I²R Multi-Pass Machine Translation System for IWSLT-2008

Boxing Chen, Deyi Xiong, Min Zhang, Aiti Aw and Haizhou Li

Department of HLT
Institute for Infocomm Research (I²R), Singapore

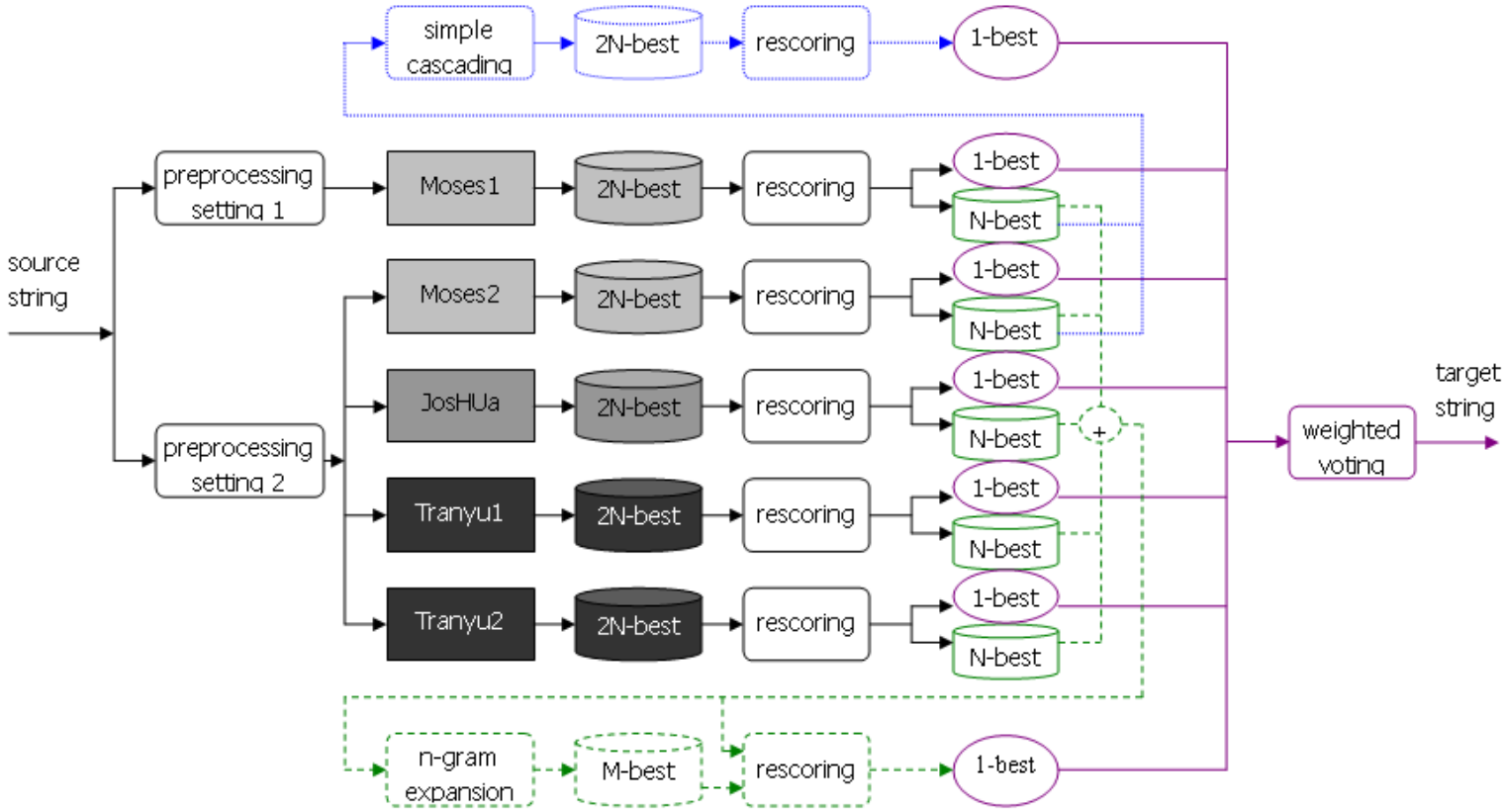
Tasks

- Chinese-to-English
  - BTEC task
  - Challenge task
- Chinese-to-English-to-Spanish PIVOT task
  - Joint effort with UPC-TALP
  - Will be reported by the co-worker of UPC

