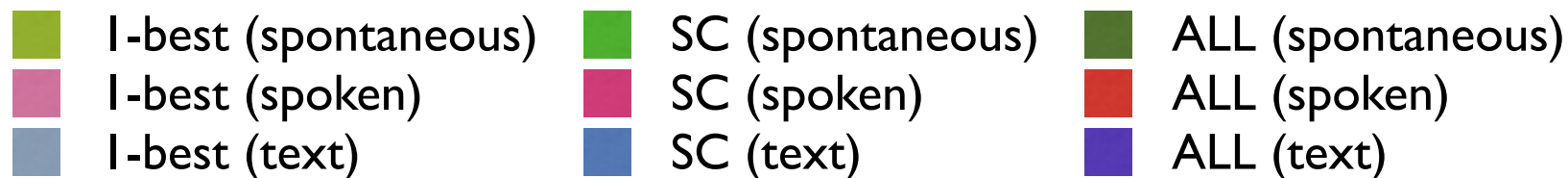
		BLEU	NIST	METEOR	mPER	mWER
ar-en	spoken	20.71 (5th)	4.84	43.97	64.67	56.65
	text	22.65 (5th)	5.33	47.76	62.79	54.15
it-en	spoken	27.69 (7th)	6.70	56.07	57.00	48.13
	text	34.49 (5th)	7.83	64.31	50.79	41.57
ja-en	spoken	19.84 (2nd)	5.48	45.00	71.08	55.12
	text	22.03 (2nd)	5.91	48.77	69.02	52.17
zh-en	spontaneous	15.59 (6th)	4.18	39.46	70.20	59.72
	spoken	18.34 (5th)	4.53	42.15	68.44	57.71
	text	21.35 (5th)	5.13	47.43	65.47	53.70

Remarks: reranked with only SC features

Results on Hierarchical Phrase-based SMT



Results on Reranking



Conclusion

- Better than *non*-hierarchical translation
- Benefit from sparse features (RU,AL) in reranking
- Hierarchical Phrase-based SMT as a baseline
 - Target normalized form + top-down parsing
- Reranking by Voted Perceptron
 - BLEU-based updates + Approximated-BLEU