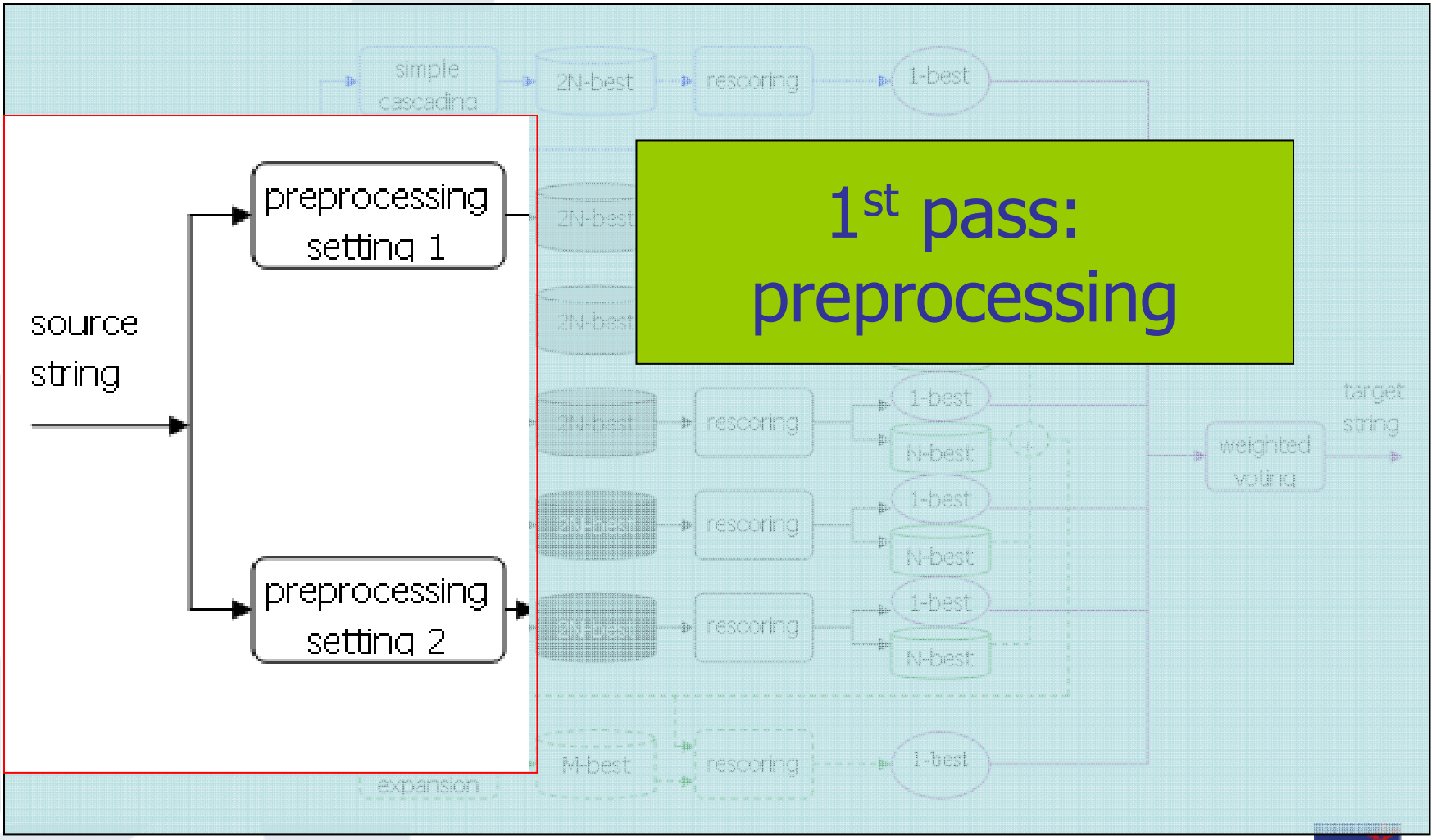
Outline

- Multi-pass MT System
  - System Architecture
  - 1st pass: preprocessing
  - 2nd pass: decoding
  - 3rd pass: rescoring
  - 4th pass: system combination
- Experiments and results
- Conclusion

System Architecture



Preprocessing

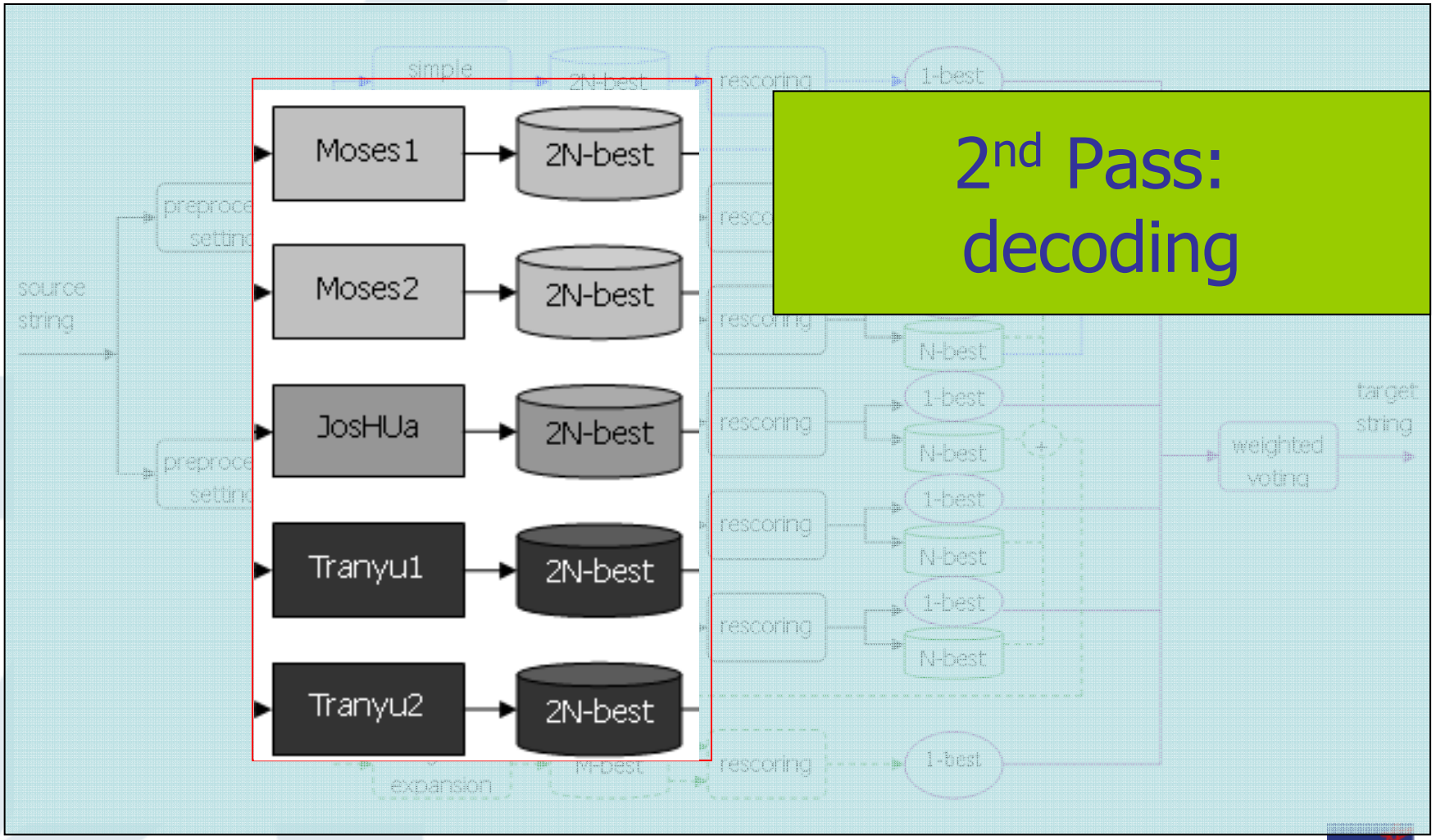


Preprocessing

- Preprocessing
  - Tools: LDC-SEG (L) , ICTCLAS (I)

	Preprocessing 1		Preprocessing 2	
	ch	en	ch	en
Tokenization	L	x	I	x
Txt-to-digit	x	x		
Lower-casing		x		x

Decoding


Moses1
2N-best
Moses2
2N-best
JosHUa
2N-best
Tranyu1
2N-best
Tranyu2
2N-best
2nd Pass: decoding
source string
target string
weighted voting
rescoring
1-best
N-best

Decoding

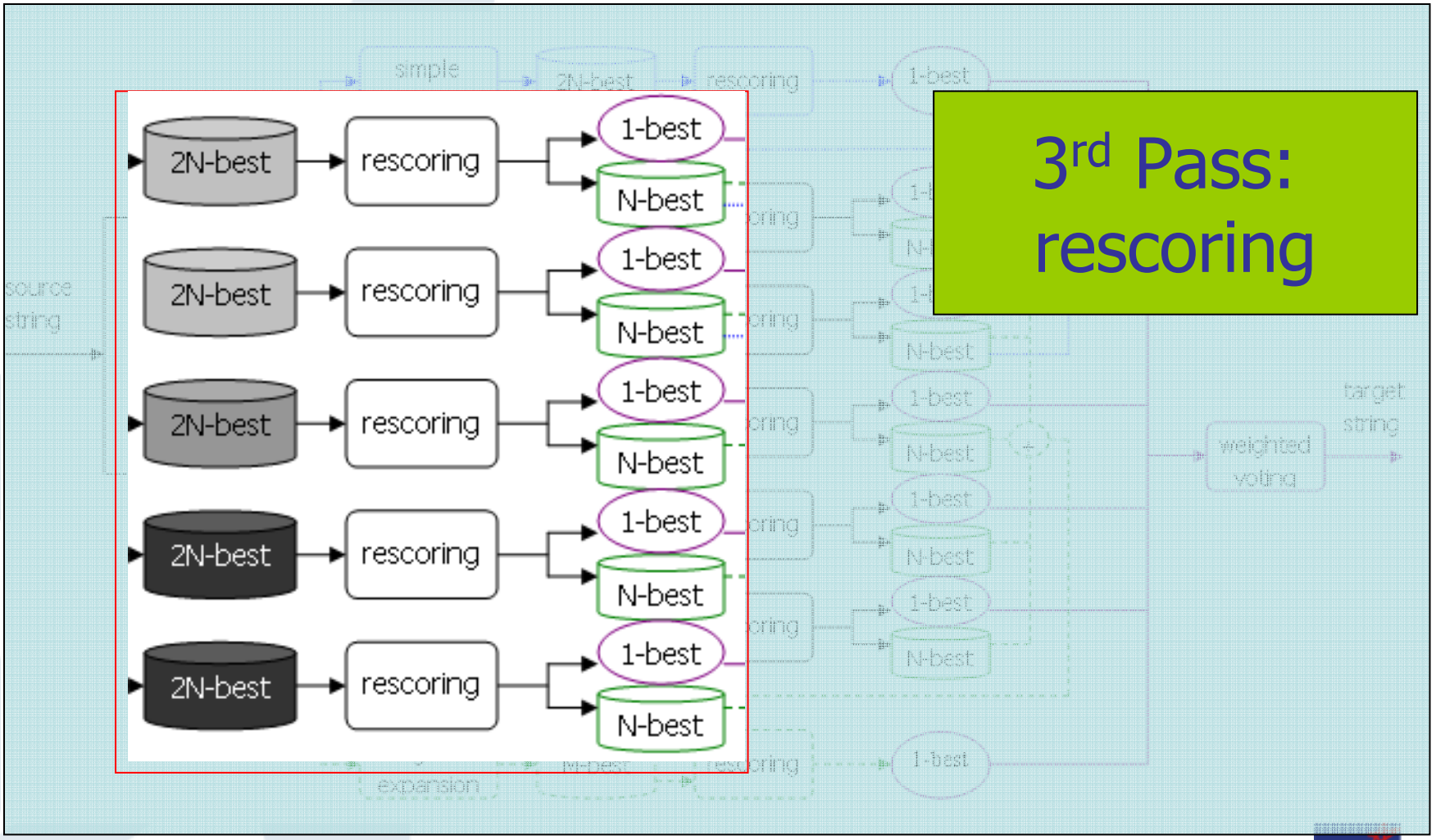
- Preprocessing Setting
  - Moses1: preprocessing 1
  - All other 4 systems: preprocessing 2

- Moses: (open source)
  - Phrase-based system
- JosHUa: (open source)
  - Hierarchical phrase-based MT system
- Tranyu: (in-home)
  - BTG-based system

Tranyu

- Adapting BTG to phrasal translation
- CKY-style decoder
- Reordering models
  - MaxEnt-based
  - Features:
    - Boundary words (Xiong et al. 2006)
    - Linguistic annotations (Xiong et al. 2008)
- Systems
  - Tranyu 1: boundary words based reordering model
  - Tranyu 2: boundary words based reordering + linguistically annotated reordering model

Rescoring


2N-best
rescoring
1-best
N-best
2N-best
rescoring
1-best
N-best
2N-best
rescoring
1-best
N-best
2N-best
rescoring
1-best
N-best
2N-best
rescoring
1-best
N-best
3rd Pass:
rescoring

Rescoring

- Rich additional feature functions

Moses Features:

- Translation Model
- Reordering model
- Language Model
- Word penalty

Translation confidence

Rescoring Features:

1) Dir/Inv IBM model 1 and 3 score
2) Word-based association score

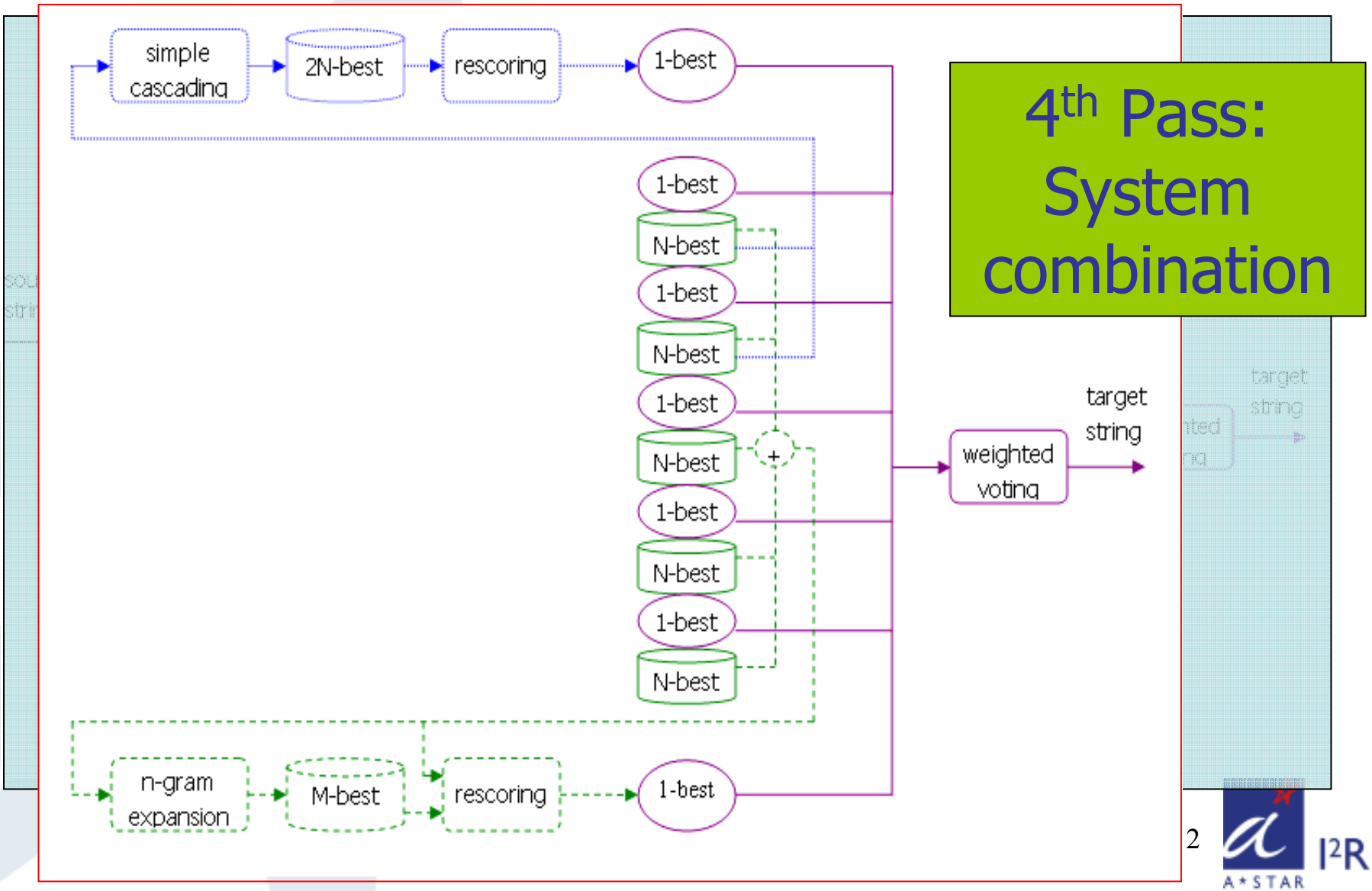
3) lexicalized word/block reordering probabilities

4) 6-gram target LM
5) 8-gram target word-class based LM

6) source and target length ratio

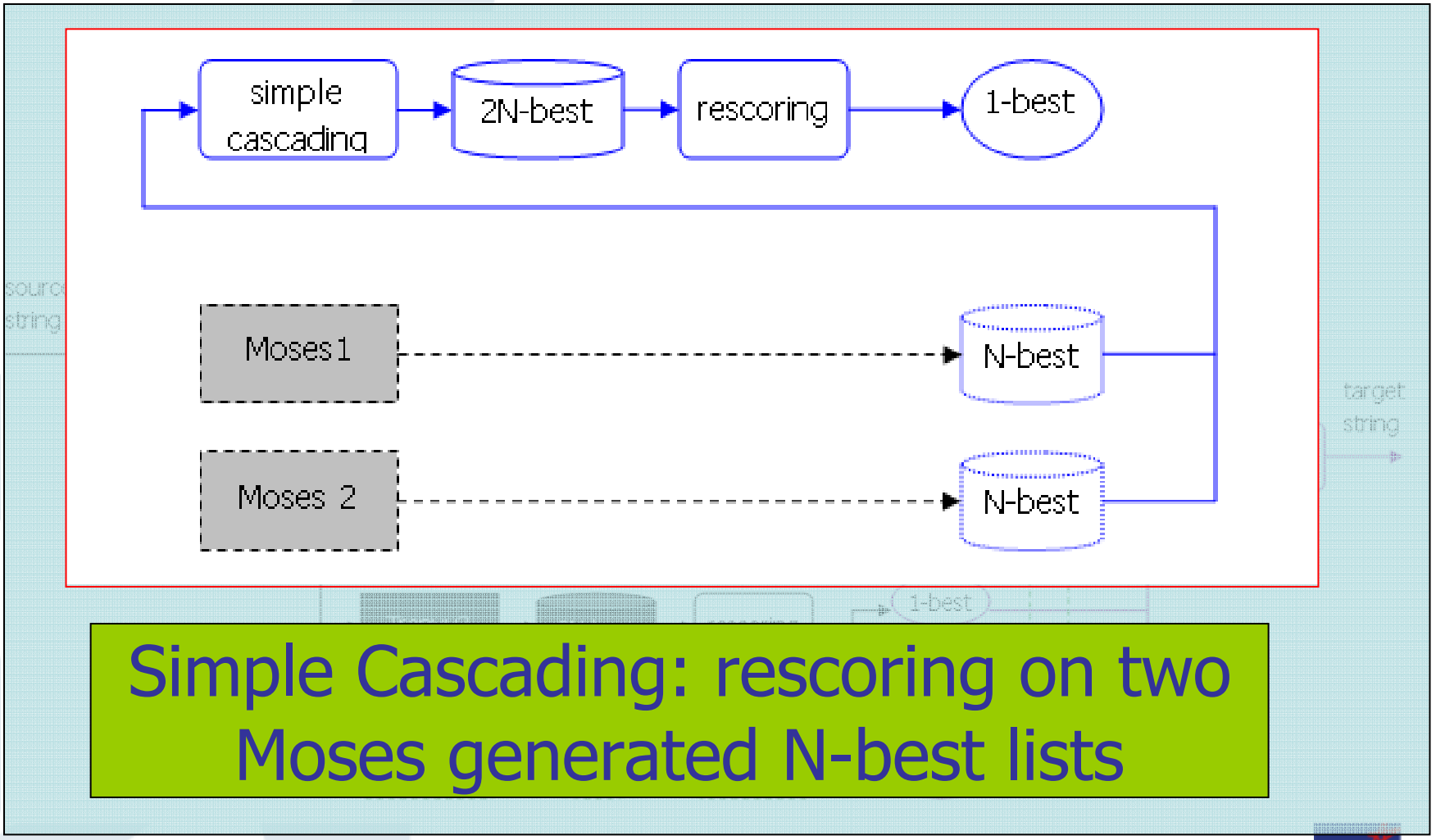
7) question feature
8) frequency of n-grams in the N-best
9) n-gram post-probabilities
10) sentence length post-probabilities

System Combination



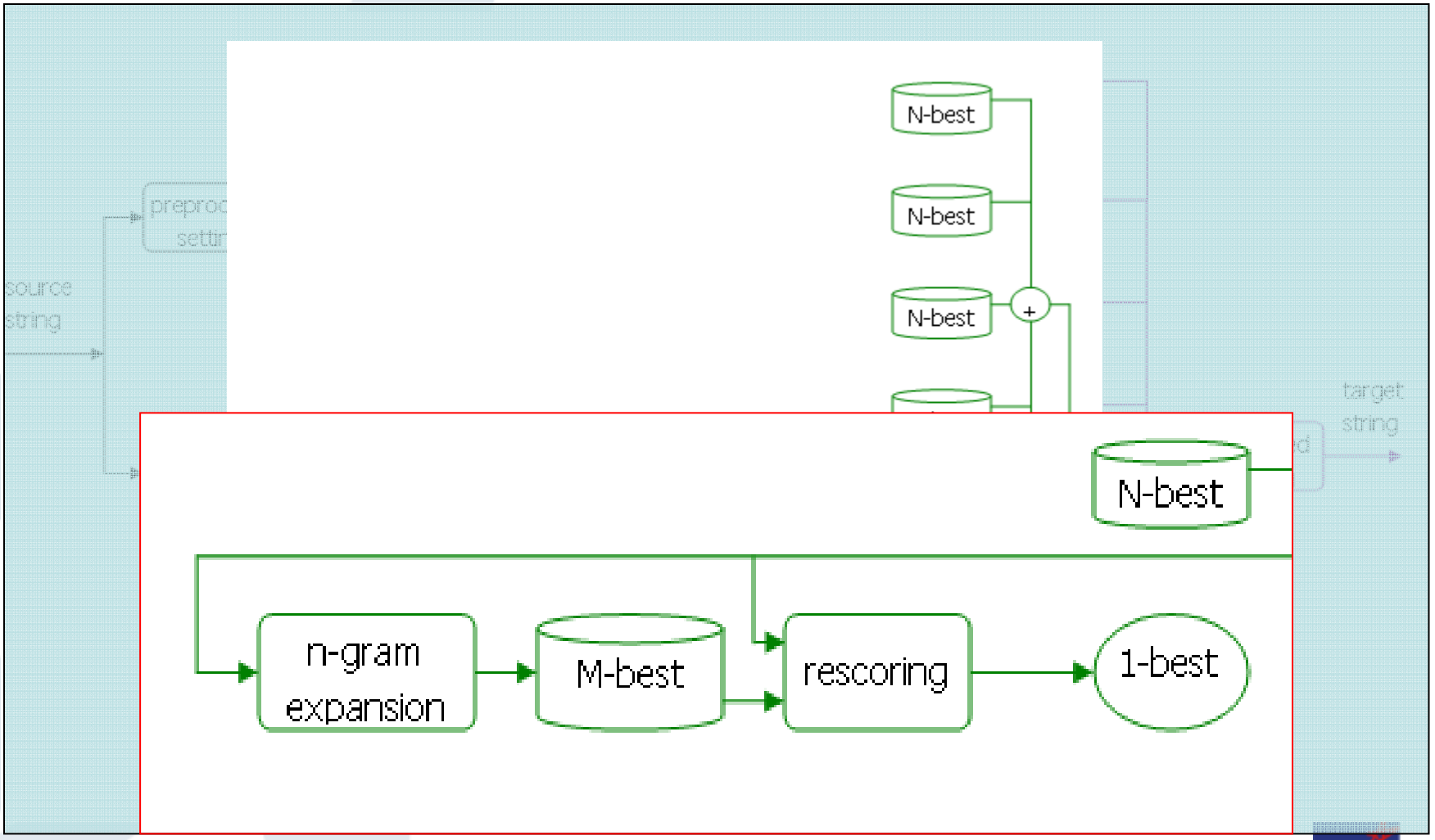
I²R A*STAR

System Combination: Simple Cascading



Simple Cascading: rescoring on two Moses generated N-best lists

System Combination: N-gram expansion

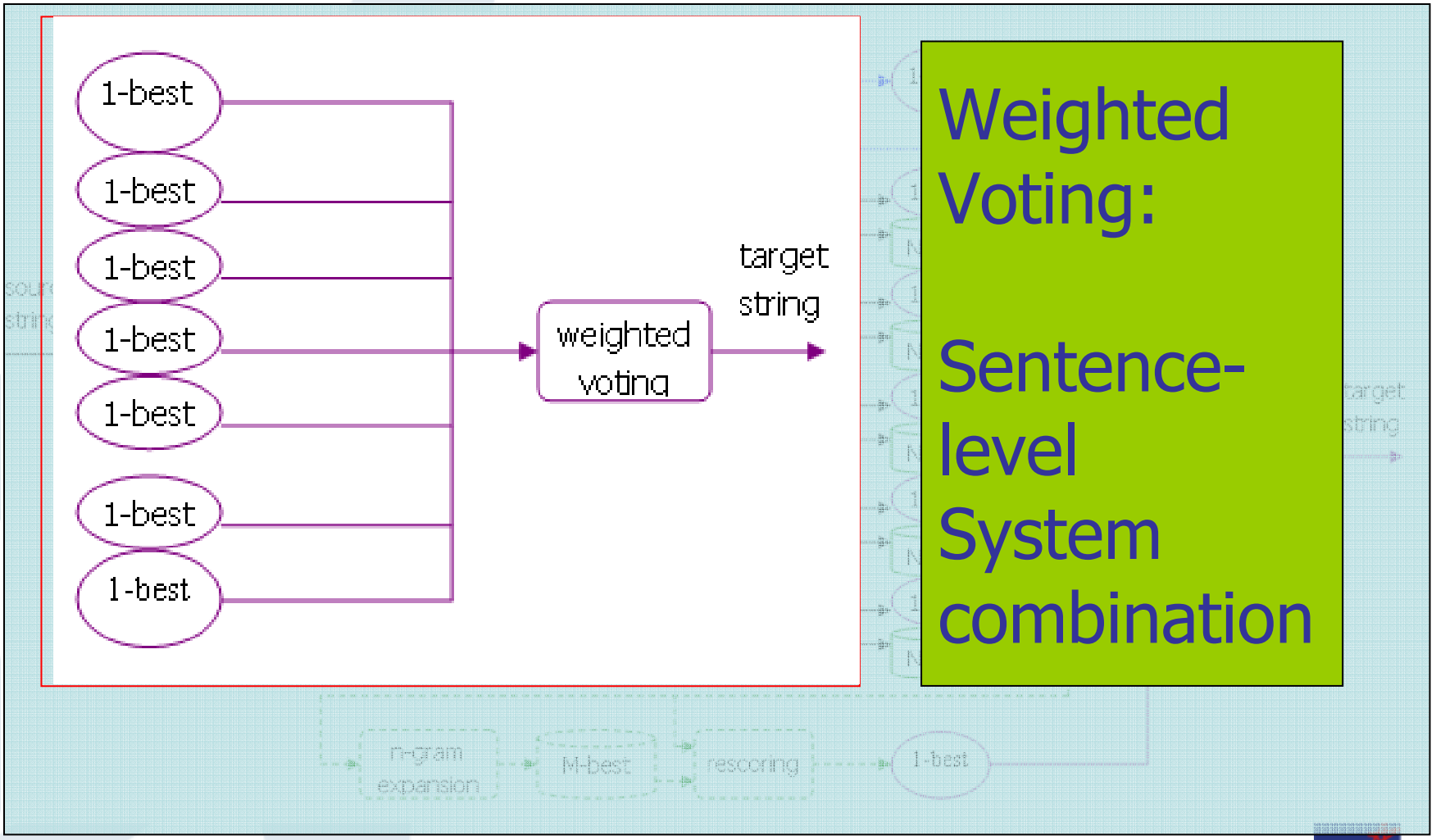


System Combination: N-gram expansion

- *n*-gram expansion generates new hypotheses
  - Collect all the *n*-grams from the original N-best
  - Continuously expand the partial hypothesis through the *n*-grams.

Reference:	my book is in the green basket .
Original entry:	my book is in the green case . my book is inside the green basket .
3-grams:	my book is, book is in, is in the, in the green, the green case, is inside the, the green basket …
n-gram expansion	Partial Hyp: my book is in *n*-gram: is in the New partial Hyp: my book is in the
New Hyp:	my book is in the green basket .

System Combination: Weighted Voting



Experiments

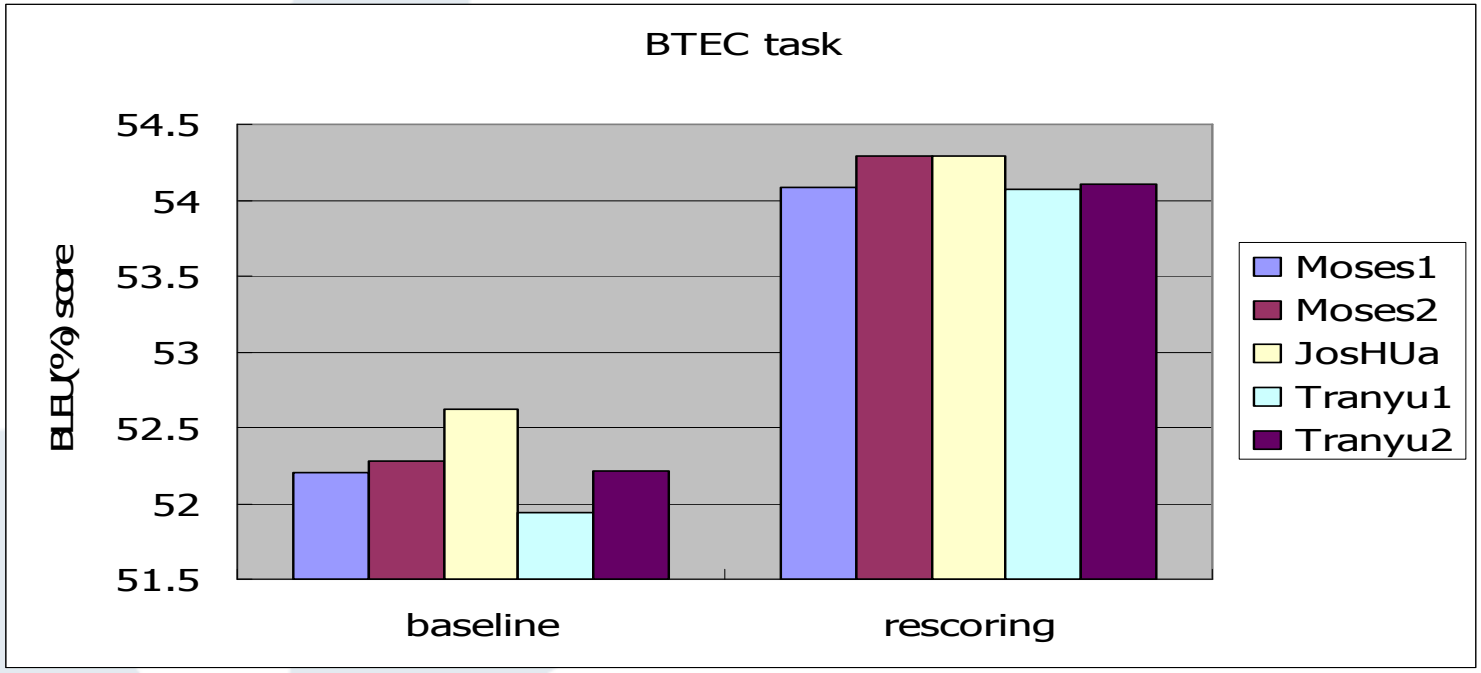
- Training data
  - Bilingual Training data:
    - BTEC supplied data (20K sentences)
    - HIT-corpus (132K sentences)
    - Olympic-corpus (54K sentences)
    - PKU-corpus (200K sentences)
    - Total: 399K sentence-pairs, 5.2M target words
  - Dev data: 6K sentences
  - Additional target data: Tanaka corpus
    - 155K sentence-pairs, 1.4M target running words

Effect of additional data

- BLEU% score on dev sets

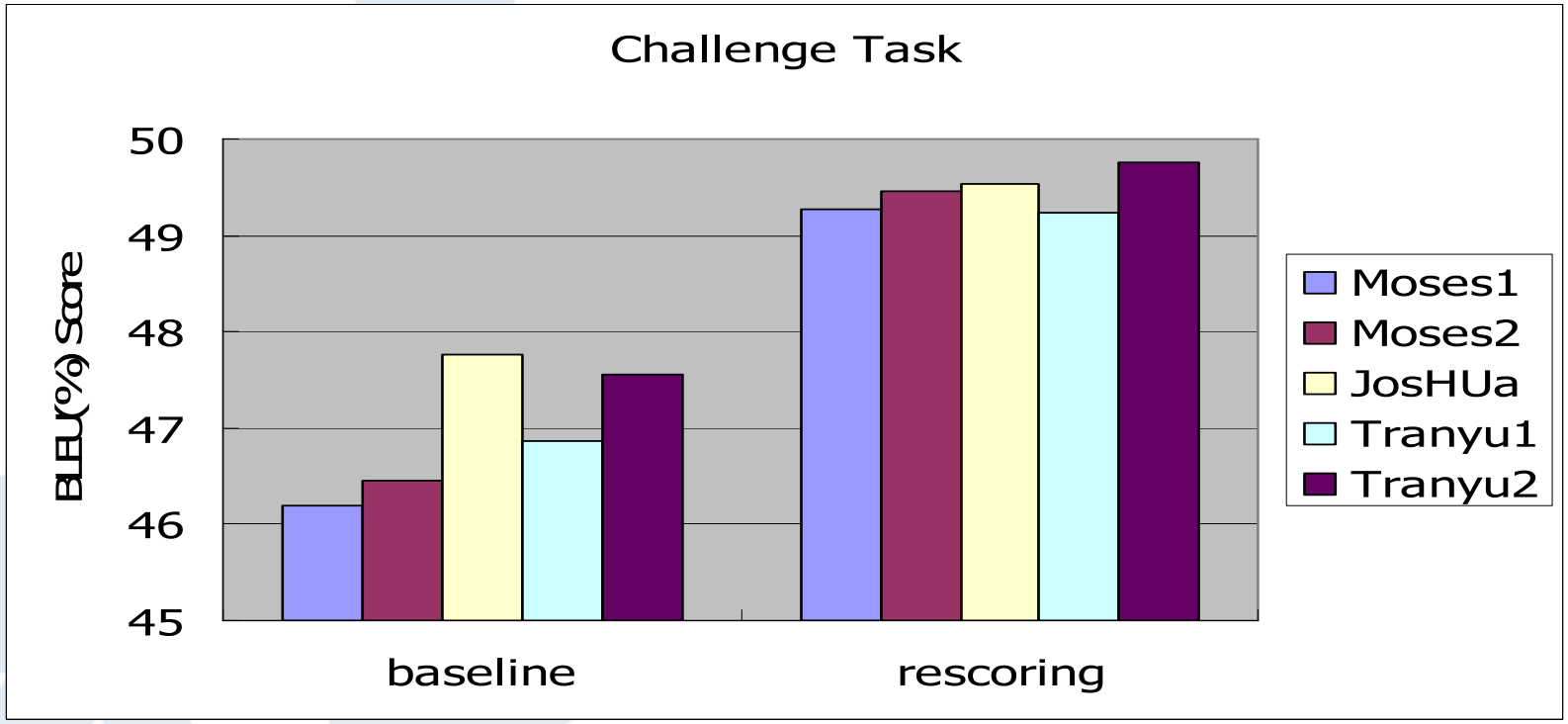
	CSTAR03 (BTEC)	DEV08 (Challenge)
Supplied data	40.96	36.12
+dev. data	45.76	42.29
+addi. Data	50.98	44.92
All data	52.28	46.45

Results (Base & Resc): BTEC task



- Performances of five systems are very similar:
- Baseline: JosHUa > Moses2 > Tranyu2 > Moses1 > Tranyu1
- Rescoring: Moses2 = JosHUa > Tranyu2 > Moses1 > Tranyu1
- Rescoring improved about 1.6-2 BLEU-score for all systems

Results (Base & Resc): Challenge Task



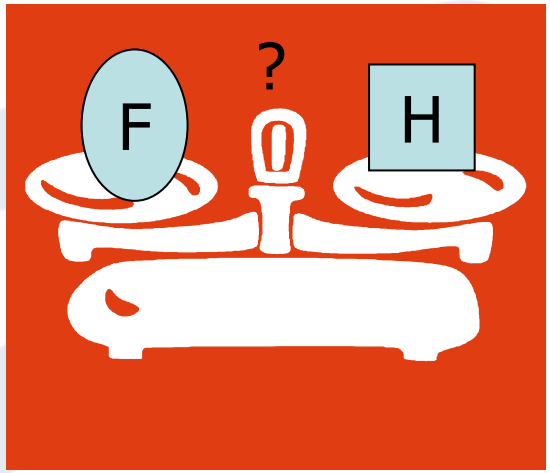
- Performances of five systems are also similar:
- Baseline: JosHUa > Tranyu2 > Tranyu1 > Moses2 > Moses1
- Rescoring: Tranyu2 > JosHUa > Moses2 > Moses1 > Tranyu1
- Rescoring improved about 2-3 BLEU-score for all systems

Results: 1st stage System Combination

Simple Cascading

Advantages:
More features (include local feat. used in decoding)

Disadvantages:
Less distinct hypotheses



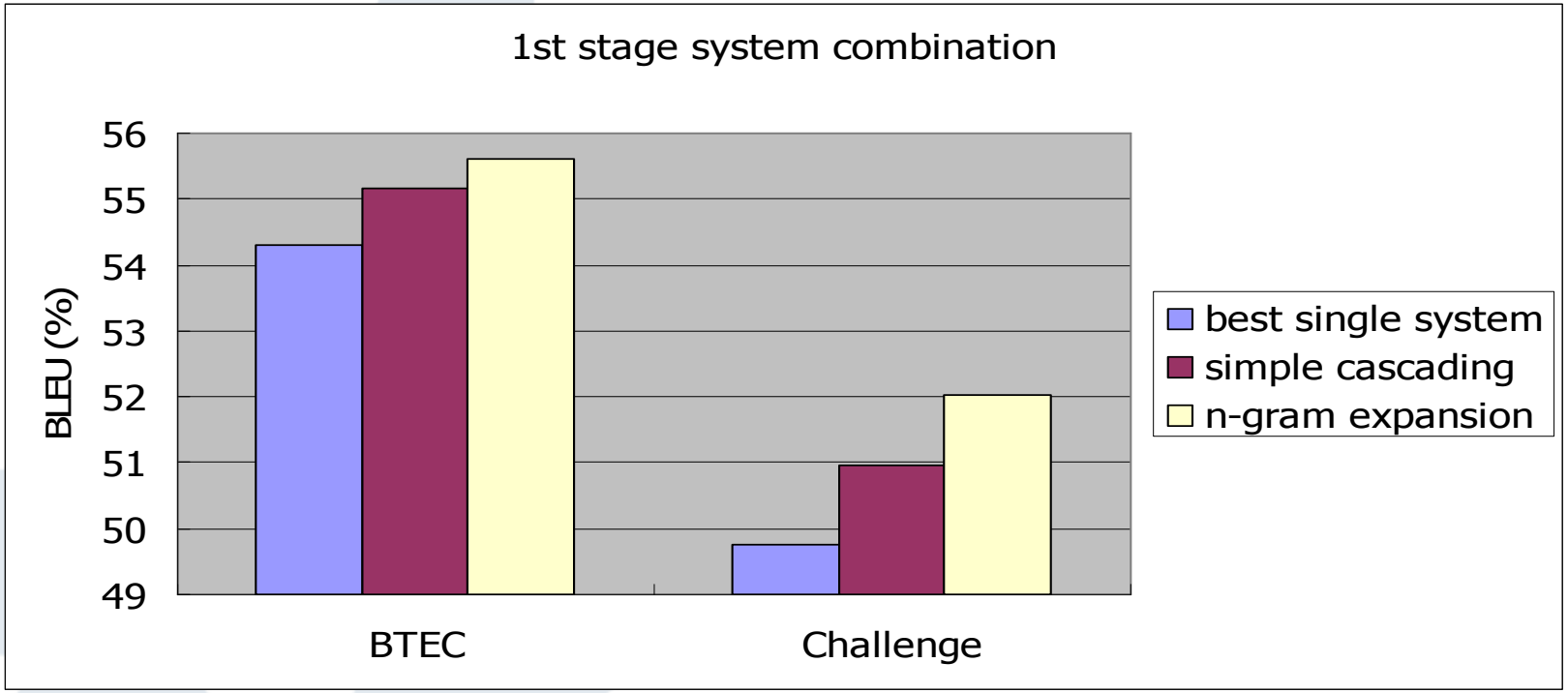
N-gram expansion

Advantages:
More distinct hypotheses

Disadvantages:
Less features (no local features)

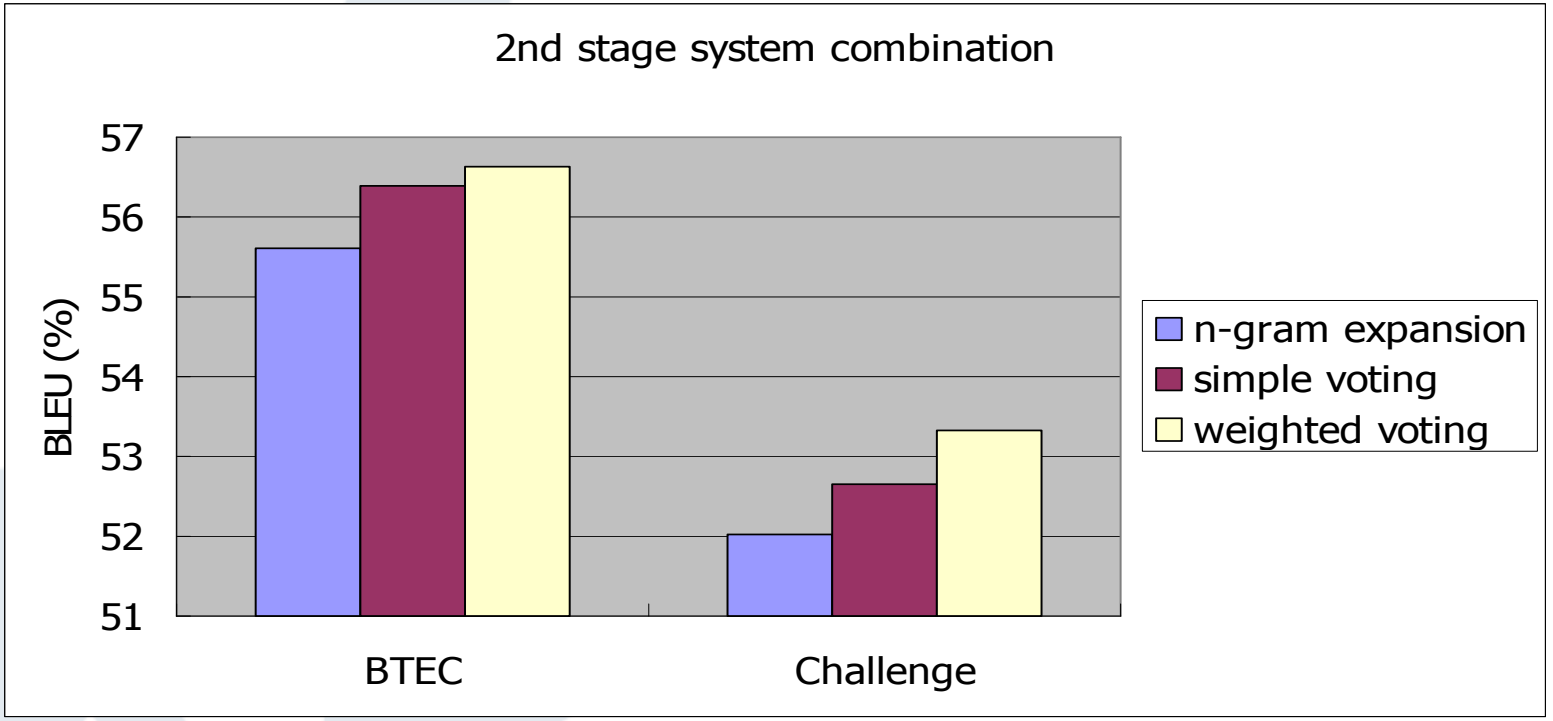
A*STAR I²R

Results: SC vs NE



- N-gram expansion (NE) outperformed simple cascading (SC)
- Compared with the best single system:
  - Simple cascading obtained about 0.9/1.3 BLEU-score
  - N-gram expansion obtained about 1.3/2.3 BLEU-score

Results: weighted voting



- Simple voting: weights of all systems are set to 1.
- Compared with the results of n-gram expansion:
  - Simple voting obtained about 0.8/0.6 BLEU-score
  - Weighted voting obtained about 1.0/1.3 BLEU-score

Official score

- Chinese-to-English BTEC and Challenge tasks

		BLEU (%)	NIST	METEOR
BTEC task	ASR	43.57	6.87	0.6017
	CRR	49.26	7.65	0.6446
Challenge task	ASR	39.38	5.96	0.6142
	CRR	46.89	6.66	0.6560

Conclusion and Discussion

- Conclusion
  - Multi-decoder to produce N-best lists
  - Rich additional feature functions to do rescoring
  - *n*-gram expansion to generate new hypotheses
  - Two-stage system combination
- Comments
  - As one reviewer pointed out: *the 5 systems are all phrase-based system, so the N-best lists are quite similar. It could not provide enough space for system combination. This may be the primary reason that its evaluation result is not too outstanding.*

Thanks for your attention!

Any questions?